



Southeast Asian Fisheries  
Development Center



United Nations Environment  
Programme



Global Environment  
Facility

**Establishment and Operation of a Regional System of Fisheries *Refugia*  
in the South China Sea and Gulf of Thailand**

**Report  
Regional Meeting on Indicators for Fisheries *Refugia* Management  
and Discussion on Project Follow-up**

A-one The Royal Cruise Hotel, Pattaya City, Chonburi Province, Thailand  
9<sup>th</sup> – 11<sup>th</sup> September 2019



**SEAFDEC/UNEP/GEF/ Fisheries *Refugia*  
September 2019**



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## Report of the Meeting

### 1. OPENING OF THE MEETING

#### 1.1 Welcome Speech from the Project Director

- 1) Dr. Somboon Siriraksophon, Project Director of SEAFDEC/UNEP/GEF Project on Fisheries Refugia and as a chairperson of the meeting welcomed all participants to A-one The Royal Cruise Hotel, Pattaya city, Chonburi Province whereas the meeting venue.

#### 1.2 Introduction of Participants

- 2) The Chairperson noted that there were a number of new members attended to the regional working groups, he therefore invited the participants to introduce themselves to the meeting. The list of participants is attached as [Annex 1](#) to this report.

### 2. BACKGROUND, OBJECTIVE OF THE MEETING AND ADOPTION OF AGENDA

#### 2.1 Background and Objectives of the Meeting

- 3) Dr. Somboon Siriraksophon presented the background and objectives of the meeting. He referred to the project requirements on development of the standardized information and data collection procedures in support of longer-term operation of a regional system of fisheries *refugia*, including design of stress reduction and environmental state indicators for managed *refugia* that is one of the regional activities under the SEAFDEC/UNEP/GEF Project on Establishment and Operation of a Regional System of Fisheries *Refugia* in the South China Sea and Gulf of Thailand. The provisional prospectus is shown as [Annex 2a and 2b](#).
- 4) The meeting also aims to follow-up the project outputs based on activities that have been implemented for 2017 and 2018 by Cambodia, Malaysia, Philippines and Thailand. In addition, to consult with all focal points of Fisheries Refugia Project on the development of a new concept proposal on “FishTrawl” before further development and address at the next Project Steering Committee Meeting in Miri, Sarawak, Malaysia in the 2<sup>nd</sup> week of November 2019.

#### 2.2 Adoption of the Meeting Agenda

- 5) Dr. Somboon Siriraksophon introduced the provisional agenda of the meeting in which later it was adopted with no amendment as shown as [Annex 3](#).

### 3. DEVELOPMENT OF THE INDICATORS FOR MANAGEMENT OF FISHERIES *REFUGIA* IN THE SOUTHEAST ASIA

#### 3.1 Introduction of the steps for drafting the indicators for management of Fisheries *Refugia*

- 6) Dr. Somboon Siriraksophon informed the meeting on the steps for drafting the indicators for management of fisheries *Refugia* which is support the future implementation by relevant countries after project end. In addition, it is also considered that the adopted indicators are aimed to guide the other ASEAN Member States the way to establish fisheries *refugia* for sustainable fisheries at national and regional levels.
- 7) He suggested 4 steps for this brainstorming session for development of the indicators as follows: 1) Identify the objectives; 2) Identify the dimensions and key issues/problems; 3) Identify the criteria; and 4) Identify the indicators.

#### 3.2 Standardized methodology for data collection and analysis for management of fisheries *refugia*

- 8) Dr. Somboon Siriraksophon informed the meeting on the importance of the standardized methodology for data collection and analysis to support the establishment and management of fisheries *refugia*. This information will guide country on what need to do, and how to support holistic approach for establishment of fisheries *refugia*. In this connection, from the literature reviews of regional fisheries issues, the SEAFDEC/PCU identify the knowledge gaps

together with the required actions and methodologies for data collection and analysis in which are necessary to support long term management of fisheries *refugia*.

- 9) He presented the draft paper on Standardized Methods for Collection and Analysis of Data and Information, for the use in Assessing the Impacts of Fisheries *Refugia* and in the Designing of Appropriate Indicators for Long Term Management of the Regional System of Fisheries *Refugia* as shown in [Annex 4](#). Additionally, he pointed out this comprehensive part needed to put together with the Indicators guidebook.
- 10) The meeting supports the idea to include all necessary guides, manual, procedures or standardized methods together in one publication to support the establishment and effective management of fisheries *refugia*.

#### 4. BRAINSTORMING SESSION

##### 4.1 Identify objectives and dimensions

- 11) From the brainstorming among 6 countries focal points, the meeting considers that objectives should reflect on healthy and sustainability in 4 dimensions including ecosystem, economic, social, and governance issues. After discussion, the experts agreed on 3 objectives for development of the indicators as follows:
  - a. Maintain the fish stock and critical habitat;
  - b. Satisfy fishing community, social needs now and futures; and
  - c. Put in place on effective management system
- 12) However, climate change impacts is one of the key cross-cutting dimension that necessary to include in the discussion. But the focus of climate change impacts is to ecosystem dimension only. This indicator guidebook not include the impacts of climate change to other dimensions such as social, and or economic dimensions.

##### 4.2 Identify key issues/problems in each dimension

- 13) Based on the identified 5 dimensions in para 4.1, the meeting raised up problems and issues facing by countries in the region that are aligned with 5 dimensions as follows:
  1. Ecosystem
    - fisheries resources;
    - habitat (mangrove, coral, seagrass, and other critical habitats); and
    - environment (impact from human act.)
  2. Social
    - livelihoods;
    - stakeholder participation (indigenous people, gender, etc.);
    - education (local knowledge, local wisdom)
  3. Economic
    - economic condition (to community)
    - fisheries production, fishing efforts
    - innovative fisheries technology
  4. Governance
    - fisheries management policy (fishing/user right, precautionary approaches/ science-based management, and synergistic way/strategy)
    - stakeholder cooperation/coordination (regional / national levels)
    - enforcement
    - capacity building
    - funding (infrastructure, enforcement, etc.)
  5. Climate change
    - fish stock
    - impact to habitat
    - impact to environment

##### 4.3 Identify criteria and indicators

- 14) The meeting continuously discussed on the key criteria that link to 17 issues or sub-dimensions. There are 44 criteria and about 89 indicators that need to consider for effective management of fisheries *refugia*.
5. **REPORTING AND FINALIZING THE 1ST DRAFT INDICATORS AND STANDARDIZED METHODOLOGY FOR DATA COLLECTION AND ANALYSIS FOR MANAGEMENT OF FISHERIES *REFUGIA***
- 15) The meeting considered the draft overall objectives, issues/problems, criteria and indicators developed based on the 4 dimensions and one cross-cutting dimension as presented by facilitator, Dr. Somboon Siriraksophon. There was some amendment on the draft but later the draft was finalized and adopted in principle by the meeting as shown in [Annex 5](#).
- 16) Refers to the earlier discussion by the meeting that the regional guidebook will include not only the indicators but including the standardized methodology for data collection and analysis to support the management of fisheries *refugia*.
- 17) Regarding this a completed regional guidebook will be further drafted for consideration by the Regional Scientific and Technical committee and the Project Steering Committee before seek approval from the countries as well as by the ASEAN-SEAFDEC mechanism by end of 2020.
- 18) In this connection, the PCU, Project Director requested all relevant countries to support and further promote the publication when it is in place.
6. **DISCUSSION ON THE CONTENTS OF INDICATORS PAPER AND WORKPLANS FOR ADDRESSING TO SEAFDEC/ASEAN FOR CONSIDERATION, ENDORSEMENT AND SUPPORT**
- 19) Dr. Somboon Siriraksophon informed the meeting on the draft table of contents of the regional guidebook on Indicator for management of fisheries *refugia* for consideration and suggestions.
- 20) The meeting suggested that the regional guidebook should have executive summary, preface, acknowledgement and also references. Additionally, the message from partners or national lead agency from 6 relevant countries. Regarding this the Table of Contents was principle adopted by the meeting as shown in [Annex 6](#).
- 21) The meeting also agree that the guidebook title should be changed to “Sustainability Indicators Framework for Management of Fisheries *Refugia* In the South China Sea and Gulf Of Thailand.
7. **DISCUSSION AND FOLLOW-UP ON THE PROJECT OUTPUTS**
- 22) The PCU Project Director refers to the working paper on “Follow-up the Results Framework Outputs” as shown as [Annex 7](#). He encourages relevant countries to submit the progress reports based on quarterly activities. He also pointed out that all implemented activities outputs should be reflected or aligned with the results framework.
- 23) The meeting also was informed on the progress outputs implemented by country that have been submitted to the PCU by each country summarized by the SEAFDEC/PCU. It is also noted that the progress outputs include regional activities implemented by the PCU as shown in [Annex 8](#).
8. **CONSULTATION ON THE PROPOSED NEW PROJECT ENTITLED “IMPROVING ECOSYSTEM HEATH THROUGH THE BEST PRACTICES ON TRAWL FISHERIES”**
- 24) The PCU Project Director presented to the meeting a proposed new concept project entitled “Improving Ecosystem Heath through the Best Practices on Trawl Fisheries” or FishTrawl project for consideration and further suggestion by relevant countries in the coastal areas of the South China Sea and Gulf of Thailand Large Marine Ecosystem as shown as [Annex 9](#).
- 25) The FishTrawl Project integrates the ecosystem-based fisheries management approach through the development of effective national/regional fishery policies on sustainable fisheries and innovative technology for bottom trawl gears and methods including reduction

of green-house gas emission from fishing activities. Additionally, building partnerships between multiple public and private sectors, e.g. local government/communities, research institutions, net makers, fisheries associations, fish meal industry, fish processors, etc. would be among the approaches to improve and change this production practice into more environmentally positive. The Project also includes resources enhancement activities that aim to create offshore artificial habitats or artificial reefs to protect some demersal fish stocks due to loss of seabed habitats affected by the bottom trawl net. Cooperation among country partners and concerned inter-agencies that have the existing programs to deploy artificial reefs along the coastal areas for small scale fisheries is also needed taking into account the offshore demersal fish stocks that have already been depleted.

- 26) Through the UNEP partnership, the project is planned to seek funding from the Green Climate Fund, however, the endorsed mechanism from eligible countries are needed. This is therefore an objective to introduce the concept note and seek the cooperation from meeting.
- 27) The meeting also suggested that at country level the responsible agency to implement the project should be fisheries agency due to most of the activities related to fisheries aspects which impact on ecosystem.
- 28) The meeting also noted that this is the starting point on drafting of the Concept note by PCU-*refugia*. It is needed to consult with UNEP for the next steps.

#### 9. CONCLUSION WRAP UP OF THE MEETING

- 29) Dr. Somboon Siriraksophon informed the meeting on budget for this Regional Meeting which used under the regional activity 3.5 entitled: Standardized methods for collection and analysis of info and data on *refugia* effectiveness (including indicator system). The remaining budget is for hiring the consultants for drafting the publication.
- 30) After the Regional meeting, the results will be addressed at the 2<sup>nd</sup> Meeting of the Project Steering Committee held on 5-6 November in MIRI, Sarawak, Malaysia. In addition, the 1<sup>st</sup> draft papers will be consulted with countries again at the 3<sup>rd</sup> Meeting of the Regional Scientific and Technical Committee in Feb. 2020.
- 31) It is expected that the final completed paper will be addressed for final consideration and adoption by the 3<sup>rd</sup> Meeting of the Project Steering Committee in November 2020 (tentative).

#### 10. CLOSING THE MEETING

- 32) Dr. Somboon Siriraksophon - on behalf of the Project Coordinating Unit – expressed his sincere attitude to all national focal points for their active intervention for the last three days, that the meeting could come-up the Indicator system including draft standardized methods for data collection and analysis to support the effective management of fisheries *refugia*. He also wishes to work with all country participants again for finalizing the completed publication by end of 2020.
  - 33) The meeting was closed at 17:20 of 11<sup>th</sup> September 2019.
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## ANNEX 2

### PROSPECTUS

#### I. BACKGROUND

The regional agreement on standardized information and data collection procedures in support of longer-term operation of a regional system of fisheries *refugia*, including design of stress reduction and environmental state indicators for managed *refugia* is one of the regional activities needs under the SEAFDEC/UNEP/GEF Project on Establishment and Operation of a Regional System of Fisheries *Refugia* in the South China Sea and Gulf of Thailand. In this connection, the SEAFDEC/Project Coordinating Unit (PCU) proposes to organize the Regional Meeting on Indicators for *Refugia* Management during the 2nd week of September 2019 in Bangkok. The key persons such as national focal point and national scientific and technical focal point from each country are invited to the meeting through the brainstorming discussion on identification and finalization of the agreed indicators. In addition, the PCU will address and follow-up the project outputs - based on activities that have been implemented during the past 2 years for 4 countries namely Cambodia, Malaysia, Philippines and Thailand - are aligned with the Results Framework as endorsed by the GEF.

#### II. OBJECTIVE

- To discuss on the regional standardized information and data collection procedures including design of stress reduction and environmental state indicators for managed *refugia*;
- To discuss on project outputs including the template and format of report.

#### III. EXPECTED OUTPUT

- Draft regional paper on Indicators for fisheries *refugia* management.
- A set of guidelines including template and format of the technical report.

#### IV. EXPECTED OUTCOME

Strengthened knowledge management and information sharing and access for enhanced uptake of good practice in integrating fisheries management and biodiversity conservation in the design and implementation of fisheries and environmental management systems.

#### V. MEETING DATE AND VENUE

Regional Meeting will be held on 9-11 September 2019, in Chonburi Province, Thailand.


#### VI. PARTICIPANTS

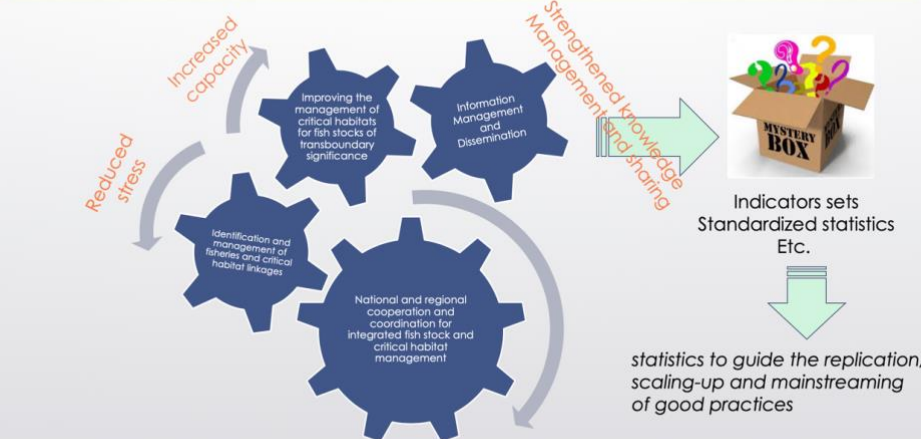
- National Focal Points or alternative(s) from the SEAFDEC/UNEP/GEF Project on Establishment and Operation of a Regional System of Fisheries *Refugia* in the South China Sea and Gulf of Thailand: Cambodia, Indonesia, Malaysia, Philippines, Thailand, Viet Nam
  - A National Focal Point (or Alternate)
  - A National Scientific and Technical Focal Point (or Alternate)
- Representatives from SEAFDEC Secretariat, and relevant SEAFDEC Departments and PCU staffs



ANNEX 3

INTRODUCTION AND OBJECTIVES


**Regional Meeting on Indicators for Fisheries Refugia Management and Discussion on Project Follow-up.**  
 9-11 September 2019. The Royal Cruise Hotel, Pattaya City, Chonburi Province, Thailand



**FR-RM1. ESTABLISHMENT AND OPERATION FOR A REGIONAL SYSTEM OF FISHERIES REFUGIA 2**



## INDICATORS

Aims to support effective decision-making through the spectrum of activities that is the fisheries management process.

Indicators assist decision-making in problem identification, objective setting, and identification of gaps in research and data, monitoring and performance assessment (FAO 1999a; Garcia 2000).

Indicators is a part of log-frame.



## INDICATORS for Achieving Project Goal

Project Log-frame for Establishment of Fisheries Refugia in SCS

Component	Outcomes	Indicator	Baseline	Targets End of Project	Source of Verification	Risks and Assumptions
1. Identification and management of fisheries and critical habitat linkages at priority fisheries refugia in the South China Sea and Gulf of Thailand	1. <b>Reduced stress</b> on fish stocks and coastal habitats via improved national management of key anthropogenic threats to fisheries and critical habitat linkages in the South China Sea and Gulf of Thailand	Status of formal designation, management plan adoption, and community engagement in implementation of agreed management measures, including enforcement, for priority sites	Rate of coastal habitat loss from SCS basin is high (e.g., 30% per decade for seagrass). Fishing identified as a key threat to coastal habitats	Effective management of key threats to 14 fisheries refugia sites [269,500 ha], including ~50 percent reduction in fishing pressure within sites at times critical to the life-cycles of fished species of transboundary significance	Adopted management plans. Regular reports of meetings of national and regional project management bodies. Reports of independent mid-term and terminal project evaluations	Adequate local cooperation to compile and analyze information to establish baselines and standardized procedures to measure and monitor the effectiveness of agreed stress reduction measures



## **OBJECTIVES are:**

- To discuss on the key issues needed to be considered for further identifying the effective indicators for management of fisheries refugia;
- To consult on the standardized statistics to guide the replications?;
- To strengthen the cooperation from participating countries on reporting; and
- To introduce and seeking an idea on a new proposal on [FishTrawl](#).



**ANNEX 4**  
**ADOPTED AGENDA**

<b>9 SEPTEMBER 2019</b>	
08.30-09.00	Registration
09.00-09.10	Agenda 1: Opening of the Meeting
09.10-09.30	Agenda 2: Background, Objectives of the Meeting and Adoption of Agenda
09.30-10.30	<b>PART 1: INDICATOR FOR MANAGEMENT OF FISHERIES REFUGIA</b> Agenda 3: Development of the Indicators for management of fisheries <i>refugia</i> in the Southeast Asia 3.1 Introduction of the steps for drafting the Indicators for management of Fisheries <i>Refugia</i> 3.2 Standardized methodology for data collection and analysis for management of Fisheries <i>Refugia</i> 3.3 Check list of issues /knowledge gaps/ priority areas for identification on the Indicators
10.30-11.00	<i>Coffee break and group photo</i>
11.00-12.00	Agenda 4: A: Brainstorming Session for Standardized methodology for data collection and analysis
12.00-13.30	<i>Lunch,</i>
13.30-15.00	Agenda 4: <i>Continued</i> > Brainstorming Session
15.00-15.30	<i>Coffee break</i>
15.30-17.00	Agenda 4: B: Brainstorming Session for Check list of issues /knowledge gaps/ priority areas for identification on the Indicators
18.30-20.30	<i>Reception Dinner hosted by SEAFDEC/PCU</i>
<b>10 SEPTEMBER 2019</b>	
09.00-10.30	Agenda 5: Reporting and finalizing the 1 <sup>st</sup> Draft Indicators and Standardized methodology for data collection and analysis for management of Fisheries <i>Refugia</i>
10.30-11.00	<i>Coffee break</i>
11.00-12.00	Agenda 6: Discussion on the Contents of Indicator paper and workplans for addressing to SEAFDEC/ASEAN for consideration, endorsement and support
12.00-13.30	<i>Lunch</i>
13.30-15.00	<b>PART 2: PROJECT OUTPUTS FOLLOW-UP</b> Agenda 7: Discussion and follow-up on the Project Outputs
15.00-15.30	<i>Coffee break</i>
15.30-17.00	Agenda 7: <i>Continued</i> > Discussion and follow-up on the Project Outputs
<b>11 SEPTEMBER 2019</b>	
09.00-10.30	<b>PART 3: NEW PROJECT ON IMPROVING ECOSYSTEM HEALTH</b> Agenda 8: Consultation on the proposed new project entitled “Improving Ecosystem Health through the Best Practices on Trawl Fisheries”

10.30-11.00	<i>Coffee break</i>
11.00-12.30	<b>PART 4: CONCLUSION WRAP UP</b> Agenda 9: Conclusion wrap up of the meeting.
12.30-12.40	Agenda 10: Closing the meeting
12.40	<i>Lunch</i>

## ANNEX 5

**STANDARDIZED METHODS FOR COLLECTION AND ANALYSIS OF DATA AND INFORMATION,  
FOR THE USE IN ASSESSING THE IMPACTS OF FISHERIES REFUGIA AND IN THE DESIGNING OF APPROPRIATE INDICATORS  
FOR LONG TERM MANAGEMENT OF THE REGIONAL SYSTEM OF FISHERIES REFUGIA**

Issues/Knowledge Gaps	Requirements	Data Collection Methods	Analysis methods	
<b>1) Ecosystem Component</b>				
<b>1.1. Fisheries Resources</b>	○	○	○	○
a. Availability of fishery data and information	<ul style="list-style-type: none"> <li>○ Fishing operation, fishing area and the fishery status</li> <li>○ Group and species composition of catches from each fishing gear deployed to catch target species</li> <li>○ Catch and effort of each fishing gears deployed to catch target species</li> <li>○ Catch/effort trend</li> </ul>	<ul style="list-style-type: none"> <li>○ Statistic data collection</li> </ul>		
b. Mortality parameters of target species:	<ul style="list-style-type: none"> <li>○ Z - Total mortality coefficient, or instantaneous rate of total mortality or total mortality rate (per time unit),</li> <li>○ M - natural mortality coefficient, or instantaneous rate of natural mortality or natural mortality rate (per time unit).</li> <li>○ F - fishing mortality coefficient or instantaneous</li> </ul>	<ul style="list-style-type: none"> <li>○ <math>Z = M + F</math> (including the Z estimation from catch/effort data)</li> </ul>	<ul style="list-style-type: none"> <li>○ Catch curve analysis is used to estimate L50% (length at which 50% of the fish is retained by the gear 50% escape) and convert it to age, t50% (age at which 50% of the fish is retained in the gear).</li> </ul>	

Issues/Knowledge Gaps	Requirements	Data Collection Methods	Analysis methods	
	rate of fishing mortality (per time unit).			
	○ Determination of Exploitation rate	○ E ( $E = F/Z$ ) using mortality parameters.	○	○
	○ Determination of yield per recruit (Y/R) pattern.	○	○	○
	○ Stock unit/population structure	○ morphological and DNA methods	○	○
	○ F-array	○ by length and Cohort Analysis including Thompson and Bell Prediction Model.	○	○
c. Availability of fishery biological data	○ Monthly size composition	○ Samplings at landing site	○ Length-weight relationship ○ Length at first maturity ○ Sex ratios	○
	○ Growth rate	○ Growth parameters 1) $K$ - Curvature growth 2) $L_{\infty}$ - Asymptotic length 3) $t_0$ - Age at length equal to 0 ○	○	○
	○ Spawning season	○ Determination from Gonado Somatic Index (GSI) and % of maturity	○	○
	○ Spawning grounds	○ Eggs & larval fish samplings 1) Bongo net	○	○
	○	○ Local knowledge reviews	○	○
	○ Nursery & Feeding grounds	○ Zooplankton samplings	○	○
	○	○ Phytoplankton sampling	○	○
	○	○ Fish samplings for stomach contents study	○	○

Issues/Knowledge Gaps	Requirements	Data Collection Methods	Analysis methods	
d. Stock status and trends	<ul style="list-style-type: none"> <li>○ Stock Assessment</li> </ul>	<ul style="list-style-type: none"> <li>○ Ref. 1.1</li> <li>○ Historical catch data</li> <li>○ Standardized CPUEs data</li> </ul>	<ul style="list-style-type: none"> <li>○ Ref. to Fish Stock Assessment Manual (FAO, 2003)</li> </ul>	○
	<ul style="list-style-type: none"> <li>○ Risk Assessment</li> </ul>	○	○	○
<b>1.2. Environment</b>	○	○	○	○
a. Habitat linkages	<ul style="list-style-type: none"> <li>○ Status of marine habitats e.g. mangrove, corals, seagrass, and wetland.</li> </ul>	○	○	○
	<ul style="list-style-type: none"> <li>○ Area of critical habitats</li> </ul>	○	○	○
b. Effluent discharge	<ul style="list-style-type: none"> <li>○ Monitoring the effluent discharge</li> <li>○ Forecasting system</li> </ul>	<ul style="list-style-type: none"> <li>○ Ocean forecasting: <a href="http://221.215.61.118:2018/#/">http://221.215.61.118:2018/#/</a></li> <li>○ Survey</li> </ul>	<ul style="list-style-type: none"> <li>○ Sea surface temperature</li> <li>○ Wind</li> <li>○ Wave</li> <li>○ Salinity</li> <li>○ Current Stream</li> <li>○ Current vector</li> </ul>	○
	<ul style="list-style-type: none"> <li>○ Evaluate the impacts</li> </ul>	<ul style="list-style-type: none"> <li>○ Questionnaires</li> <li>○ Interviews</li> <li>○ Survey</li> </ul>	○	○
<b>2) Social Component</b>				
○ Impacts on Social aspects	<ul style="list-style-type: none"> <li>○ Fishing community characteristics</li> </ul>	<ul style="list-style-type: none"> <li>○ Questionnaires</li> <li>○ Interviews</li> <li>○ Survey</li> </ul>	○	○
	<ul style="list-style-type: none"> <li>○ Gender mainstreaming in fisheries</li> </ul>	<ul style="list-style-type: none"> <li>○ Questionnaires</li> <li>○ Interviews</li> <li>○ Survey</li> </ul>	○	○
	<ul style="list-style-type: none"> <li>○ Income AND Livelihoods</li> </ul>	<ul style="list-style-type: none"> <li>○ Questionnaires</li> <li>○ Interviews</li> <li>○ Survey</li> </ul>	○	○

Issues/Knowledge Gaps	Requirements	Data Collection Methods	Analysis methods	
<b>3) Economic Component</b>				
○ Impacts on Economic	○ Fisheries exports value (compared with total value of exports)	○	○	○
	○ Investment in fishing fleets and processing facilities	○	○	○
	○ Taxes and subsidies	○	○	○
	○ Employment	○	○	○
	○ Income/ Fishery net revenues	○	○	○
	○ Fisheries contribution to GDP	○	○	○
<b>4) Institutions/Governance</b>				
	○ Fishery Management Policy	○	○	○
	○ Regional Cooperation	○	○	○
	○ Stakeholder Participation	○	○	○
<b>5) IMPACT OF CLIMATE CHANGE</b>				
	○ Affecting of climate change to fish behavior/ fishing	○	○	○
	○	○	○	○

## ANNEX 6

RESULTS OF THE BRAINSTROMING SESSION ON INDICATORS FOR LONG TERM MANAGEMENT OF FISHERIES *REFUGIA*

- 1) OBJECTIVES
  - a. Maintain the fish stock and critical habitat;
  - b. Satisfy fishing community, social needs now and futures; and
  - c. Put in place on effective management system
- 2) INDICATORS FOR MANAGEMENT OF FISHERIES *REFUGIA*

Dimensions	Sub-dimensions	Criteria	Indicators
<b>1) Ecosystem</b>	<b>Fisheries Resources</b>	Abundance stock / Distribution / Fishing Effort	Biomass Estimation (ton)
			Level of MSY (ton)
			Level of MEY (ton)
			Level of CPUE (Kg/...)
			CPUA (Kg/Area)
			Catch landing (ton or Kg)
		Biological Parameter	Length at first capture (Lc)
			Length at first mature (Lm)
			Sex ratio
			Spawning Potential Ratio
			Length frequency
			Exploitation rate
		Species composition / Catch structure	GSI (Gonadosomatic Index)
			Percentage of dominance species
			Number of species
	% Main economic/commercial species		
	Healthy/ condition/	Percentage of Bycatch	
Size Coverage (Percent)			
Healthy Index			

Dimensions	Sub-dimensions	Criteria	Indicators	
	<b>Habitat (mangrove, coral, seagrass, and other critical habitats)</b>	Area	Target habitat density (IUCN reference)	
		<b>Environment (Impact from human act.)</b>	Pollution	Standard Water Quality (e.g. COD, BOD)
	Eutrophication		Phytoplankton Abundance	
			Phosphate, Nitrate Concentration (Nutrient loading)	
	Anthropogenic (Human activity)		Coastal reclamation area	
			Level of maritime activity (If appropriated)	
	Erosion		Level and distribution of sedimentation	
			Loss of area/habitat	
	<b>2) Social</b>		<b>Livelihoods</b>	Choice of Occupation
		Fish consumption		Fish consumption per capita per year
Nutrition		% animal protein (if appropriate)		
<b>Stakeholder Participation (Indigenous People, Gender, etc.)</b>		Participation	Ratio of Number of participations (gender and IP)	
		Local Organization	Number of organizations,	
			Number of Best practices applied	
		Networking	Number of networking	
			Type /way of direct or indirect communication	
			Number of agreements	
<b>Education (Local knowledge, Local wisdom)</b>		Awareness program (e.g. information center, information education campaign (IEC))	Number of information center or similar.	
			Number of consultations	
			Number of best practices	
			Number of awareness program	
			Number of understanding by stakeholder	
<b>3) Economic</b>		<b>Economic Condition (to community)</b>	Capacity building	Number of training/Extension
	Poverty incident		Poverty Index	
	Capital accessibility Income		Number of financial accessible	
			Income per household	



Dimensions	Sub-dimensions	Criteria	Indicators	
	<b>Fisheries Production, Fishing Efforts</b>	Contribution of target species / Availability	Value of contribution/production	
	<b>Innovative Fisheries Technology</b>	Effectiveness fishing gear	level of CPUE	
		Cost effectiveness	Cost reduction, time, human power	
		Environment friendly (Green technology)	Reduce of fuel consumption	
			Reduce bycatch	
		Investment	Number of investment (for e.g. fishing fleet, processing, ship builder, management tools/software, etc.)	
	New domestic product			
	<b>4. Governance</b>	<b>Fisheries management policy (Fishing/User Right, Precautionary approaches/Science-based management, and Synergistic Way/Strategy)</b>	Legal framework	Number of law and regulation
			Harvest strategy/ Limit of fishing effort	Fishing close, (area and seasonal closure, Zoning
				Number of Input control (Number, mesh size, length of fishing gear, Licensing control, Capacity (e.g. Gross tonnage, horsepower, etc.)
Number of output control (TAC, Quota, Target species)				
Fisheries management plan/ strategy/ framework			Available/not available	
			Management plan of Fisheries <i>refugia</i> in place, Habitat rehabilitation, protection and stock enhancement.	
Efficiency fishing gear		Length limit (e.g. crab fishery)		
<b>Stakeholder Cooperation/Coordination (Regional / national levels)</b>		Management mechanism	Management board/ committee, transboundary committee, RPOA for <i>refugia</i> in place	
			Linkage to the existing management/conservation framework (e.g. MPAs)	
<b>Enforcement</b>		Coordination mechanism	Inter-agency coordination in place, Number of joint operations	
			Fishery Law enforcement	Level of enforcement
Frequency of regular patrol				

Dimensions	Sub-dimensions	Criteria	Indicators		
	<b>Capacity Building</b>	Best Practice	Number of violation prosecution Adoption of best practice in place		
		Maritime policy and regulation/ International policy	Number of training/workshops		
		Sustainability	Long term commitment of Government on finance		
	<b>Funding (Infrastructure, Enforcement, etc.)</b>	Source of funding (incentive, soft loan, donation/CSR)	Number of donors Type of funds		
		incentive	Type of incentive Number of activities Number of best practices		
	<b>5) Climate Change and Disaster</b>	<b>Fish Stock</b>	Impact to Fish Stock	Availability/levels of knowledge abundance, distribution, genetic diversity, recruitment	
				Update information impact to fish stock	
		<b>Impact to Habitat</b>	Coral bleaching	Area Incident/ frequency Recovery Rate	
Destruction of mangrove				Area coverage Recovery Rate	
				Destruction of sea grass	Area coverage Recovery Rate
<b>Impact to Environment</b>			Sea level rise		Saline intrusion Mean sea level annual Coastal Erosion (Area)
				Physical/chemical parameters (T, Salinity, PH, DO)	Level of physical and chemical parameters
				Precipitation (rainfall) Ocean acidification	Level of Precipitation PH level

**ANNEX 7**

**TABLE OF CONTENTS FOR THE PUBLICATION ENTITLED:  
“SUSTAINABILITY INDICATORS FRAMEWORK FOR  
MANAGEMENT OF FISHERIES *REFUGIA* IN THE SOUTH CHINA SEA AND GULF OF THAILAND**

<b>I.</b>	<b>EXECUTIVE SUMMARY</b>
<b>II.</b>	<b>PREFACE</b>
<b>III.</b>	<b>MESSAGES FROM PARTNERS</b>
<b>IV.</b>	<b>ABBREVIATIONS AND DEFINITIONS</b>
<b>V.</b>	<b>INTRODUCTION AND BACKGROUND</b>
	<ul style="list-style-type: none"><li>• <b>A REGIONAL SYSTEM OF FISHERIES <i>REFUGIA</i> (2017-2020)</b></li><li>• <b>LOG-FRAME FOR ESTABLISHMENT OF THE FISHERIES <i>REFUGIA</i></b></li></ul>
<b>VI.</b>	<b>SUSTAINABILITY AND PURPOSE OF INDICATORS</b>
<b>VII.</b>	<b>INDICATORS FOR SUSTAINABLE MANAGEMENT OF FISHERIES <i>REFUGIA</i></b>
<b>VIII.</b>	<b>ASSESSMENT FRAMEWORK</b>
<b>IX.</b>	<b>DATA COLLECTION AND ANALYSIS NEEDS</b>
<b>X.</b>	<b>ACKNOWLEDGEMENTS</b>
<b>XI.</b>	<b>REFERENCES</b>
<b>XII.</b>	<b>ANNEXES</b>



## ANNEX 8

## FOLLOW-UP THE RESULTS FRAMEWORK OUTPUTS

1. In the process on the project monitoring and evaluation (M&E), the agreed Project Document on “*Establishment and Operation of a Regional System of Fisheries Refugia in the South China Sea and Gulf of Thailand*” mentioned very clear to follow UNEP standard monitoring, reporting and evaluation processes and procedures. It is also noted that the project M&E plan have to consistent with the GEF Monitoring and Evaluation policy. Regarding this, the Project Results Framework presented in **Annex 1**, includes SMART indicators for each expected outcome as well as mid-term and end-of-project targets, will be used as a guideline for effective implementation to meet the project outcomes.
2. Refers to the clause 197 of the Project Document mentioned that the M&E plan can be reviewed and revised as necessary during the project inception workshop to ensure project stakeholders understand their roles and responsibilities vis-à-vis project monitoring and evaluation. The PCU therefore includes this agenda with aims to strengthen the country implementation that needs to achieve the project outputs and outcome as required from the project.
3. Considering the expected outputs of each project component as mentioned in the Annex 1 are able to summarize as follows:

Components	Expected Outputs
1) Identification and management of fisheries and critical habitat linkages at priority fisheries <i>refugia</i> in the South China Sea and Gulf of Thailand	<ul style="list-style-type: none"> <li>• 14 fisheries <i>refugia</i> profile reports (Annex 3-template), including GIS maps &amp; site characterizations, published</li> <li>• 14 published management plans and 24 annual reports</li> <li>• Quarterly reports [224] of network meetings and activities [including list of participants and results of work]</li> <li>• 4 annual partnership reports</li> </ul>
2) Improving the management of critical habitats for fish stocks of transboundary significance via national and regional actions to strengthen the enabling environment and knowledge-base for fisheries <i>refugia</i> management in the South China Sea and Gulf of Thailand	<ul style="list-style-type: none"> <li>• 6 published national reviews and recommendations for reforms of national, provincial and municipal regulations/ordinances for responsible fishing practices at priority <i>refugia</i></li> <li>• 6 endorsed revised policies</li> <li>• 6 published national guidelines on establishing and operating fisheries <i>refugia</i></li> <li>• 6 national reports on policy, legal and institutional aspects of <i>refugia</i> establishment and management published</li> <li>• Endorsed policy and executive orders, provincial/local ordinances and by-laws</li> <li>• 6 endorsed National Action Plan for the management of priority fisheries <i>refugia</i> and associated biodiversity</li> <li>• 1 endorsed Regional Action Plan for fisheries <i>refugia</i></li> <li>• 96 quarterly and 24 annual reports on fish stocks and habitats published online</li> <li>• 6 databases online and populated with datasets</li> <li>• 6 national and 1 regional Geographical Information System online and populated with site-based information</li> </ul>

	<ul style="list-style-type: none"> <li>• Characterisations for 14 <i>refugia</i> sites accessible online (<b>Annex 2</b>)</li> <li>• 1 modelling system online</li> <li>• 4 published reports of the results of demonstrations</li> </ul>
3) Information Management and Dissemination in support of national and regional-level implementation of the fisheries <i>refugia</i> concept in the South China Sea and Gulf of Thailand	<ul style="list-style-type: none"> <li>• 6 online national and 1 regional catalogue of best practice approaches and measures</li> <li>• 24 communications on best practices published and syndicated</li> <li>• 24 awareness materials published online</li> <li>• Annual reports of outreach programmes at 14 priority locations, including tracking of extent of community acceptance [56 reports]</li> <li>• 6 online national web portals on fisheries <i>refugia</i></li> <li>• 6 published GEF IW experience notes (one per country and one regional) on application of fisheries <i>refugia</i> in the South China Sea and Gulf of Thailand</li> <li>• Information and education materials accessible at SEAFDEC and online</li> <li>• 1 endorsed regional report on “Standardized Methods for Collection and Analysis of Data and Information, for the use in Assessing the Impacts of Fisheries <i>Refugia</i> and in the Designing of Appropriate Indicators for Long Term Management of the Regional System of Fisheries <i>Refugia</i>” published online</li> </ul>
4) National and regional cooperation and coordination for integrated fish stock and critical habitat management in the South China Sea and Gulf of Thailand	<ul style="list-style-type: none"> <li>• 6 NFRC Terms of Reference and 48 biannual meeting reports (joint management decisions and participant lists)</li> <li>• 6 NSTC Terms of Reference and 96 quarterly meeting reports (scientific and technical advice and participants lists)</li> <li>• 14 Management Board Terms of Reference and 224 quarterly meeting reports (joint management decisions and participant lists)</li> <li>• RSTC Terms of Reference and 4 annual meeting reports (documenting scientific and technical advice and participant lists)</li> <li>• PSC Terms of Reference and 4 annual meeting reports (documenting joint decisions and participant lists)</li> <li>• Terms of Reference and contracts for project coordination unit staff</li> </ul>

## ANNEX 9

## FOLLOW-UP THE RESULTS FRAMEWORK OUTPUTS

PROGRESS ON THE TARGET OUTPUTS FROM ESTABLISHMENT AND OPERATION OF A REGIONAL SYSTEM OF FISHERIES *REFUGIA* (2017-2020) AS OF SEPTEMBER 2019

☹ : Not yet, 😊 : On going, 📄 : Just Start project, 👍 : good work

Components	Expected Outputs	CAM	ID	MY	PH	TH	VN	PCU
Identification and management of fisheries and critical habitat linkages at priority fisheries <i>refugia</i> in the South China Sea and Gulf of Thailand	14 fisheries <i>refugia</i> profile reports (Annex 3-template), including GIS maps & site characterizations, published	☹	📄	☹	☹	☹	📄	
	14 published management plans and 24 annual reports	👍	📄	☹	☹	😊	📄	
	Quarterly reports [224] of network meetings and activities [including list of participants and results of work]	👍	📄	☹	☹	😊	📄	
	4 annual partnership reports	😊	📄	😊	😊	😊	📄	
Improving the management of critical habitats for fish stocks of transboundary significance via national and regional actions to strengthen the enabling environment and knowledge-base for fisheries <i>refugia</i> management in the South China Sea and Gulf of Thailand	6 published national reviews and recommendations for reforms of national, provincial and municipal regulations/ordinances for responsible fishing practices at priority <i>refugia</i>	😊	📄	😊	😊	😊	📄	
	6 endorsed revised policies	😊	📄	☹	☹	?	📄	
	6 published national guidelines on establishing and operating fisheries <i>refugia</i>	😊	📄	☹	☹	☹	📄	
	6 national reports on policy, legal and institutional aspects of <i>refugia</i> establishment and management published	😊	📄	☹	☹	☹	📄	
	Endorsed policy and executive orders, provincial/local ordinances and by-laws	😊	📄	☹	☹	☹	📄	
	6 endorsed National Action Plan for the management of priority fisheries <i>refugia</i> and associated biodiversity	😊	📄	☹	☹	☹	📄	
	1 endorsed Regional Action Plan for fisheries <i>refugia</i>							☹
	96 quarterly and 24 annual reports on fish stocks and habitats published online	☹	📄	☹	☹	☹	📄	
	6 databases online and populated with datasets	☹	📄	☹	☹	☹	📄	
	6 national and 1 regional Geographical Information System online and populated with site-based information	☹	📄	☹	☹	☹	📄	😊
	Characterisations for 15 <i>refugia</i> sites accessible online	😊	📄	😊	😊	😊	📄	😊
1 modelling system online							😊	

Components	Expected Outputs	CAM	ID	MY	PH	TH	VN	PCU
	4 published reports of the results of demonstrations							☺
Information Management and Dissemination in support of national and regional-level implementation of the fisheries <i>refugia</i> concept in the South China Sea and Gulf of Thailand	6 online national and 1 regional catalogue of best practice approaches and measures	☺	📄	☺	☺	☺	📄	☺
	24 communications on best practices published and syndicated	☺	📄	☺	☺	☺	📄	☺
	24 awareness materials published online	☺	📄	☺	☺	☺	📄	☺
	Annual reports of outreach programme at 14 priority locations, including tracking of extent of community acceptance [56 reports]	☺	📄	☺	☺	☺	📄	
	6 online national web portals on fisheries <i>refugia</i>	☺	📄	☺	☺	☺	📄	☺
	6 published GEF IW experience notes (one per country and one regional) on application of fisheries <i>refugia</i> in the South China Sea and Gulf of Thailand							☺
	Information and education materials accessible at SEAFDEC and online							☺
	1 endorsed regional report on “Standardized Methods for Collection and Analysis of Data and Information for the use in Assessing the Impacts of Fisheries <i>Refugia</i> and in the Designing of Appropriate Indicators for Long Term Management of the Regional System of Fisheries <i>Refugia</i> ” published online							☺
National and regional cooperation and coordination for integrated fish stock and critical habitat management in the South China Sea and Gulf of Thailand	6 NFRC Terms of Reference and 48 biannual meeting reports (joint management decisions and participant lists)	☺	📄	☺	☺	☺	📄	
	6 NSTC Terms of Reference and 96 quarterly meeting reports (scientific and technical advice and participants lists)	☺	📄	☺	☺	☺	📄	
	14 Management Board Terms of Reference and 224 quarterly meeting reports (joint management decisions and participant lists)	☺	📄	☺	☺	☺	📄	
	RSTC Terms of Reference and 4 annual meeting reports (documenting scientific and technical advice and participant lists)							☺



Components	Expected Outputs	CAM	ID	MY	PH	TH	VN	PCU	
	PSC Terms of Reference and 4 annual meeting reports (documenting joint decisions and participant lists)	[REDACTED]							☺
	Terms of Reference and contracts for project coordination unit staff								



**ANNEX 10****CONCEPT NOTE****Improving Healthy Ocean Ecosystems through  
Best Practices in Trawl Fisheries****I. INTRODUCTION**

Bottom trawl remains one of the major fishing gears in Southeast Asia that contributes to high fisheries production making many countries in the region among the top ten highest producers of fish in the world. However, the perceived lack of selectivity of the trawl net and the resultant capture of huge quantities and diversity of non-target species, including endangered species, coupled with its significant effect on the environment as overfishing threatens fish stocks globally, reduces biodiversity, alters the ecosystem functioning, and jeopardizes the food security and livelihoods of people.

Although, modern gear, materials, practices, and management of bottom trawling have gone a long way in reducing the catch of unwanted species and the environmental damage caused by trawl fishing, their impacts on the marine environment that include degradation of the bottom/seabed habitats, spread of marine plastic debris, and occurrence of microplastics from lost or abandoned trawl nets, have not undergone changes until the present. In addition, the existing large numbers of traditional trawlers in Southeast Asia, about 40,000 are still active, add to the increased emission of CO<sub>2</sub> into the air. These negative trends will intensify through time if major measures are not taken to address those mentioned impacts.

To solve these problems, the project considers four main actions that are urgently needed: the promotion of effective trawl fisheries management policies, development of innovative trawl technology, reduction of carbon footprint in fisheries, and creation of the artificial habitats to protect demersal fish stocks in the affected offshore areas. Given that, the enormous impacts of bottom trawl fishing on the health of the oceans should be impeded, particularly the alterations caused on the seabed habitats and in marine biodiversity on the continental shelf of Southeast Asia (Sunda Shelf). Such evidence is also necessary to effectively assess and manage the environmental impacts of fishing methods and to address tradeoffs given that bottom trawl fishing makes a substantial contribution to human food supply in the world market.

**II. THE PROPOSAL**

The South China Sea and Gulf of Thailand are geographically located on the important Sunda Shelf as a southeast extension of the continental shelf of Southeast Asia that includes the Malay Peninsula, Sumatra, Borneo, Java, Madura, Bali, and their surrounding smaller islands (Ben-Avraham 1973). It covers an area of approximately 1.85 million km<sup>2</sup> (Van Bemmelen 1949) and comprises large fishing areas suitable for bottom trawl fishing since the past.

Bottom trawl fishing in Southeast Asia has emerged since early 1970s, as a major industrialized fishing method, and became a dominant fishing method in offshore and coastal areas. Rapid expansion of trawl fishing effort, conversion of vessels, expansion of the geographical range of fishing, and retention of most animals caught have resulted in rapid depletion of stocks and changes to stock composition, destroying critical habitats, causing high impacts on benthic communities, catching of bycatch species, threatening and endangering major aquatic species, and even altering the associated ecological communities (Kongprom *et.al.* 2003; Nurhakim 2003; Campos 2003). This declining trend is compatible however with the fishing 'down marine food web', reported from well-studied parts of the South China Sea, notably the Gulf of Thailand (Christensen *et.al.* 2003).

In terms of socioeconomic impacts, more valuable fish caught by bottom trawl fisheries has decreased sharply and that there has been proportionate increase in smaller, less valuable species. These results provide a clear picture of the extent of stock rehabilitation and management efforts that are required to restore the maximum economic value to the fisheries of the region (Silvestre *et.al.* 2003).

On carbon footprint in fisheries, global fisheries burned almost 200 billion liters of fuel in 2016 compared to 47 billion liters in 1950 (Greet *et al.* 2019). The most fuel-intensive fishing practices not only contribute most to the damaged seabed habitats and reef formations but also worsen the impacts of climate change. Bottom trawling techniques are the most fuel intensive fishing techniques. Additionally, the intensity of fuel consumption by fisheries in the Southeast Asia is high about 500-2000 liters km<sup>-2</sup> (EC 2007) compared to the other regions in the world. Reducing the carbon footprint of fisheries, particularly in bottom trawling with less fuel consumption and causing less impact from trawling is therefore needed.

Achieving effective fisheries management for bottom trawling is therefore increasingly important as overfishing threatens fish stocks globally, reduces biodiversity, alters ecosystem functioning, and jeopardizes the food security and livelihoods of hundreds of millions of people worldwide (Golden *et al.* 2016; Jackson *et al.* 2001; Pauly *et al.* 2005; Szuwalski *et al.* 2017; World Bank 2009). As such, the Project intends to come up with effective fisheries management policies, innovative technology for best practices, reduction of carbon footprint, and stock rehabilitation programs.

### III. PROJECT DESCRIPTION

This concept note for the Project “Improving Healthy Ocean Ecosystems through Best Practices in Trawl Fisheries in the South China Sea and Gulf of Thailand” (FishTrawl) is being developed to meet the need for Strategic Action Program for the South China Sea. The FishTrawl Project would be executed regionally by the Southeast Asian Fisheries Development Center (SEAFDEC) in partnership with the government agencies responsible for fisheries in the 6 participating countries: namely Cambodia, Indonesia, Malaysia, Philippines, Thailand, and Viet Nam.

The FishTrawl Project integrates the ecosystem-based fisheries management approach through the development of effective national/regional fishery policies on sustainable fisheries and innovative technology for bottom trawl gears and methods including reduction of green-house gas emission from fishing activities. Additionally, building partnerships between multiple public and private sectors, *e.g.* local government/communities, research institutions, net makers, fisheries associations, fish meal industry, fish processors, etc. would be among the approaches to improve and change this production practice into more environmentally positive. The Project includes resources enhancement activities that aim to create offshore artificial habitats or artificial reefs to protect some demersal fish stocks due to loss of seabed habitats affected by the bottom trawl net. Cooperation among country partners and concerned inter-agencies that have the existing programs to deploy artificial reefs along the coastal areas for small scale fisheries is also needed taking into account the offshore demersal fish stocks that have already been depleted. The Project shall comprise the following 4 project components:

**Component 1** will consider the results of the impact assessment and management of bottom trawl fisheries through enhanced social dimensions and developed effective fisheries management policies. The outcome of this component is improved baseline data collection and effective fisheries management policies through enhancement of Data Management System. Taking into account the social dimensions concerns, the economic value of fishes and economic efficiency in the industries as well as data collection and management are improved for long term achievements of the Project. Supporting activities are:

- 1.1. Closing the knowledge gap on the ecosystem/environmental impacts of bottom trawling via baseline data collection and evaluation, and establishment of the data management system
- 1.2. Reduction of the pressures of bottom trawling on marine ecosystem and environment via adoption of effective fisheries management policies at national and regional levels
- 1.3. Catalyzing the public-private sectors on the actions via the ecosystem-based fisheries management to build resilient fishery resources and reduce the impacts of bottom trawling via enhanced stakeholder engagement taking into account gender mainstreaming in fisheries management
- 1.4 Establishment of cross-sectorial agreement on national guidelines for effective management of bottom trawl fishing
- 1.5 Endorsement of policy, legal, and planning frameworks, both at national and regional levels, for improving the ecosystem health through best practices in trawl fisheries
- 1.6 Improvement of economic efficiency in the industry and the individual fishers via enhanced traceability system along the value chain of fish and fishery products from bottom trawling

- 1.7 Increasing the economic value of fishes from medium scale bottom trawlers via promotion of marketing and branding as well as marine tourism at local communities;
- 1.8 Sharing of the knowledge and lessons learned to serve as useful platforms for data and information management for utilization by various stakeholders, the wider public and practitioners

**Component 2** focuses on improving the bottom trawl fishing gears and methods to be more eco-friendly and fuel-efficient gears through the development of innovative technology and best practices. The outcome of this component is reduced effects of bottom trawling on seafloor/benthic habitats and on the air quality through enhanced innovative technology and best practices in trawl fisheries. Supporting activities are:

- 2.1 Mitigation of the impacts of bottom trawling on marine ecosystem including the seabed habitats, fish stocks, by-catch, ghost fishing, etc. via enhanced ecosystem-friendly fishing gears and methods, bottom trawl innovations, and use of alternative fishing gears;
- 2.2 Enhancement of energy saving trawling including the low impact and fuel efficient fishing through innovative technology for increased fuel-efficient gear and reduced energy consumption or carbon footprint;
- 2.3 Reduction of post-harvest losses from bottom trawlers through improved preservation technology and increased quality of catches;
- 2.4 Enhancement of public-private partnership on innovative and eco-friendly technology through creation of business opportunities and economic considerations;
- 2.5 Building the capacity and knowledge specifically in the field by collaborating with stakeholders for exchanging of the best practices;

**Component 3** focuses on rehabilitation of the seabed habitats and fisheries resources enhancement in the offshore areas via installation of artificial reefs. The outcome of this component is increased fisheries production through fisheries enhancement and rehabilitation of seabed habitats programs particularly in the offshore-deep areas where no MPAs have been established and no fish shelters have existed. Using the data management system especially spatial data on fishing effort, the project will monitor the pressures of bottom trawling on seabed and identify the seabed/grounds for installing the artificial fish habitats to increase fish production in the offshore areas. Supporting activities are:

- 3.1. Investigation of the suitable grounds for deployment of the artificial reefs through the assessment of critical seabed habitats using high-resolution spatial data on fishing effort
- 3.2. Provision of platform for knowledge sharing and exchange of the best practices in installing artificial reefs
- 3.3. Increasing the shelters of fishes in the offshore areas via the deployment of artificial reefs based on scientific data, establishment of trawl ban areas, marine protected areas, etc.
- 3.4. Catalyzing the inter-agencies cooperation for the rehabilitation of offshore seabed habitats

**Component 4** will foster the national and regional cooperation and coordination in enhancing the healthy ecosystems through the establishment of data management system, development of the bottom trawl best practices and alternative gears as well as creation of the offshore artificial fish habitats where there are no MPAs or shelters for fish to hide. At national level, the project will strengthen cross-sectoral coordination and will harness the national scientific and technical expertise and knowledge necessary to promote the policy, legal and institutional reforms for fisheries *refugia* management in the participating countries. Regionally, Component 4 will foster regional cooperation in: the integration of scientific knowledge and research outputs with effective fisheries management policies; and in enhancing the healthy ocean through the Best Practices in Trawl Fisheries. This component also includes project coordination and management activities aimed at: ensuring the timely and cost-effective implementation of the regional and national-level activities; and satisfying the reporting requirements of UNEP and the GEF. Supporting activities are:

- 4.1. Strengthening of the cross-sectoral coordination in improving the ecosystem health
- 4.2. Harnessing of the national scientific and technical expertise and knowledge in promoting policy, legal and institutional reforms for enhancing the healthy oceans and implementing the best practices in trawl fisheries

- 4.3. Regional cooperation in the integration of scientific knowledge and research outputs with effective fisheries management policies
- 4.4. Regional cooperation in enhancing the healthy ocean ecosystems through the Best Practices in Trawl Fisheries
- 4.5. Effective coordination of regional and national-level activities and satisfying the reporting requirements of UNEP and GEF

The longer-term goals of this Project are to contribute to: improved seabed ecosystems and protected areas in the South China Sea and Gulf of Thailand; improved national fisheries management policies of the bottom trawling that threatens the demersal fish stocks and critical seabed habitat linkages; and enhanced uptake of best practices in bottom trawl fisheries management and biodiversity conservation in the design and implementation of regional and national fisheries management systems. The medium-term objectives are to: build the resilience of Southeast Asian bottom trawl fisheries to the effects of high and increasing levels of fishing effort on seabed habitats; improve the understanding among stakeholders, including fisherfolk, scientists, policy-makers, and fisheries managers, of the seabed ecosystem and fishery linkages as basis for integrated fisheries and ecosystem/habitat management; and build the capacity of fisheries departments/ministries and all relevant private partnerships to engage in meaningful activities regarding the improvement of fisheries and management of interactions between fisheries and critical seabed habitats. The related end-of-project targets are:

- by 2024, regional data management systems are established for effective fishing management and monitoring of the effects of bottom trawling on seabed habitats
- by 2024, six effective artificial reefs or protected areas or trawl bans are established in the offshore areas of the SCS and Gulf of Thailand
- by 2025, fisheries management policies on the best practices in bottom trawl are developed and implemented
- by 2025, about 20% improved bottom trawlers are adopting the best practices in bottom trawl and reducing their effects on the sea-bed habitats
- by 2025, about 25% reduction of carbon footprint from bottom trawling in Southeast Asia is achieved