



**The 3rd Regional Scientific and Technical Committee Meeting for
the SEAFDEC/UN Environment/GEF Project on Establishment and Operation of
a Regional System of Fisheries *Refugia* in the South China Sea and Gulf of Thailand**

5th – 7th February 2020
Classic Hoang Long Hotel, Hai Phong City, Viet Nam

**EXECUTIVE SUMMARY OF
REGIONAL ACTION PLAN FOR MANAGEMENT OF TRANSBOUNDARY SPECIES:
INDO-PACIFIC MACKEREL (*RASTRELLIGER BRACHYSOMA*)
IN THE GULF OF THAILAND SUB-REGION**

The Regional Action Plan for Management of Transboundary Species: Indo-pacific Mackerel (*Rastrelliger brachysoma*) in the Gulf of Thailand Sub-Region is developed through a series of Technical Consultation Meetings where scientists from various institutions and fishery policy people from six countries surrounding the Gulf of Thailand and the South China Sea agree on the urgent requirement of cooperation for sustainable utilization of Indo-pacific mackerel due to declining of fish stock and knowledge gaps for effective management. The objective of this RAP is to serve as guide for concerned countries in implementing actions to achieve the goal of “Sustainable Indo-Pacific mackerel fisheries in the Gulf of Thailand sub-region through science-based management for shared benefit to other ASEAN Member States by 2030.” This Guide also support the requirement of International instrument e.g. the 1982 United Nations Convention on the Law of the Sea (UNCLOS), the United Nations Fish Stock Agreement (UNFSA), and the UN Sustainable Development Goal (SDG) 14. In addition, the Guide is as a supplementary guide that support the ASEAN-SEAFDEC Resolution and Plan of Action on Sustainable Fisheries for Food Security for the ASEAN Region adopted by the ASEAN-SEAFDEC Member Countries in 2001, 2011 and the new Resolution and Plan of Action for 2030. Besides, the Guide also specified the importance of establishing and implementing effective fisheries management through ecosystems approach by integrating habitat and fisheries resources and increasing social and economic benefit to relevant stakeholders and applying knowledge science-based development and management of fisheries.

As a supplementary guide of the ASEAN-SEAFDEC Resolution and the Plan of Action, process of endorsement and adoption by higher official level are needed. Regarding this the draft of RAP Indo-pacific mackerel was minor amended at the 42nd Meeting of the SEAFDEC Program Committee held in November 2019 as enclosed herewith. It is scheduled to address the amended RAP for consideration and adoption by the SEAFDEC Council in April 2020, and later by ASEAN through its mechanism.

ACTIONS BY THE RSTC3:

- ❖ Considering the amended texts proposed after the 42PCM;
- ❖ Comments on missing, increase the importance;
- ❖ Inform, share and suggest to Country for the effort for development and support the endorsement of this RAP and Supplementary Guide at next SEAFDEC Council



**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 Collaboration with
SEAFDEC/Sweden Project on Fisheries and Habitat Management, Climate
Change and Social Well-being in Southeast Asia (2013-2019)**

**REGIONAL ACTION PLAN
FOR MANAGEMENT OF TRANSBOUNDARY SPECIES:
INDO-PACIFIC MACKEREL (*Rastrelliger brachysoma*)
IN THE GULF OF THAILAND SUB-REGION**

**SEAFDEC/UNEP/GEF/Fisheries *Refugia*
NOVEMBER 2019 (amended by 42PCM)**

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**REGIONAL ACTION PLAN
FOR
MANAGEMENT OF TRANSBOUNDARY SPECIES:
INDO-PACIFIC MACKEREL (*Rastrelliger brachysoma*)
IN THE GULF OF THAILAND SUB-REGION¹**

SEAFDEC

I. INTRODUCTION

Mackerels (Family Scombridae) particularly the Indo-Pacific mackerel (*Rastrelliger brachysoma*), also known as short mackerel, are among the most economically important small pelagic fishes in the Southeast Asian region, contributing to approximately 38% of the region's total small pelagic fisheries production or 11% of total capture fisheries production in 2010. Comparing among several Mackerel species, in 2016 Indo-Pacific mackerel contributed to 78% of the total Mackerel production with the average price of 1,492 USD/MT, decreasing from the production reported in 2015. (SEAFDEC, 2018).

On the production of Indo-Pacific mackerel by countries, Indonesia was the major producer in the region, reporting the highest production at 283,106 MT in 2016, followed by Philippines at 38,339 MT (SEAFDEC, 2018). As for Thailand, the Mackerel production was not segregated by species, but the total production of all Mackerel species was reported to be 81,017 MT. Nevertheless, it could be observed that the country's total Mackerel production in 2016 had drastically reduced from those of 194,845 MT in 2012. Similar to Thailand, Philippines also reported the declining trends in its Mackerel production through the period (SEAFDEC, 2018).

The Gulf of Thailand Sub-region (GoT) is one of the important ecosystems for Indo-Pacific mackerel, where the peak of highest catch using purse seine and falling net was reported in 1996 at 328,955 MT; while low catch was reported during 3 periods, in 1999, 2005 and 2010 at 289,285 MT, 283,984 MT and 259,354.56 MT, respectively, and the catch has never reached 300,000 MT as recorded in 1996 again (SEAFDEC, 2018).

In general, the species was caught by various types of fishing gears in the GoT; and the three major types recorded in 2008 were purse seines (45%), driftnets (31%), trawls (18%). The landings show declining trends indicating that the mackerel stocks in the South China Sea and GoT were already overexploited. For instance, in 2016, Thailand reported the catch production of Indo-Pacific mackerel by 3 main fishing gears, purse seine at 3,008 MT, trap at 691.6 MT, and trawl at 630.3 MT (SEAFDEC, 2018).

II. STOCK STATUS OF *R. BRACHYSOMA*

Indo-Pacific mackerel is considerable inexpensive but contains high protein, making the species popular for consumption in the Southeast Asian countries such as Cambodia, Indonesia, Thailand, Malaysia, etc. However, with drastic increase in the production of canned mackerels to replace the decreasing sardines, the catch of Indo-Pacific mackerel has recently been declining as a result of overfishing and unregulated fishing operations in several countries. Such situation has become a great concern by countries in the Southeast Asian region.

A number of fish species including mackerels were reported to be in the overexploitation state in the Gulf of Thailand (Puthy, 2007). In his study using the Schaefer and Fox models, the result

¹ Drafted at Technical Consultative Meeting on Drafting of the Regional Action Plan for Management of Transboundary Species Indo-Pacific Mackerel in the Gulf of Thailand Sub-region, 12-13 September 2019, Thailand. Commented by 42nd Meeting of the SEAFDEC Program Committee, November 2019.

indicated that mackerel stocks are both biologically and economically overexploited, but there were still opportunities to increase the mackerel stocks by reducing fishing efforts which would allow the stocks to recover.

Thailand also reported that the species was under overexploitation state throughout the past years. The species also had changing population patterns, which could be due to the environmental impacts. Furthermore, distribution of fish larvae could also be influenced by changes in phytoplankton, water current, and temperature (SEAFDEC, 2017).

In Indonesian waters, over-exploitation of pelagic fishery resources, including Indo-Pacific mackerel has been highlighted in Java Sea and other Indonesian waters; however, the recent population dynamic study by Zamroni, A.& Ernawati, T. (2019) showed that Indo-Pacific mackerels in Northern Coast Java of Indonesia water was still under fully exploitation state, and the recruitment process has not been disturbed. Although the species has yet to reach the heavily exploitation state, suggestion was made that fishing efforts should be reduced; while fishing permits, such as number of units, size of fishing fleet, fishing gear dimensions, and fishing technology pressure, should also be controlled. Nevertheless, due to limited biological information of Indo-Pacific mackerel, genetic diversity study of the species including in Java Island was conducted (Indaryanto *et al.* 2015).

Meanwhile, the declining of Indo-Pacific mackerel due to changes in environmental condition and water quality, and modification and loss of critical habitats, has been documented in several countries and reported by the media.

III. ISSUES, KNOWLEDGE GAPS, AND CHALLENGES

Based on the reviews and inputs from six Southeast Asian countries, namely Cambodia, Indonesia, Malaysia, Philippines, Thailand, and Viet Nam, in response to SEAFDEC questionnaires in September 2019, the issues, knowledge gaps and challenges for sustainable utilization of Indo-Pacific mackerel could be summarized as follows:

3.1) Data and Information

- Insufficient information on the indo pasific mackerel fishery characteristics
- Insufficient series catch and effort data, series of size data, biological data collection for population and abundance study
- No current information of migratory route, spawning ground and season for a whole life cycle
- No regular monitor data collection on capture production

3.2) Understanding the Status of Fish Stock

- Lack of the knowledge on stock structure (need on DNA study)
- Insufficient stock status of *R brachysoma* (distribution and abundance)
- Insufficient information on Population dynamics (Growth parameters, mortalities and relationship to other regional stock)
- No Actual effort to exploit the resources
- Trans-boundary distributions
- Lack of knowledge on how to assessment Multi-fishing gears to harvest

3.3) Management Responses

- No Fisheries Management Plan
- No information on existing and effectiveness of regulations
- No co-management schemes/arrangements
- No transboundary management mechanism/plan
- No information on Effects/Loss to IUU fishing

- No [reliable](#) database or software for Assessment
- No Traceability system using electronic logbook
- support the Sustainable management concept, Co-management, and EAFM

3.4) Awareness Building

- Educate people and student in fisheries communities
- Distribute brochures or any media to promote of fisheries management
- Raise awareness of both small-scale fishers and commercial fishers
- Sharing of the findings to both policy management level and fishermen
- develop consultation among researchers, managers and stakeholders (EAFM)
- to support the Sustainable management concept, Co-management, and EAFM

3.5) Strengthen Regional Cooperation

- Standardization on data collection for regional stock assessment
- Data sharing
- Lack of management body
- Develop the transboundary management mechanism/plan (same as 3.3)

3.6) Study the Environment Impact

- Temporary disappear of short mackerel in the Gulf of Thailand
- impact of climate change to fish migration route

3.7) Enhance Capacity Building

- Strengthen knowledge on research works as follows:
 - Species identification of small size (juvenile) and larval fishes
 - otolith (to know age of fish)
 - Data collection at landing sites: catch and biological data
 - Data analysis
 - Stock Assessment and modeling for stock assessment
 - [Harvest Strategy](#)
- Fishing gear technology
- Fisheries manager
 - Translating scientific advice into management measures and actions
 - Understand various fisheries management tools and used them in the actual implementation

3.8) Inform the agreed management measures to

- [Related stakeholder i.e fishers/fishing industry, local community etc., and](#)
- [Ensure its compliance](#)

IV. REQUIRED REGIONAL COOPERATION FOR TRANSBOUNDARY SPECIES

Since 1953, Thailand undertook several management actions for Indo-Pacific mackerel stock. From 1953 to 2015, several studies were conducted, and 13 Notifications were released in relation to closure of fishing area in the Gulf of Thailand with the objective of conserving the spawning grounds and nursery stages of aquatic resources (Saikliang 2016). Thailand also undertook several studies to enhance knowledge on migration patterns of Indo-Pacific mackerel within the country's EEZ in the Gulf of Thailand. The country's efforts for effective fisheries management for Indo-Pacific mackerel were continued up to the present.

Although information on migration patterns of Indo-Pacific mackerel within the country's EEZ in Gulf of Thailand sub-region is already available for almost 30 years. However, the recent result from genetic analysis of Indo-Pacific mackerel using individual assignment and mixed-stock analysis shows the contradictory migratory behavior of the species between the stock in the inner Gulf of

Thailand and the stock in the eastern part of the Gulf of Thailand (Kongseng, et al, 2020). Additionally, the population from Pattani Province may also migrates across eastern Gulf of Thailand through southern part of Viet Nam and Cambodia waters. Such results indicated that Indo-Pacific mackerel is transboundary species and joint management cooperation at the regional or sub-regional levels among countries that harvested Indo-Pacific mackerel is necessary for sustainable management of the species.

V. PROVISIONS OF THE REGIONAL ACTION PLAN FOR MANAGEMENT OF TRANSBOUNDARY INDO-PACIFIC MACKEREL

There are a number of international instruments aiming at conservation and management of marine resources, *e.g.* the 1982 United Nations Convention on the Law of the Sea (UNCLOS), the United Nations Fish Stock Agreement (UNFSA), and the UN Sustainable Development Goal (SDG) 14. These instruments also support initiatives in combating of illegal fishing towards sustainable use of seas and marine resources, as well as to enhance the environmental, economic and social well-being of coastal fishers and communities. At the regional level, the ASEAN-SEAFDEC Resolution and Plan of Action on Sustainable Fisheries for Food Security for the ASEAN Region adopted by the ASEAN-SEAFDEC Member Countries in 2001 and 2011 also specified the importance of establishing and implementing effective fisheries management through ecosystems approach by integrating habitat and fisheries resources and increasing social and economic benefit to all stakeholders, and applying knowledge/science-based development and management of fisheries.

Recognizing the needs to strengthen cooperative efforts among countries toward sustainable utilization of the marine resources particularly the Indo-Pacific mackerel that is important transboundary resource in the Gulf of Thailand, SEAFDEC with the funding support from the Government of Sweden through the SEAFDEC-Sweden Project on “Fisheries and Habitat Management, Climate Change and Social Well-being in Southeast Asia” and 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 (Fisheries *Refugia*)” therefore facilitated discussion among the Gulf of Thailand countries to develop the Regional Action Plan (RAP) for Management of Indo-Pacific mackerel. The RAP contains five Sections, namely:

Section 1: Introduction;

Section 2: Stock Status of Indo-Pacific mackerel;

Section 3: Issues, Knowledge Gaps and Challenges;

Section 4: Required Regional Cooperation for Management of Transboundary Species; and

Section 5: Provisions of the RAP including goal, outcomes, objectives and actions.

The Provisions of RAP were categorized into 5 dimensions, which are: 1) Governance; 2) Social; 3) Economic, 4) Ecosystem; and 5) Climate Change; and these were aligned with the concept of the Ecosystem Approach to Fisheries Management (EAFM).

This RAP for Management of Indo-Pacific mackerel is a non-legal binding document that is meant to serve as a foundation to identify practices and processes that support the implementation of the relevant ASEAN-SEAFDEC Resolution and Plan of Action. It marks an evolutionary step towards concerted regional approach to support countries’ efforts to manage this transboundary fish stock in the Gulf of Thailand.

4.1 THE GOAL OF REGIONAL ACTION PLAN

This RAP is intended to serve as guide for concerned countries in implementing actions to achieve the goal of

“Sustainable Indo-Pacific mackerel fisheries in the Gulf of Thailand sub-region through science-based management for shared benefit to other ASEAN Member States by 2030.”

4.2 EXPECTED OUTCOMES

- 1) Healthy Indo-Pacific mackerel resources through the implementation of fishery management plan of the Gulf of Thailand
- 2) Accurate and comprehensive information on Indo-Pacific mackerel of the Gulf of Thailand
- 3) Model for development of management plan for Indo-Pacific mackerel that could be applicable to other sub-regions

4.3 ACTIONS

| A) GOVERNANCE DIMENSION | | | |
|--|---|------|---|
| <p>Overall Objective: Regional/sub regional fisheries management mechanism are in place building upon national regulations and management scheme</p> <p>Specific Objectives</p> <p>A1. Fisheries management mechanism developed and approved (including fisheries management plan and arrangement, the effective of regulation)</p> <p>A2. Data management system are enhanced and considered regional/sub-regional standardization data management system in place</p> <p>A3. Standard for assessing fishing effort large, medium and small-scale fishery agreed</p> <p>A4. Understandings on national law and management schemes within the sub-regional are communicated and applied</p> <p>A5. Impact of unregulated and unreported fishing assessed</p> <p>A6. Catch documentation system applied as a tool to improve traceability of the short mackerel fishery</p> | | | |
| Knowledge Gaps/Issues | Actions | Ref. | Responsibility |
| Insufficient catch and landing data | Develop the SOP/technical guidance for data collection (including catch data, biological data) | A2 | SEAFDEC University Government agency Fishery research institute |
| | To further develop catch documentation | A2 | |
| | Harmonization/standardized on data collection and develop database system | A2 | |
| Insufficient biological data collection | Conduct capacity building program for data collection to enumerator and scientist, researchers | A3 | SEAFDEC University Government agency Fishery research institute |
| | Conduct time series data collection with standardized method | A3 | |
| Insufficient Fishing effort (include commercial and small scale) | Link to the catch documentation include commercial and small-scale fishery (as available) | A4 | Government and Private sector |
| | Regular monitor data collection on fishing effort capture production (include commercial and small scale) | A4 | |
| Fisheries Management Mechanism (including fisheries management plan and arrangement, the effective of regulation) | Develop fisheries management plan for short mackerel at national and sub-regional level Initiate the development of harvest strategy | A1 | SEAFDEC University Government agency Fishery research institute All stakeholder (fishers, others) |

| | | | |
|--|--|----|---|
| | Establish regional cooperation on monitoring, control and surveillance | A1 | Existing national MCS partners/network |
| | Raise awareness of both small-scale fishers and commercial-scale fishers <ul style="list-style-type: none"> ○ Policy and regulations ○ Management measures ○ Sustainable utilization ○ Involvement the participation, considering gender sensitivity | A1 | SEAFDEC University Government agency Fishery research institute All stakeholder |
| | Promote stakeholder consultation among researchers, managers and stakeholders using EAFM | A1 | SEAFDEC University Government agency Fishery research institute All stakeholder International organizations (FAO, NOAA, etc) |
| | Conduct habitat conservation and rehabilitation and conduct stock enhancement programs | A1 | SEAFDEC University Government agency Fishery research institute All stakeholder |
| Understanding national law and regulations | Comparative review of national law and regulations, (including local wisdom) | A5 | Government and resource person |
| | Disseminate knowledge and information on the conservation and management of Indo-pacific mackerel to fisheries communities and students | A5 | Government Other stakeholders |
| Flexibility of regulation to respond to science advise | Encourage periodic evaluation of policy and regulation | A1 | Government |
| Management schemes/arrangements including transboundary aspects. | Develop management schemes/arrangements at sub-regional area including transboundary aspects | A1 | SEAFDEC University Government agency Fishery research institute All stakeholders |
| | Support establishment of regional cooperation/management mechanism (non-legal binding and scientific advisory committee) | A1 | |
| Illegal, Unregulated and Unreported Fishing | Assessing the impact of Illegal, Unregulated and Unreported Fishing | A6 | Government and resource person |
| | Strengthen the Monitoring, Control and Surveillance network against the illegal fishing (none legal binding) | A6 | Inter-agencies coordination |
| Traceability system for fish and fishery product (using electronic logbook, etc) | Develop the catch documentation that suitable for traceability system e.g. electronic logbook, etc. | A6 | Government and resource person |

B) SOCIAL DIMENSION

Overall Objective:

Social responsibility and involvement in fisheries management achieved

Specific Objectives

B1. Understanding the social condition of people involving in fishery at local and national level.

B2. Increase participation and involvement of stakeholder in various level.

B3. Resolve conflict on land and resource use

B4. Build awareness and capacity in all level

| Knowledge Gaps/Issues | Actions | Ref. | Responsibility |
|--|--|------|---|
| Social and economic at local and national level | Conduct a baseline survey based on available information on social and economic at local and national level (S) | B1 | Government University |
| Traditional fishing (indigenous knowledge and social responsibility) | Improve and disseminate the best practice to other (indigenous people) | B1 | Government |
| People engagement in fishery activity (include small scale fishery and large scale/commercial fishery, processing) | Conduct stakeholder analysis for understanding the important and influence of stakeholder in various level | B2 | Government University |
| People engagement in policy making (fisherfolk organization, academy, private sector, | Promote Public Private Partnership | B2 | Government |
| | Promote multi stakeholder engagement in policy making | B2 | Government and relevant stakeholder |
| Social structure (community small scale and large scale, gender, migrant labor, and fisher) | Encourage gender equality based on understanding of social structure in community | B2 | Government and relevant stakeholder |
| Conflict on land and resource use | Promote stakeholder consultation | B3 | Government and relevant stakeholder |
| | Promote marine spatial planning and coastal zone management | B3 | Government Resource person Relevant stakeholder |
| Awareness Raising | Distribute brochures or any media (e.g. digital media) to promote fisheries management and regulations Capacity building and experts exchange Fishing gear technology for eco-friendly (Reduce bycatch, cost and expenditures) | B4 | SEAFDEC Government Relevant stakeholder |

C) ECONOMIC DIMENSION

Overall Objective:

Equal distribution of economic benefit, economic return and employment opportunities

Specific Objectives:

- C1. Ensure the national government and private sector commitment for long-term funding and support.
- C2. Understanding the structure and ownership of asset within fishing industry (large, medium and small scale).
- C3. Maximized economic benefit return for management response and reduced unequal distribution.

| Knowledge Gaps/Issues | Actions | Ref. | Responsibility |
|--|--|------|---|
| Funding | To ensure the national government commitment for long-term funding and support | C1 | Government Private sector Funding agency/donor |
| | Explore various potential donor | C1 | |
| | Promote capital access through micro finance scheme | C1 | |
| | Promote corporate social responsibility | C1 | |
| Structure and ownership of asset within the fishing industry (large and small scale) | Review structure and ownership of asset within the fishing industry (large, medium and small scale) for management responses | C2 | Government Resource person |
| Benefit and economic return and unequal distribution | Assess benefit and economic return throughout the value chain | C3 | Government Resource person |
| Increase of cost (fuel and other inputs) | To ensure the fuel and other input exist for local fishermen | C3 | Government |
| Fisheries employment revenue | To create the alternative work | C3 | Government Private Sector Relevant stakeholder |
| | Require the contract among people engage in fishing | C3 | |

D) ECOSYSTEM DIMENSION

Overall Objective:

Maintain healthy ecosystem for the wellbeing of short mackerel resources

Specific Objectives

D1. Understand current status and improve the knowledge of short mackerel resources for scientific based management

D2. Understand various habitats of short mackerel throughout its life cycle

| Knowledge Gaps/Issues | Actions | Ref. | Responsibility |
|---|---|------|---|
| Migratory route | Update, further define and confirm the migratory route at national, sub-regional or regional area | D2 | Fisheries Agencies, National Research Institutions, Regional Institutions |
| | Conduct tagging program, e-DNA, DNA | D1 | Fisheries Agencies, Research Institutions |
| Spawning and nursery grounds (including dispersion and distribution of fish larvae) | Conduct comprehensive larvae survey (e.g. ichthyoplankton) | D1 | Fisheries Agencies, Research Institutions |
| | Study on critical habitats | D2 | Fisheries Agencies, Research Institutions, |
| Seasonal changes | Conduct comprehensive larvae survey (e.g. ichthyoplankton) | D1 | Fisheries Agencies, Research Institutions, SEAFDEC |
| | Conduct reproductive biology study | D1 | Fisheries Agencies, Research Institutions, SEAFDEC |
| Physical and chemical oceanographic conditions and ocean circulation | Conduct oceanography survey | D2 | Fisheries Agencies, Research Institutions, SEAFDEC |
| | Develop oceanographic modelling | D2 | Fisheries Agencies, Research Institutions, IOC/WESTPAC |
| | Conduct satellite imagery (GIS, remote sensing) analysis | D2 | Fisheries Agencies, Research Institutions |
| Stock structure | Conduct DNA study, otolith, tagging, etc. | D1 | Fisheries Agencies, Research Institutions, SEAFDEC |
| Stock status at national | Conduct stock assessment at national, | D1 | Fisheries Agencies, |

| | | | |
|--|---|------|---|
| and regional of <i>R. brachysoma</i> (distribution and abundance) | sub-regional or regional level | | Research Institutions, SEAFDEC |
| | Share data, information and findings from scientific research to relevant stakeholders | D1 | Fisheries Agencies, Research Institutions, SEAFDEC |
| | Standardized data collection for regional stock assessment | D1 | Fisheries Agencies, Research Institutions, SEAFDEC |
| | Develop modeling for stock assessment | D1 | Fisheries Agencies, Research Institutions, SEAFDEC, FAO |
| Species Identification | Provide capacity building on species identification of small size (juvenile) and larval fishes | D1 | Fisheries Agencies, Research Institutions, SEAFDEC |
| Status and Trends | Investigate the trend of short mackerel catch at national, sub-regional levels | D1 | Fisheries Agencies, Research Institutions, SEAFDEC |
| Population dynamics (Growth parameters, mortalities etc.) | Conduct survey on fisheries biology | D1 | Fisheries Agencies, Research Institutions |
| Impact of fishing effort on stock structure (Multi-fishing gears to harvest) | Conduct study on impact of fishing effort on stock structure (Multi-fishing gears to harvest) to improve the fishery management | D1 | Fisheries Agencies, Research Institutions, SEAFDEC |
| | Enhance Fishing gear technology for eco-friendly (Reduce bycatch, cost and expenditures) | D2 | Fisheries Agencies, Research Institutions, SEAFDEC |
| Stock assessment and distributions for transboundary species | Enhance the cooperation for information sharing among the bordering countries | D1 | Fisheries Agencies, SEAFDEC |
| Capacity building and experts exchange | Training, workshop, conference and experts exchange | D1,2 | Fisheries Agencies, Research Institutions, SEAFDEC, FAO, UNEP-GEF |

E) CLIMATE CHANGE DIMENSION

Overall Objective:

Adaptive management based on understanding the impact of climate change and disaster

Specific Objectives:

- E1. adaptive management measures **in place** in response to the impact of climate change and disaster to short mackerel fisheries and habitats
- E2. mitigation and precautionary measures **adopted** to compensate the effects of climate change

| Knowledge Gaps/Issues | Actions | Ref. | Responsibility |
|--|---|------|---|
| Impact of climate change to fish migration route | Assess the impact of climate change/disaster/anthropogenic activities to fish migration route, habitat and behavior | E1 | Fisheries and Environmental Agencies, Research Institutions, SEAFDEC, UNEP-GEF, UNDP, FAO |
| | Study effect of environmental changes on the migratory pattern and spawning patterns based on climate change | E1 | Fisheries and Environmental Agencies, Research Institutions, SEAFDEC, UNEP-GEF, UNDP, FAO |
| | Share information from the findings of scientific research to both fisheries managers and fishers | E2 | Fisheries and Environmental Agencies, Research Institutions, SEAFDEC, UNEP-GEF, UNDP, FAO |
| Sensitivity of species on critical habitats and environment impact to ecosystem (pollution, climate change, etc) | Conduct study on sensitivity of species on environment change (pollution, climate change, etc) to support the management response | E1 | Fisheries and Environmental Agencies, Research Institutions, SEAFDEC, UNEP-GEF, UNDP, FAO |
| | Study on the critical habitats (spawning and grounds) | E1 | Fisheries and Environmental Agencies, Research Institutions, SEAFDEC, UNEP-GEF, UNDP, FAO |
| | Study effect of environmental changes on the migratory pattern and spawning | E1 | Fisheries and Environmental |

| | | | |
|--|---|----------|---|
| | patterns | | Agencies, Research Institutions, SEAFDEC, UNEP-GEF, UNDP, FAO |
| | Data sharing (assign focal person to share information) | E1 | Fisheries and Environmental Agencies, Research Institutions, SEAFDEC, UNEP-GEF, UNDP, FAO |
| Capacity building and experts exchange | Training, workshop, conference and experts exchange on CC impacts | E1 E2 | Fisheries and Environmental Agencies, Research Institutions, SEAFDEC, UNEP-GEF, UNDP, FAO |

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