FISH for the PEOPLE

A Special Publication for the Promotion of Sustainable Fisheries for Food Security in the ASEAN Region

Volume 24 Number 1: 2026
Bangkok, Thailand, ISSN: 1685-6546

Promoting gender-inclusive initiatives to empower women towards sustainable **small-scale fisheries livelihoods in Southeast Asia**

Southeast Asian Fisheries Development Center

Production of this publication is supported by the Japanese Trust Fund.

Editorial

Co-management of fishery resources fosters a collaborative environment where every stakeholder, from resource users to government authorities, takes part and share responsibilities related to information, decision-making and implementation. In practice, however, power sharing can vary significantly. The integration of the ecosystem approach to fisheries management (EAFM), which looks at fisheries management as a whole ecosystem, where ecological, social and governance are considered, complements the fisheries co-management approach. To ensure management strategies are effective and context-specific, the use of SWOT analysis is recommended during the planning phase to identify strengths and challenges unique to the area. This collaborative model can help enhance the livelihoods of small-scale fishing communities and promote sustainability through collective action.

Women comprise nearly half of the small-scale capture fisheries workforce. Despite this, their contributions have remained "invisible," and they continue to face an uphill battle in terms of participation in decision-making as well as access to resources and financial services. Traditional gender stereotypes and a lack of confidence due to skills gaps continue to limit women's participation in leadership roles and capacity-building activities. SEAFDEC, at the forefront of mainstreaming gender equality in fisheries in the Southeast Asian region, has made gender a cross-cutting issue in its Plan of Action on Sustainable Fisheries for Food Security Towards 2030. Collaborative projects, such as the one with FAO and several Member Countries (Lao PDR, Myanmar, the Philippines, and Thailand), help ensure that both men and women have equal opportunities to shape policies that sustain their livelihoods.

The issue of gender equality also looms large in fisheries management initiatives in Indonesia. Efforts have been made to acknowledge the contributions of women, which include integrating gender analysis in the development of fisheries groups. The formation of fisheries groups, which serve as a cooperation platform, production unit and business entity, is one of the responsibilities of fisheries extension officers as defined by law. Extension officers are working towards making fisheries groups more inclusive by encouraging women to participate in capacity-building activities, decision-making, and business management. This approach ensures women can access the economic and social benefits offered through this initiative.

With modernization, traditional fishing practices that previously relied heavily on intensive labor can now transition to more mechanized means, significantly improving efficiency. In the case of purse seine fishing in Thailand, the installation of advanced equipment, including the hydraulic hauling system, *i.e.* Power Block, has helped streamline operations, reduce physical strain on the crew, and cut energy consumption. While there are tangible benefits, vessel upgrade plans must be weighed against higher capital investment and maintenance costs and other expenses, among other factors. Policy support, in the form of access to affordable financing schemes and training of personnel, would also be needed for scaling up the operation. At the same time, it is important to ensure that advancements in fishing operations do not lead to overcapacity and affect sustainability.

Innovation and improvement of fishing technologies are necessary for sustainability. In the case of small-scale fishing operations in Thailand, these could result to a reduction in fuel consumption, lower operational cost, and increased energy efficiency. As these upgrades would require substantial investment, institutional support (in the form of research on the benefits of investing in technological upgrades and legislation), as well as access to financial services, could help persuade vessel owners to proceed with the upgrades.

Advances in stock assessment have accelerated over the last ten years. To ensure data integrity and accuracy in managing fish stocks, practitioners must adopt the latest models and approaches. Given the complex nature of analyzing the data, it is also important to keep in mind the technological proficiency of stock assessment practitioners, who may not be familiar with advanced programming languages. Technological innovations, such as user-friendly, menu driven assessment tools using modern surplus production models (SPMs) could give policymakers a better picture of the current health of their fish stocks and make management decisions accordingly. It is therefore critical that institutions that previously relied on outdated models transition to current ones and conduct sustainable capacity building activities for staff practitioners.

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Developing Efficient Strategic Plans for Small-scale Fisheries Co-management: Case Study in Cambodia, Lao PDR, and Thailand

Rattana Tiaye, Thanyalak Suasi, and *Lieng Sopha*

Keywords: co-management, ecosystem approach to fisheries management, ecological well-being, good governance, human well-being, SWOT analysis

The case study, which aims to develop efficient strategic plans for small-scale fisheries co-management utilizing SWOT analysis, was conducted under the project "Community Fisheries Co-management: Capacity Building and Sharing Experiences and Lessons Learned among Mekong Region Member Countries" implemented by the Community Fisheries Development Department (CFDD) of the Fisheries Administration (FiA), Ministry of Agriculture, Forestry and Fisheries (MAFF) of Cambodia, with support from the Mekong-Lancang Project. Its main objective is to strengthen the capacity of officers and relevant stakeholders in fisheries co-management for sustainable fisheries resource management by sharing experiences, good practices, and lessons learned among the participating countries, namely: Thailand, Lao PDR, Viet Nam, China, and Cambodia. The Mekong-Lancang Project provided support for the conduct of the case study, which focused on its three participating countries that are also ASEAN Member States (AMSs): Cambodia, Lao PDR, and Thailand.

Under the Community Fisheries Co-management Project of CFDD, several capacity-building activities were conducted, such as the Training Workshop on Fisheries Co-management on 11–17 June 2023 in Siem Reap Province, Cambodia; Field Visit to fisheries co-management sites in Lao PDR and Thailand on 25–29 September 2023; and Reflection on the Co-management Situation in Siem Reap Province, Cambodia on 30 November–01 December 2023.

The participants in the Training Workshop included representatives from the Mekong-Lancang Participating Countries—Thailand, Lao PDR, Viet Nam, China, and Cambodia, with resource persons from various institutions, including those from Conservation International (CI), Culture and Environment Preservation Association (CEPA), and the Training Department (TD) of the Southeast Asian Fisheries Development Center (SEAFDEC). The fishers' groups from the study sites in Cambodia, Lao PDR, and Thailand also participated in focus group discussions. Several staff members from SEAFDEC/TD took part in activities to facilitate knowledge- and experience-sharing on fisheries co-management.

Fisheries co-management has been implemented for many years to promote a shared responsibility and authority between resource users and the government in managing fishery resources and areas (Tiaye, 2023). More specifically, Try and Sitha (2011) defined co-management in the fisheries sector as a process of management in which the government shares power with fishery resource users, with fishery users being given specific rights and responsibilities relating to information, decision-making, and implementation of the fishery management activities. On the other hand, the ecosystem approach to fisheries management (EAFM) is a practical participatory approach that seeks to balance ecological and human well-being with good governance (Weerawat, 2020). These two approaches can complement each other effectively (**Box 1**), as several countries, particularly the AMSs, have recognized the benefits of applying fisheries co-management alongside the EAFM. Fisheries co-management and the EAFM are effective management approaches (SEAFDEC, 2022). Before adoption, fishery managers—including officers, fishers, and resource users—should carefully consider the various aspects, such as impacts, challenges, threats, weaknesses, strengths, and opportunities of a specific management strategy. This is essential to ensure sustainable fisheries resource management and to support the well-being of fishing communities.

Box 1. Definition of Co-management and Ecosystem Approach to Fisheries Management

Co-management	A collaborative approach that focuses on shared responsibility, where governments and indigenous or community partners work together to make decisions about natural resources. However, the level of actual power-sharing can vary widely (Parsons, Fisher, and Crease, 2021) co-management initiatives are increasingly commonplace and are intended to improve sustainable environmental management as well as foster more equitable power-sharing between states and Indigenous or local communities.
Ecosystem Approach to Fisheries Management	A way of managing fisheries that looks at the whole ecosystem rather than just individual fish stocks, where ecological, social, and governance considerations are brought together, and ongoing learning experience, stakeholder involvement, and co-management are considered. The process is adaptive—after issues are identified, a plan is created and implemented, and the results are monitored so that the plan can be updated as conditions change.

During the Training Workshop on Fisheries Co-management in Siem Reap Province in June 2023, representatives from the Mekong–Lancang participating countries, together with the resource persons, presented the fisheries co-management approach, which uses the three EAFM components: ecological well-being, good governance, and human well-being (**Box 2**). The participants also selected

Cambodia, Lao PDR, and Thailand as study sites for focus group discussions of key stakeholders, such as the fishers, agriculturists, and processing groups. Results of the group discussions indicated that fisheries co-management and EAFM can be applied according to each country's specific circumstances. In terms of ***ecological well-being***, activities implemented by government officers, community fisheries, and relevant stakeholders include establishing conservation areas, conducting fish releases, habitat rehabilitation, and capacity-building initiatives. In the area of ***good governance***, the participating countries should strengthen enforcement mechanisms and policy measures while promoting people's participation in planning, implementation, monitoring, and evaluation. To enhance ***human well-being***, livelihoods and occupational development activities—such as modifying fishing gear, creating job opportunities, and promoting savings groups—should be introduced. A summary of fisheries co-management activities and related aspects in Cambodia, Lao PDR, and Thailand, categorized by the three components of EAFM, is presented in **Table 1** (CFDD, 2023).

Box 2. Three Components of EAFM
Ecological well-being means that the habitat is healthy, fishery resources are sustainable, and pollution is reduced
Good governance encompasses the effective institutions and arrangements for implementing rules and regulations
Human well-being means there is food security, sustainability in fishers' livelihood, and equitable wealth

Table 1. Activities/aspects concerning fisheries co-management

Ecological well-being	
Cambodia	• Establishment of fish conservation zones in coastal and inland fishing areas protected by the Community Fisheries (CFi) • Protection of flooded forests by the CFi • Co-management of the deep-pools in the upper Mekong by CFi and the provincial authority
Lao PDR	• Conduct of resource enhancement activities (releasing of fish seeds and broodstocks) • Demarcation of conservation areas leading to high species abundance (more than 400 fish species, 37 amphibian species, seven crab species, and ten shrimp species recorded)
Thailand	• Conservation and restoration of resources - Habitat restoration - Fisheries enhancement - Training and capacity building • Organization of fishers' groups for aquatic conservation and ecotourism
Good governance	
Cambodia	• Cancellation of all fishing lots by the government • Encouraging local participation in fisheries management • Giving the rights to establish the CFi and management • Setting up of a Sub-decree on the CFi management and proclamation of the CFi guidelines
Lao PDR	• Development of policies and strategies for fisheries co-management • Implementation of the Guidelines for fisheries co-management in 2009 • Establishment of the Fisheries Management Committee (FMC) in the communities • Participation of the communities in decision-making, implementation, and monitoring of fishery projects
Thailand	• The new Royal Ordinance on Fisheries promotes participation and supports communities to manage, maintain, conserve, restore, and sustain utilization of aquatic animal resources, *i.e.* the registered local fishing community has the right to propose fisheries management measures • Participation of local fishing communities in policy planning, resource enhancement, and monitoring of the projects
Human well-being	
Cambodia	• Promotion of additional livelihoods, *i.e.* agriculture, aquaculture, livestock, and fish processing, that bring more income to the CFi and reduce fishing pressures • Encouraging participation in community fisheries activities • Promotion of micro-credit schemes through savings groups • Promotion of ecotourism to provide jobs and incomes to CFi in an environmentally friendly manner
Lao PDR	• Establishment of fishers' groups or marketing groups to promote fishery products and value-added products • Creation of more benefits for local communities through fisheries co-management, such as increased income, secured food, and enhanced nutritional benefits
Thailand	• Promotion of occupational development and strengthening of the communities through - Career development, such as the modification of fishing gear, promotion of fish processing, and creation of marketing channels - Livelihood development, such as facility and public utility improvements • Gender inclusion and empowerment • Raising awareness and capacity enhancement to support cooperation among stakeholders

Conducting a focus group discussion on fisheries co-management in the study sites in Cambodia, Lao PDR, and Thailand was a valuable approach in understanding the dynamics of fisheries management across key areas in these countries. In Cambodia, the discussion covered both inland and coastal fisheries; the established inland fisheries communities in Cambodia: Kampong Phluk Fisheries Community and Thmor Da Toek Chhar Fisheries Community; and the Trapeang Sangkae Fisheries Community for coastal fisheries (**Figure 1**). The Naxaythong Fisheries Management Committee, formed by the community living in Nam Xouang Reservoir of Vientiane Capital, served as the subject for the group discussion in Lao PDR (**Figure 2**). For Thailand, the Huai Bong Fisheries Community, established in Ubolratana Reservoir in Nong Bua Lam Phu Province (**Figure 3**), was discussed. The in-depth information gathered from the discussions offered a clearer understanding of the community context, co-management processes, and significant changes observed after adopting co-management practices across ecological, human well-being, and governance dimensions. The discussions also highlighted key problems, challenges, and strategies needed to sustain successful fisheries co-management in each area.

SWOT Analysis of Co-management in Small-scale Fisheries Communities in Cambodia, Lao PDR, and Thailand: The Case Study

From the focus group discussions, several problems, issues, and challenges were identified that required attention. It was necessary to conduct a strengths, weaknesses, opportunities, and threats (SWOT) analysis (**Box 3**) within each community to obtain deeper insights into specific conditions and needs across the different areas, enabling the development of strategic plans tailored to address these issues effectively. Such strategic planning is expected to enhance human well-being in small-scale fisheries, support the recovery and sustainability of resources and habitats, and strengthen fisheries governance. Although the conditions of the study sites in Thailand, Cambodia, and Lao PDR varied and local issues differed, their challenges were common, including insufficient policy or legal frameworks and unclear management mechanisms. A summary of the main points derived from the SWOT analysis is presented in **Table 2**.

Box 3. SWOT Analysis

Davies and Bergh (2001) defined "SWOT analysis" as a tool for determining the Strengths, Weaknesses, Opportunities, and Threats of a specific situation, and for developing the strategies to address them. SWOT analysis could provide valuable information on the potential threats of a situation that need to be discussed and addressed, which is an important factor in making an effective strategic plan. SWOT analysis is a simple and beneficial tool that could be used by any organization or authority in planning, especially for fisheries development and management.

Figure 1. Locations of the fisheries communities in Cambodia covered in the group discussions: 1) Kampong Phluk Fisheries Community in Siem Reap Province, 2) Thmor Da Toek Chhar Fisheries Community in Kampong Cham Province, and 3) Trapeang Sangkae Fisheries Community in Kampot Province

Figure 2. The Naxaythong Fisheries Management Committees in Nam Xouang Reservoir in Vientiane Capital of Lao PDR

Figure 3. The Huai Bong Fisheries Community in Ubolratana Reservoir in Nong Bua Lam Phu Province of Thailand

Table 2. Results from the SWOT analysis of fisheries co-management in pilot sites in Cambodia (KH), Lao PDR (LA), and Thailand (TH)

Strengths	Opportunities
1. Good cooperation/participation among fishers, government, and key stakeholders (KH, LA, TH) 2. Legal framework for the CFi available (KH) 3. Abundance of fish (TH) 4. Fisher's groups established (KH, LA, TH) 5. Stakeholders' willingness to participate in the groups (KH, LA, TH) 6. Effective planning for management activities (KH, TH) 7. Willingness and enthusiasm of women to improve their livelihoods (LA, TH)	1. Support could be tapped from various agencies/government/NGOs/relevant stakeholders, especially in terms of legal framework, education, skills development, construction, and funding (KH, LA, TH) 2. Governments provide the rights for fisheries management and support to set up CFi (KH, LA)

Weaknesses	Threats
1. Inadequate participation/coordination of key stakeholders (KH, LA) 2. Insufficient capital for group operation (KH, LA) 3. Inadequate capacity of leaders (KH) 4. Varying community rules/regulations between districts in the same management area (LA) 5. Insufficient knowledge and skills to improve fishery management, processing techniques, and marketing (LA) 6. Insufficient cost for patrolling activities (TH) 7. Low solidarity among villagers (TH) 8. The co-management plan is not sufficiently clarified/submitted to the government authorities/key stakeholders (LA, TH) 9. Gaps in the functional capacities of fisher's groups (KH, LA)	1. Jurisdiction of the management area not well defined (LA) 2. Limited support from the government in terms of staff (KH, LA) 3. Inadequate policy/legal framework, unclear and outdated management mechanisms (KH, LA, TH) 4. Fragmented capacity building activities (KH, LA, TH) 5. Powerful companies investing in certain areas are difficult to deal with (KH) 6. Law does not give rights for fishers to arrest illegal fishing activities (KH, LA, TH) 7. Many fishers from outside the community come to the reservoir when it is open for fishing (TH) 8. Illegal fishing still occurs, especially by fishers outside the community (LA, TH) 9. Roads around the village are not in good condition (TH)

Note: KH=Cambodia; LA=Lao PDR; and *TH=Thailand*

To develop an effective fisheries management tool, fisheries officers and planners should formulate strategies that leverage existing strengths to maximize opportunities (***SO-strategy***) and minimize threats (***ST-strategy***), and tap the opportunities to address the weaknesses (***WO-strategy***) and mitigate threats (***WT-strategy***).

By identifying the strengths of a fishery community—such as the establishment of fisher groups, the existing legal framework, and an effective management plan—the community can adopt strategies to seek support from various agencies, governments, NGOs, and other relevant stakeholders to address the gaps, such as skills development in fishery management (***SO-strategy***). Moreover, the strong cooperation and participation among fishers, the government, and key stakeholders are crucial for addressing external threats, such as illegal fishing by outsiders. Therefore, both the government and local community should play a central role in establishing and reinforcing community rules against illegal fishing, including monitoring, control, and surveillance (MCS) through active community involvement (***ST-strategy***).

On the other hand, the identified opportunities can help address the weaknesses in the fishing community, such as limited knowledge and skills in fishery management and fish processing. Support from various agencies, the government, NGOs, and other relevant stakeholders could be a key factor in strengthening these capacities. Consequently, to meet community needs and enhance fishery management and processing, the government should provide education and awareness programs on management and processing techniques, including market access, or collaborate with other agencies to ensure broader support (***WO-strategy***). The government should also encourage fishers and local communities to actively participate in community activities, such as fishery management, training, and environmental initiatives. Furthermore, collaboration among the government, the community, and key stakeholders is essential for developing effective management plans (***WT-strategy***).

In summary, while fishery officers and planners can develop an effective strategic plan based on the results of SWOT analysis, the plan must ensure that local communities are actively involved and be tailored to specific areas, as circumstances and conditions can vary across countries and regions.

Conclusion and Recommendations

The fisheries co-management approach and the Ecosystem Approach to Fisheries Management (EAFM) provide a foundation for effective planning toward sustainable fisheries management and improved livelihoods by considering ecological well-being, human well-being, and good governance, with strong participation and cooperation from fishers, officers, and relevant stakeholders. In developing management plans, fishery officers, planners, managers, and fishers could apply SWOT analysis to identify, analyze and establish appropriate strategies. In so doing, project analysts must gather relevant data and information from key persons through focus group discussions or interviews. The results of the SWOT analysis can help fishery officers, planners, managers, and fishers better understand and adapt to the specific conditions of a particular fishery, thereby supporting the development of efficient strategic plans. More specifically, strategic planning for small-scale fisheries co-management can be effectively developed using SWOT analysis; however, such plans must be tailored to the specific context of each area or country to enhance fisheries resources and management, as well as to improve the livelihoods of small-scale fishers.

Acknowledgments

SEAFDEC sincerely appreciates the Mekong–Lancang Project and *Dr. Lieng Sopha*, the Vice president of Cambodia Agricultural Science Academy, Ministry of Agriculture, Forestry and Fisheries, Cambodia, for inviting and supporting the participation of SEAFDEC in training workshops and related events. Moreover, the authors are grateful to all the resource persons and participants for their valuable efforts in knowledge-sharing and cooperation during the workshops. The authors are also grateful to the fisheries communities and local officers in Cambodia, Lao PDR, and Thailand for their active participation and coordination during the focus group discussions, as well as for providing information that served as the basis for the analysis in this article.

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Identifying Gender Perspectives in Small-scale Fisheries and Aquaculture in Southeast Asia through Access and Control Profiles

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Keywords: gender equality, gender analysis, small-scale fisheries, access and control profile, fisheries development

The Southeast Asian Fisheries Development Center (SEAFDEC) is recognized as one of the regional fisheries organizations that promote gender equality, enabling women to participate fully in the fisheries value chain and gain recognition for their work. Women provide significant contributions to the fishery industry. However, limited access to resources has resulted to gender inequalities in economic development, leading to women's invisibility as major players in the fishery industry. Women comprise almost half of the labor force in small-scale capture fisheries-related activities. While men fish farther from shore, women are engaged in local small-scale fishery activities inshore to earn additional income for their households. These include harvesting shellfish and seaweeds for sale and family consumption, repairing nets, processing fish products, and marketing, in addition to managing their households and taking care of their families. Nonetheless, the 'invisibility' of women in small-scale fisheries has been recognized lately and is being addressed through programs and projects that aim to mainstream gender into fisheries development (Needham, 2011).

One of the gender equality issues in fisheries is the lack of awareness of the need to engage women in decision-making processes, especially in fisheries management plans. To understand and analyze the level of women's and men's participation in decision-making processes for their own development and that of their communities, access and control over the fishery resources have been used as tools in the gender analysis framework (SEAFDEC, 2022). In a gender analysis study of SEAFDEC, results reveal that women and men have equal access to household properties, fishing and aquaculture properties, public services, and finances. However, in building their capacities, women seldom participate in training or seminars because they are not confident about their knowledge in fisheries and aquaculture. In the control of household, fishing, and aquaculture properties, men take on more responsibilities because of the traditional gender stereotype that men are good at leadership; therefore, women always depend on men. To promote gender equality in fisheries management, women should be empowered so that their voices are heard, especially in the development of fisheries management plans for sustainable fishery livelihoods and resources.

During the Workshop of the role players in gender and development conducted in Siem Reap on 2–5 November 2010, best practices for mainstreaming gender into small-scale fisheries policies were developed and used as a guide during the formulation of policies to ensure that gender issues are mainstreamed into the plans and programs for sustainable small-scale fisheries (Needham, 2011). Specifically, the small-scale fishery sector not only contributes 70 percent to the global fish catch but also provides livelihood to 90 percent of the world's fishers, with 200–300 million people, many of whom are women, working in fishery value chains (Kolding *et al.*, 2014), and 50 percent of women globally in fish processing and trade (FAO, 2011). About 500 million people rely on small-scale fisheries for their livelihoods, including 53 million involved in subsistence fishing, 45 percent of whom are women (FAO, 2024). The fisheries and aquaculture sector employs an estimated 62 million people in primary production alone, where about 24 percent of the total workforce are women (FAO, 2024).

Gender Perspectives in Small-scale Fisheries and Aquaculture

Gender is how we look at issues concerning both men and women, in a new way, in every action at every level, and in all aspects of our society and community. This is not a standalone issue, but rather a perspective in which we can look at how policies impact both men and women. Gender also refers to the sociocultural attributes of men and women, which are not fixed but can change over time, and vary from one society to another. Gender is also related to the relations between men and women and the socially constructed acceptable roles for each sex. It represents gender equality, empowering people to gain the same opportunities. To achieve this, the process of gender mainstreaming has been used, with several tools to analyze gender equality promotion. One such tool is gender analysis, which examines the impacts of development projects on women and men, individually, considering their economic and social relationships. In gender analysis, the focus is on the Division of Labor, Access and Control Profile, and Assessment of Influencing Factors.

In SEAFDEC, gender has been placed as a cross-cutting issue in the ASEAN-SEAFDEC Plan of Action on Sustainable Fisheries for Food Security for the ASEAN Region Towards 2030: "Strengthen the capacity of relevant stakeholders and harmonize initiatives that support fishing communities and governments, with a special focus on women and youth" (SEAFDEC, 2020). Also, under the Strategies of SEAFDEC Towards 2030, Strategy 5 focuses on "Addressing cross-cutting issues, such as labor, gender, and climate change, especially with respect to international fisheries." These oversights and regulations can impact a country's capacity to achieve targets under SDG 5 (Gender Equality), particularly 5. A, which aims to "undertake reforms to give women equal rights to economic resources, as well as access to ownership and control over land and other forms of property, financial services, inheritance, and natural resources, in accordance with national laws."

Gender perspectives refer to how gender identities and roles influence economic and sustainable development in our society. They are necessary to carry out gender analysis, the results of which are subsequently mainstreamed into proposed programs and policies. This article discusses gender analysis to identify gender perspectives in small-scale fisheries and aquaculture, based on the Access and Control Profiles derived from the results of the "Gender Dimension in the Value Chain of Small-scale Fisheries and Aquaculture in Southeast Asia," a project supported by the Food and Agriculture Organization of the United Nations (FAO) and conducted by the SEAFDEC Training Department in selected SEAFDEC Member Countries, *i.e.* Lao PDR, Myanmar, the Philippines, and Thailand.

This article is intended to serve as a platform for disseminating information compiled from the aforesaid project and demonstrating cooperation among SEAFDEC, partner organizations, and SEAFDEC Member Countries in promoting gender aspects in fisheries. The Access and Control Profile (**Box 1**) was compiled from the analysis of the framework for access to and control over the resources and benefits made in 2020–2021. Semi-structured interviews with fishers and farmers in each country's target community were conducted at the study sites comprising four areas, namely: Small-scale Inland Aquaculture in Lao PDR; Small-scale Inland Capture Fisheries in Myanmar; Small-scale Marine Capture Fisheries in the Philippines; and Small-scale Marine Aquaculture in Thailand (**Figure 1**). Results from the interviews are summarized in **Table 1**.

Box 1: Access and Control Profile
Access and Control Profile examines the "Access to and Control over the Resources and Benefits" of men and women, their participation level, and their decision-making processes for their own lives and the development of their community.
The Resources include family land, houses, income, and capital in cash and kind, family livestock, family equipment and materials, and labor (of self and family members).
The Benefits include education and training, health care services, credit, community development activities, community forest and water resources, government extension services, information and media, communication and transportation services, electricity, local market, membership, religion, and external aids. The benefit also involved participation, which should not only mean joining in doing something but also taking into account their decision-making capacity. Benefits involve meaningful participation, while also considering their decision-making capacity.
Basic questions for this analysis: **"Who has what?" and "Who makes decisions?"**

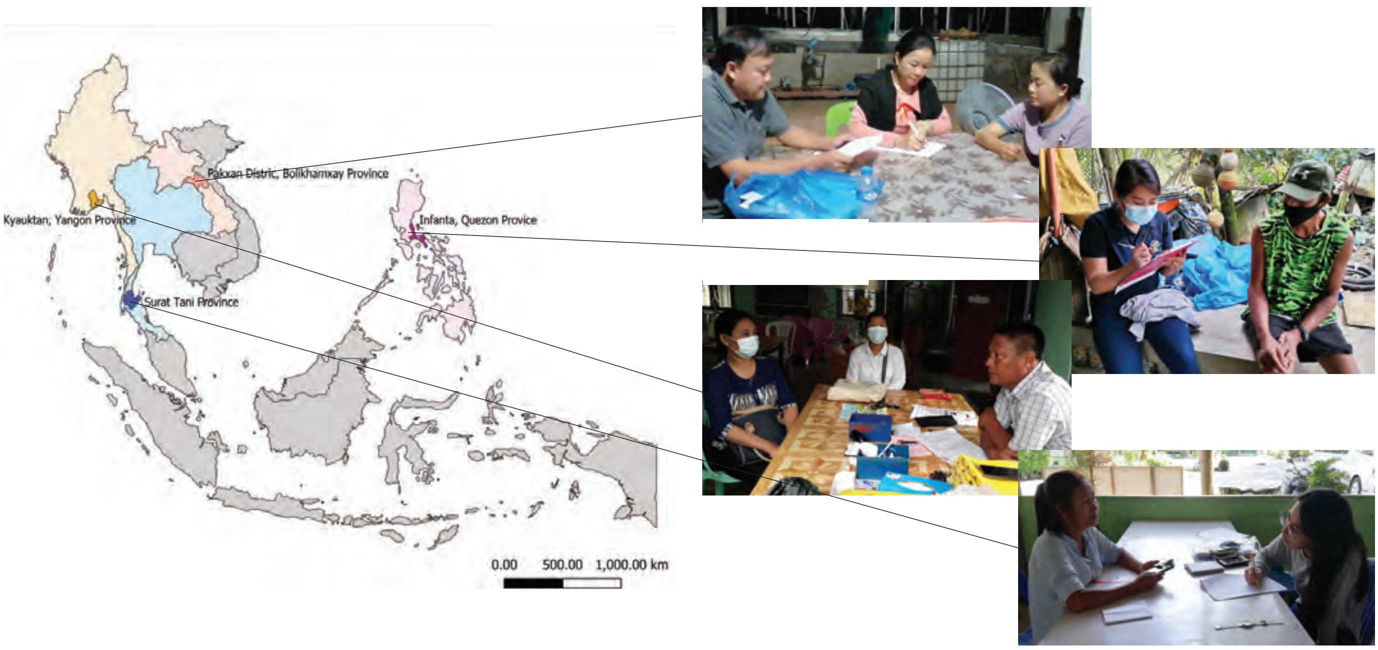

Figure 1. Study sites for the gender analysis study on Access and Control Profile

Table 1. Study sites, data collection period and sampling for the gender analysis study

Countries	Study Sites	Period of data collection	No. of Respondents
Lao PDR (Inland Aquaculture)	Bolikhamxay Province	25–29 January 2021	28 persons (8 women and 20 men)
Myanmar (Inland Capture Fisheries)	Kyauktan, Yangon Province	24–28 May 2021	40 Persons (12 women and 28 men)
Philippines (Marine Capture Fisheries)	Infanta, Quezon Province	16–19 November 2021	40 Persons (18 women and 22 men)
Thailand (Marine Aquaculture)	Surat Thani Province	28–30 August 2020	93 (29 women and 64 men)

Lao PDR

The gender analysis for Small-scale Inland Aquaculture was conducted in Pakxan District, Bolikhamxay Province in Lao PDR, where two main fish species, tilapia and catfish, were cultured in inland ponds. Results indicated that for access, ownership, and control over family resources (**Table 2**), the percentage was high for both men and women in household assets, such as houses, farmland, cars, and motorcycles. Moreover, both men and women can access and control financial investments through loans from banks, microfinance, and private entities. While both men and women could engage in money lending, they also have equal access to public services, such as health, and can have their own car insurance. In addition, both men and women get equal opportunities to obtain employment. In terms of aquaculture equipment and materials, men have greater access than women because they are the primary workers in fish culture. Generally, both men and women make their own decisions and have equal control over such decisions, especially in product harvesting and selecting buyers. This is advantageous for women because their participation in decision-making concerning their family and resources is recognized.

Table 2. Access and control over resources in Pakxan District Bolikhamxay Province, Lao PDR

Item	Access				Control			
	No.	Men	Women	Both	No.	Men	Women	Both
Resources: Household assets								
(1) House	**28**	25 %	11 %	64 %	**28**	11 %	7 %	82 %
(2) Farmland	**28**	18 %	7 %	75 %	**28**	4 %	4 %	92 %
(3) Car	**24**	38 %	4 %	58 %	**24**	21 %	4 %	75 %
(4) Motorcycle	**28**	25 %	4 %	71 %	**28**	21 %	4 %	75 %
(5) Expenses in the house	**26**	8 %	4 %	88 %	**18**		8 %	92 %
Benefit: Services (Financial/insurance/health)								
(6) Loan from bank for investment	**14**	21 %	7 %	72 %	**15**	7 %	7 %	86 %
(7) Loan from microfinance	**6**	17 %		83 %	**14**	17 %		83 %
(8) Loan from private entities	**2**			100 %	**6**			100 %
(9) Money lending	**3**			100 %	**2**			100 %
(10) Life/health insurance	**8**	25 %	12 %	63 %	**3**	14 %	14 %	72 %
(11) Car insurance	**10**	50 %		50 %	**7**	30 %		70 %
(12) Public health	**18**	6 %	6 %	88 %	**10**		6 %	94 %
Resources: Management of inland aquaculture								
(13) Employment	**7**	29 %	29 %	42 %	**24**	20 %	20 %	60 %
(14) Equipment for aquaculture	**26**	50 %	8 %	42 %	**5**	20 %	8 %	72 %
(15) Fish feed	**26**	42 %	8 %	50 %	**25**	9 %	4 %	87 %
(16) Storage for keeping equipment	**26**	54 %	4 %	42 %	**23**	24 %	4 %	72 %
(17) Workers' dormitory	**13**	54 %	8 %	38 %	**25**		36 %	64 %

Table 2. Access and control over resources in Pakxan District Bolikhamxay Province, Lao PDR (*Cont'd*)

Item	Access				Control			
	No.	Men	Women	Both	No.	Men	Women	Both
(18) Seeding	**26**	58 %	8 %	34 %	**11**	26 %	4 %	70 %
(19) Medicines or chemicals for aquaculture	**26**	69 %	12 %	19 %	**23**	30 %	9 %	61 %
(20) Farm registration	**11**	55 %	9 %	36 %	**11**	9 %	9 %	82 %
(21) Decision to select customers	**28**	11 %	18 %	71 %	**23**	4 %	13 %	83 %
(22) Decision to select buyers and product harvesting	**25**	12 %	12 %	76 %	**20**	5 %	5 %	90 %
Benefit: Capacity building								
(23) Training/study tour/others	**24**	33 %	8 %	59 %	**18**	22 %	6 %	72 %

Myanmar

The gender analysis for Small-scale Inland Capture Fisheries was conducted in Kyauktan, Yangon Region, Myanmar, where the drift net is mainly used to catch multispecies of fish, *e.g.* threadfin (*Polynemus* sp.), catfish (*Arius* sp.), croaker (*Johnius* sp.), hilsa (*Tenualosa ilisha*), and basa fish (*Pangasius* sp.). Results of the analysis **(Table 3)** showed that both men and women have access to and control over their household assets such as their house, although men have more control over ownership. Both men and women have control over farmland, but men have more control over cars and motorcycles, the most common form of transportation within the family. While women have greater access to bank loans for investment and microfinance, both men and women have control over microfinance loans. Only one of the women respondents had non-performing loans, and only one man had life insurance. Men had the main access to lending money. The respondents did not mention car insurance and medical (sickness) treatment. As for household expenses, both men and women had equal access to and control over such expenditures. Meanwhile, both women and men participated in training and study trips, and both could decide on their participation.

Table 3. Access and control over resources in Kyauktan, Yangon Region, Myanmar

Item	Access				Control			
	No.	Men	Women	Both	No.	Men	Women	Both
Resources: Household assets								
(1) House	**40**	3 %	3 %	94 %	**37**	5 %	3 %	92 %
(2) Farmland	**14**	21 %	50 %	29 %	**12**	25 %	17 %	58 %
(3) Car	**4**	75 %	25 %		**5**	20 %	40 %	40 %
(4) Motorcycle	**24**	92 %		8 %	**23**	83 %	4 %	13 %
(5) Expenses in the house	**29**	3 %	14 %	83 %	**23**	4 %	13 %	83 %
Benefit: Services (Financial/insurance/health)								
(6) Loan from bank for investment	**4**	25 %	50 %	25 %				
(7) Loans for microfinance	**27**	44 %	52 %	4 %	**3**		33 %	67 %
(8) Non-performing loans	**1**		100 %					
(9) Lending	**6**	50 %	17 %	33 %				
Benefit: Capacity building								
(10) Training/study tour/others	**19**	16 %	5 %	79 %	**15**	13 %	13 %	74 %

The Philippines

The gender analysis for Small-scale Marine Capture Fisheries was conducted in Infanta, Quezon Province, in the Philippines. The main fishing gear used by fishers are hook and line, although other gear, such as set net, gill net, and miscellaneous gear are also used. The species caught include, among others, skipjack tuna, yellowfin tuna, sardines, dolphin fish, herring, red snapper, threadfin bream, clownfish, goatfish, grouper, round scad, big-eye snapper, hardtail mackerel, Indian mackerel, milkfish fry and adult, and moonfish.

Results of the analysis **(Table 4)** indicated that women and men can access ownership and control of resources and services with high percentages. Work related to fisheries, such as employment and boat and gear registration, is more accessible and controlled by men. Women can decide to select the buyers or customers and harvest the products. However, women have little access to capacity-building activities, such as training and study tours.

Table 4. Access and control over resources in Infanta, Quezon Province, Philippines

Item	Access				Control			
	No.	Men	Women	Both	No.	Men	Women	Both
Resources: Household assets								
(1) House	**37**	8 %	5 %	87 %	**30**	3 %	3 %	94 %
(2) Farmland	**12**		33 %	67 %	**9**	22 %		78 %
(3) Car	**4**		75 %	25 %	**5**	40 %		60 %
(4) Motorcycle	**19**	53 %	10 %	37 %	**10**	40 %		60 %
(5) Other properties	**7**		43 %	57 %	**8**	13 %		87 %
(6) Expenses in the house	**23**	9 %	35 %	56 %	**25**	4 %	16 %	80 %
Benefit: Services (Financial/insurance/health)								
(7) Loans from the bank for investment	**7**	29 %	42 %	29 %				
(8) Loans for microfinance	**16**	13 %	25 %	62 %	**11**		9 %	91 %
(9) Non-performing loans	**1**		100 %		**1**			100 %
(10) Lending	**4**	25 %	75 %		**2**		100 %	
(11) Life/health insurance	**3**	67 %	33 %		**8**	12 %	12 %	76 %
(12) Car insurance	**8**		25 %	75 %	**2**			100 %
(13) Sickness (medical) treatment	**3**		33 %	67 %	**1**			100 %
Resources: Management of marine fishing								
(14) Employment	**5**	60 %	20 %	20 %	**1**			100 %
(15) Boat and gear	**28**	46 %	4 %	50 %	**21**	43 %	5 %	52 %
(16) Boat and gear registration	**23**	52 %	4 %	44 %	**18**	38 %	6 %	56 %
(17) Decision to select the customers	**30**	30 %	43 %	27 %	**19**	26 %	32 %	42 %
(18) Decision to select wholesale buyer and product harvest	**30**	30 %	47 %	23 %	**19**	16 %	31 %	53 %
Benefit: Capacity building								
(19) Training/study tour/others	**12**	42 %	25 %	33 %	**6**	17 %	17 %	66 %

Thailand

The gender analysis of Small-scale Marine Aquaculture was conducted in Surat Thani Province in southern Thailand. Three groups of respondents were engaged for the three species cultured, one group each for crab, fish, and shrimp. Results of the analysis **(Table 5)** indicated that women and men have equal access to household assets such as houses, farmland, cars, and motorcycles. However, men are dominant in the ownership and control of those assets. Both women and men have access to loans from banks, microfinance, and private entities. However, in terms of ownership and control, loans from banks are made by men, loans from microfinance are made by women, but both women and men share the loans from private entities equally. Men's greater access to loans could be linked to their ownership and control of their houses, held by men. Money lending is mostly accessed, owned, and controlled by women, while women and men can access life/health insurance, car insurance, and public health. Ownership and control of cars are held by men, as the main owners of family cars. Women and men spend equally on household expenditures, but in terms of employment, equipment, materials, and planning related to aquaculture operations, men have greater access, ownership, and control than women, because men provide the main workforce in aquaculture.

Table 5. Access and control over resources in Surat Thani, Thailand

Item	Access				Control			
	No.	Men	Women	Both	No.	Men	Women	Both
Resources: Household assets								
(1) House	**93**	12 %	9 %	79 %	**86**	63 %	35 %	2 %
(2) Farmland	**89**	19 %	11 %	70 %	**81**	68 %	28 %	4 %
(3) Car	**54**	24 %	4 %	72 %	**54**	58 %	25 %	16 %
(4) Motorcycle	**83**	22 %	8 %	70 %	**79**	47 %	30 %	23 %
(5) Expense in the house	**89**	12 %	9 %	79 %	**57**	23 %	17 %	60 %
Benefit: Services (Financial/insurance/health)								
(6) Loan from bank for investment	**51**	20 %	18 %	62 %	**50**	53 %	39 %	8 %
(7) Loan from bank for microfinance	**24**	17 %	29 %	54 %	**24**	29 %	50 %	21 %
(8) Loan from private entities	**4**	25 %		75 %	**4**	50 %	50 %	
(9) Money lending	**4**	22 %	67 %	11 %	**4**	43 %	43 %	14 %
(10) Life/health insurance	**9**	18 %	24 %	58 %	**14**	18 %	24 %	58 %
(11) Car insurance	**50**	36 %	16 %	48 %	**28**	49 %	24 %	27 %
(12) Public health	**59**	10 %	9 %	81 %	**54**	14 %	14 %	72 %
Resources: Management of marine aquaculture								
(13) Employment	**31**	61 %	10 %	29 %	**30**	63 %	20 %	17 %
(14) Equipment for aquaculture	**51**	60 %	7 %	33 %	**59**	79 %	9 %	12 %
(15) Fish feed	**53**	58 %	8 %	34 %	**59**	68 %	17 %	15 %
(17) Storage for keeping equipment	**41**	59 %	3 %	38 %	**44**	76 %	8 %	16 %
(18) Workers' dormitory	**19**	76 %		24 %	**20**	96 %		4 %
(19) Seeding	**53**	62 %	8 %	30 %	**50**	71 %	17 %	12 %
(20) Medical or chemical for aquaculture	**51**	72 %	3 %	25 %	**47**	80 %	8 %	12 %
(21) Farm registration	**48**	62 %	15 %	23 %	**49**	71 %	24 %	5 %
(22) Decision to select customers	**48**	56 %	18 %	26 %	**39**	69 %	18 %	13 %
(23) Decision to select wholesale buyers and product harvesting	**38**	66 %	17 %	17 %	**37**	70 %	18 %	12 %
Benefit: Capacity building								
(24) Training/study tour/others	**34**	52 %	14 %	34 %	**33**	71 %	17 %	12 %

Conclusion and Recommendations

The gender perspective shows the distinctions in status and power and explores how this form of discrimination influences the immediate requirements and long-term interests of both women and men (ECOSOC, 1997). In the abovementioned study, the results show that by law, women and men have equal access to resources and benefits. The results revealed a gender disparity, with men exercising greater control over decision-making processes compared to women. On the impact of participation in a capacity-building program, women are generally not involved as much because they are not recognized as fishers or farmers. This perspective is an obstacle to women's empowerment, as it requires confidence so that their voices are heard and they can make their own decisions.

Intermediate goals should focus on engagement and creating a program for women in fisheries management to improve confidence, while long-term success requires gender equality awareness to balance household and resource control. This will enable them to understand each other and reduce the traditional stereotype of femininity and masculinity, which can ultimately help improve household livelihoods.

Way Forward

SEAFDEC has a gender strategy in place. Several projects conducted by SEAFDEC have raised gender equality as a cross-cutting issue by promoting gender equality at all levels and for all stakeholders, including fishers and farmers. This aspect will be continued as framed in the ASEAN-SEAFDEC Plan of Action on Sustainable Fisheries for Food Security for the ASEAN Region Towards 2030: "Strengthen the capacity of relevant stakeholders and harmonize initiatives that support fishing communities and governments, with a special focus on women and youth" (SEAFDEC, 2020).

Acknowledgments

We wish to express our sincere thanks to the Food and Agriculture Organization (FAO) for supporting the gender study, and to the Bureau of Fisheries and Aquatic Resources (BFAR) in the Philippines, Department of Fisheries (DOF) in Myanmar, Department of Fisheries (DOF) in Thailand, and the Department of Livestock and Fisheries (DLF) in Lao PDR for assistance in the information and data collection. We are also grateful to the fish farmers and fishers involved for providing the needed information.

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Advancing Gender Roles in Fisheries Group Development: A Case Study in Indonesia

Nurwanti and *Dina Muthmainnah*

Keywords: fisheries extension, fisheries groups, gender roles, Socio-Demographic Index (SDI), national poverty rate, marine capture fisheries, aquaculture, fish processing and marketing

The southern part of Sumatra Island in Indonesia comprises five provinces: South Sumatra, Lampung, Jambi, Bengkulu, and Bangka Belitung. The Research Institute for Inland Fisheries and Extension, hereinafter abbreviated as RIIFE, was established in 1969 to serve as a technical implementation unit of the Ministry of Marine Affairs and Fisheries, Republic of Indonesia, in the field of inland fisheries research and fisheries extension. Under the responsibility of the Chairman of the Marine and Fisheries Research and Human Resources Agency, RIIFE has an important task of carrying out extension activities in these five provinces, performed by the Fisheries Extension Officers targeting the island's leading actors and business actors based on Law Number 16 of 2006 concerning Agricultural, Fisheries, and Forestry Extension Systems. In addition, Law Number 7 of 2016, concerning the Protection and Empowerment of Fishers, Fish Cultivators, and Salt Farmers, extends the role of Fisheries Extension Officers in providing assistance and counseling that empower the leading actors and marine and fisheries business actors. In the five provinces of Southern Sumatra in Indonesia, three major fisheries groups have been established with the assistance of Fisheries Extension Officers. Analysis of gender roles in fisheries has been initiated by the Inland Fishery Development and Management Department of the Southeast Asian Fisheries Development Center (SEAFDEC/IFRDMD). This article is therefore aimed at advancing the role of gender in establishing fisheries groups in the five provinces of southern Sumatra Island, Indonesia.

Fisheries extension involves changing the behavior of fisheries actors and their families by increasing their awareness and enhancing their willingness and ability to solve problems in their daily routines, boosting their business efforts, and improving their quality of life. Activities in fisheries extension include education, planning, implementation, evaluation, reporting, development, professional growth, and support. In Indonesia, fisheries extension officers are classified as civil servant fisheries extension workers, independent fisheries extension workers, private fisheries extension workers, or auxiliary fisheries extension workers (Law Number 62 of 2014).

The responsibilities of fisheries extension officers in Indonesia are defined by Law Number 16 of 2006 concerning Agricultural, Fisheries, and Forestry Extension Systems and include: (1) collecting data on the country's fishery sector; (2) establishing fisheries groups; (3) raising the standard of fishery groups; (4) assisting micro, small, and medium enterprises (MSMEs); (5) supporting cooperatives in the fishery sector; (6) helping fisheries stakeholders access capital, markets, technology, and other resources; (7) conserving environmental resources; (8) facilitating the delivery of government assistance; (9) preparing weekly reports on extension activities; and (10) producing annual reports and fish production reports. Additionally, Law Number 7 of 2016 concerning the Protection and Empowerment of Fishers, Fish Cultivators, and Salt Farmers enhances the role of fisheries extension officers by providing assistance and counseling to empower fishery stakeholders.

One concern in fisheries extension is the formation of fisheries groups that serve as platforms for discussion and catalysts for fisheries development in rural areas. As agents of fisheries development, fisheries groups not only conduct training sessions but also serve as a cooperation platform, production unit, and business entity. In developing the fisheries groups, the role of fisheries extension is vital, as improvements in fisheries development can lead to success in fisheries. This success is measured not only in terms of better fishery resources and facilities but also in the strengthened roles of the fisheries groups.

In Indonesia, fisheries extension plays a strategic role because it benefits from the quality of human resources that support it—those capable of adapting, adopting, and utilizing the developed technologies to manage the fishery resources for sustainable fisheries. A Regulation of the Head of Agency for Marine and Fisheries Research and Human Resources, Number 4/PER-BRSDM/2020, which includes the Guidelines for Management of Marine and Fisheries Group Profiles, states that extension, as a form of non-formal education, encourages people to become aware of and willing to implement new ideas, focusing on improving knowledge, skills, and attitudes.

Fisheries extension in the southern part of Sumatra Island in Indonesia is introduced into nine administrative units across five provinces: Jambi Province, Bangka Belitung Province, Bengkulu Province, Lampung Province, and South Sumatra Province. The distribution of fishery extension workers in this region is shown in **Figure 1**; the same locations are also used as study sites for gender analysis of the fisheries groups.

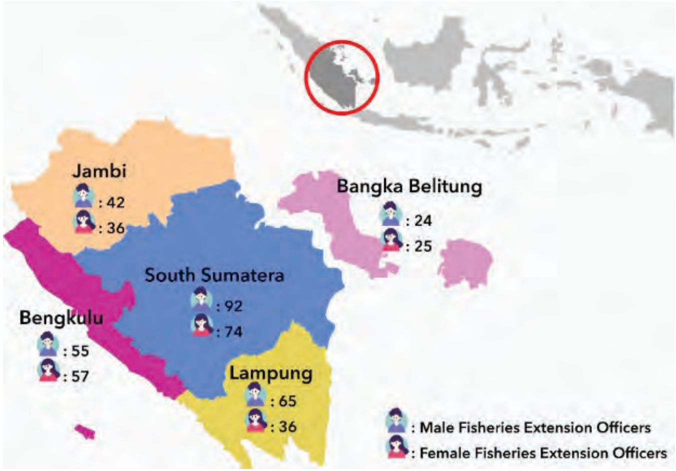

Figure 1. Study sites for the gender analysis of fisheries group development in southern Sumatra Island, Indonesia

As a learning process, extension aims to increase the capacity of fisheries extension targets—the main fishery and business actors—to organize themselves for the development of their fisheries business efforts, increasing their income and welfare, while also paying attention to preserving environmental functions. The main fishery actors include fishers, fish culturists, fish processors, fish marketers, salt farmers, and other water-conservation practitioners. Business actors are individual Indonesian citizens or legal entities organized in accordance with Indonesian Law, responsible for managing part or all of the fishery business activities from upstream to downstream.

Based on the Decree of the Ministry of Marine Affairs and Fisheries Number 28/2024 concerning General Guidelines for the Development and Strengthening of Institutions for Business Actors and Supporting Actors in the Marine and Fisheries Sector, fisheries groups are divided into four (4) classes, as shown in **Box 1**.

Box 1. Four classes of fisheries groups indicated in Indonesian Law	
1.	The beginner class, the lowest class in terms of groups' ability, with an assessment scoring of less than 250
2.	The advance class, where groups have carried out planning activities, although they may still be limited, with a scoring limit of 250 to 500
3.	The intermediate class, the highest class where groups have carried out the activities from planning to implementation, although they may still be limited, with a scoring limit of 500 to 750
4.	The main class, the highest class where groups have carried out the activities from planning to implementation in a more structured and sustainable manner, with a scoring limit of 750 to 1,000

Establishment of Fisheries Groups

Fisheries groups have been established in five provinces in the southern part of Sumatra Island, specifically in South Sumatra, Bangka Belitung, Jambi, Bengkulu, and Lampung, from January to December 2022. In reality, a fisheries group can be formed at any time, depending on the group's readiness. The steps for establishing the Main Fisheries Actor Groups, known as the fisheries groups, are outlined in **Box 2**.

Box 2. Establishment of the Main Fisheries Actor Groups, the fisheries groups	
a.	Extension officers provide outreach lectures or seminars about group establishment to key fisheries actors and the community
b.	The outreach lecture or seminar, which is carried out in one day, aims to make people understand group growth. The output of this activity is information on regional identification, land area data, and regional maps
c.	Extension officers coordinate with the main actors to discuss group growth plans
d.	The discussion is carried out for a maximum of 3 days, with the information on the identification of the area, data on the land of the main actors, data on group members, and a map of the village area already available, resulting in an output which is a plan for forming a group
e.	Group Establishment Process, which involves the village officials, main fisheries actors, the community, and extension workers, is conducted in one week
f.	Then, a gender analysis is conducted by collecting the available and relevant data, identifying gender differences and the underlying causes of gender inequalities, and developing the policy and program design

Description of the Study Sites

South Sumatra Province

The province has a young population, with 2.8 million children representing 35 percent of the Province's total population, which is expected to reach around 9.35 million by 2030. The agricultural sector is the cornerstone of employment in the Province, absorbing about 1.9 million people. The potential of South Sumatra's agricultural resources is promising, with annual rice production of 4.200 million tons, palm oil production of 2.718 million tons, and coffee production of 135.200 thousand tons. The province has a Socio-Demographic Index (SDI) of 0.67, slightly lower than the national average of 0.71.

Bengkulu Province

Bengkulu has a population of 2,060,092 according to the mid-2022 estimate. The majority of residents are Rejang, followed by Javanese and other minority indigenous groups such as Lembak, Serawai, Pekal, Enggano, Pasemah, Minangkabau, and Malays. The province has a poverty rate of 12.5 percent, and its economy is mainly based on agriculture, with rubber, coffee, and palm oil being the primary crops. Bengkulu has high tourism potential. The Province has natural attractions, such as beaches, waterfalls, and national parks. The Province's level of education is relatively low, with only 7.5 percent of the population having received a bachelor's degree or higher. The province has a Socio-Demographic Index (SDI) of 0.61, which is lower than the national average of 0.71.

Lampung Province

The province has a diverse population, with the three main ethnic groups being the Javanese, Lampungese, and Sundanese. The poverty rate in the province stands at 11.6 percent. The economy of Lampung is primarily agricultural, with rubber, coffee, and palm oil as its main crops. The Province has significant tourism potential. It is endowed with natural attractions such as beaches, waterfalls, and national parks. It also has a relatively low level of education, with only 7.5 percent of the population holding bachelor's degrees or higher. The province's Socio-Demographic Index (SDI) is 0.62, which is lower than the national average of 0.71.

Jambi Province

Located on the east coast of central Sumatra, Indonesia, Jambi has a population of 3,631,136, according to the mid-2022 estimate. The area has a diverse population, with the three main ethnic groups being the Jambi Malays, Javanese, and other Malays. The per capita income of Jambi Province is USD 3,763.89, which is below the national per capita income of USD 4,580.00. The poverty rate in Jambi Province, mainly concentrated in urban areas, is 10.48 percent, higher than the national poverty rate of 7.53 percent. The economy of Jambi is primarily agricultural, with most residents working as laborers or farmers. The province has a Socio-Demographic Index (SDI) of 0.61, lower than the national average of 0.71.

Bangka Belitung Province

Bangka Belitung consists of two main islands, Bangka and Belitung, along with several smaller ones. The population of Bangka Belitung was 1,494,621 as of mid-2022. The Province is ethnically, culturally, and linguistically diverse, with major ethnic groups including Malays, Chinese, and Javanese. It has a young population, with 34 percent of the population being children. The poverty rate is 23.5 percent for households with an IWI below 70, 6.64 percent for those below 50, and 1.65 percent for households below 35. The economy is mainly dependent on mining, agriculture, and fisheries. The Province has achieved near-universal access to primary education, but children from the poorest households are much less likely to complete secondary school compared to their wealthier peers. Its Socio-Demographic Index (SDI) is 0.63, lower than the national average of 0.71.

The Fisheries Groups in Southern Sumatra

Three fisheries groups have been established in the five provinces of Southern Sumatra, Indonesia. These are: the Capture Fisheries Group, the Aquaculture Group, and the Fish Processing and Marketing Group.

Capture Fisheries Group

The capture fisheries group uses various types of fishing gear and methods to catch fish. The common gear types they use include longlines, spears, demersal trawls or bottom trawls, gillnets, purse seines, hook and line, pots and traps, dredges, fish aggregating devices, midwater trawls, bottom trawls, longline trawls, and turtle exclusion devices in trawl fisheries. Since different gear types have varying impacts on bycatch, habitat, and overfishing rates, and because different fish species stay in different parts of the water column and behave differently, the group ensures that the fishing gear used is specifically designed and suitable for each target species. Additionally, the fishing gear should minimize unwanted impacts on target species and marine ecosystems. Therefore, some gear types with bycatch issues have been modified, such as adding "escape zones" or exclusion devices to nets to allow unwanted animals to escape.

Target fish species

The capture fisheries group targets various fish species depending on the location, fishing gear, and fishing mode. The most commonly targeted species include Peruvian anchoveta, Alaska pollock, skipjack tuna, various sardine species, Atlantic herring, chub mackerel, scads, yellowfin tuna, Japanese anchovy, and large-head hairtail. However, the specific fish species targeted can vary greatly based on the area and fishing practices. Fisheries management policies and population ecology are used to assess the sustainability of harvesting these species in marine fisheries. Fish abundance in each population is monitored and estimated using sonar acoustic methods and fishing activities to identify specific species within the ecosystem. The catch shares of traditionally targeted demersal fish and species with trophic levels above 3.5 reflect the biological aspects of marine capture fisheries.

Aquaculture Group

The aquaculture group practices fish culture in freshwater, brackish, and saltwater environments, cultivating a variety of species and utilizing multiple production facilities and methods.

Aquaculture methods

After freshwater aquaculture had started in Sumatra in the late 1970s, fish production increased significantly due to the introduction of new fish farming technologies, which led to the availability of hatchery-produced seeds and the development of compound fish feeds. The aquaculture methods used in South Sumatra are shown in **Box 3**.

Box 3. Aquaculture methods practiced in South Sumatra

Freshwater aquaculture	Involves the farming of fish in freshwater ponds, tanks, or cages, with the most common farmed species including tilapia, catfish, and carps
Brackishwater aquaculture	Involves the farming of fish in brackishwater ponds, tanks, or cages, with the most common farmed species including milkfish, shrimps, and crabs
Marine aquaculture	Involves the farming of fish in marine water ponds, tanks, or cages, with the most common farmed species including seaweeds, groupers, and snappers
Polyculture	Involves the culture of multiple species in the same pond or tank to increase productivity and reduce the risk of disease outbreaks
Monoculture	Involves the culture of a single species in a pond or tank to maximize the growth and yield of a particular species

Aquaculture plays a vital role in Indonesia's fisheries development by supporting national food security, creating income and jobs, and earning foreign exchange. This makes aquaculture development a potential driver for the country's economic recovery. The aquaculture group ensures that growth in this sector is guided by sound environmental planning to reduce adverse effects on the ecosystem and promote sustainable expansion.

Common species cultured

Aquaculture in the five provinces is carried out in freshwater, brackish, and marine waters using various species, facilities, and methods. Common species include common carp (*Cyprinus carpio*), catfish (*Clarias* spp., *Pangasius* spp.), Nile tilapia (*Oreochromis niloticus*), milkfish, white-leg shrimp, pangasius catfish, Asian tiger shrimp, grouper, and snapper. These species are farmed across different water types employing practices such as freshwater culture, brackishwater culture, and marine culture. Both polyculture and monoculture are used to boost productivity, reduce disease risks, or maximize growth and yields for specific species.

Recognizing that the ecological impacts of aquaculture depend on the fish species chosen for aquaculture, management, and location of facilities, the aquaculture group emphasized that in planning for sustainable development, serious consideration should be made on how the different fish species and production systems relate to available resources and ecosystems at the national and local levels. **Figure 2** shows the various capacity-building activities conducted under the aquaculture group.

Figure 2. Participants attend capacity-building activities under the aquaculture group conducted in Merangin Regency (top) and in Batanghari, Jambi, Indonesia (bottom)

Fish Processing and Marketing Group

Several fish preparations are produced by the Fish Processing and Marketing Group in Southern Sumatra. The most common are salted, smoked, and shredded fish.

Processing salted fish involves curing it with dry salt and preserving it for later use. Salting and drying are among the oldest methods for preserving fish and meat. Before the fish is salted, water is drawn out, allowing the salt to penetrate the flesh. After maturing in salt for about a month, the salted fish should have a water content of roughly 55 percent. The water becomes saturated with salt, making it difficult for most microorganisms to survive. Once several enzymes are broken down, the fish is already preserved. Usually, the salted fish is left in the sun for several days to dry completely, enhance the flavor, and help extend its shelf life.

In smoked fish, the process involves curing and preserving the fish through smoking. After smoking, the flesh becomes tender and takes on a distinct smoky flavor that enhances the taste. Additionally, smoking helps preserve the fish by reducing its moisture content, which inhibits the growth of harmful bacteria and extends its shelf life without creating a “fishy” odor. Smoking also gives the fish product a desirable texture, making it tender and flaky. It is a healthier cooking method than frying or grilling because it doesn’t require fats or oils. However, smoking fish requires choosing the appropriate smoking wood for specific fish species during curing and smoking. The process can take several hours, depending on the type of fish and the desired level of smokiness.

In processing shredded fish, the fish is cooked and then shredded into small pieces. It is a popular dish in many cultures and regions, including India and the Caribbean. Shredded fish can be prepared in various ways, such as stir-frying, grilling, or smoking. Shredded fish is a versatile ingredient in various recipes, such as tacos, salads, and sandwiches. It is a healthy source of protein and can be prepared in various ways to suit different tastes and diet preferences.

Results and Discussion

Sex-disaggregated Data

To analyze the gender perspective of the fisheries groups in South Sumatra, data on the participation of females and males in each group were compiled. The data revealed a disparity in the involvement of men and women in the fisheries groups, as shown in **Table 1**. This gap is particularly evident in women’s representation in aquaculture, fishing, and supervisory roles, whereas men’s engagement is low in fish processing and marketing groups.

As shown in **Table 1**, five provinces of South Sumatra have 733 fisheries groups with 8,356 members. Among them, 6,942 are males and 1,414 are females, comprising only 16 percent. Specifically, in aquaculture, fishing, and monitoring groups, most members are males, but females are more prevalent in fish processing and marketing groups.

From a gender perspective, there is a gap between men and women in the fisheries groups. Women’s representation is low in aquaculture, fishing, and management and monitoring groups; men’s representation in processing/marketing groups is low, but women’s representation in the implementation stage is higher than men’s. Based on interviews with stakeholders, men consider fish processing and marketing as women’s territory, so men tend to leave this area to women.

During interviews with fishery stakeholders, the planning and decision-making parameters are limited in the fisheries groups. This is because most fishers cannot take advantage of the opportunities provided by extension workers, who have previously encouraged fishers to participate actively in group discussions by asking questions, sharing opinions, developing solutions to problems, and engaging in planning and decision-making across various fishery activities. Many fishers tend to depend on group administrators and extension workers for planning and decision-making when implementing fishery programs. Consequently, Mulyaningsih *et al*. (2017) noted that, overall, most programs carried out by fishery groups have not been evaluated after completion.

Table 1. The involvement of men and women in the fisheries groups, as established in 2022

Province	Fisheries Group	Number of fisheries groups	Average number of members per group	Female	Male
Lampung	Aquaculture	97	13	115 (9 %)	1,172 (91 %)
	Capture	28	15	14 (3 %)	417 (97 %)
	Fish processing/marketing	14	11	115 (77 %)	35 (23 %)
Jambi	Aquaculture	82	13	189 (18 %)	849 (82 %)
	Capture	6	15	15 (16 %)	77 (84 %)
	Fish processing/marketing	10	9	75 (82 %)	17 (18 %)
Bengkulu	Aquaculture	49	11	111 (21 %)	419 (79 %)
	Capture	49	8	0 (0 %)	370 (100 %)
	Fish processing/marketing	12	11	116 (86 %)	19 (14 %)
Sumatera Selatan	Aquaculture	208	11	208 (9 %)	2019 (91 %)
	Capture	42	11	42 (9 %)	431 (91 %)
	Fish processing/marketing	34	10	296 (89 %)	36 (11 %)
	Fisheries management	1	34	1 (3 %)	33 (97 %)
Bangka Belitung	Aquaculture	27	10	35 (13 %)	244 (87 %)
	Capture	64	12	1 (0.1 %)	783 (99.8 %)
	Fish processing/marketing	10	10	81 (79 %)	21 (21 %)
Total		**733**	**8,356**	**1,414**	**6,942**

Gender Role

The role of women in fisheries is heavily shaped by social and cultural traditions, discrimination, stereotypes, and the marginalization of women in society, as well as their dual responsibilities in public and domestic spheres (Nasution, 2007). According to sociocultural traditions, women are unlikely to go out to sea to fish; consequently, in certain ethnic groups, women's access to productive assets and sources of capital is limited. Additionally, opportunities for women to enhance their knowledge and technical skills are quite restricted. A gender perspective was employed to conduct the gender analysis, and the results are presented in **Table 2**.

Table 2. Role of women and men in marine capture fisheries, aquaculture, fish processing and marketing, and fisheries management in the southern part of Sumatra Island, Indonesia

Sub-sector	Activity Profile	Access and Control Profile	Factors and Trends
Marine Capture Fisheries	• The role of women in capture fishing as a whole is less valued because it requires muscle work • Men dominate in capture fishing, which uses fishing gear such as gillnet, trap, hook and line, *etc.*; the average fishing period is 4-5 hours/day, and the fishing grounds are in the sea, lake, or river	• Wives play important roles as fishing partners of their husbands, but because of women's physical characteristics, they are more active in reproductive roles • Women do the cleaning, trading, and processing unsold fish for household consumption • Wives also sell the catch to collectors or middlemen when their husbands are busy	• The number of women involved in the fishery value chain has slightly increased • Men go fishing without women because it requires physical work and is constantly dangerous • Women's perspective in terms of production is not expected to expand unless fisheries extension interventions are available
Aquaculture	• Usually, men plan their aquaculture activities • Mostly, men dominate in making decisions on culture facilities, like ponds, and the fish species to be cultured • Mostly, men are engaged in seed rearing, nursery, fingerling releasing, and harvesting • Mostly, women are involved in feed preparation and maintaining the water quality	• Men had more access to and control of the resources • Women prefer to be more involved in aquaculture activities • Women have low participation in decision-making in fisheries management	• Men are engaged in aquaculture activities without women because it requires hard work and is often time-consuming • Women dominate in feeding fish and maintaining the ponds' water quality
Fish processing and marketing	• Women dominate in fish processing and trading • Women know how to process fish into valuable products • Women see the value of fish better than men because they are more aware of the situation in the fish market • Both men and women are involved in decision-making in processing, selling, and buying • Women and children work together, but they have greater responsibility for preparing ingredients, cleaning and drying fish, and marketing	• Women are more responsible for fish processing and marketing, including deciding on buying and selling fishery products • Women prefer to work in fish processing; nonetheless, both women and men worked together	• Women dominate fish processing, marketing, and trading activities rather than fishing
Monitoring, control, and surveillance	• Women's supervisory role is undervalued overall, as this activity requires muscular and dangerous labor • Men dominate surveillance activities • Supervision includes illegal fishing activities, use of dangerous fishing gear, *etc.*	• Women play fewer roles in fisheries monitoring/patrol	• The number of women involved in monitoring activities is minimal • Men conduct surveillance without women because it is a dangerous task

Men predominantly hold productive roles, while women are mainly involved in reproductive and household activities. Gender issues, the socially constructed differences between men and women, are key factors influencing sustainable livelihoods. Both men and women state that their participation in sociocultural activities is closely linked to biology, with men taking on more strenuous labor associated with masculinity and women engaging in lighter tasks. Recognizing and understanding women's practical and strategic needs is essential for improving development efforts and expanding benefits. However, the roles of wives are increasingly vital as they support their husbands in stabilizing fishery business operations. Both men and women contribute valuable labor to the use of marine and fishery resources. Through counseling, training, and empowerment, the engagement of both genders in the fishery industry is strengthened, leading to higher family income and improved welfare.

The study by Tabassum and Nayak (2021) explained that social and cultural norms are key factors that determine how much women can participate in decision-making, control productive assets, and have balanced power relations. They underpin inequalities that place women at a disadvantage within the household and society. Promoting better power dynamics, increasing women's involvement in decision-making, and ensuring equal control over assets can help women contribute to food, nutrition, and income security for their households and wider communities.

Marine Trends (2020) reported that in Indonesia's fisheries sector, women make up more than 42 percent of the workforce engaged in fishing activities. However, there is limited gender-specific data and information on fishing activities. Despite women's significant labor and economic contributions, statistics tend to focus on male-dominated activities. The roles of women and men in different fishery activities were described based on the gender analysis framework, which includes an activity profile, an access and control profile, and factors and trends.

In anguillid eel fisheries in Indonesia, Muthmainnah *et al.* (2022) reported that women's participation is significant, especially in marketing. However, this should be strengthened by improving their abilities, such as selling skills, how to access markets, promoting equal access and rights in utilizing eel fish resources, and incorporating local wisdom that views men (leading actors) as partners rather than competitors with women. Women are not seen as supplementary actors in the management and use of eel resources.

Growing the number of women with knowledge and skills in fisheries is essential because it can boost women's participation in extension and empowerment activities. It offers an understanding of gender-responsive materials that highlight the need for a balanced role between men and women in marine and fisheries development.

Three subsectors are developed into fisheries groups in each province of southern Sumatra: capture fisheries, aquaculture, and fish processing and marketing. Meanwhile, in South Sumatra Province, one subsector has begun to develop, specifically monitoring, control, and surveillance. However, its implementation faced several challenges. The key factors limiting the effectiveness of fisheries monitoring, control, and surveillance include: a) weak enforcement of fisheries laws and regulations; b) lack of adequate equipment and patrol vessels to monitor fisheries activities; c) shortage of skilled personnel to enforce fisheries regulations; d) fishermen's lack of awareness of fisheries regulations.

Conclusion and Way Forward

Fisheries extension is essential to support fishers who have trouble accessing information. Fisheries extension workers are government representatives responsible for sharing knowledge, skills, and insights with women, especially those living in remote areas of southern Sumatra.

Gender roles in fishing communities in the southern part of Sumatra, Indonesia, have a significant impact on household dynamics. Some of the ways that gender roles affect household dynamics are indicated in **Box 4**.

Box 4. Ways in which gender roles can affect fishing household dynamics
• Women's roles in fisheries can be limited to collection, post-harvest processing, and sales, which can restrict their income and economic power within the household
• In fishing families, women are often responsible for household chores and childcare, while men take the lead role in fishing and other income-generating activities
• Women's participation in the fisheries sector is often limited due to cultural and social norms, which can restrict their decision-making power and status within the household

Several policies and initiatives aimed at reducing gender disparities in fishing communities have been established and implemented in the southern part of Sumatra, Indonesia, as shown in **Box 5**.

Box 5. Policies and initiatives to reduce gender disparities in fishing communities in the southern part of Sumatra, Indonesia

Policies and Initiatives	Objective
Good practice policy to eliminate gender inequality in the fish value chain	For the promotion of gender equality in the fish value chain by addressing gender-based barriers and encouraging women's participation in the sector
Reducing barriers to women's involvement in small-scale aquaculture	For the promotion of gender equality in aquaculture by reducing barriers to women's participation and increasing their productivity and income
Mainstreaming gender in fisheries and aquaculture	For the promotion of gender equality in fisheries and aquaculture by encouraging women's participation in decision-making and leadership roles, enhancing their access to information, counseling, and financial services, and working to reduce gender-based violence
Understanding and addressing gender inequalities in small-scale fisheries	For combatting gender inequalities by promoting women's involvement in decision-making, enhancing access to resources and services, and reducing gender-based violence
The importance of gender in fisheries	For the promotion of gender equality by encouraging women's participation in decision-making, improving access to resources and services, and reducing gender-based violence
Exploring gender inclusion in small-scale fisheries management and development	For the promotion of gender inclusion in small-scale fisheries by identifying and addressing gender-based barriers and encouraging women's participation in decision-making and leadership roles

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Economic Performance of Purse Seine Fishing with Upgraded Fishing Vessel and Equipment: A Case Study in Pattani Province, Thailand

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Keywords: purse seine fishing, fish aggregating devices, power block system, depreciation cost, variable cost, operational cost, return on investment

Purse seine is a net fishing gear that surrounds fish schools from the bottom and is closed by a purse line passing through all purse rings attached at the bottom of the net (Yingyuad and Chanrachkij, 2010). Usually, hauling the net during fishing operations is done manually by 30-40 laborers, with the cod end of the net kept in the water for scooping the catch, thus requiring several crew members to be on board a purse seine fishing vessel.

Currently, Thai purse-seine fishing vessels have been upgraded by installing modern equipment, including radar, sonar, echo sounder, wireless radio communication systems, and global positioning system (GPS), as well as other auxiliary tools. The development of such innovations for Thai purse seine fishing vessels is necessary to improve energy efficiency, reduce fuel consumption, and minimize the workforce required in fishing operations.

The Southeast Asian Fisheries Development Center/Training Department (SEAFDEC/TD) initiated the use of auxiliary equipment in purse seine fishing vessel, such as a hydraulic hauling device, known as Power Block, which was pilot tested in Pattani Province, Thailand (**Figure 1**) to improve the technology of the hauling system and reduce the number of laborers onboard fishing vessels (Thanasarnsakorn *et al.*, 2019). The Power Block is a mechanized system that uses a crane and a specialized power-block winch attached to the crane. Powered by a hydraulic pump and generator engine, the Power Block system facilitates easier hauling of fishing nets, significantly increasing efficiency and reducing manual labor compared to traditional methods.

The installation of the hydraulic crane and power block on the pilot purse seine fishing vessel has been effective in reducing the number of crew members onboard during fishing operations and relieving them of the hard work of manually hauling the net (Thanasansakorn and Thimkrap, 2019). However, since it is crucial to consider the economic assessment of purse seine fishing using vessels with improved technology, including the overall cost of an upgraded fishing vessel and its operations and maintenance costs, as well as the anticipated benefit of purse seine fishing, SEAFDEC/TD, in collaboration with the Department of Fisheries (DOF) of Thailand, conducted a pilot economic study of purse seine fisheries in Pattani Province, Thailand. The study aimed to determine the economic performance of purse seine fishing using upgraded vessels equipped with a Power Block system. The purse seine fisheries data used were collected from the owner of the purse seine fishing vessel involved in the SEAFDEC/TD pilot study.

Fishing in Pattani Province, Thailand Using a Purse Seine Vessel Equipped with a Hydraulic Hauling System

The purse seine fishing vessel, Nor Larpprsert 8, is 91 GT, 21.85 m long, equipped with a hydraulic hauling system, and powered by a 525-HP engine. It operates in the Gulf of Thailand **(Figure 1)**, conducting purse seine fishing operations throughout the year (January to December) at distances of approximately 80 nautical miles offshore. Its typical fishing pattern involves three trips per month, with each trip lasting 7–10 days (Rattanasitorn S., personal communication, 23–24 April 2019).

This purse seine fishing vessel goes fishing at night by using luring lights and Fish Aggregating Devices (FADs) consisting of coconut leaves, rope, bamboo poles, stone, and a float. Several sets of FADs are placed at the bottom of the fishing grounds to attract schools of fish (Yamazaki, 1978). Two luring light boats are stationed at the FADs' location, operating the luring light to aggregate fish schools, before putting down the surrounding purse seine net (mesh size of the net is 25 mm). When the purse seine fishing operation is completed, the net is hauled using the hydraulic crane and power block system. In the upgraded fishing vessel, only 18 crew members are involved in the fishing operation, while about 30 were involved in the former operation that did not use the power block system. Then, the fish caught are scooped from the bunt into the fish hold, which takes about 2.0 hours. However, it usually takes 2.5 hours for the fishing operation when the net is manually hauled without a power block system. The purse seine fishing vessel could operate 2–3 times per night, and the main fish species caught are sardines, round scads, and mackerel, with an average catch of about 17,500 kg per trip **(Table 1)**. Upon arriving at the fishing port, fish workers transfer the catch and sort it by fish species, size, and quality. The fish are sold to fish vendors, fish canning factories, and exported to neighboring areas.

Figure 1. Map of Thailand showing the Gulf of Thailand and Pattani Province
Source: Adapted from Google Maps, https://maps.google.com

Table 1. Purse seine fishing operation in Pattani Province, Thailand, using a vessel equipped with a Power Block system

Purse seine fishing operation	Pilot fishing in Pattani Province, Thailand
Fishing vessel size (GT)	91
Fishing trips (trip/month)	3
Fishing days (days/trip)	7–10
Fishing operation (number of times/night)	2–3
Number of laborers (persons)	18
Harvesting period (hours)	2.0
Average catch (kg/trip)	17,500

Source: Interview with the vessel owner

Upgrading of a Purse Seine Fishing Vessel

Upgrading a purse seine fishing vessel and installing it with improved technology, such as the hydraulic purse seine hauling device, requires investment. The upgrading and modernization of the vessel's equipment to make it suitable for fishing operations comprises the installation of a Power Block system, repair of the fishing vessel structure, and improvement of the net fishing gear, as described in **Table 2**. Consequently, the costs for repairing the vessel and maintaining the equipment will be incurred annually.

Table 2. Components of vessel upgrading and modernization of equipment

Components of upgrading	Description
1) Installation of the Power Block system	An auxiliary equipment for hauling the net from the sea that minimizes the workforce required during fishing operations, the power block system comprises a crane and a power block winch powered by a hydraulic pump. It is intended to control the speed and direction of the generator engine. A crane, used for lifting, lowering, or moving materials, normally has 3 dynamic sections with a power block attachment. The Power Block is a mechanized system with a spindle-shaped winch for hauling the net from the water (**Figure 2**)
2) Repair of the fishing vessel structure	Reinforcement of the vessel's hull structure to accommodate the installation of a crane and power block for hauling heavy nets (**Figure 3**). This requires reinforcing the designated crane placement area on the vessel's deck. Steel and wood can be used to create a robust support structure capable of withstanding the crane's weight and operational loads. Additionally, strengthening the starboard side of the hull is necessary as this area experiences significant wear and tear during net release, sinker deployment, and purse ring removal from the net before pulling through the power block. Reinforcing the starboard side with steel plates can significantly reduce hull damage caused by these activities
3) Improvement of the net fishing gear	The net should be modified for suitable use with a hauling device. The bunt is assembled at the last part of the net, moving it from the middle part, to collect fish after hauling the net into the fishing vessel (**Figure 4**). To prevent the net from breaking, selvedge nets are added in the net connection with the main net, the float line, and the sinker line. The sinker and purse ring are designed to be separately removable from the sinker line before the net is pulled through the power block

Figure 2. Installation of hydraulic machinery (crane and power block)

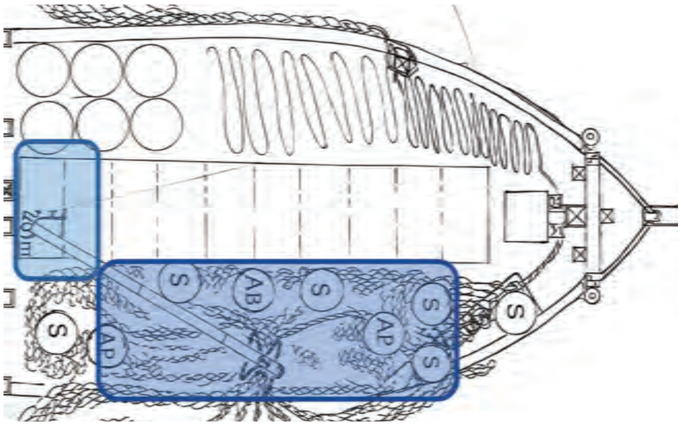

Figure 3. Repair of boat structure

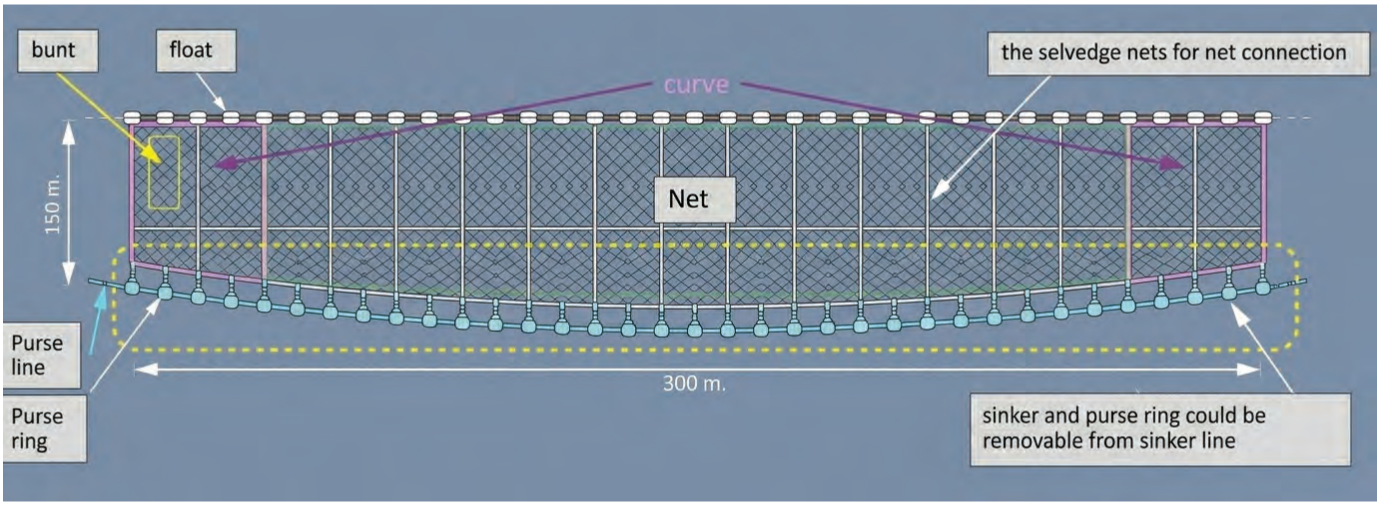

Figure 4. Improvement of net fishing gear

Cost and Return of Purse Seine Fisheries: The Pilot Case Study

The data used for the case study on the cost and return of purse seine fishing operation of the upgraded pilot purse seine vessel was compiled from the interview with the owner of the vessel equipped with the Power Block system. The cost of upgrading a fishing vessel includes the involvement of 18 fishing laborers for the fishing operation. In the case of a purse seine vessel without a power block system, 30 fishery workers are needed for net hauling. The cost and return are expressed in Thai Baht per trip.

Cost Structures

The costs of purse seine fisheries are categorized into fixed costs and variable costs. Fixed costs include the depreciation of fishing assets, such as the hull of a fishing vessel, engines, net fishing gear, and equipment. These costs should be funded when starting a purse seine fishing business. Depreciation costs are non-cash expenses calculated using a straight-line method based on the fishing vessel value, salvage value, and economic life. In this case, where the fishing vessel is equipped with a hydraulic net hauler, the depreciation of the power block system is included in the fixed cost.

Variable costs are the expenses incurred by the purse seine vessel to go to sea for fishing operations or the operating costs paid in cash. Variable costs comprised four components: materials, labor, vessel operational costs, and other costs (**Table 3**).

Table 3. Components of variable costs for purse seine fishing operations

Components of variable costs	Details
Materials costs	Include the cost of fuel, lubricants, ice, and materials for FADs installation
Labor costs	Consists of wages, food, and supplies for the crew, as well as labor charges such as registration for foreign labor, work permits, immigration clearance, medical examination, sea book, and insurance
Vessel operational costs	Expenses for repair and maintenance of the vessel, gear, and equipment onboard, and additional costs for the repair and maintenance of the power block system
Other costs	Include the fee for the use of a Vessel Monitoring System (VMS), harbor dues, and expenses for sorting and selling the fish catch

Return on Investment in Purse Seine Fishing

The revenue from purse seine fishing is the landing catch value in a fishing trip, which is calculated from the catch volumes and the price of the catch by fish species. The main fish species caught from purse seine fishing are sardines and mackerel. The return of purse seine fisheries takes into consideration the net income, which is total revenue minus the variable cost, and the profit after deducting all the costs of fishing represents the depreciation cost (DOF, 2008). The rate of return from purse seine fishing, which indicates the profitability of the fishing investment, is the profit divided by the cost of fishing and expressed as a percentage (Tietze *et al.*, 2005).

Table 4 shows the economic performance of purse seine fishing in the pilot case study with the power block system. The net income of THB 54,719.08 per trip indicates that the fishing expenses, which are the cash costs, are covered. Taking into consideration the total costs, including depreciation, the purse seine fishing in the Pattani case study earned a profit of THB 8,441.30 per trip, with a rate of return of 1.97 percent. The factor that should be considered for a purse seine fishing operation is the income from the catch. Fishers can focus on variable costs rather than fixed costs and decide whether to operate purse seine fisheries as long as the income obtained covers the fishing expenses or cash costs.

Table 4. Economic performance of purse seine fisheries in the Pattani case study

Economic indicators	THB/trip	%
Revenue (THB/trip)	**437,500.00**	**-**
Variable cost	**382,780.92**	**89.2**
– Materials	160,483.33	37.4
– Labor	128,889.40	30.0
– Vessel operations	70,666.66	16.5
– Others	22,741.53	5.3
Net Income	**54,719.08**	**-**
Fixed cost	**46,277.78**	**10.8**
– Depreciation	46,277.78	10.8
Total Cost	**429,058.70**	**100.0**
Profit	**8,441.30**	**-**
Rate of Return	**1.97 %**	**-**

Results and Discussion

Based on the composition of variable costs for purse seine fisheries in Pattani Province as shown in **Figure 5**, materials and labor costs accounted for the majority of the expenses. The cost of materials, the most important component of variable costs in purse seine fishing vessels, accounted for the highest at 37.4 percent, followed by labor costs at 30 percent.

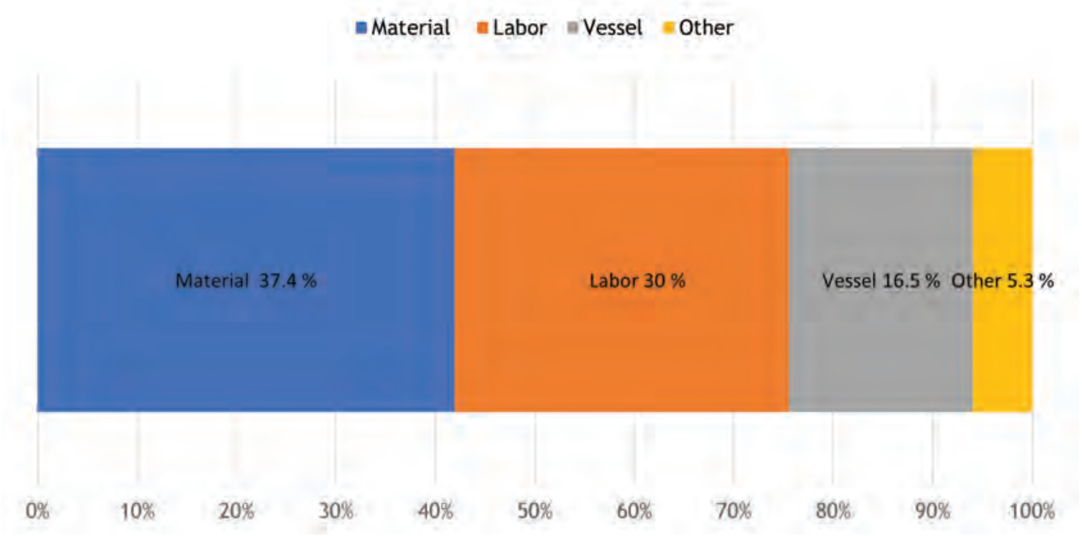

Figure 5. Variable costs of purse seine fisheries in the Pattani case study

Vessel operational costs of about 16.5 percent are used mainly for regular maintenance and repair of the net hauling equipment. The lowest component of variable costs is the other costs at 5.3 percent for fees and dues, and for sorting and selling the catch. The total cost of purse seine fisheries in the Pattani case study is shown in **Figure 6**, where the fixed cost comprises a minor part of the total fishing cost, and is associated with the age of the fishing vessel, equipment, and corresponding depreciation, accounting for 10.8 percent of the total cost, with the depreciation expenses for the installed hydraulic hauling equipment now included. Meanwhile, the variable cost, which accounts for 89.2 percent, is the major component of the total cost of purse seine fishing.

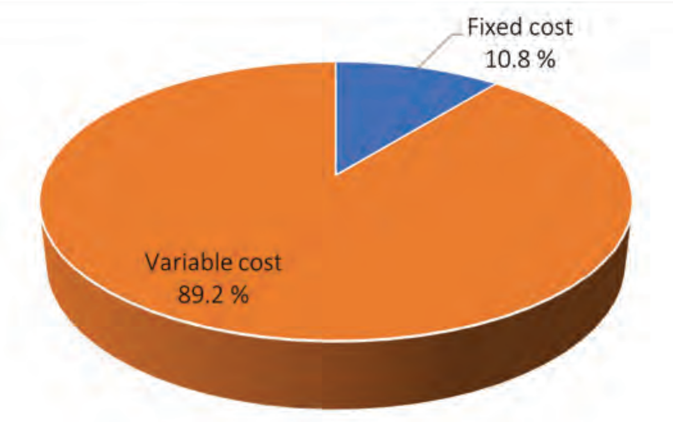

Figure 6. Total cost of purse seine fishing in the Pattani case study

The economic performance of purse seine fishing in the Pattani pilot case study was analyzed using the cost and return on investment, focusing on the vessel that had been upgraded with a Power Block system and with a smaller fishing crew. The purse seine fishing operation equipped with a Power Block system resulted in a positive profit. Income, which covers operating costs and depreciation of fishing assets, increased despite expenses for maintaining and repairing the hydraulic hauling device and fixed costs related to the depreciation of hydraulic machinery. At the same time, labor costs decreased because of lower wages for the smaller crew, as the Power Block system is used for hauling the fishing net.

Conclusion and Recommendations

Investing in the Power Block system offers a compelling solution to the labor shortage in Thailand, addressing workforce issues, improving working conditions by reducing physical strain on crew members, and fostering a better work environment and crew well-being. Efficiency in fishing operations has improved because the Power Block system has significantly sped up net hauling compared with the traditional manual method. The pilot case study has shown that purse seine fishing with the Power Block system is financially beneficial, contributing to overall profitability through increased efficiency and lower labor costs.

A key factor in increasing the fishers' income is their ability to obtain better prices for their catch, which is closely related to the quality of fish landed. Improvements in fish handling practiced onboard fishing vessels, such as the installation of a cooling storage system, can help preserve fish quality and enhance the market value of the catch.

This study, however, uses data from a single purse seine fishing vessel equipped with a Power Block system, which received technical and financial support from SEAFDEC. Therefore, the findings may not fully represent the overall performance of other vessels, as differences in vessel characteristics, crew size, and fishing areas may affect operational efficiency, costs, and returns. In addition, the data collection period was relatively short and conducted during the initial stage of the installation and trial operation of the Power Block system. During this period, technical adjustments, system stability, and crew familiarity with the equipment may have influenced operational performance. Furthermore, the data did not cover the entire fishing season. Although the Power Block system can help reduce labor requirements, labor remains essential, with approximately 20 crew members still required onboard to ensure continuous operations. Moreover, potential long-term costs for equipment repair and maintenance may offset some labor cost savings. Finally, fluctuations in fish prices, fuel costs, and labor wages may affect the analysis of costs and returns, meaning that the findings reflect conditions during the study period only.

Nonetheless, the results of this case study could provide useful information to support the development of policies by government agencies to assist purse seine fishers in accessing loans at lower interest rates and encouraging them to invest in upgrading their fishing equipment. The results could also serve as useful materials for training programs that could be developed and implemented to equip purse seine fishers with the necessary technical knowledge to effectively upgrade their fishing vessels with the Power Block system, including its operations and maintenance.

Way Forward

As fishing technologies continue to develop for purse seine fisheries, an assessment should be made of the ecological factors and fishery resources that could be affected by innovations and the uncontrolled capacity of fishing vessels. It would also be important to monitor the economic performance of fishing activities to establish the most appropriate fisheries management for sustainable fisheries.

Acknowledgments

The authors would like to express their sincere gratitude to *Mr. Surat Rattanasitorn,* the owner of the pilot fishing boat "Nor Larpprsert 8," for providing valuable information on the purse seine fisheries including cost and return data; to *Ms. Rattanawaree Polsawat* of the Department of Fisheries (DOF) of Thailand, for the useful advice during the course of this study, and the Officers of DOF for their support during data collection; and to the SEAFDEC/TD staff, *Mr. Suthipong Thanasansakorn*, *Mr. Thaweesak Thimkrap,* and *Mr. Isara Chanrachkij* for their advice and support.

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Options for Innovation and Improvement of Currently Used Fishing Technologies and Operations in Thailand to Attain Sustainability

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Keywords: capture fisheries, initial capital investment, fisheries management plan, IUU fishing, vessel monitoring system, small-scale and commercial fishing fleets

Sustainability of fishing operations is a growing concern worldwide. To achieve this, transitions carried out by fishers regarding their fishing methods should be financially supported, particularly for small-scale fishing operations. Access to financial services would facilitate the fishing businesses to innovate and comply with improved fisheries management measures, and thus, generate social, economic, and environmental benefits. To address such concerns, FAO initiated in 2021 the Multi-Disciplinary Fund Project "Financing innovation for sustainable fisheries with the private sector," aimed at supporting fishing businesses in Thailand to access formal microfinance and credit sources.

This article summarizes the study report submitted to FAO by the SEAFDEC Training Department (SEAFDEC/TD) in 2022, on the Assessment of the Sustainability of Currently Used Fishing Technologies and Operations in Thailand and Options for Innovation and Improvements (FAO, 2022). The study features a literature review on the current situation of the marine capture fisheries sector, and an analysis of the currently used fishing technologies and operations to identify the options for innovation and improvements in fishing vessels, onboard equipment, and gear. Data gathering by literature review was done in 2021, followed by a field survey in Rayong Province, Thailand. The knowledge and experience of the researchers from SEAFDEC/TD were used to estimate the costs and benefits of introducing the most promising innovations. These were validated by discussing with stakeholders which included owners of fishing vessels, university lecturers, representatives from the Asia-Pacific Rural and Agricultural Credit Association (APRACA), representatives from the Bank for Agriculture and Agricultural Cooperatives (BAAC), officers from the Department of Fisheries of Thailand, technical consultants, and technical officers from SEAFDEC during the national workshop on 04 October 2021. The workshop was organized by SEAFDEC/TD and Rayong Marine Fisheries Research and Development Center of the Department of Fisheries, Rayong Province, Thailand. The monograph on the Assessment of the Sustainability of Currently Used Fishing Technologies and Operations in Thailand and Options for Innovation and Improvements was published by FAO for dissemination to the fisheries sector and to investors and financial service providers.

This article also reviews the main components of the aforesaid study report, namely: the trend of capture fisheries in Thailand; characteristics of the main fishing fleets operating in Thailand; innovations and technological upgrades; and national legislation, policies, and plans that affect fishing operations and technologies used.

Capture Fisheries Trends in Thailand, 1960-2018

Marine capture fisheries is socially and economically important for Thailand. However, several challenges have posed serious threats to its sustainability, including the degradation of fishery resources and critical habitats (mangroves, seagrasses, and coral reefs), as well as illegal, unreported, and unregulated (IUU) fishing. From 1960 to 1994, fishery production of Thailand from capture fisheries, marine and inland fisheries increased with a peak of 3,031,074 MT in 1995 (World Bank, 2020); however, the trend started to decline in the 2000s, with the lowest production points appearing around the year 2015 through 2017, as shown in **Figure 1**.

The slightly increasing trend of production from 2018 onwards could be attributed to the wide-ranging reforms in the marine capture fishery subsector, including the adoption of countermeasures to combat IUU fishing and the "IUU-free" strategy of Thailand by licensing the unregistered fishing vessels carried out by the Department of Fisheries (DOF) of Thailand (DOF, 2016; 2018b).

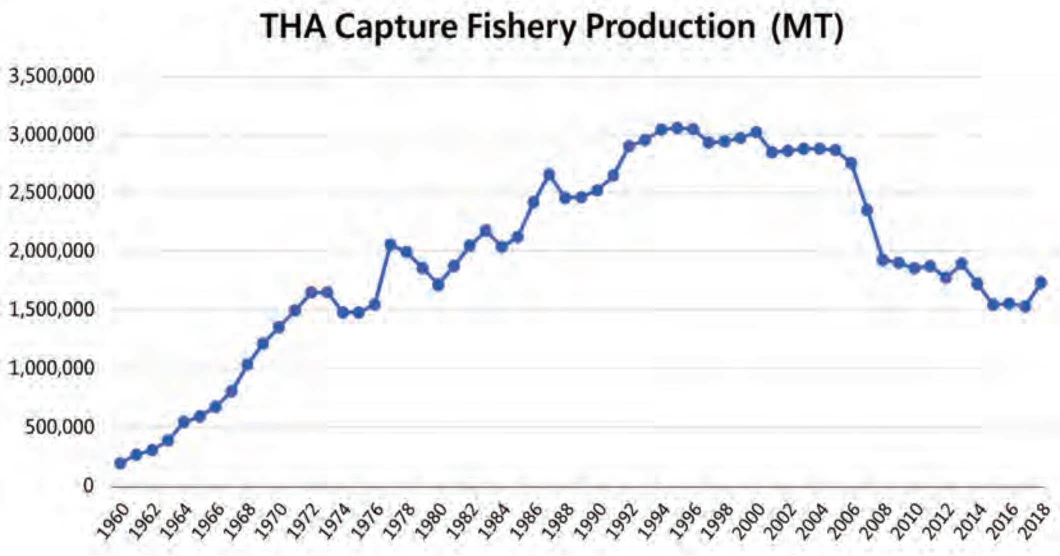

Figure 1. Capture fishery production of Thailand from 1960 to 2018 (World Bank, 2023)

The landing trends of the main target fishery species from the Gulf of Thailand and Andaman Sea during 2014–2018 are shown in **Figure 2**. In the Gulf of Thailand, the main species commonly caught that generate the highest commercial value in Thai Baht (THB), based on total catch value from five fishery groups (otter board trawlers, squid cast netters, pair trawlers, gill netters, and purse seiners) in 2018, were squid (*Loligo* spp.) valued at THB 9,458,385,000; blue swimming crab (*Portunus pelagicus)* at THB 2,689,336,000; yellowtail scad (*Atule mate*) at THB 2,277,703,000; Indian mackerel (*Rastrelliger kanagurta)* at THB 1,602,408,000; and Spanish mackerel (*Scomberomorus* spp.) at THB 615,802,000. In the Andaman Sea, the main species landed were squid (*Loligo* spp.) valued at THB 1,588,066; round scad (*Decapterus* spp.) at THB 942,224,000; Indian mackerel (*Rastrelliger kanagurta)* at THB 693,264,000; snappers (*Lutjanus* spp.) at THB 118,112,000; and threadfin bream (*Nemipterus* spp.) at THB 98,969,000 (DOF, 2020).

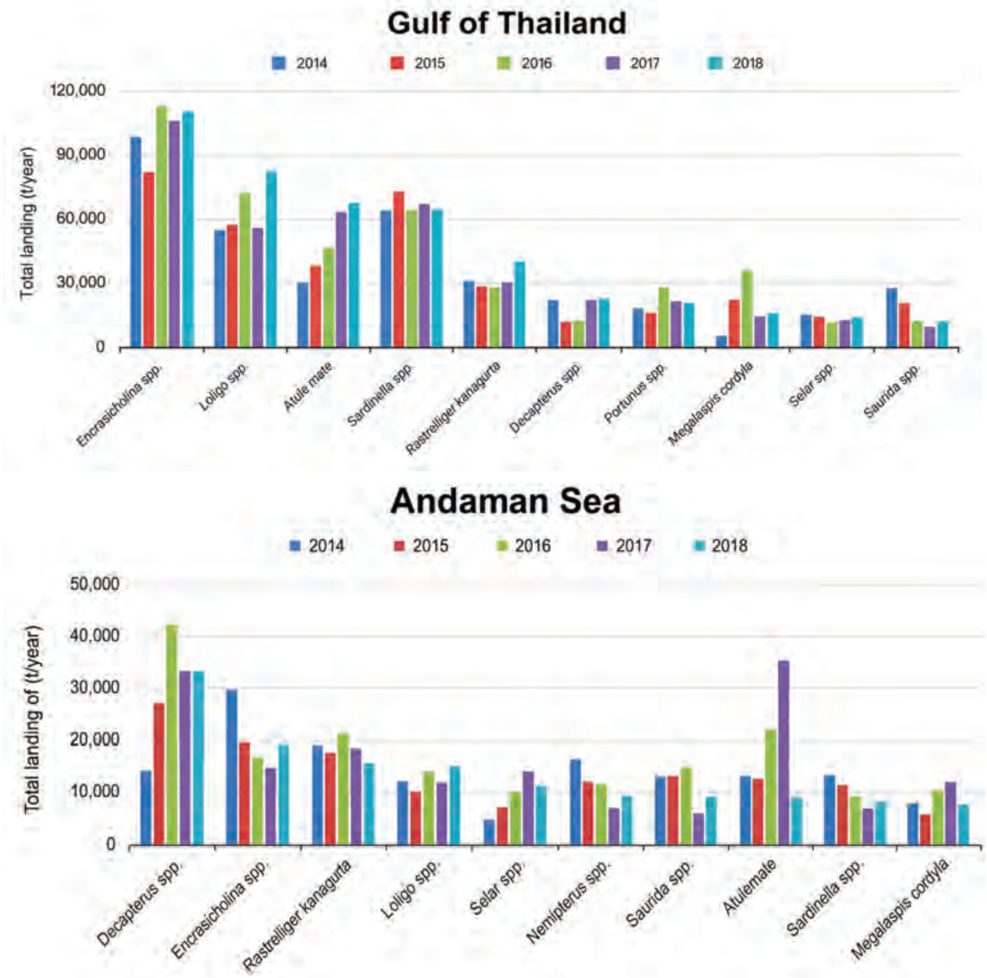

Figure 2. Total landing (t/year) of target fish species in the Gulf of Thailand and Andaman Sea in 2014–2018 (DOF, 2016; 2017; 2018a; 2019; 2020)

Since 2015, the Department of Fisheries of Thailand has adopted a quota system on fishing days to alleviate commercial fishing efforts, which also motivated commercial fishers to register for fishing operations in the waters of Thailand. As a result, the number of fishing vessels increased from 23,556 (7,596 commercial-scale and 15,960 small-scale) in 2014 to 37,018 (10,645 commercial-scale and 26,373 small-scale) in 2018.

In 2018, the six economically most important small-scale and commercial fishing fleets, in terms of the number of vessels operating in the Gulf of Thailand and the Andaman Sea, are: otter board trawl, squid cast net, pair trawl, purse seine, gillnets, and anchovy falling net (**Figure 3**). In the Gulf of Thailand, otter board trawl is the largest fleet in terms of the number of fishing vessels, followed by the squid cast net, pair trawl, gillnet, and purse seine; and in the Andaman Sea, the important fleets are the otter board trawl, purse seine, pair trawl, anchovy falling net, and squid cast net (DOF, 2020a). Most commercial-scale fishing vessels are made of wooden hulls and are powered by inboard diesel engines. As of 2020, only 15 steel-hulled commercial-scale fishing vessels were flying the Thai flag. All vessels are decked, except for a very small number of small purse seine and gillnet vessels. The basic and standard deck hauling system is a winch, while only some purse seine and gillnet vessels are equipped with a net hauler. All vessels have onboard ice and cool storage facilities for their catch. As most vessels are made of wood, regular maintenance is required at least once a year to ensure vessel stability and facilitate license renewal.

Characteristics of the Thai Fishing Fleet: Economic Assessment

A field survey in 2021 was conducted by interviewing 27 fishermen who operate in the eastern provinces along the Gulf of Thailand (**Table 1**). **Figure 4** shows the annual revenue from the sale of catch at landing, with the gross value depending on fish species and price. In general, commercial-scale fishing vessels have higher revenues compared to small-scale fishing vessels. This has enabled the owners of commercial-scale vessels to more frequently and adequately maintain their vessels. On the other hand, small-scale fishing vessels can easily switch their fishery target because of the lower investment costs required by the vessels and the gear used.

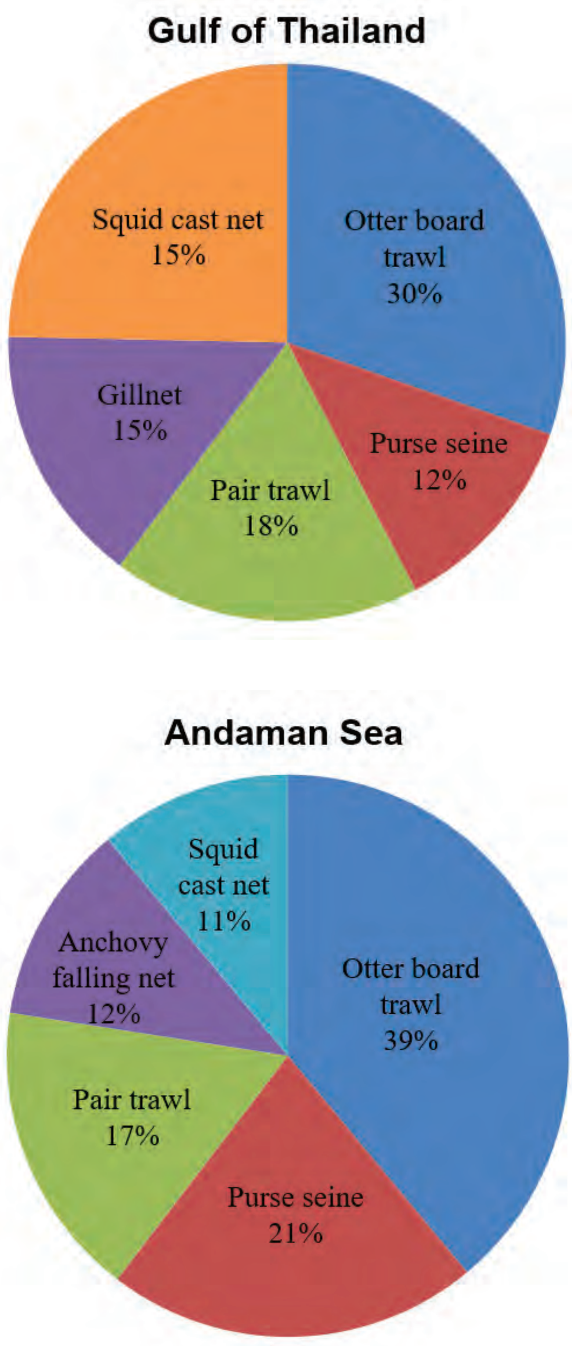

Figure 3. Percentage of the main commercial-scale fishing vessels in Thailand operating in the Gulf of Thailand and Andaman Sea in 2018 (DOF, 2020a)

Table 1. Fishers/owners of vessels interviewed for the financial and economic characteristics of fleets in August 2021

Fleet/Gear	Province	Size (GT)	Length (m)	No. of crew
Otter board trawl				
Vessel no.1	Rayong	26.84	15	6
Vessel no.2	Rayong	44.71	17	7
Vessel no.3	Rayong	28.5	14	5
Vessel no.4	Rayong	58.89	19.29	6
Squid cast net				
Vessel no.1	Rayong	40	18	5
Vessel no.2	Rayong	28.82	17.6	5
Vessel no.3	Rayong	56	21	7
Vessel no.4	Rayong	28	14	6
Vessel no.5	Rayong	47.88	18.97	6
Pair trawl				
Vessel no.1	Chanthaburi	78.65	21.54	15
Vessel no.2	Trat	92.34	21.62	15
Vessel no.3	Trat	61.81	18.79	13
Gillnet				
Vessel no.1	Rayong	80	20	17
Vessel no.2	Rayong	90	20	16
Vessel no.3	Rayong	57.39	18	14
Vessel no.4	Rayong	59.34	20.72	15
Vessel no.5	Rayong	36.26	16.7	16
Purse seine				
Vessel no.1. Group 1	Rayong	21.3	14.4	14
Vessel no.2. Group 1	Rayong	22.4	15.5	13
Vessel no.3. Group 2	Rayong	139.22	24.97	38
Vessel no.4. Group 2	Rayong	172.83	27.7	40
Vessel no.5. Group 2	Rayong	180.41	26.9	38
Anchovy falling net				
Vessel no.1. Group 1	Chanthaburi	20	15.45	10
Vessel no.2. Group1	Chanthaburi	35.02	15.86	16
Vessel no.3. Group 1	Chanthaburi	46.71	16.39	11
Vessel no.4. Group 2	Chanthaburi	52.47	18.79	11
Vessel no.5. Group 2	Chanthaburi	65.03	21	12

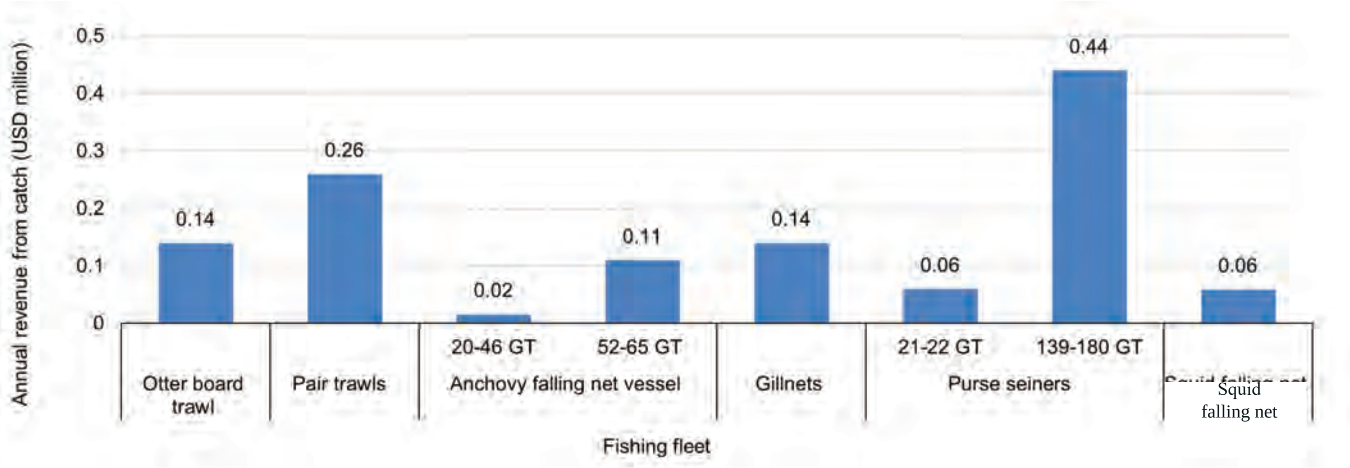

Figure 4. Revenue (million USD) from the catch of fishing fleets operating in the Gulf of Thailand

The initial capital investment for each type of commercial fishing vessel, which includes hull, engine, winch, ice storage, fishing gear, echo sounder, sonar, radar, vessel monitoring system, MS, GPS, Radio and other communication equipment, is shown in **Table 2.**

The average cost of operating a fishing fleet by type of gear **(Table 3)** includes operational costs consisting of fuel, labor, and others (lubricant, harbor dues, ice, and food), and owner costs that include vessel and gear repair and maintenance, gear replacement, and others.

Table 2. Initial capital investment of the fishing fleet in Thailand

Fishing fleet	Initial capital investment (THB)	Percentage (%) of investment				
		Hull	Engine	Equipment	Fishing gear	Electronic devices
Otter trawl	1,826,083	64.3	15.3	5.1	5.0	10.3
Squid cast net	1,563,553	74.2	12.6	4.3	3.5	5.4
Pair trawl	11,235,334	83.1	11.6	0.6	1.1	3.6
Gillnet	3,668,800	49.1	26.4	0.5	20.1	3.9
Purse seine						
21–22 GT	2,177,500	39.0	9.0	4.6	32.1	15.3
139–180 GT	13,988,167	66.7	8.1	2.3	16.2	6.7
Anchovy falling net						
20–46 GT	2,641,167	47.3	7.6	8.9	19.4	16.8
52–65 GT	3,083,500	56.8	22.0	1.6	14.6	5.0

Table 3. Average cost for operating a fishing fleet by type of gear

Fishing fleet	Operational costs (%)				Owner costs (%)			
	Fuel	Labor	Others	Total	Repair and maintenance	Depreciation Cost[1]	Others	Total
Otter board trawl	54.15	17.90	19.69	**91.74**	5.70	1.93	0.62	**8.26**
Squid falling net	32.38	33.97	10.16	**86.51**	9.90	2.94	0.65	**13.49**
Pair trawls	40.67	31.74	8.44	**80.85**	12.55	6.25	0.35	**19.15**
Gillnets	12.34	57.64	19.85	**89.83**	6.34	3.25	0.58	**10.17**
Purse seiner								
21–22 GT	12.72	64.33	17.2	**94.25**	1.89	3.39	0.47	**5.75**
139–180 GT	18.33	50.10	17.45	**85.88**	8.84	5.05	0.23	**14.12**
Anchovy falling net								
20–46 GT	13.07	49.96	17.75	**80.78**	13.94	4.74	0.54	**19.22**
52–65 GT	12.01	30.00	32.09	**74.10**	22.69	2.61	0.60	**25.90**

[1]Depreciation cost includes the cost of the vessel, engine, equipment, and gear that last more than 3 years

Fishery Workers

Based on the same survey, results showed that fishery workers are generally on full-time employment and are mostly foreign nationals. Operators of the fishing fleet employ Thai workers to serve as the vessel captain and engineer. There are no female workers on board the fishing vessels. Purse seine fishery vessels usually have the highest number of workers (29 persons) on average, followed by vessels using gillnet (16), pair trawl (14), anchovy falling net (12), otter board trawl (6), and squid cast net (6). Most fishing vessel crew members have participated in general fisheries education/training and basic safety training and have access to health insurance and banking services. However, they do not take part in the national social security scheme and therefore do not contribute to any pension fund. They also have little or no participation in fishers' organizations, cooperatives, or unions.

The average monthly wages of the captains/skippers in each fishing vessel range from THB 11,367 to 37,500. The captain of the gillnetter vessel gets the highest monthly wage, while the captain of a squid falling net vessel earns the lowest wage. Crew members of each fishing fleet receive an average monthly wage on board of around THB 11,347 **(Table 4)**.

Table 4. Monthly income of fishery workers by fishing gear

Fishing gear	Monthly income (Thai Baht)					
	Skipper/Master			Crew		
	Min	Max	Ave	Min	Max	Ave
Otter board trawl	10,000	20,000	17,500	10,000	10,100	10,275
Squid falling net	10,100	12,000	11,367	10,100	10,100	10,100
Pair trawls	20,000	30,000	23,333	12,000	12,000	12,000
Purse seine	12,000	30,000	20,667	10,100	15,000	12,525
Anchovy falling net	15,000	20,000	16,667	9,700	12,000	10,350
Gillnets	30,000	40,000	37,500	12,000	15,000	12,833

Technological Innovations in Vessels, Equipment, and Gear

The study report provides some recommendations for a loan guarantee program that supports the commercial lending scheme of Thailand offered to fishing vessel owners. A case study of the improvement of a 91-GT Thai purse seiner in Pattani Province in Thailand was conducted by reconfiguring the said vessel (**Figure 9**). The technology upgrade had increased efficiency by making it easier and faster to haul in and handle the catch, reduced labor requirements, improved refrigeration and preservation of the catch (thus increasing the catch's market value) and enhanced the working conditions and livability of the crew onboard. After the reconfiguration, revenues increased to THB 1,425,000 and the cost of labor had decreased to THB 874,146 per year.

Findings from the case study were used as a basis for the recommendations for a loan guarantee program. A soft loan program for purse seiner reconfigurations and modified old fishing net of THB 2.0–2.5 million (with a new fishing net, THB 3–4 million or more is required) would allow fishing operators, with support from public and private lending institutions, to make these improvements and comfortably repay loans in about two years (3–5 years in case of a new fishing net). A loan guarantee program that supports THB 160 million in lending, for example, can help reconfigure 80–100 vessels (specifically purse seiners) in a two-year cycle.

Regulations and Technology Adoption

A study on the effects of some policies and regulations on vessel owners' willingness to make capital investments in upgrades, new vessels, or new technology, as well as the economic viability of their business, has identified several innovations, technologies, onboard facilities, and devices that owners can invest in, benefit from, and contribute to social and environmental objectives. These range from small items like hooks and Juvenile and Trash Excluder

Figure 9. Reconfiguration of a 91-GT Thai purse seiner: Hydraulic crane and power block for hauling purse seine net (left) and refrigeration system for chilling the catch (right)

Devices to the replacement of engines or vessels with hulls of materials other than wood (which would allow several features to be installed, such as a bulbous bow). Costs of some innovations are provided, but most are indicative. In most cases, the assessment showed a mix of quantitative data and qualitative statements. Identifying barriers to innovation and sustainability helps inform policies and financial measures that encourage vessel owners to invest in technological upgrades and access to capital.

Innovations and Technological Upgrades

Thai fishing vessels, onboard equipment, and gear currently used in fishing fleets could benefit from improvements that would reduce fuel consumption, raise the efficiency of energy use, and bring down operational costs, with a positive contribution to climate change mitigation. Other improvements can be made to increase fishing efficiency, reduce the environmental (habitat, biodiversity, and ecosystem) impact of fishing, and improve fish handling and product quality, as well as safety at sea and on-board working conditions.

Vessel Upgrade

Vessel hulls made of materials other than wood, preferably aluminium, steel, or fiberglass could lower maintenance costs and provide better maneuverability and faster movement. Refinement in the shape of the appendages of the hull (in large vessels) could result in improved stability and safety. A vessel should have a buoyancy compartment and should be installed with bulwarks and guardrails. The installation of a bulbous bow reduces water resistance at the bow and saves fuel consumption by about 5% during steaming and reduces fuel consumption and exhaust gas emissions. Therefore, fishing vessel operators need to retrofit their existing wooden-hulled vessels with steel-hulled vessels. The construction cost of a steel-hulled 75.87 GT vessel, LOA 23.95 m, is about THB 30,000,000 (not including gear).

Equipment Upgrade

Replacement of engines, *i.e.* by a modified diesel-electric generator diesel, could increase fuel and fishing efficiency and reduce exhaust gas emissions. Fishing vessel operators need to use a suitable new diesel engine and propeller to improve fuel efficiency. For a trawl fishing boat made of steel, its inboard diesel engine should be 5 to 6 HP per ton of displacement. Typically, the optimal fuel efficiency of a diesel engine is at 85 % maximum continuous rating. Two owners of trawlers were interviewed; the first trawler (LOA 18 m) uses a modified second-hand diesel-electric generator engine with 275 HP as the main propulsion engine and costs between THB 100,000–150,000, plus another THB 50,000 for installation services. The second trawler owner uses a 180 HP Hino truck diesel engine with modification and installation costs of THB 20,000 and THB 50,000, respectively.

An electric propulsion system is a new propulsion technology for local Thai fishing boats and helps in reducing fossil fuel costs and non-renewable greenhouse gas emissions. However, it has a high initial capital investment and installation costs. Retrofitting of an electric driving system of a personal car performed by a local mechanic shop included a permanent magnet synchronous motor (PMSM) with a Rated Power of 30 kW and Peak Power of 60 kW, a 384 VDC for a 3-ton maximum load, 120 Ah 64 kWh lithium-manganese-cobalt-oxide batteries (MNC), that allow 250–280 km per charge, and available speed range of 140–150 km/hr. The system costs about THB 600,000. Total installation and operating costs for the retrofitted electric car amount to THB 1,182,400 (582,400 + 600,000). The cost ratio between an electric and diesel-powered engine is 0.598. Matching a suitable new diesel engine and propeller is key to fuel efficiency, about which most fishers do not have the knowledge before having their trawl fishing boat modified.

Reconfiguration of the vessel also requires the installation of such systems as a crane, hydraulic system, power block, and a central cooling and refrigeration system. The installation of a fuel flow monitor/electronic data logger can help the skipper know the real-time condition of the engine and fishing vessel for better planning and management of the fishing route, saving on time and fuel. Moreover, replacement of sustainable energy engine (solar and/or wind power), and installation of emergency stop devices for winches and hauling equipment, lightning conductors, distress signal devices, lifesaving equipment and survival crafts, radio communications, firefighting equipment, and provision of first aid kit, medical equipment and medicines, and cooking, eating, sanitary and water facilities are also necessary for the efficient operation of a fishing vessel.

Fishing Gear

Fishing gear could be improved through some innovations, *i.e.* the use of low-resistance fishing gear (suitable for offshore trawls) and circle hook for long line fishing (reduces mortality rate of non-target species, specifically sea turtles), which cost from THB 450–850 per 100 hooks; installation of Turtle Excluder Devices (TEDs) to avoid catching sea turtles and other non-target species (Size 0.5 x 0.8 m), and installation of Juvenile and Turtle Excluder Device (JTED) to avoid catching juveniles and "trash fish" as they compose the undersized economically important species.

Improved Operations

The operation of the hydraulic pump and hydraulic system could slow down speed, and the use of a fish finder can reduce fuel consumption and increase fishing efficiency by reducing steaming time and distance to the location of the fish. Installation of a Vessel Monitoring System (VMS) enables the monitoring and surveillance of the vessels by authorities to, among others, prevent IUU fishing, provide quick alerts and warnings of storms, and easily monitor the location of the vessels in case of emergency. Adoption of Fish Aggregating Devices (FADs) can raise fishing efficiency by attracting more fish into the FAD area and reduce steaming time spent on locating target fish species.

National Legislation, Policies, and Plans that Affect Fishing Operations and Technology Use

The new Fisheries Law of Thailand, the Royal Ordinance on Fisheries B.E. 2558 (2015), was enacted on 14 November 2015, seven months after the EU issued an IUU yellow card to Thailand. The law provides for a comprehensive reform of the legal framework governing Thai fisheries. The law changed the conservation and management of Thailand's aquatic living resources from an "open access" system to a controlled system under a licensing regime. This was based on scientific evidence, *i.e.* the maximum sustainable yield (MSY), and a prescribed total allowable catch to prevent overexploitation. A key aspect of the law provides that IUU fishing is an international crime and, commensurately, imposes serious sanctions to ensure effective compliance.

In addition, the Royal Ordinance on Thai Vessels B.E. 2561 (2018) was brought into law in March 2018 to enforce the regulations contained in the Navigation in Thai Waters Act, and is also aimed at combating IUU fishing. Thailand is a party to key international treaties that promote sustainable fisheries, such as the United Nations Fish Stock Agreement (UNFSA), Agreement on Port State Measures to Prevent, Deter and Eliminate IUU fishing (PSMA), and other Regional Fisheries Management Organization (RFMO) agreements. A buy-back scheme was launched to help fishers affected by the government's program of reducing the number of fishing vessels and bringing the fishery resources back to balance. For some 305 fishing vessels with less than 90 GT (bought back as of 2019), the compensation amount was estimated at THB 764.45 million.

National Plan of Action to Prevent, Deter, and Eliminate IUU Fishing

The National Plan of Action to Prevent, Deter and Eliminate IUU Fishing (NPOA-IUU), which was approved on 03 November 2015, reflected the Thai Government's recognition that IUU fishing is a serious threat to marine fishery resources, and that concerted global, regional and national actions are required to address the challenge. It specifies actions and measures needed to prevent, deter, and eliminate IUU fishing both inside and outside Thai waters, drawing on the FAO IPOA-IUU and Thailand's international obligations. The measures stipulated in the NPOA-IUU aim to fulfil Thailand's responsibilities as a flag state, coastal state, port state, and market state.

Marine Fisheries Management Plan (FMP)

The Marine Fisheries Management Plan (FMP, 2015–19) of Thailand is closely linked to the NPOA-IUU and the National Control Plan (NCP) 2015. Based on a risk assessment, two high-priority issues were identified: (i) overfishing and overcapacity, especially by commercial fleet, and (ii) IUU fishing (DOF, 2021). The FMP, which aims to reduce fishing capacity and fishing effort over three years, was designed to reduce IUU fishing to a level that can be controlled through regular MCS arrangements. Specific management measures to achieve this include: (a) strengthening Monitoring, Control, and Surveillance measures, and (b) improving the licensing and registration system so that all vessels are registered and licensed (DOF, 2022). Any vessel with a history of IUU fishing would not be registered.

Regulations and Technology Adoption

Highly relevant to the issue of technology adoption by the fishery sector are the findings of the International Labour Organization (ILO) on the effect of some policies and regulations on vessel owners' making capital investments on upgrades, new vessels, or new technology, as well as the economic viability of their business. The ILO findings (ILO, 2019) are noteworthy:

- Concern of vessel owners about changes in vessel monitoring system (VMS) regulations that require additional cost for a secondary system to supplement and replace the system already in place
- Report of many vessel owners on the rapid policy change, which is difficult for the industry to adapt to; thus, any new changes should be properly researched to support the industry, and that the industry should be consulted when the rules are to be changed, and should be given time for implementation after a law is passed so that the industry can make the necessary adjustments
- Concern of some Thai vessel owners that although a tight labor market would drive investment in new technologies, this would lead to increased mechanization of the fishing fleet and a consequent reduction in the level of labor required. However, to take up labor-reducing technologies, new vessels would need to be purchased, which is not easy as in the case of purse seine vessels which make up 909 (or 17 percent) of the approximately 5,500 vessels in the Thai commercial fishing fleet over 30 GT in size
- Reluctance of owners to invest in vessel upgrades likely reflects the lack of informed debate among vessel owners about available technologies, costs, and means of accessing financing capital investments
- Vessel owners contemplating on making capital investments require predictability and evidence of prospects for profitability, while commercial lenders, likewise, look for predictability
- The long-term plan of the Department of Fisheries (DOF) to decrease the size of its commercial fishing fleet by adopting a buy-back scheme (as of 2019, 305 vessels had been bought by the Thai Government), and the plan of DOF to adopt measures for increasing the use of labor-saving technologies to reduce the requirements for fishery workers

Conclusion

Thailand's fishing fleet, onboard equipment, and gear currently used in fishery vessels could benefit from improvements to reduce fuel consumption, raise the efficiency of energy use, and bring down operational costs, with a positive contribution to climate change mitigation. Likewise, other innovations would also increase fishing efficiency, reduce the negative environmental impacts of fishing, improve fish handling and product quality, and improve safety at sea and on board working and living conditions.

A few innovations, several technological upgrades, and a range of technical, operational, and material features have been identified through this study, contributing to the general objective of attaining sustainability in the fishing industry. Some innovations require a small investment, such as the use of hooks and installation of JTED to avoid catching non-target species and juveniles. Moreover, significant investments would be necessary for the replacement of vessel engines; even more sizeable investments need to be made for the replacement of ageing wooden-hulled vessels with hulls made of steel, aluminum, or fiberglass. The refurbished vessels would allow the installation of innovative and efficiency-enhancing features like a bulbous bow, fins fitted forward, a duct on the propeller, as well as a safety feature like a buoyancy compartment. The costs of investing in some of these features have been determined, although some of the amounts are only indicative. In most cases, the assessments are a blend of quantitative information and qualitative statements derived from interviews with vessel owners, published studies, as well as from the experiences and expertise of the fishers and experts that took part in the stakeholders meeting, and the members of the team from SEAFDEC/TD who worked on this study. Indications of the economic benefits from investing in certain technological upgrades are also provided, as these could contribute to addressing the interlinked issues of what modes of assistance and what forms of incentive can be provided to vessel owners to persuade and enable them to invest in innovations and technological upgrades.

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Sayonara ASPIC and Welcome JABBA to SEAFDEC

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Keywords: JABBA, Bayesian state-space, Harvest Control Rule, routine stock assessments, ASPIC

Sayonara ASPIC and welcome JABBA

A Stock Production Model Incorporating Covariates (ASPIC) is one of the surplus production models (SPMs). It has been used in SEAFDEC over the past decade primarily for neritic and oceanic tuna but has recently become outdated theoretically and practically. In contrast, Just Another Bayesian Biomass Assessment (JABBA) is a more recent SPM that can offer more reliable, robust and plausible results. For this reason, the authors strongly recommend that fish stock practitioners switch from ASPIC to JABBA.

Routine assessments using the JABBA-HCR approach

Based on past experience, it has been observed that participants, during and especially after stock assessment training sessions organized by SEAFDEC, require the assistance of resource persons to carry out proper, reliable and plausible stock assessments. This situation will continue even if JABBA is introduced. In addition, in previous SEAFDEC meetings, recommendations were made to conduct routine stock assessments for important species (neritic tuna), which are still pending. To address these issues, the introduction of routine stock assessments using the JABBA-Harvest Control Rule (HCR) approach needs to be considered. A simple HCR can derive catch limits or Total Allowable Catch (TAC) using only catch or CPUE without conducting full stock assessments. Hence, this approach can be implemented by stock assessment practitioners in the SEAFDEC Member Countries without the assistance of resource persons.

Implementing the JABBA-HCR approach

The initial stage of implementing the JABBA-HCR approach should prioritize the unhealthy stocks in the most important species. As an example, it can be carried out as follows: (1) JABBA will be conducted with the assistance of resource persons every three years; and (2) during the two years between these assessments, SEAFDEC can independently implement annual HCRs to derive the TAC without the assistance by resource persons (refer to the text for the healthy stock case). This will enable routine assessments in a timely and cost-effective manner while complying with pending recommendations. This effort is vital for SEAFDEC to fulfil its mission of securing sustainable food sources and livelihoods for its Member Countries.

Sustainable capacity building framework

This framework is designed to supervise trainees' stock assessment work continuously, especially after the training, to ensure that they achieve satisfactory proficiency. In this regard, Thailand, Indonesia, Sri Lanka and the Republic of Korea have shown strong interest in this approach and have requested to carry it out. Between 2024 and 2026, eight face-to-face training sessions were conducted with 49 participants. The initial sessions mainly comprised lectures and practices for the newly developed menu driven JABBA software. This software makes it possible to implement proper, transparent and reliable assessments smoothly. During the initial training sessions, a few important species were selected in each country and preliminary assessments were carried out. Afterwards, online training and discussion sessions have been implemented for 1–3 years to complete the full assessment work. In addition, to demonstrate their proficiency, they were asked to write scientific papers to submit to international peer-reviewed journals. Unlike the normal snapshot-type training, this approach enables continuous collaboration between stock assessment practitioners and resource persons, ensuring its sustainability. Some of their achievements are introduced and referenced in this article. Implementing this approach in SEAFDEC will be quite challenging or impossible under its current structure.

Two main issues with JABBA

In summary, the authors address two important issues to initiate JABBA-related activities: (1) routine assessments by the JABBA-HCR approach under the current SEAFDEC structure; and (2) sustainable capacity building framework with JABBA and other models through long-term supervision. It includes follow-up online training and discussion sessions as well as publication support to ensure assessments conducted are proper, reliable and plausible.

Introduction

This article reviews past stock assessment activities in SEAFDEC and proposes a future direction based on the perspective of the authors experienced with conducting these initiatives. One of proposals is to introduce JABBA (Just Another Bayesian Biomass Assessment) (Winker *et al.* 2018), one of the most advanced and powerful surplus production models (SPMs). While ASPIC (A Stock Production Model Incorporating Covariates) has been the standard SPM within SEAFDEC for the past decade, it is now technically and theoretically outdated. To facilitate the efficient implementation of JABBA, Nishida and Iwasaki (2024) developed the menu driven JABBA software without using R (engine of JABBA).

Regarding JABBA, two important issues are raised in this article, *i.e.* the routine stock assessments and sustainable capacity building. For the first issue, the JABBA-Harvest Control Rule (HCR) is introduced. This will enable routine assessments in a timely and cost-effective manner, while at the same time, its recommendations can be complied with. This effort is vital for SEAFDEC to fulfil its mission of securing sustainable food sources and livelihoods for its Member Countries. Derived catch limits or TAC should only serve as a reference since SEAFDEC does not function as a Regional Fisheries Management Organization (RFMO); hence, compliance is not mandatory. Nevertheless, Member Countries are encouraged not to exceed the recommended catch limits.

For the second issue, the authors introduce the sustainable capacity building framework by the following reasons. Based on past experience, it has been observed that participants were unable to carry out proper, reliable and plausible stock assessments <u>after</u> training sessions. This is because resource persons cannot supervise their own assessment work after the training as this is beyond the scope of their contracts. This can be solved through the sustainable (continuous) capacity-building framework. The actual activities carried out in Thailand, Indonesia, Sri Lanka and the Republic of Korea are introduced.

In summary, the author addresses to initiate two JABBA-related activities in SEAFDEC: (1) routine assessments by the JABBA-HCR approach under the current SEAFDEC structure and (2) sustainable capacity building framework by JABBA or other models under a special arrangement.

Review of Stock Assessment Practices Within SEAFDEC

Table 1 shows the three types of fish stock assessment models. This section reviews SEAFDEC's use of these models in the past and suggests future directions, with a particular focus on the implementation of JABBA.

Table 1. Summary of the three types of fish stock assessment models

Type	Data characteristics	Information (data type)	Data volume (actual data)	Data period	Reference point (RP) (MSY, F_{MSY}, TB_{MSY}, target & limit RP)	Models and application (examples)	Implementation methods
TYPE 1	Qualitative	✓Parameters ✓Attributes				• ERA • PSA	✓R ✓SRAplus
TYPE 2	Quantitative	✓Real data ✓Parameter values	(a) Data limited (length)	Short (< a few years)	Temporal & relative [snap shot type]	• Length or age based models (ELEFAN, FiSAT, Y/R (YPR), S/R (SPR), LBSPR, Thompson & Bell, TropFishR)	✓Software ✓Shiny ✓Others
			(b) Data limited (catch)	Long (> 10 years)	Available [Relative, less reliable and less robust]	• Depletion rate assumed (CMSY & OCOM) • Depletion rate not assumed (ORCS & SSCOM) • Robin-hood methods	✓Excel ✓R ✓Others
TYPE 3		✓Real data ✓Parameter values ✓Priors (Bayesian approach)	(a) Data moderate (catch + CPUE + priors)		Available [reliable, robust and objective]	• Surplus Production models (SPM) (ASPIC, SPiCT, **JABBA**)	✓Own codes ✓R ✓[MENU]
			(b) Data rich (catch + CPUE + biology + priors + life history)			• Age/size structured model (VPA, ASPM, SCAA, SCAS) • Integrated models (SS, CASAL)	

ASPM Age-structured Production Model
CASAL C++ Algorithmic Stock Assessment Laboratory
CMSY Catch MSY (advanced state-space Bayesian method)
ELEFAN Electronic length frequency analysis
ERA Ecological Risk Assessment
FiSAT FAO-ICLARM Stock Assessment Tools
LBSPR Length-based Spawning Potential Ration
[MENU] Menu driven fish stock assessment software development team (Japan)
OCOM Optimized Catch-Only Model
ORSC Only Reliable Catch Stocks
PSA Productivity Susceptibility Analysis
SCAA Statistical-catch-at-age Model
SCAS Statistical-catch-at-size Model
SPiCT Stochastic surPlus Reduction Model in Continuous Time
SPM Surplus Production Model
S/R (SPR) Spawner per Recruit Analysis
SRA Stock Reduction Analysis (catch only SA)
SS Stock Synthesis
SSCOM State-space Catch-only Model
VPA Virtual Population Analysis
Y/R (YPR) Yield per Recruit Analysis

Type 1 (qualitative) assessments

Type 1 assessments are qualitative approaches using parameters and attributes such as Ecological Risk Assessment (ERA) and Productivity Susceptibility Analysis (PSA). Type 1 assessments have not yet been conducted in SEAFDEC. FAO is currently preparing PSA for specific species in Southeast Asia, with the second author of this article participating in the project. In addition, a technical workshop on PSA was held in SEAFDEC/TD in 2025 to build the capacities of the participants (SEAFDEC/TD, 2025). These activities will eventually pave the way for its gradual implementation in SEAFDEC Member Countries.

Type 2 (data limited) stock assessments: (a) length and (b) catch

Outline
Type 2 (data-limited) assessments are classified into two types: Type 2(a), which is based on short-term length-frequency data, and Type 2(b), which is based solely on catch data over a longer period. Since SEAFDEC Member Countries generally do not have long-term catch, CPUE nor biological data, Type 2(a) assessments have been mainly implemented. Type 2(a) assessments provide only a **snapshot** evaluation of stock status based on relative and temporary assessments over a short period. Hence, Type 2(a) cannot produce robust or reliable MSY, stock status and reference points compared to Type 3 assessments (see next section). While Type 2(b) uses a longer period of catch data and thus provides slightly more reliable results, its application in Member Countries has been limited.

Application in SEAFDEC
Software for Type 2(a) fish stock assessments, such as ELEFAN, FiSAT, LBSPR, and Thomson and Bell, have been developed by organizations such as FAO and ICLARM as well as by various universities and research institutes. These organizations have been providing extensive training worldwide, including for SEAFDEC Member Countries. Because of their user-friendly design, they can be accessed by a wide range of users. SEAFDEC Member Countries apply these tools to waters mainly within their own countries because (1) application in a closed area is a basic assumption under these models; and (2) the input data (length) can be easily obtained over a short period in these small regions.

Training within SEAFDEC
SEAFDEC/TD conducted a training session in 2023 at the SEAFDEC/TD facility in Samut Prakan, Thailand titled "Regional Training Course on Data-Limited Fish Stock Assessments Using R-Statistical Program" to encourage Member Countries to apply Type 2(a) assessments using the R computer language (SEAFDEC/TD, 2023). The second co-author of this article was the resource person for the session.

Type 3 (a) data moderate and (b) data rich

Outline
Type 3 assessments are based on a longer period of data (ideally more than ten years). There are two subtypes based on data availability. For Type 3(a) (data moderate), assessments use catch and CPUE. Representative approaches include surplus production models such as ASPIC and JABBA. For Type 3(b) (data rich), assessments include additional biological data. Representative approaches include integrated models such as SS (*stock synthesis*) and CASAL (*C++ Algorithmic Stock Assessment Laboratory*).

The ASPIC model has served as the primary tool for Type 3(a) assessments in SEAFDEC over the last decade and its relevant activities are summarized in **Table 2**. There is no documented application of Type 3(b) data rich assessments in SEAFDEC Member Countries.

Advantages
Type 3 assessment results are based on long-term population dynamics (ideally spanning more than 10 years) which can provide reliable MSY, F_{MSY},TB_{MSY}, target and limit reference points and can therefore provide more reliable and robust results than Type 2 assessments.

ASPIC in SEAFDEC
ASPIC has been the primary stock assessment tool used in SEAFDEC over the last ten years primarily for neritic and oceanic tuna. To consider future stock assessment efforts in SEAFDEC, it is important to understand the ASPIC-related activities conducted in SEAFDEC as summarized in **Table 2**. During the same period, SPMs after ASPIC have evolved and improved concurrently. These advancements will be discussed in the next section.

ASPIC and JABBA

Evolution of SPMs

Table 3 shows the evolution of surplus production models (SPMs), tracing their trajectory from the original equilibrium SPMs in the 1950s to the most recent Bayesian state-space SPMs developed in the 2010s. The three original SPMs, which have been the standard for almost six decades (1950s–2000s), were based on an assumption of an equilibrium condition (biomass unchanging), which rarely occurs. The emergence of non-equilibrium models, including ASPIC, represented a significant shift in the 2000s. They were actively used for almost two decades (2000s–2010s). Afterwards, the (three) Bayesian state-space SPMs have served as the primary standard over the last decade.

Table 2. ASPIC and JABBA related activities in SEAFDEC and Member Countries (2016–2026)

Year	Activities	Funded by	Programming language or software	Resource persons and/or assistants	Reference
Neritic Tuna (ASPIC)					
2016	Neritic tuna projects (training & publication)	SIDA	Menu driven software	Dr. Nishida (FRA) Dr. Supapong (TD) Dr. Taki (MFRDMD)	SEAFDEC (2026)
2017					
2018					
2019					
2020					
2021		JTF			MFRDMD (2021)
2024	Training and Publication (seerfish)	JTF	ASPIC 5 (Prager, 2013) (original language)	Dr. Matsumoto (FRA) Dr. Supapong (TD)	MFRDMD (2024)
Other Species (ASPIC & JABBA)					
2016	SSS (Sulu and Sulawesi Seas) project. Assessment of Oceanic tuna & publication	JTF	Menu-driven software	Dr. Nishida (FRA) Dr. Supapong (TD)	Nishida (2017) Pangsorn & Nishida (2020)
2017					
2018					
2019					
2020	Training (Vietnam)				
2022	2nd Regional Training Workshop	FAO	Original JABBA	Dr. Rishi Sharm (FAO) Others	FAO (2022)
2023	Seminar	SEAFDEC & [MENU]	Updated ASPIC menu driven software	Dr. Nishida [MENU] Dr. Supapong (TD)	SEAFDEC (2024)
2024	1st joint workshop Thailand (DOF) & [MENU] (training & publication) (*)	DOF & [MENU]	Menu driven software (ASPIC)	Dr. Nishida [MENU] Dr. Supapong (TD) Mr. Weerapol (DOF)	DOF & [MENU] (2024)
	1st joint workshop BRIN (Indonesia) & [MENU]	BRIN & [MENU]	Menu driven software (JABBA)	Dr. Nishida [MENU]	
2025	2nd joint workshop Thailand (DOF) & [MENU] (training & publication) (*)	DOF & [MENU]		Dr. Nishida [MENU] Dr. Supapong (TD) Mr. Weerapol (DOF)	DOF & [MENU] (2025)
2026	2nd joint workshop BRIN (Indonesia) & [MENU] (training & publication) (plan)	BRIN & [MENU]		Dr. Nishida [MENU] Dr. Supapong (TD)	

SIDA: Swedish International Development Cooperation Agency
JTF : Japan Trust Fund
BRIN: National Research and Innovation Agency (Indonesia)

(*) *Dr. Supapong* (TD) was officially invited as a resource person upon the approval by the SEAFDEC SG
[MENU] Menu driven fish stock assessment software development team (Japan)

Table 3. Evolution of SPMs (Surplus Production Models)

Type	Authors	Features				Remarks
		Non-equilibrium condition (biomass changing over time)	Bayesian approach	Error type		
				Observation error (CPUE)	Process error (Model)	
Original SPM	Schaefer (1954), Pella & Tomlinson (1969) and Fox (1970)					Original SPM
ASPIC (ver2~5)	Prager (2004-2013)					Non-equilibrium SPM
ASPIC (ver7)	Prager (2014~)					
SPiCT (Stochastic surplus production model in continuous time)	Pedersen & Berg (2017)	*incorporated*	*incorporated*	*incorporated*	*incorporated*	Bayesian state space SPM
JABBA (Just Another Bayesian Biomass Assessment)	Winker *et al.* (2018)					
JABBA-Select	Winker *et al.* (2020)					

(Note) Representative SPMs are listed. For others, refer to Cousido-Rocha et al. *(2022)*

Problems with ASPIC

ASPIC has three main limitations: (1) ASPIC accounts only for observation errors, whereas statistical models incorporate both observation errors (the variance between observed and predicted values) and process errors (difference between actual and predicted biomass changes); (2) ASPIC relies on the Root Mean Squared Error (RMSE) estimation method, which produces biased results when parameters are selected at the local minimum due to incomplete searches; and (3) the RMSE cannot estimate uncertainties precisely as in the Bayesian approach; as a result, it cannot generate reliable uncertainties and forecasts required for Kobe I (Kobe plot) and Kobe II (Risk assessment).

Bayesian state-space SPM and JABBA

Over the past decade, the development of the Bayesian state-space SPMs has addressed the limitations of earlier assessment methods such as ASPIC. This coincides with the duration of ASPIC utilization in SEAFDEC (**Table 4**). The three key Bayesian state-space models currently in use are SPiCT (Pedersen and Berg, 2017), JABBA (Winker *et al.*, 2018), and JABBA-Select (Winker *et al.*, 2020). JABBA is suggested as the preferred successor to ASPIC in SEAFDEC for three practical reasons: (1) it is an annual-based and discrete-time model like ASPIC; (2) it accepts the coarse-scale data mainly available in SEAFDEC Member Countries; and (3) JABBA is a user-friendly application that provides ready-made figures and tables. These three factors can facilitate a more seamless transition from ASPIC to JABBA for users.

Table 4. Timeline of the transition from ASPIC to JABBA within SEAFDEC

Year	ASPIC	JABBA	Publication of three key Bayesian state-space SPMs
2016	Training, application and publication (SEAFDEC)		
2017			SPiCT (2017)
2018			JABBA (2018)
2019			
2020		Welcome!	JABBA-select (2020)
2021			
2022		2nd Regional training workshop (FAO)	
2023		1st joint workshop by BRIN (Indonesia) and [MENU] (JAPAN)	
2024			
2025	Sayonara!	2nd joint workshop by DOF (Thailand) and [MENU] (Japan) (Lizardfish & short mackerel)	
2026		2nd joint workshop by BRIN (Indonesia) and [MENU] (plan)	

Comparison summary (ASPIC vs. JABBA)

Table 5 compares features between ASPIC and JABBA, highlighting the benefits of transitioning to JABBA.

Table 5. Comparison between ASPIC and JABBA

Specification	ASPIC	JABBA
Equilibrium condition (biomass unchanging)	*Incorporated*	
Estimation method	*RMSE*	*Bayesian state-space approach*
Optimum results	*Problem of apparent results*	*Robust*
Observation error	*Incorporated*	
Process error	*Not incorporated*	*Incorporated*
Estimation of uncertainties	*Less accurate*	*Accurate*

(advantage; disadvantage)

JABBA in SEAFDEC

As detailed in **Table 4**, JABBA has been introduced through four training sessions conducted in SEAFDEC and its Member Countries.

Sayonara ASPIC and Welcome JABBA

What is the future direction for stock assessment practices within SEADEC?

Figure 1 illustrates the frequency of stock assessment activities for Types 1, 2 and 3 based on a comprehensive review of past stock assessment practices within SEAFDEC in this article. Type 2 (data limited) accounted for approximately 80 percent of the total, followed by Type 3(a) (data moderate) assessments at almost 20 percent; Type 1 (qualitative) and Type 3(b) (data rich) contribution is almost nil.

Table 6 shows a summary of the future directions for the three stock assessment models also based on this review. Future Type 3 (data moderate) assessment models, particularly JABBA, will be discussed in more detail in the next section.

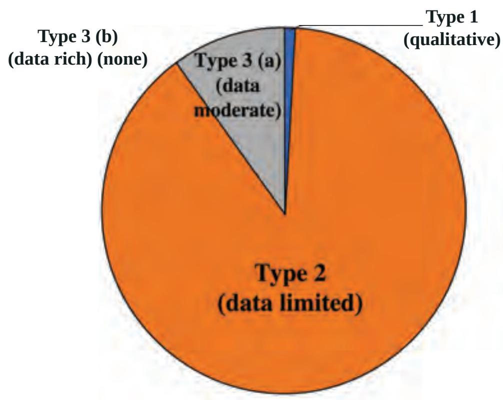


Figure 1. The frequencies of Types 1, 2 and 3 stock assessment models used within SEAFDEC to date

Table 6. Future direction of stock assessments for SEAFDEC based on the review in this article

Type	Data Type	To Date	Future
Type 1	Qualitative (parameter)	• FAO is preparing PSA for SEAFDEC species Workshop on PSA (SEAFDEC, 2025)	• Continue this initiative and apply other approaches, such as ERA
Type 2	Quantitative (data limited)	• Length-based models and catch only methods have been conducted using software	• Continue to apply
Type 3	Quantitative (data moderate)	• SPM: ASPIC has been used	• Change to JABBA
	Quantitative (data rich)	• No age-structured models (integrated models) were used	• Simple age structured model ASPM (*) can be initiated

(Note) (*) Menu driven ASPM (Age Structured Production Model) software is available in [MENU], which has been used many times in the IOTC

The challenges in implementing Type 3 stock assessment

Type 3 stock assessment models are essential for providing reliable and robust MSY-based reference points based on long-term population dynamics, which cannot be obtained by Type 2 (data limited) nor Type 1 (qualitative) assessments. In this regard, if catch and CPUE data gathered over a long period are available, SEAFDEC should apply Type 3(a) data moderate assessments (JABBA), especially for species deemed important in the livelihoods in Member Countries. In addition, the first application of a simple Type 3(b) (data-rich) assessment model with biological data in SEAFDEC can be initiated. For example, the Age Structured Production Model (ASPM) could be implemented using the ASPM software with a menu driven interface developed by [MENU]. To ensure proper and reliable assessments, resource persons must supervise participants' work even after the training sessions through a special arrangement to be discussed later.

JABBA-HCR Approach

To address these challenges and provide management advice such as setting catch limits (TAC) without access to resource persons, the harvest control rule (HCR) can be a useful and effective solution for SEAFDEC. HCR has been developed over many years and is used globally. Some model-free HCRs are simple and effective, relying solely on catch or CPUE data to derive catch limits. These HCRs can allow stock assessment practitioners in SEAFDEC Member Countries by themselves to derive catch limits without any assistance from the resource persons.

Two examples of simple models include: (1) TAC derived from the average catch in the most recent three years (data limited case) (ICES, 2022); and (2) TAC derived from the slope of the CPUE against time over the last five years. The second HCR was originally developed by *Professor Doug Butterworth* (University of Cape Town; the technical reviewer of this article) and has been applied in Regional Fisheries Management Organization (RFMOs), which included the Commission for the Conservation of Southern Bluefin Tuna (CCSBT), the Northwest Atlantic Fisheries Organization (NAFO), and the South East Atlantic Fisheries Organization (SEAFO) **(Figure 2)**.

The JABBA-HCR approach should be implemented only for important species in SEAFDEC. This approach can be conducted by two ways by the stock status: (1) (top priority) for unhealthy stocks, JABBA can be implemented every three years with the support of resource persons. During the two intervening years, stock assessment practitioners can apply HCRs to derive the annual TAC. (2) (less priority) for healthy stocks For healthy stocks, JABBA can be implemented every five years without using HCR in collaboration between resource persons and SEAFDEC stock assessment practitioners. In this way, effective routine assessments can be implemented in a timely and budget-friendly manner as shown in **Figure 3.**

Based on comprehensive and in-depth discussions presented thus far, the main theme of this article, *"Sayonara ASPIC and Welcome JABBA to SEAFDEC,"* has now been clearly addressed.

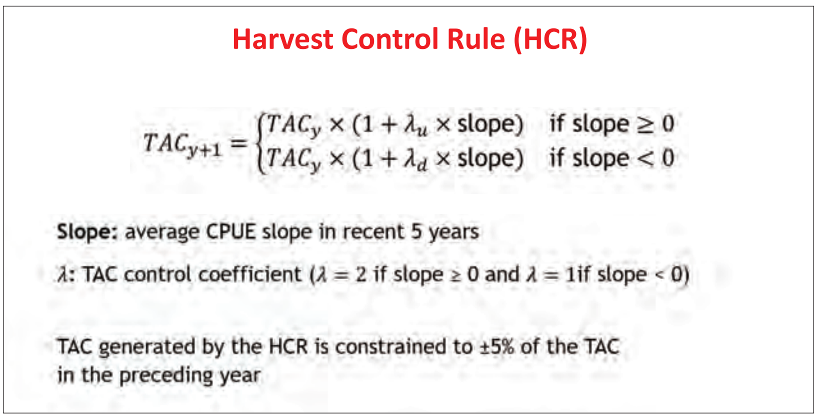


Figure 2. HCR to derive TAC using average CPUE slopes from the last five years (SEAFO, 2014)

Preparation			(1) Unhealthy stock (3 years cycle) (JABBA-HCR approach)													
			Phase		1st			2nd			3rd			4th		
2027	2028	2029	Methods	Responsibility	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
(1) Decide on a simple HCR method (2) Identify stock status by JABBA To be implemented by resource persons and stock assessment practitioners in SEAFDEC			HCR	SEAFDEC		update	update		update	update		update	update		update	update
			JABBA	Resource persons & SEAFDEC	update			update			update			update		
			(2) Healthy stock (5 years cycle) (only JABBA)													
			Phase		1st					2nd					3rd	
			JABBA (no HCR)	Resource persons & SEAFDEC	update					update					update	

Figure 3. Example of schedules of routine stock assessments for the most important species in SEAFDEC, designed to comply with the recommendations of previous consultative meetings: (1) 3-year cycle using the JABBA-HCR approach for unhealthy stocks and (2) 5-year cycle using only JABBA (without using HCR) for healthy stocks

Note: Since SEAFDEC is not an RFMO, any derived TAC or catch limits are non-mandatory. These figures serve as references and management targets for Member Countries

Menu driven JABBA software

Outline

While the original JABBA software is based on the R statistical computer programming language, its direct application depends on users who know how to code. In developing countries, few users can apply programming languages such as R. To bridge this gap, [MENU] has been developing various menu driven fish stock assessment-related software that does not require any programming nor application-specific languages. In addition, this software was designed for beginners/non-experts using fewer technical terms and is as easy to operate as standard applications such as Windows, MS Word and Excel. **Figure 4** illustrates this concept.

The menu driven JABBA software was developed by Nishida and Iwasaki (2025), with technical assistance from article co-author *Professor Wang* (National Taiwan Ocean University) and article reviewer *Professor Emeritus Butterworth* (University of Cape Town). It is based on the original paper by Winker *et al.* (2018), with the practical section referring to 'Good Practices for SPMs' by Kokkalis et al. (2024). **Figure 5** shows a schematic diagram of the original JABBA application.

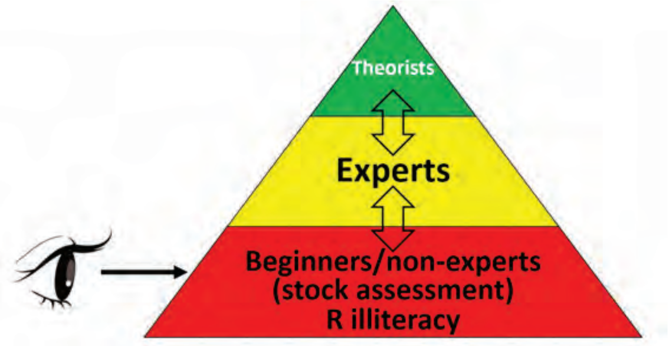


Figure 4. Types of stock assessment specialists and their composition. Target users for menu driven software are at the bottom

Professor Wang linked the original JABBA R source codes into a menu-driven software that implements two standard SPMs (Schaefer, 1954 and Fox, 1970). While the original JABBA application includes the general model with four parameters developed by Pella and Tomlinson (1969), it is not included in the menu driven JABBA software because its results tend to be similar to those of the Schaefer or Fox models. This also keeps the software simple. The entire process runs automatically through the menu interface making it easy, consistent and transparent for anyone to use.

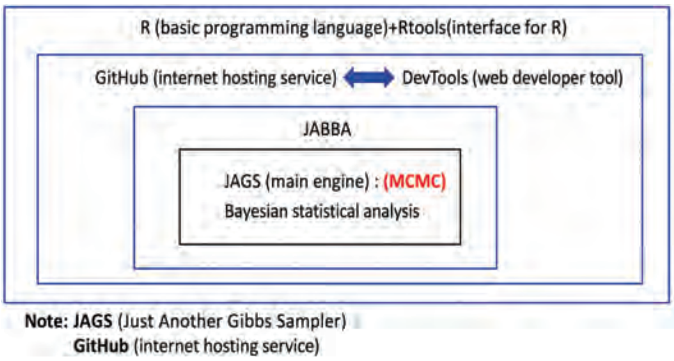


Figure 5. Schematic diagram of JABBA components and their relationships

Grid search approach

JABBA uses six parameters **(Table 7)**. When no information on depletion levels is available, the software employs a grid search approach with three default prior configurations: (1) observation and process variances, where priors are defined in the original paper; (2) r and K, where empirical priors based on prior knowledge form the accumulated information as stated in **Table 7**; and (3) q, which follows the original JABBA protocol and is estimated during optimization using Markov Chain Monte Carlo (MCMC).

Table 7. Six parameters/priors and SPMs in JABBA; Original vs. Grid search approach

No.	Parameters	Meanings	Priors	Original	Grid search approach	
1	r	Intrinsic population growth rate	Log normal model	• Mean • SE=1		
			Uniform model	• Mini and max	• Min~max: median & 95% CI by species available in FishBase (FAO). 95% CI (upper & lower border) is used for mini & max	empirical priors
2	K	Carrying capacity	Log normal model	• Mean • SE=1		
			Uniform model	• Mini and max	• 2*Max (Catch)~10*Max (Catch) (*)	empirical priors
3	q	Catchability	Uniform model	• Parameters will be estimated during the JABBA optimization		default
4	ψ (psi)	Depletion	Log normal model	• Mean value (0~1) • SE=0.2	• Inspection of the full range (0~1) by 0.2 (base case) (8 grids) & 0.1 (sensitivities) (4 grids)	grid search
5	σ^2_η	Process variance	Inverse gamma model (fixed)	• Shape=4 • Scale=0.01	σ^2_η ~ 1/*gamma*(4, 0.01)	default
6	$\sigma^2_{\varepsilon,y,i} = \hat{\sigma}^2_{SE,y,i} + \sigma^2_{fix} + \sigma^2_{est,i}$	Observation variances	(1) Basic variance $\sigma^2_{SE,y,i}$	• Estimated CV by fleet in standardized CPUE		
			(2) Additional variance (fixed) σ^2_{fix}	• $(0.2)^2$		
			(3) Additional variance $\sigma^2_{est,i}$.	• Inverse gamma model (shape parameter=0.001 and scale parameter=0.001 fixed) $\sigma^2_{est,i}$ ~ 1/*gamma*(0.001, 0.001)		
	SPMs (Surplus Production Models)			• Schaefer, Fox and Pella Tomlinson	• Schaefer and Fox	

(*) Personal communication with Prof. Seng-Ping Wang (National Taiwan Ocean University) (based on expert knowledge)

In the first step (base case), the grid search approach inspects the full depletion range (0~1) by a 0.2 interval grid (0.2, 0.4, 0.6 and 0.8) to select the best depletion level to produce the optimum results based on diagnostics. In the second step for sensitivities, the finer grid (0.1) before and after the depletion level in the best base case will be inspected to identify the final best depletion level to produce the optimum JABBA results. The grid search approach prevents selecting apparent optimum results produced when the limited range of the depletion rates are searched.

In case pre-knowledge on the depletion level is available, there is no need to search the full range (0~1); instead, only a few numbers of grids around such levels can be inspected. In addition, in case pre-knowledge of prior values for other parameters are available, the grid search and sensitivities around these prior values will be conducted to identify the optimum priors and depletion level that produce the best results.

Running the software

After installing the software, its icon will appear on the desktop (**Figure 6,** *left*). The first main menu will appear after clicking the icon (**Figure 6,** *right*). Another window will appear (**Figure 7,** *top*) after clicking the sub-menu for model selection (*e.g.* Schaefer). In this window, four inputs need to be entered: (1) run ID name; (2) prior values for r which can be selected from the popup Excel (**Figure 7,** *bottom*); If there are no values, get the data from FishBASE (FAO) and enter values to the popup Excel and save; (3) prior values for K; and (4) the depletion rate based on the grid search.

(Note for K) the software will automatically calculate and provide the minimum and maximum K values using the formula displayed in the window; manual entry is not required.

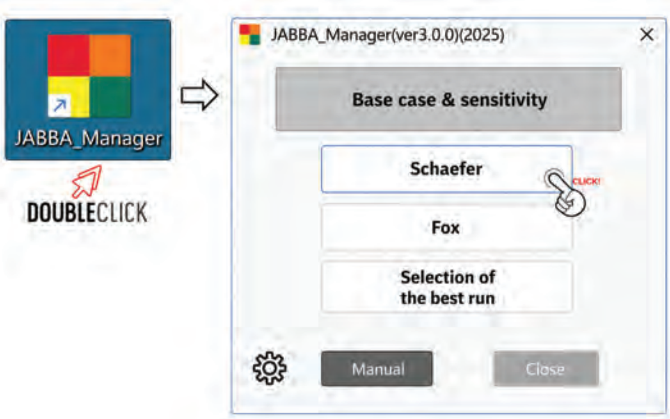
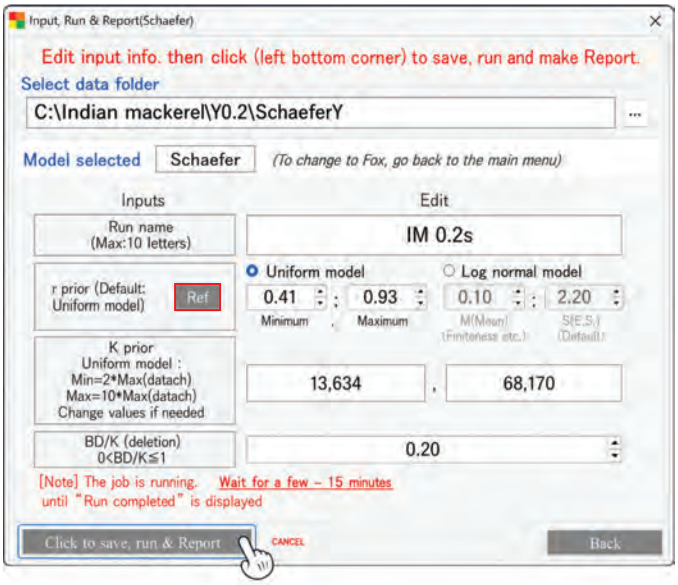


Figure 6. Software icon (*left*) and the first window (*right*)



Reference of Mini & Max for r by species. Users can add. Min~Max is based on the 95% CI						
species			Mini	Max	Median	Source
code	English name	area				
SWO	Swordfish	all ocean	0.30	0.69	0.46	FishBASE
IM	Indian mackerel	Sri Lanka	0.41	0.93	0.62	FishBASE
SM	Short mackerel	G.of Thailand	0.79	1.79	1.19	FishBASE
SU	brushtooth lizardfish	G.of Thailand	0.37	0.85	0.57	FishBASE
KAW	Kawakawa	World	0.57	0.45	0.95	FishBASE

Figure 7. (*top*) Input window for the Schaefer run (example) (*bottom*) Pop-up Excel file for r values by species. It will appear if Ref (red box on *top*) is clicked. If there are no values, obtain the data from FishBASE (FAO) and enter values in the popup Excel and save

The JABBA run will begin once the 'Save, Run & Report' button in the bottom left-hand corner is clicked. Depending on PC performance and the volume of data (number of years and number of fleets/CPUE), processing time could take up to 20 minutes. Once the run has finished, a 19-page standardized report will be automatically provided. An example of the first page is shown in **Figure 8.**

Report_IM 0.2s (Schaefer)

Contents

Input (catch, standardized CPUE, parameters and priors)

Summary of key results and diagnostics

1. Convergence
   Heidelberger and Welch Statistical test (MCMC)
2. Model fit
   2.1 CPUE Residuals (Randomness & Outliers)
   2.2 RMSE (Root Mean Square Error)
   2.3 Prior to Posterior Median/Variance Ratio (PPMR/PPVR)
   2.4 Posterior Predictive Check (PPC)
3. Retrospective analyses (Model mis-specification)
4. Future projections and Hindcast analyses
5. Estimated parameter values
6. Stock status (Kobe plot & Surplus production phase plot)
7. Next step

Figure 8. First page of the standardized report on the results of the menu driven JABBA software (19 pages)

Selection forms to determine the optimum result

Evaluation of the JABBA results is conducted using the Selection form composed of 11 diagnostics. Visual inspections for the Kobe plot and retrospective patterns are the top two priorities, followed by nine equally weighted diagnostics. Only when the two top diagnostics are satisfied, the other nine can then be conducted. The nine diagnostics are: convergences (2 types), model fits (3), retrospective analyses (1) and hindcast analyses (3). Although this is the default setup, users can customize it. Details of how to select the final optimum results using the Selection form will be described in the next section.

Sustainable Capacity Building Framework Using JABBA Software

This framework is designed to continuously supervise the stock assessment work of trainees especially after the training sessions because it is the only way to ensure that they can be implemented in a proper, reliable and plausible manner. This requires a long-term continuous effort; hence, it will not be possible to achieve this goal through traditional snapshot-type training.

Thailand, Indonesia, Sri Lanka and the Republic of Korea have shown strong interest in this framework to be implemented. Between 2024 and 2026, eight face-to-face training sessions were conducted with 49 participants. The initial sessions mainly comprised lectures and practical exercises for the newly developed, menu driven JABBA software. This software facilitates the smooth implementation of proper, transparent and reliable stock assessments.

During the initial training sessions, a few important species were selected in each country and preliminary assessments were carried out. Afterwards, online training and discussion sessions were conducted. In addition, to reinforce their learning, they were asked to write scientific papers for submission to international journals. Unlike conventional snapshot-type training, this approach enables continuous collaboration between stock assessment practitioners and resource persons, ensuring its sustainability. For reference, some of their key achievements are highlighted below.

Thailand

The second joint workshop to implement stock assessment for important species in Thailand was co-organized by the Department of Fisheries (DOF) and [MENU] (Japan). Twelve participants took part in the workshop which was held at the DOF Bangkok office in May 2025 **(Figure 9)**.

Figure 9. Participants in the second joint workshop by DOF (Thailand) and [MENU] (Japan) to implement stock assessments for important species in Thailand using the menu driven JABBA and CPUE software (May 2025)

Figure 11. Participants in the first joint workshop co-organized by BRIN (Indonesia) and [MENU] (Japan) to implement stock assessments for important species in Indonesia (April 2024)

The menu driven JABBA and CPUE standardization software was applied in two species working groups (WG): brushtooth lizardfish (*Saurida undosquamis*) (SU WG) and short mackerel (*Rastrelliger brachysoma*) (SM WG). After three days of hands-on PC training with technical assistance by SEAFDEC/TD resource person *Dr. Pattarapongpan* (the second author of this article), all participants could use the software independently and produce plausible results. A selection of the standardized report produced by the SM-WG using the menu driven JABBA software is shown in **Figure 10.**

Indonesia

The menu driven JABBA software was introduced during the inaugural joint workshop organized by the National Research and Innovation Agency (Badan Riset dan Inovasi Nasional or BRIN) (Indonesia) and [MENU] (Japan) in April 2024. The workshop was attended by 19 participants **(Figure 11)** and resulted in the formation of two dedicated working groups focusing on squid and mackerel. A second workshop is planned in 2026 and will focus on the practical application of JABBA using real-world data on these two species.

Sri Lanka

The second joint workshop on the assessment of important species in Sri Lanka was co-organized by NARA (National Aquatic Resources Research and Development Agency) and [MENU] (Japan). It was conducted at the NARA office in October 2024. A total of eight participants attended the workshop (**Figure 12**).

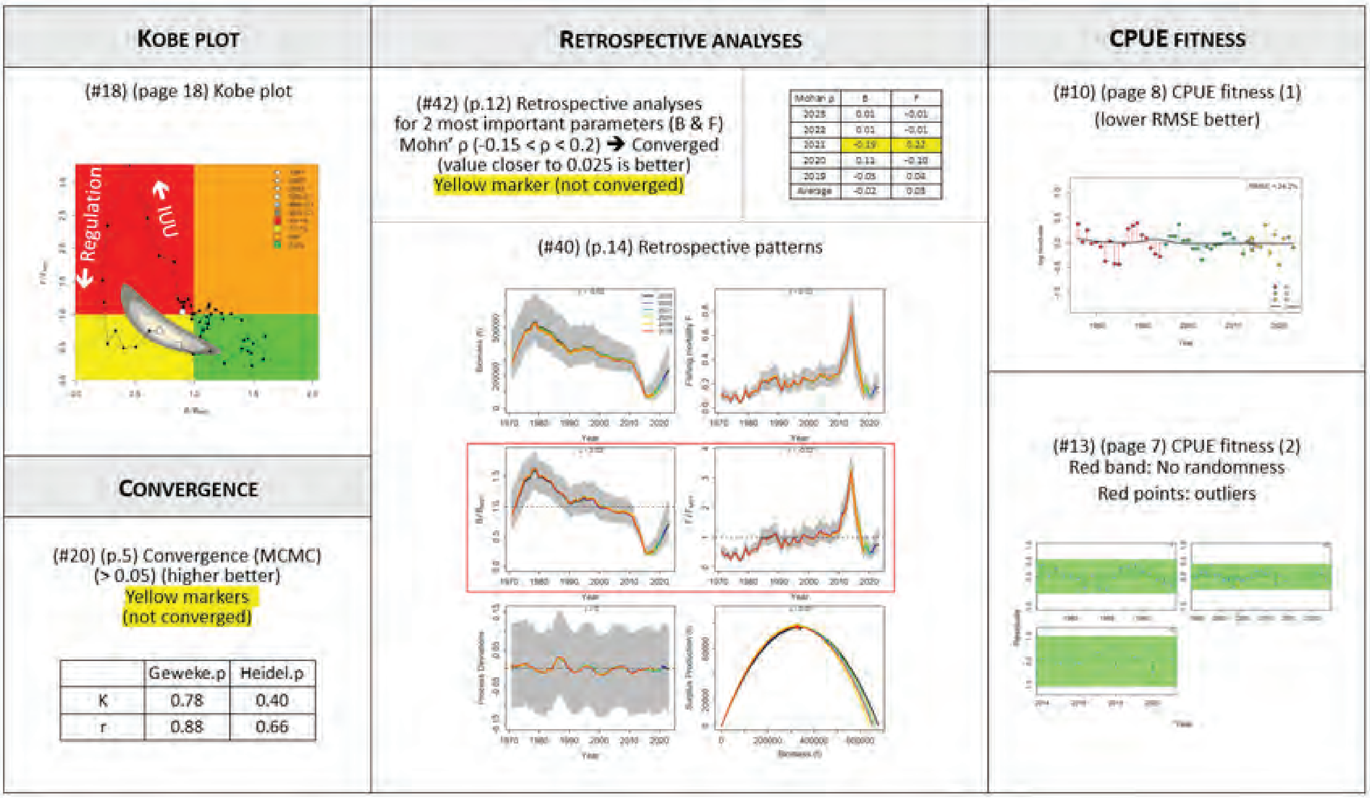


Figure 10. Part of the results of the short mackerel stock assessments (Gulf of Thailand) by the menu driven JABBA software. The results from the standardized report were provided by the SM-WG (short mackerel working group)

Figure 12. Participants in the second joint workshop co-organized by NARA (Sri Lanka) and [MENU] (Japan) to implement stock assessment for important species in Sri Lanka (October 2024)

Although Sri Lanka is not a SEAFDEC Member Country, the progress on case studies by the menu driven JABBA and CPUE software was introduced for reference. JABBA software was used for two working group species: Indian mackerel (*Rastrelliger kanagurta*) (IM-WG) and kawakawa (*Euthynnus affinis*) (KAW-WG). All the participants were able to use the software independently and produced plausible results after three days of hands-on PC training. **Figure 13** shows a part of the result, *i.e.* Kobe II (Risk assessments) for Indian mackerel produced by the IM working group.

Republic of Korea

The first joint workshop, co-organized by Pukyong National University (Republic of Korea) and [MENU] (Japan), was held at the Ocean and Fisheries Development International Cooperation Institute in the University (Busan) in January 2026. Convened at the request of Professor Jung Hwa Choi, the workshop provided lectures and practical training on menu driven software (JABBA and CPUE standardization). The first session, which was attended by ten participants (**Figure 14**), was designed to enable graduate students to apply these software for their master's theses or doctoral dissertations. A second progress joint workshop is scheduled for later in 2026.

Figure 14. Graduate students participating in the first joint workshop co-organized by Pukyong National University (Busan, Republic of Korea) and [MENU] (Japan). This workshop aimed to apply the menu driven JABBA and CPUE software to their master's theses or doctoral dissertations (January 2026)

Kobe II (Risk assessment) (TB & F combined)

Probabilities (%) violating MSY levels (both TB and F combined) within 10 years by catch level.

Color legend

Green: Probability < 50% (lower risk) — Yellow ≥50% (higher risk)

% of the current catch (*)	Catch (tons)	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
40%	1,870	42	40	38	28	22	18	16	14	13	12	12	11
60%	2,805	42	40	38	30	25	22	19	18	16	16	15	14
80%	3,739	42	40	38	33	29	27	24	23	22	21	20	19
100%	4,674	42	40	38	36	34	33	32	31	30	29	29	28
118%(MSY)	5,560	42	40	41	42	43	44	45	46	47	47	48	48
120%	5,609	42	40	41	42	43	44	45	46	47	47	48	49
140%	6,544	42	40	51	55	59	63	65	67	69	71	72	73
160%	7,479	42	40	61	68	74	78	81	83	85	86	87	88

(*) The current catch is the average catch over the recent three years.

MSY (t)	Median	Lower (80%)	Upper (80%)
	5,560	4,665	8,747

Figure 13. Part of the results of Kobe II (risk assessments) on the Indian mackerel (Sri Lanka) based on the menu driven JABBA software (Standardized Report is provided in each JABBA run). This was provided by the IM WG (Indian mackerel working group)

Way Forward

The authors suggest two issues related to the application of JABBA to be addressed and initiated in SEAFDEC together with the resource person and stock assessment researcher in SEAFDEC/TD (the second author of this article).

(1) Routine assessments by the JABBA-HCR (Harvest Control Rule) approach under the current SEAFDEC structure

The initial stage of this new approach should prioritize a few unhealthy stocks in the most important species which are the main sources of livelihood in SEAFDEC Member Countries before gradually expanding to other limited important species. This effort is vital for SEAFDEC to fulfill its mission of ensuring food security in the region.

(2) Sustainable capacity building framework under a special arrangement

It is ideal to enable the continuous supervision of stock assessment practitioners' work in SEAFDEC especially after training. This is the only way to ensure that they can implement proper, reliable and plausible stock assessments. This requires long-term commitment; hence, it will not be possible to achieve this goal through conventional snapshot-type training. Therefore, it will be quite challenging or impossible to initiate this framework under the current SEAFDEC structure, especially when it comes to finding dedicated resource persons and budgets. One possible option is to engage retired experts or consultants who can supervise on a semivoluntary basis for extended periods after training sessions. In any case, this is the only way to achieve satisfactory proficiency and comprehensive capacity building in the long term.

Acknowledgments

The authors extend their sincere gratitude to the Department of Fisheries (Thailand), BRIN (Indonesia), NARA (Sri Lanka), and Pukyong National University (Republic of Korea) for approving the joint workshops. These sessions were instrumental in assessing the stock status of important species in participating countries using the newly developed menu driven JABBA and other software.

The authors also thank Professor Emeritus *Dr. Doug S. Butterworth* (University of Cape Town, South Africa), a world-leading stock assessment expert, for his peer review of this article. His contributions were invaluable, which included providing theoretical and technical advice as well as refining the English manuscript, given that all the authors are non-native English speakers.

Special thanks to *Dr. Suttinee Limthammahisorn*, the former Secretary-General of SEAFDEC, for authorizing the participation of *Dr. Supapong Pattarapongpan* as a resource person for the two joint workshops co-organized by DOF Thailand and [MENU] (Japan). *Dr. Supapong* is affiliated with SEAFDEC/TD and serves as the second author of this study.

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Guide to Contributing Articles

Fish for the People is a policy-oriented Special Publication produced by the Southeast Asian Fisheries Development Center (SEAFDEC). The first issue of the Special Publication was launched in early 2003 to commemorate the first anniversary of the ASEAN-SEAFDEC Conference on Sustainable Fisheries for Food Security in the New Millennium: "Fish for the People" organized in 2001 from which the Special Publication got its banner title *Fish for the People*. Through the years, *Fish for the People* has been recognized by various stakeholders as a significant source of information to support their works on the sustainable development and management of fisheries and aquaculture in the region. The SEAFDEC Secretariat publishes three issues of the Special Publication each year with support from the Japanese Trust Fund. The publication of articles in *Fish for the People* is free of charge.

Prospective Contributors

- SEAFDEC Secretariat and Departments (researchers, technical staff, project managers)
- SEAFDEC Member Countries (national focal persons of SEAFDEC projects, researchers, fishery officers, professors, students)
- SEAFDEC partner organizations (researchers, technical staff, project managers)
- Non-member countries and other organizations (researchers, managers of projects in the SEAFDEC Member Countries, researchers, fishery officers, professors, students, and those who wish to share experiences that could be applicable to Southeast Asia)

Types of Articles

- **Research article** - report of new and original research findings including the methodology, data, and analysis in popularized format (2,000–4,000 words)
- **Short communications** - brief analysis and commentary on fisheries development and management that may not be suitable for a full-length research article (1,000–2,000 words)
- **Report on activities under projects** - results and implications including strategy or approach, conclusions, and recommendations for the future direction of work (2,000–4,000 words)
- **Conference analysis** - a comprehensive overview of a meeting or session and discuss how the presentations and discussions may affect fisheries development and management (1,000–1,500 words)
- **Feature article** - a brief overview of scientific findings for a general audience; interviews and newsworthy topic based on the author's personal experience
- **Review article** - critical and constructive analysis of existing published literature in fisheries and aquaculture, through summary, analysis, and comparison, often identifying specific gaps or problems and providing recommendations (1,000–2,000 words)
- **Book review** - analysis of recent publications relevant to fisheries development and management (500–1,500 words)
- **Emerging studies** - discuss and analyze new fields of research and methodologies relevant to ecological, economic, cultural, and social aspects of fisheries development and management (1,000–2,000 words)

Format and Structure

- Articles should be written in Times New Roman font 11, single space, one-column layout
- The total number of words excludes the abstract, acknowledgments, references, etc.
- Articles should be written in correct English by using spell-check and grammar-check functions and applications to avoid unnecessary errors
- Articles should contain standard style and formats based on SEAFDEC Style (access at http://www.seafdec.org/documents/2021/12/seafdec-style.pdf)
- Articles should be written in gender-sensitive and inclusive language
- The title should be concise and informative for easy retrieval in information systems
- Authorship should be limited to those who have made a significant contribution to the conception, design, execution, or interpretation of the article, and therefore share collective responsibility and accountability for the information provided
- Abstract/summary should be concise and accurate and should be able to stand alone and briefly state the issues/problems, objectives, methods, key results, discussions, and major conclusions (200–300 words)
- A maximum of five keywords should be provided for indexing purposes and easy retrieval of the article in search engines
- Introduction should provide sufficient background (*e.g.* relevance to the RES&POA-2030 and/or other international, regional, or national instruments) and specify the goal and objectives of the work
- Describe the details of materials and method applied, as appropriate for the specific type of article
- Discuss the significance of the key results of the work
- Tables should be created as editable text and not as images
- Figures should be in line with text and not wrapped with text; figure caption should be written below the figure and not in a text box
- Math equations should be given in editable text and not as images
- National currencies should be converted to or provided with equivalent US Dollars (USD)
- Present the main conclusions based on the objectives of the work and applicability of the work to other sites, countries, or regions
- Indicate the future activities of the work, if any
- For non-SEAFDEC articles, indicate the relevance of the work to Southeast Asia
- Briefly describe the role of the donor(s) in the conduct of the work and/or preparation of the article
- Recognize the individuals who provided help during the research and participated in certain substantive aspects of the article (*e.g.* data collection, translations, language editing)
- Ensure that all in-text citations are included in the reference list, and vice versa, please see SEAFDEC Style for the detailed guide to the proper format; consider using a reference management software (*e.g.* Zotero, Mendeley, others) for automatic formatting and make sure to unlink citations and remove all field codes before submitting the article
- Provide the complete names and affiliations of each author including the office/organization's full name and address, email, and other contact details
- Articles should be free of plagiarism and false information; SEAFDEC will not be responsible for any copyright violations

Publication Process

- Please submit the editable file of the article to the Editor of *Fish for the People* through the SEAFDEC Secretariat at fish@seafdec.org
- Articles will be evaluated and reviewed through SEAFDEC review mechanism
- Approved articles will be published in electronic and printed formats
- Published articles in electronic format are immediately and permanently made accessible for free read and download from the SEAFDEC Institutional Repository; a unique link is assigned to each published article which can be shared through any communication channels including email and social media
- Printed copies of *Fish for the People* are distributed for free to authors, SEAFDEC Departments, Member Countries, partner organizations, libraries, and other networks around the world

For more details, please scan the QR code or visit https://repository.seafdec.org/handle/20.500.12066/6968

Calendar of Events

Date	Venue/Mode	Event	Organizer/s
2026			
20–21 April	Bangkok, Thailand	2nd Scientific Technical Working Group (S-TWG) Meeting	SEAFDEC/SEC (Seaweed Project)
20-24 April	Bandar Seri Begawan, Brunei Darussalam	38th Session of the FAO Regional Conference for Asia and the Pacific	FAO
27 Apr–1 May	Hua Hin, Thailand	5th World Small-Scale Fisheries (SSF) Congress	TBTI
4–6 May	Brunei Darussalam	Mid-Year Conference and Exhibition 2026: Sustaining Our Oceans: Innovation, Governance and Resilience for a Blue Future (Expedition)	DOF Brunei Darussalam
12 May	Bangkok, Thailand	Meeting on the Preparation of the 2026–2027 Work Plan (July 2026 to June 2027) for the Implementation of the BOBLME II Project	DOF Thailand & SEAFDEC
15 May	Samut Prakan, Thailand (Hybrid)	Workshop on Market Margin Analysis for the Small-scale Fisheries Supply Chain in Three Sites	SEAFDEC/TD
19–21 May	Bangkok, Thailand	58th Meeting of the SEAFDEC Council	SEAFDEC & DOF Thailand
19–22 May	Negombo, Sri Lanka	3rd Regional Project Steering Committee (RPSC) Meeting of BOBLME II	BOBLME II Project
28–30 May	Mumbai, India	14th Governing Council Meeting of BOBP-IGO and "High-Level Meeting on Policy Guidance for Leveraging Artificial Intelligence (AI) and Digital Public Infrastructure in Achieving SDG 14"	BOBP-IGO
2–5 June	Brunei Darussalam	Mid-Year Conference and Exhibition 2026: Sustaining Our Oceans: Innovation, Governance and Resilience for a Blue Future	DOF Brunei Darussalam
8–9 June	Samut Prakan, Thailand	Technical Meeting for the Discussion and Finalization of Activities and Work Plan for the Fishing Gear Marking	SEAFDEC/TD (BOBLME II Project)
8–12 June	Bangkok, Thailand	Regional Workshop on Key Challenges and Practical Solutions for Multispecies/Multigear (MSMG) Fisheries Management	SEAFDEC/SEC
9 June	Bangkok, Thailand	Workshop on Needs of MCS Implementation and Capacity Building to Combat IUU Fishing in Thailand	SEAFDEC/TD (BOBLME II Project)
9–10 June	Satun Province, Thailand	EAFM High-level Consultation for Leaders, Executives and Decision-makers (LEAD-EAFM)	SEAFDEC/TD
9–11 June	Samut Prakan, Thailand	Workshop on Finalization of the Small-scale Fisheries Supply Chain Study Report in Three Sites	SEAFDEC/TD
16–18 June	Nonthaburi, Thailand	Regional Training on Introduction and Methodology for Estimating IUU Fishing Losses in Southeast Asia	SEAFDEC/TD
30 June–3 July	Seoul, Republic of Korea	5th Meeting of the Sustainable Ocean Initiative (SOI) Global Dialogue with Regional Seas Organizations and Regional Fishery Bodies	SOI
6–10 July	Samut Prakan, Thailand	Subregional Training Course and Consultation Workshop on Data Analysis and Collaborative Study of IOD Impacts on Fisheries Resources	SEAFDEC/TD
14–16 July	Bangkok, Thailand	Training Course on Human Resource Development on Traceability for Fish and Fishery Products for Eliminating IUU Fishing	SEAFDEC/TD
28 July	Online	18th Meeting of the ASEAN Fisheries Consultative Forum (AFCF)	ASEAN & Philippines
29–30 July	Online	34th Meeting of the ASEAN Sectoral Working Group on Fisheries (ASWGFi)	ASEAN & Philippines
4–7 August	Bangkok, Thailand	Regional Workshop on Introduction from the Sea	SEAFDEC & CITES
7 August	Bangkok, Thailand	ASEAN Regional Workshop: Mitigation of Microplastic Pollution and Implications for Fisheries and Human Health	CSEAS & NIVA
4–6 September	Rome, Italy	3rd Small-Scale Fisheries Summit (SSF Summit 2026)	FAO
4–5 & 11 September	Rome, Italy	11th Meeting of the Regional Secretariat Network (RSN)	FAO
7–11 September	Rome, Italy	37th Session of FAO Committee on Fisheries (COFI)	FAO
8–10 September	Cebu, Philippines	SAFET Conference '26	SAFET
22–25 September	Bangkok, Thailand	Inter-Departmental Workshop on the Preparation of SEASOFIA 2027 and Preparation for the 60th Anniversary of SEAFDEC	SEAFDEC/SEC
19–21 October	Chiangmai, Thailand	27th Information Staff Program (ISP) Meeting	SEAFDFEC/SEC & TD
26–28 October	New Delhi, India	61st CIML Meeting	OIML
16-18 November	Chiangmai, Thailand	49th Meeting of SEAFDEC Program Committee	SEAFDEC/SEC & TD
19-20 November	Chiangmai, Thailand	29th Meeting of the Fisheries Consultative Group of the ASEAN–SEAFDEC Strategic Partnership	SEAFDEC/SEC

Southeast Asian Fisheries Development Center (SEAFDEC)

What is SEAFDEC?

SEAFDEC is an autonomous intergovernmental body established as a regional treaty organization in 1967 to promote sustainable fisheries development in Southeast Asia. SEAFDEC currently comprises 11 Member Countries: namely: Brunei Darussalam, Cambodia, Indonesia, Japan, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Viet Nam.

Vision

Sustainable management and development of fisheries and aquaculture to contribute to food security, poverty alleviation and livelihood of people in the Southeast Asian region

Mission

To promote and facilitate concerted actions among the Member Countries to ensure the sustainability of fisheries and aquaculture in Southeast Asia through:

i. Research and development in fisheries, aquaculture, post-harvest, processing, and marketing of fish and fisheries products, socio-economy and ecosystem to provide reliable scientific data and information.
ii. Formulation and provision of policy guidelines based on the available scientific data and information, local knowledge, regional consultations and prevailing international measures.
iii. Technology transfer and capacity building to enhance the capacity of Member Countries in the application of technologies, and implementation of fisheries policies and management tools for the sustainable utilization of fishery resources and aquaculture.
iv. Monitoring and evaluation of the implementation of the regional fisheries policies and management frameworks adopted under the ASEAN-SEAFDEC collaborative mechanism, and the emerging international fisheries-related issues including their impacts on fisheries, food security and socio-economics of the region.


Secretariat


TD


MFRD


AQD


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The fourth-prize winner, *Nichakarn Sornkae*, from the national drawing contest in Thailand.

National Drawing Contests were organized in all ASEAN-SEAFDEC Member Countries as part of the preparatory process for the ASEAN-SEAFEC Conference on Sustainable Fisheries for Food Security Towards 2020 "Fish for the People 2020: Adaptation to a Changing Environment" held by ASEAN and SEAFDEC in June 2011 in Bangkok, Thailand, in order to create awareness on the importance of fisheries for food security and well-being of people in the region.