

Republic of Maldives
Ministry of Fisheries and Ocean Resources

Republic of Maldives
The Project for Promotion of Blue Economy
in Fishery Sector

Second Period
Final Report

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Japan International Cooperation Agency

INTEM Consulting Inc.
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Abbreviations

BEFiS	The Project for Promotion of Blue Economy in Fishery Sector
Bigfish	Big Fish Maldives
GFF	Guarantee Fiberglass Fabrication
C/P	Counterpart
COVID-19	Coronavirus Disease 2019
EEZ	Exclusive Economic Zone
ENSIS	Ensis Fisheries Pvt Ltd
FRP	Fiber Reinforced Plastic
HACCP	Hazard Analysis and Critical Control Point
Horizon Fisheries	Horizon Fisheries
JCC	Joint Coordination Committee
JICA	Japan International Cooperation Agency
MASPLAN	Project for the Formulation of Master Plan for Sustainable Fisheries
MIFCO	Maldives Industrial Fisheries Company Ltd
MMRI	Maldives Marine Research Institute
MoFMRA	Ministry of Fisheries, Marine Resources and Agriculture (Ministry of Fisheries and Ocean Resources at present)
MoFOR	Ministry of Fisheries and Ocean Resources
PDM	Project Design Matrix
R/D	Record of Discussion
SAP	Strategic Action Plan (2019-2023)
SFDPIS	Sustainable Fisheries Development Plan of the Important Sub-sectors in the Maldives 2016-2025
ToR	Term of Reference
WDC	Women Development Committee

Map of Maldives

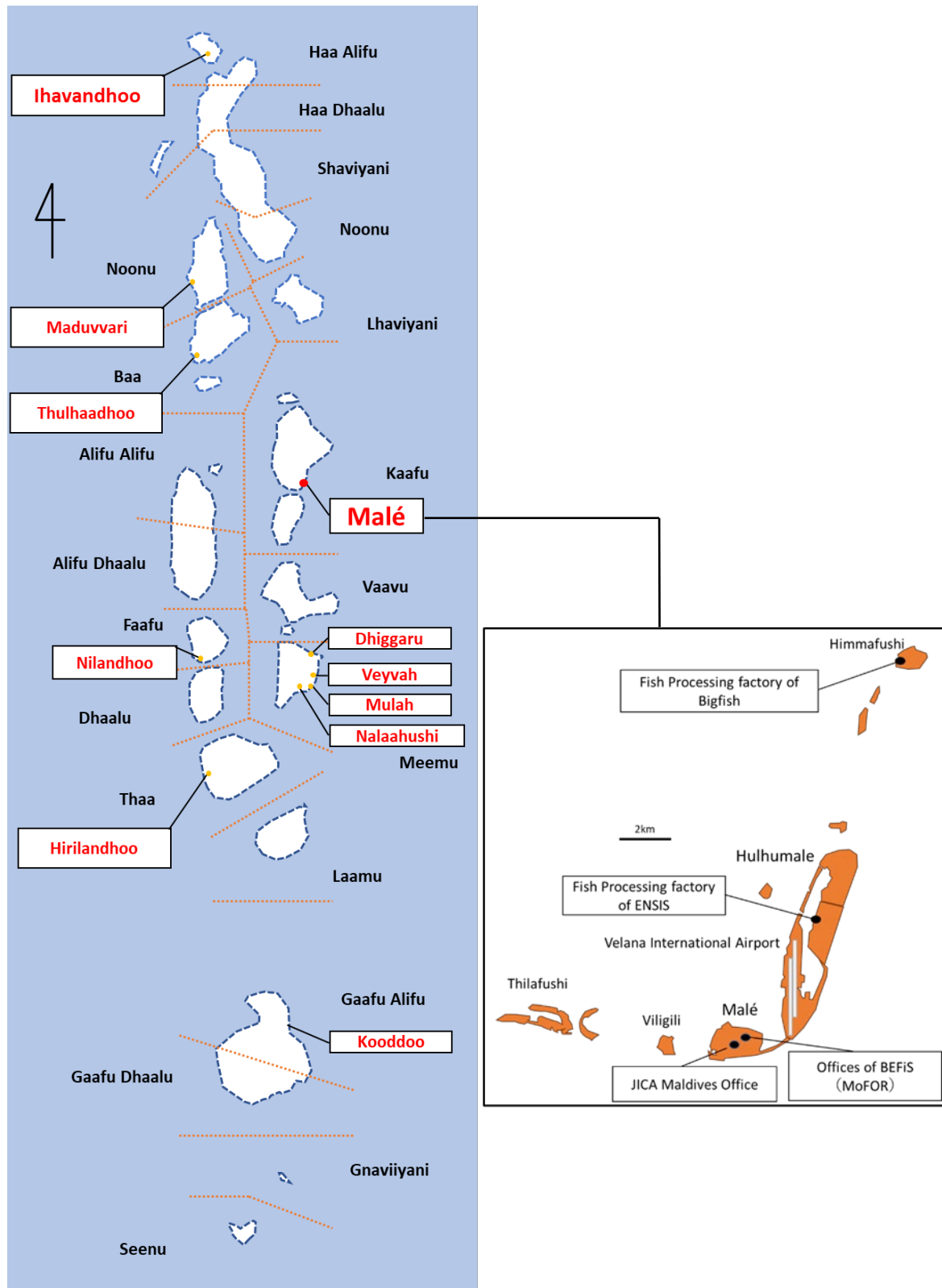


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1. Summary of the Project

1.1 Background of the Project

The fisheries sector in the Maldives is an important industry, accounting for more than 90% of the country's total exports. It is expected to play a vital role in the recovery from the economic damage caused by COVID-19 by serving as a source of foreign currency. In the Indian Ocean, each country has been allocated catch limits for tuna and tuna-like species, such as skipjack tuna, yellowfin tuna and bigeye tuna. In other words, countries cannot increase their catches beyond these allocated limits. In the future, the Maldives needs to add more value as a fisheries product to its catch by improving quality and promoting secondary processing, without increasing the catch.

To address this situation in the country's fisheries sector, JICA implemented a development survey-type technical cooperation project, "Project for the Formulation of Master Plan for Sustainable Fisheries in the Maldives" (MASPLAN) from 2014 to 2017, and supported the development of a fisheries sector development plan, which identified strategies and approaches for the sustainable and efficient utilization of fishery resources and the necessary activities. The outcome was the "Sustainable Fisheries Development Plan of the Important Sub-sectors in the Maldives 2016-2025 - Goals, Objectives and Projects - " (SFDPIS), which was submitted in August 2017, and which was formally approved by the Government in August 2019 as a policy document for the country. SFDPIS embodies the vision and strategy of the Blue Economy, which is one of the main policies of the Maldives Strategic Action Plan (SAP (2019-2023)). This project is positioned as a JICA technical cooperation project to implement the contents of this SFDPIS, based on the request of the Maldivian Government. The cooperation period is 3 years from 5th June 2022 to 4th June 2025.

1.2 Objective of the Project

The objective of the project is "Economic foundation of the fisheries sector in Maldives is strengthened based on the blue economy principles and through implementation of the SFDPIS".

1.3 Summary of the Project

The activities of this project are divided into Output 1 to Output 3. Output 1 is to improve the quality of yellowfin tuna and skipjack tuna fisheries through the improvement of on-board fish handling. This will increase the market competitiveness of major fisheries products by improving the quality of traditional fisheries products. These activities in Output 1 in this project are referred to as Blue Trade. Output 2 is to improve the survival rate of live-bait fish by the improvement of live-bait tanks for skipjack tuna vessel. And it spreads the new methods as having high resource utilization efficiency among the skipjack tuna vessels. The activities in Output 2 are referred to as Blue Production. Output 3 is to strengthen resilience of fishing communities through surveys and activities to identify issues and promote new fish processing methods. Output 3 is referred to as Blue Community. PDM for a detailed description of each output and activity is shown in Appendix 3. The activities of Output 1 and Output 2 in common were reorganized based on the agreement of the JCC meeting held in February 2024. A

summary of the project is shown as follow.

Title of the Project	The Project for Promotion of Blue Economy in the Fishery Sector (BEFiS)
Overall Goal	Resiliency & sustainability of the fisheries sector is improved through implementation of the Sustainable Fisheries Development Plan of the Important sub-sector in the Maldives (SFDPIS)
Project Purpose	Economic foundation of the fisheries sector in Maldives is strengthened based on the blue economy principles and through implementation of the SFDPIS.
Outputs	Output 1: Trade competitiveness of sustainably produced key fishery products of oceanic fisheries is improved. (canned/frozen skipjack tuna, fresh/chilled yellowfin tuna loin/whole fish) Output 2: Resource-efficient production methods are adopted in the live-bait fishery. (Note: Sustainable utilization of live-bait resources is essential for eco-friendly pole-and-line fishing for skipjack tuna) Output 3: Coping capacity of fishing communities against external changes is enhanced.
Activities	【Activities for Output 1】 1-1-1 To identify shortcomings of current practices of on-board fish handling and preservation in oceanic fisheries 1-1-2 To develop a best practice guide for on-board fish handling and preservation (booklet and videos) 1-1-3 To provide technical training on on-board fish handling and preservation for local fishers and government officials 1-1-4 To monitor the effect of improved on-board fish handling and preservation 1-2-1 To facilitate business to business linkages for the promotion of key fishery products (former activity 1-2-3) 【Activities for Output 2】 2-1-1 To conduct further improvement of on-board live-bait stocking system and facilitate its adoption to local fishing vessels 2-1-2 To provide training on handling of bait fish for fishers 2-1-3 To promote the use of improved facilities and equipment in harvest, transfer and stock of live-bait 2-2-1 To assess the feasibility of converting live-bait fishery (currently as a component of pole-and-line fishery for skipjack tuna) to an independent fishery 2-2-2 To identify necessary measures to assist the establishment of independent live-bait fishery 2-2-3 To compile a review report on the feasibility of converting live-bait fishery to an independent fishery 【Activities for Output 3】 3-1-1 To conduct a situation survey on selected fishing communities 3-1-2 To conduct comparative analysis/household survey of the MASPLAN project for the impact assessment of COVID-19 on rural fishing communities 3-1-3 To identify the issue and constraints of rural fishing communities in

	enhancing their economic resilience 3-2-1 To assess the potential markets for key fishery products (domestic/overseas) and identify market requirements in product quality and packaging (former activity 1-2-1) 3-2-2 To formulate a mid to long-term plan of economic recovery of rural fishing communities 3-2-3 To identify training needs for key players in the local economy (e.g., fishing related entrepreneurs). 3-2-4 To provide technical training and assistance for impacted local processors for sustainable trade and value addition to fishery products (combining former activity 1-2-2 and activity 3-2-3) 3-2-5 To support key players to formulate business proposals based on the economic recovery plan
Target area	The capital city, Male and remote islands in the Maldives
Related organization	Ministry of Fisheries and Ocean Resources (MoFOR)
Cooperation period	5 th June 2022 – 4 th June 2025
Implementation period	First period: April 2022 – October 2023 Second period: December 2023 – December 2025)

1.4 Implementation Structure

The Ministry of Fisheries and Ocean Resources (MoFOR) of the Maldives is the C/P organization for the project. The Director General of the Fisheries Department is the Project Director and the Deputy Director General is the Project Manager. In addition, focal points (component leaders) are appointed for the three outputs introduced earlier (1) Blue Trade, (2) Blue Production, and (3) Blue Community. The implementation team consists of the Maldives side including the Maldives Marine Research Institute (MMRI) and JICA experts. The project activities will be carried out in cooperation with the Island Council, private fish processing companies, skipjack tuna and yellowfin tuna fishing vessels, FRP processing and shipyards, and small-scale fish processors in target islands. A diagram of the project's implementation structure is shown below.

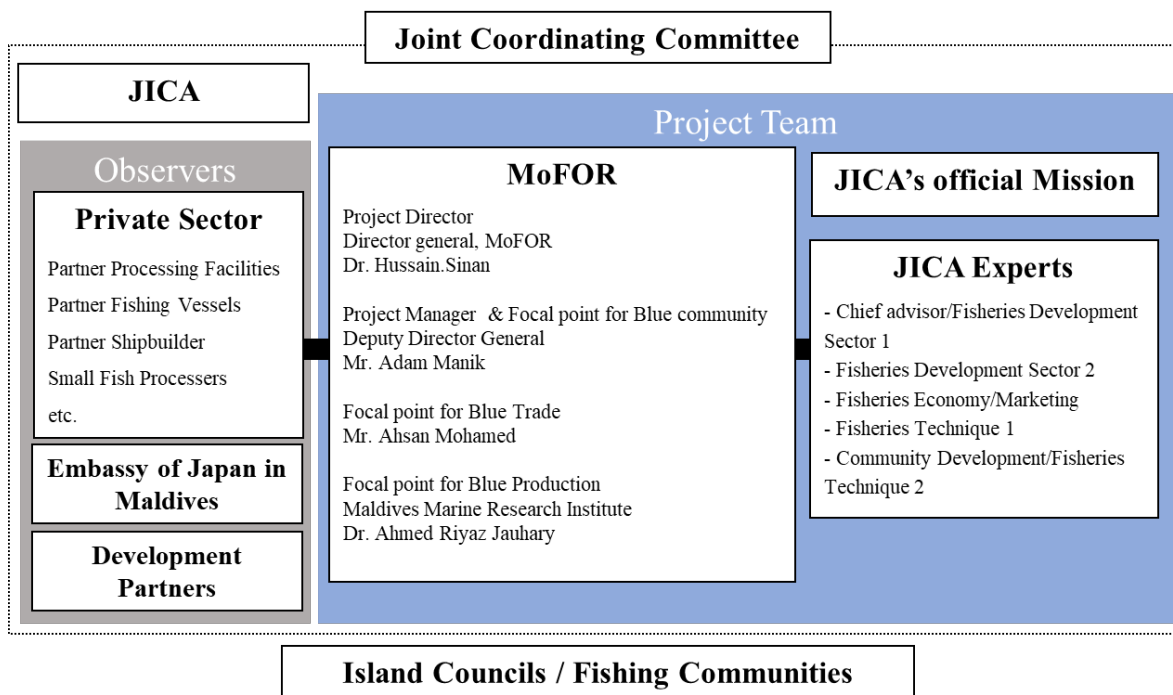


Figure 1-1 Project's implementation structure

1.5 Flow chart of the Project

The process for this project is shown as follows.

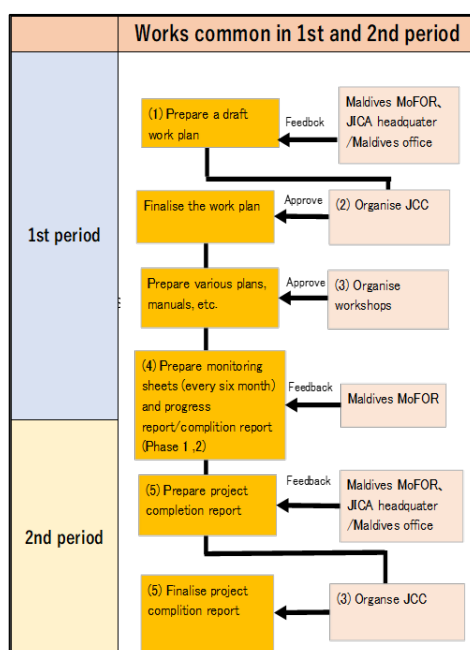
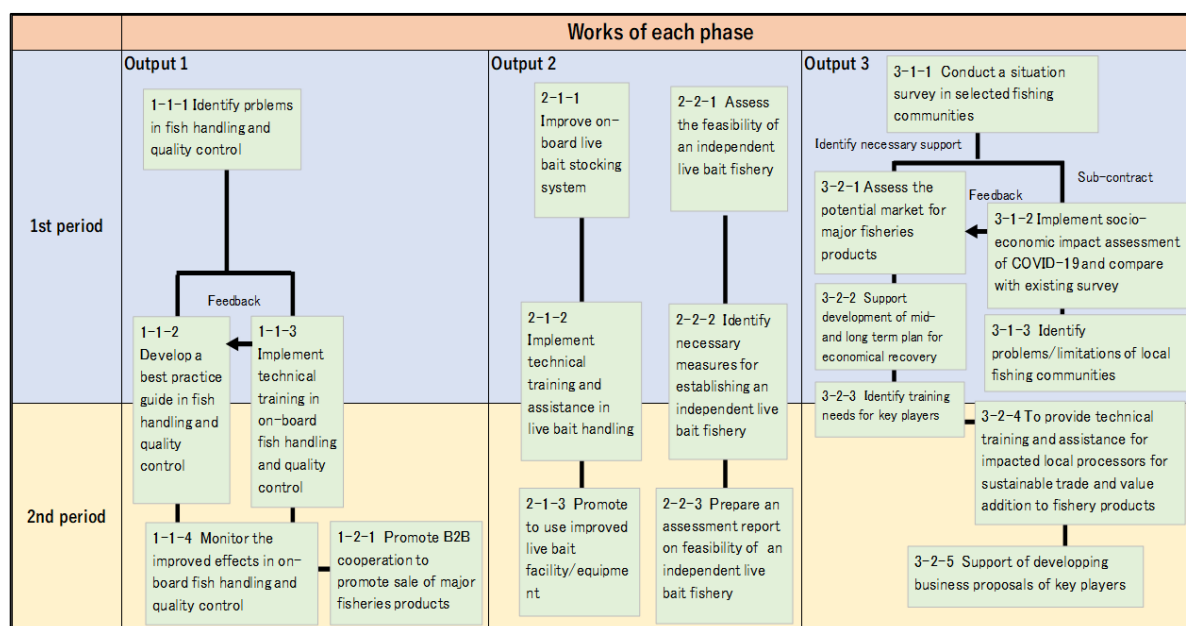


Figure 1-2 Flowchart of the project

2. Overview of the Fisheries Industry in Maldives

2.1 Fishery Production and Number of Fishing Vessels

2.1.1 Fishery Production

The Maldives, an island nation surrounded by the Indian Ocean, is endowed with abundant marine resources. The primary fisheries targets, skipjack tuna and yellowfin tuna species, are not only consumed domestically but also serve as an important source of foreign currency earnings. In recent years, due to the development of the tourism industry, the fisheries sector's contribution to the national economy has declined (4.1% of nominal GDP in 2021¹), however, fishery products have maintained their position as the top export commodity.

The production trends of skipjack and yellowfin tuna fisheries are shown in Figure 2-1. The modernization of the skipjack pole-and-line fishery, which began in the 1970s, led to a rapid increase in catch from the 1980s. Although the skipjack catch began to decline after 2006, it started to rise again from 2013 and recovered to 118,000 tons in 2021. On the other hand, the yellowfin tuna catch increased sharply after 2009, peaking at 50,000 tons in 2015, but then turned downward. In particular, in 2021, the catch dropped sharply by 43% year-on-year (to 25,000 tons).

According to MoFOR, the main reason was that 2021 saw many rough-weather days throughout the year, which significantly constrained yellowfin operations that typically require more days at sea than skipjack fishing. Similar conditions continued in 2022. Rather than a persistent decline, stakeholders note that catch fluctuations can be influenced by periodic climate variability—including Indian Ocean Dipole and El Niño events—which can produce multi-year dips roughly every 6–8 years. In addition, Indian Ocean yellowfin stocks have been overfished and subject to overfishing since 2015, which remains a management concern.

As of June 2025, official catch statistics have not yet been released, but from 2024 to 2025, the yellowfin catch has reportedly decreased further, becoming a serious issue. Many fishing vessels have temporarily suspended operations and switched to skipjack pole-and-line fishing or cargo shipping, while many yellowfin-specialized fish processing companies have been forced to shut down. At the time of project completion, only ENSIS and Bigfish remained in operation. As described later, this situation had a significant impact on the project's activities targeting the yellowfin fishery.

Skipjack and yellowfin are largely exported, with almost all yellowfin being exported. Yellowfin is mainly destined for Europe, where it is sold as sashimi-grade or cooked fillet products. Skipjack is mainly processed into frozen raw material for canning and exported to Thailand, while domestic canning production of skipjack in the Maldives is also increasing. In addition, traditional skipjack products—such as *Hikimas* (similar to dried bonito) and *Valhoamas* (similar to lightly boiled bonito)—produced locally by small-scale fish processing sector are actively produced, consumed domestically, and exported to Sri Lanka.

¹ This GDP share refers to primary fisheries activities (e.g., capture) and excludes fish processing and related manufacturing.

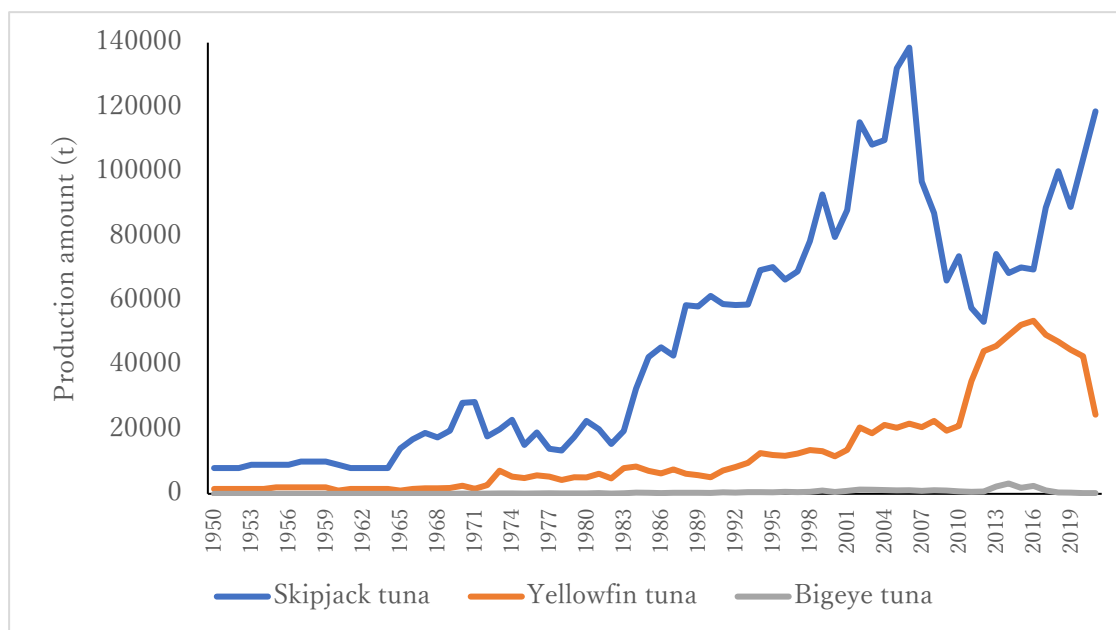


Figure 2-1 Production trend of skipjack tuna and tuna fisheries in the Maldives
(Skipjack tuna, Yellowfin tuna, and Bigeye tuna)

(Compiled by FISHSTATJ (FAO 2021), Fisheries Statistics (Ministry of Fisheries, Marine Resources and Agriculture (MoFMRA) 2021))

2.1.2 Number of Fishing Vessels

The total number of fishing vessels licensed nationwide with MoFOR is 537. Vessel counts by atoll are shown in Table 2-1. Compared to north and central Maldives, the south (from Meemu Atoll southwards) accounts for a large proportion (45%). The southern Maldives is known as a skipjack fishing ground, and most vessels home-ported in the southern atolls are skipjack pole-and-line vessels. In the central and northern atolls, both yellowfin and skipjack vessels operate, with many multi-target vessels switching between skipjack and yellowfin depending on the season.

Table 2-1 Number of fishing vessels per atoll (Fisheries Statistics (2021 MoFMRA))

Atoll in Divehi	Atoll in English	Number of vessels
Haa Alif	North Thiladhunmathi (HA)	43
Haa Dhaalu	South Thiladhunmathi (HDh)	16
Shaviyani	North Miladhunmadulu (Sh)	23
Noonu	South Miladhunmadulu (N)	17
Raa	North Maalhosmadulu (R)	41
Baa	South Maalhosmadulu (B)	18
Lhaviyani	Faadhippolhu (Lh)	18
Kaafu	Male' Atoll (K)	101
Alifu	North Ari Atoll (AA)	19
Alifu Dhaalu	South Ari Atoll (ADh)	18
Vaavu	Felidhe Atoll (V)	3
Meemu	Mulakatholhu (M) (Mulaku Atoll)	25
Faafu	North Nilandhe Atoll (F)	28
Dhaalu	South Nilandhe Atoll (Dh)	51
Thaa	Kolhumadulu (Th)	27
Laamu	Hadhdhunmathi (L)	36
Gaafu Alifu	North Huvadhu Atoll (GA)	42
Gaafu Dhaalu	South Huvadhu Atoll (GDh)	24
Gnaviyani	Gnaviyani (Gn) (Foammulah Atoll)	29
Seenu	Addu Atoll (S)	35
Total		614

2.2 Overview of Each Fishery Subsector

2.2.1 Oceanic Fisheries Subsector

Skipjack tuna and tunas are the most important fishery resource in the Maldivian fisheries. Skipjack is caught by pole-and-line fishing and yellowfin tuna by handline fishing. Large-scale net fishing such as purse seining and drift nets, which are prone to overfishing, is prohibited in the Maldives.

(1) Skipjack tuna pole-and-line fisheries

The pole-and-line fishery using live bait has a long tradition and is the most important fishery in the Maldives. In this fishery, the catching of baitfish is also considered part of the operation. Baitfish species such as sprats (*Sprattellodes spp.*) and cardinalfish (*Rhabdamia spp.*) are mainly caught inside the atolls using lift nets, after which the same vessel moves offshore to conduct pole-and-line fishing. The primary target species is skipjack, though juvenile yellowfin and bigeye are also caught, accounting for less than 20% of the catch. Because these juveniles are caught by pole-and-line, the impact on yellowfin and bigeye stocks is estimated to be small.

The Maldives pole-and-line skipjack fishery is recognised for its sustainable resource use compared to large-scale net fisheries such as purse seining, and has received the MSC (Marine Stewardship Council) eco-label certification and fair trade certification. The purchase price for skipjack set by MIFCO (Maldives Industrial Fisheries Company) as of June 2025 is MVR 16/kg for fish stored with ice and

MVR 14/kg for those without ice (both for fish over 1.5 kg in body weight). For large-scale fish processing companies, these prices effectively set the landing price.

Skipjack pole-and-line vessels have been increasing in size year by year, with vessels over 30 metres now common. Along with vessel enlargement and increased catches, demand for live bait has also grown. However, improper handling of live bait by fishers and poor live bait tank design have been pointed out as causes of high mortality, resulting in waste of resources. In order to maintain the MSC certification, there is a strong need to utilise live bait resources without waste and ensure their sustainability.

(2) Yellowfin tuna handline fisheries

The yellowfin handline fishery, targeting large yellowfin tuna, was introduced in earnest around 2000 and has since steadily increased in catch volume, becoming one of the main fisheries in the Maldives. The fishing method, known as “Fukase fishing,” uses live bait such as Indian mackerels, and fusiliers, and rainbow runners. Since this method does not require special gear or equipment, many skipjack pole-and-line vessels have converted to or combined this fishery, particularly after skipjack catches declined from 2006 onwards.

A typical operation lasts about one week, but can extend to 10 days or up to two weeks if catches are insufficient. Almost all yellowfins caught are exported. Processing companies grade them into three categories (A/B/C) according to quality, with the presence of “burnt flesh” (see Chapter 4, Column 1) having a major impact on grading. Fish below grade C are rejected (commonly referred to as grade D) and their purchase is generally refused, though they may be accepted depending on overall catch conditions and stock levels. High-quality fish (grade A) can be sold at high prices for sashimi, but more than 70% of landings are grade B or lower, which remain low-priced. Improving product quality and increasing added value has long been a challenge for the tuna fishery.

Yellowfin prices are set by processing companies, comparing European market prices and competitors’ rates. As an example, Bigfish prices in November 2024 were: grades A–C at MVR 80/kg (≥ 30 kg), grades A–C for <30 kg fish at MVR 40–50/kg, and grade D at MVR 25–30/kg. In the Maldives, there is no customary practice of setting purchase prices according to quality, which hinders incentives for quality improvement.

(3) Longline Fishing

Before 2010, longline fishing was carried out by licensed foreign vessels or joint venture (JV) vessels. From March 2010, no further licences were issued to such vessels, and from 2011, licences were reissued only to Maldivian-owned vessels. In 2014, a total of 25 licensed Maldivian vessels operated beyond 100 miles from the coast within the EEZ. However, due to inadequate government management of the fishery and the need to eliminate unlicensed operations, longline fishing was completely banned in 2019. Discussions on a new licensing and management system are ongoing within MoFOR, and the fishery may resume in the near future under a new licensing scheme.

(4) Fish aggregating devices (FAD) and fishing grounds

Skipjack and tuna fishers operate within the Maldivian EEZ, but in many cases fishing grounds are around FADs installed offshore by MoFOR. FADs are prioritised for use by pole-and-line vessels, and most such vessels utilise them. Introduced experimentally in 1981, FAD deployment has steadily increased, greatly boosting catches. As of 2021, 57 FADs were installed nationwide; by July 2025 this had increased to 100 sites. Of these, 65 are commercial FADs used for skipjack and yellowfin fishing, while the remaining 35 are for recreational use, where skipjack and tuna fishing is prohibited but trolling and jigging for sport fishing are allowed.

In addition to maintaining FADs, MoFOR is developing fishery hubs such as ports, marinas (facilities for fishers to rest and exchange information), and ice plants in each atoll to support fishing communities. The government plans to further increase the number of FADs.

The FAD Centre is located on Hulhumalé, North Malé Atoll, where FAD construction, installation, and maintenance are carried out using dedicated service vessels. The FAD body is a spherical FRP float approximately 2.4 m in diameter, connected to floats and flares to enhance aggregation effect (Figure 2-2). Due to the deep surrounding waters (2,000–2,500 m) and strong currents, FADs are frequently lost. The FAD Centre monitors their positions and redeploys replacements when necessary. According to technical staff, FADs typically last 3–5 years (up to 9 years), with 10–15 units deployed annually.

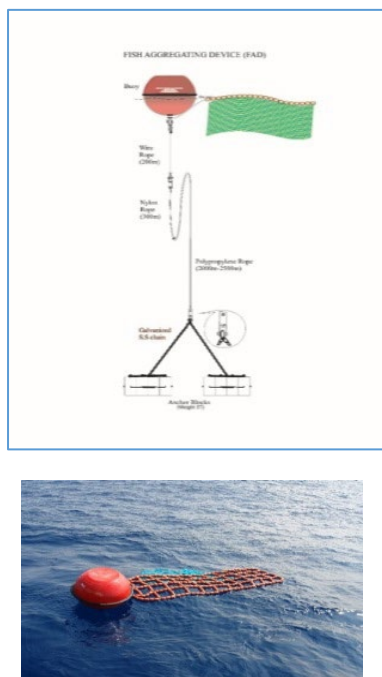


Figure 2-1 Locations of FAD installations

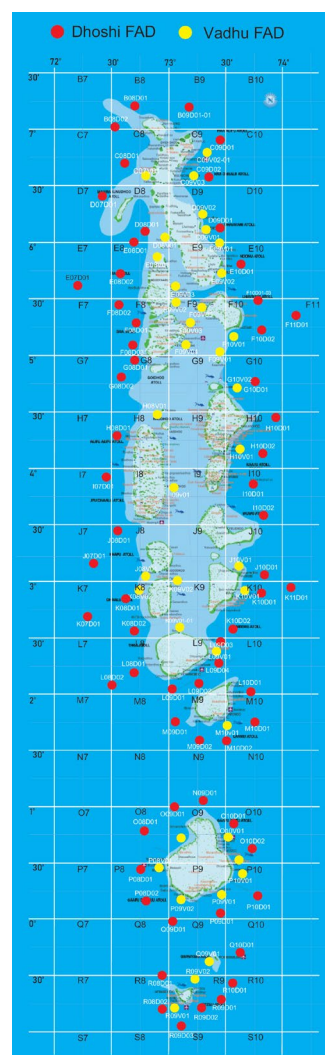


Figure 2-2 All FAD locations

2.2.2 Reef Fishing Subsector

Reef fishing refers to traditional handline fishing conducted in coastal areas within atolls, targeting fish inhabiting coral reefs and lagoons. Maldivians traditionally prefer skipjack over reef fish, so reef fisheries have historically been less active, with catches mainly used as raw material for processed products sold to Sri Lanka. In recent years, however, demand for certain reef fish for export and for the tourism-related sport fishing industry has increased, leading to a rise in targeted fishing. Compared with skipjack and tuna fisheries, the reef fish market is less developed, making it a potentially rich source of untapped resources and a promising area for future development.

On the other hand, catch statistics for reef fisheries (except for certain cases) are not collected, so the actual status of resource use is limited. In skipjack and tuna fisheries, reporting of catches is mandatory for sales to processing companies, and failure to comply results in loss of licensing, ensuring relatively accurate statistics. Such systems are not yet in place for reef fisheries, making statistical development an urgent issue.

(1) Reef fisheries for traditional salt-dried product raw materials

As mentioned above, catches from reef fisheries have traditionally been used as raw material for processed products exported to Sri Lanka. Particularly valued for salted and dried products are species such as sailfish and rainbow runner, which are still processed in the outer islands. Although exports are recovering now, they had once plummeted due to Sri Lanka's economic crisis. This highlighted the need to diversify markets and reduce dependence on a single buyer.

(2) Live grouper fishery

This fishery targets groupers caught by hook and line, mainly for live export to markets in Hong Kong and other parts of China. The sector has grown in recent years, with more vessels engaging in operations. Exports are carried out by air in special live fish containers with controlled temperature and dissolved oxygen. While reporting of export volume is mandatory, it does not accurately reflect actual catches, so the true fishing status remains unclear.

(3) Reef Fishing for Resorts

As of 2024, the Maldives has about 180 resorts, which are major consumers of reef fish. Consumption temporarily slowed during the COVID-19 pandemic but is believed to have recovered by 2025. Fishers usually receive orders directly from resorts or via wholesale suppliers serving resorts. Operations use small fishing boats and target trevallies, rainbow runner, groupers, and snappers with handlines. Reef fish consumed at resorts are eaten not only by tourists but also by staff, representing a significant volume. However, due to a lack of statistics, the exact quantities are limited. In some cases, fishers supplying resorts have low awareness of freshness management, leading to dissatisfaction with fish quality on the buyer side.

(4) Other reef Fishing

Reef fish are becoming increasingly important for Maldivians as well. For example, they are essential for barbecues during weekend picnics, and many households reportedly eat reef fish at least once a week. Consumption is thought to have increased significantly over the past decade. Recreational fishing is also common on inhabited islands such as Malé, with recreational boats operating frequently. Fish caught are mainly consumed within households. In resorts, recreational fishing is popular among foreign tourists; while many fish are released, some are cooked in resort restaurants and served to guests.

2.2.3 Aquaculture Sector and present situation

Unlike the fisheries sector, the aquaculture sector in the Maldives has seen many trials but few ongoing commercial operations, with sea cucumber being one of the few currently farmed. A recent review of aquaculture history is provided by De Silva (2014). As a new activity for the Maldives, aquaculture regulations were first discussed in 2015, and the Aquaculture regulation came into force in 2016.

The Maniyafushi Research and Training Facility of MMRI (Maldives Marine Research Institute) is located on Maniyafushi Island (approx. 4 ha) in South Malé Atoll, 10 miles south of the capital Malé. It conducts pilot projects on seed production of groupers and sea cucumbers and provides training for fishers to promote aquaculture. In 2015, MoFOR carried out renovation work on the facility, and under the IFAD Mariculture Enterprise Development Project (2012–2019), about USD 5,000 worth of seed production equipment such as FRP tanks was provided. From 2017 to 2022, the World Bank's Sustainable Fisheries Resources Development Project further improved the facility and implemented grouper aquaculture extension activities.

As a follow-up, there were plans to build a new seed production facility on Maanagalaa Island, Gaafu Alifu Atoll, and entrust its operation to a private company, but as of 2025, the project has not started.



Photo 2-1 An aquaculture training demonstration facility on Maniyahuasi Island
(left: general view, right: inside the hatching facility)

The Maldives has not yet started marine aquaculture on a commercial scale. Regarding aquaculture development so far, several projects have been implemented at the research and demonstration levels, including the following

- Seaweed cultivation by introducing seedlings from the Philippines. Aquaculture of *Eucheuma cottonii* (*Kappaphycus alvarezii*) and *E. denticulatum* (*E. spinosum*)
- Native sea cucumbers: The white teatfish, *Holothuria fuscogilva* and the prickly redfish *Thelenota ananas*.
- Semi-circular pearl culture; Penguin shell, *Pteria penguin*
- Ornamental fish aquaculture. Bearfish *Amphiprion nigripes*
- Sea cucumber (*Holothuria scabra*) aquaculture trials.

As of 2025, seed production of Brown-marbled grouper (*Epinephelus fuscoguttatus*) is underway to promote aquaculture, but production by fishers has not yet been successful.

2.3 Fisheries Processing and Distribution

2.3.1 Traditional processed seafood products

Traditional processed skipjack tuna products, such as dried and smoked skipjack tuna "Valhoamas" and "Hikimas," are produced by small-scale household industry-level fish processors in local islands and exported to Sri Lanka under the name "Maldivian fish". The product is called Rihaakuru, which is made by further heating and concentrating the broth from the boiling process of Valhoamas and Hikimas, and is also an important industry in the local islands. However, these fish processors operating at a small-scale manufacturing level sometimes lack proper sanitary management, and the sanitary conditions and quality of their products vary widely. In addition, due to the economic crisis in Sri Lanka, exports of processed marine products to Sri Lanka have plummeted, and there is an urgent need to develop new sales outlets. Skipjack tuna and small yellowfin tuna are in high demand as raw materials for the aforementioned canned products, and large fish processors have priority in purchasing them, making it difficult for small-scale processors on local islands to purchase raw fish.

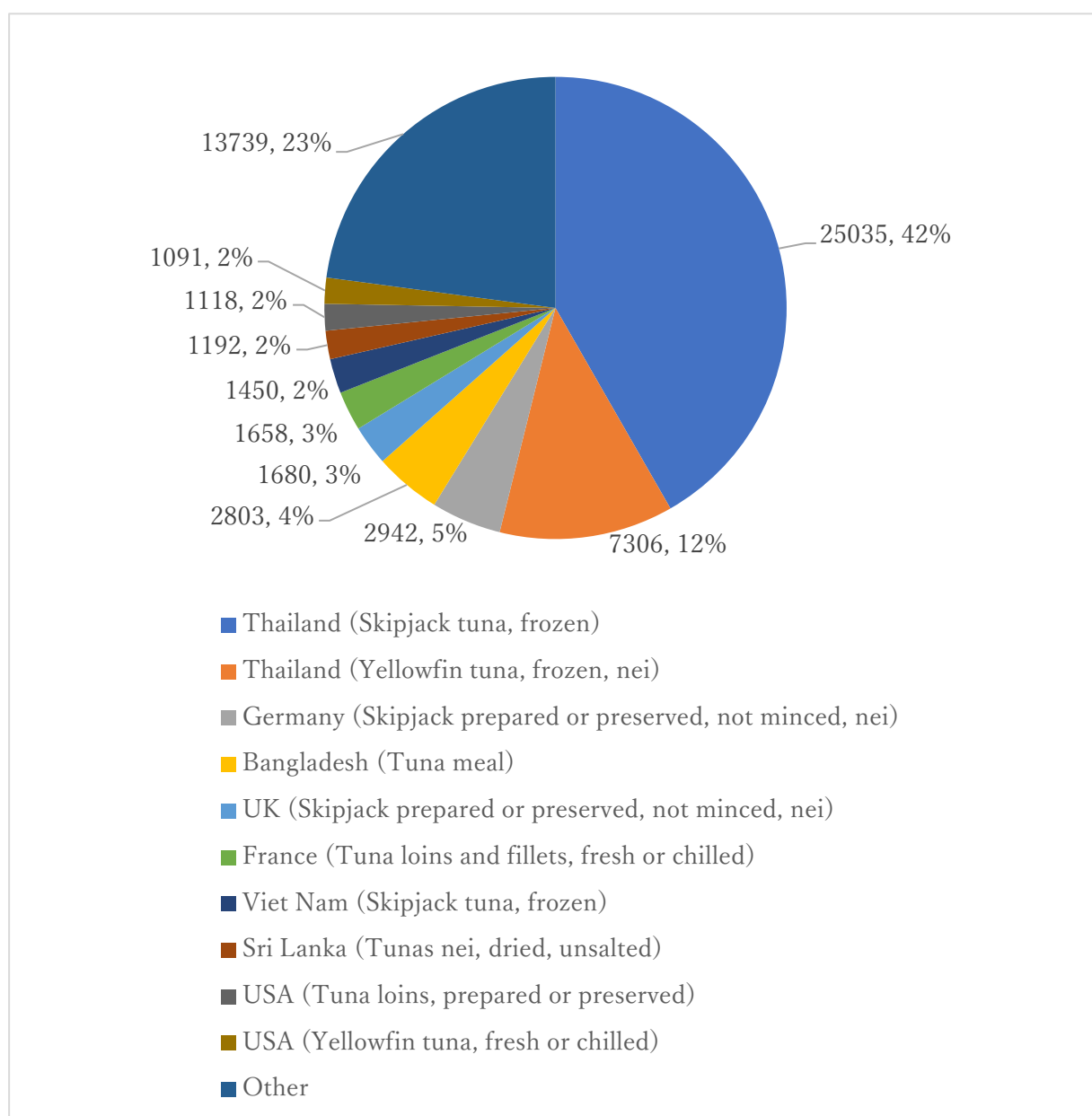
Table 2-2 shows the number of traditional small-scale fish processors in each atoll. There are 156 small-scale fish processors in total according to government records. Processors are concentrated in the drier areas where skipjack tuna, the raw material, is more readily available, with 67% of all fish processors operating in southern side from Meemu Atoll.

Table 2-2 Number of Small-scale Fish Processors per Atoll (Fisheries Statistics (2019 MoFMRA))

Atoll	Atoll in English	Number of Local Fish Processor
Haa Alif	North Thiladhunmathi (HA)	12
Haa Dhaalu	South Thiladhunmathi (HDh)	6
Shaviyani	North Miladhunmadulu (Sh)	9
Noonu	South Miladhunmadulu (N)	7
Raa	North Maalhosmadulu (R)	ND
Baa	South Maalhosmadulu (B)	11
Lhaviyani	Faadhippolhu (Lh)	4
Kaafu	Male' Atoll (K)	3
Alifu	North Ari Atoll (AA)	ND
Alifu Dhaalu	South Ari Atoll (ADh)	ND
Vaavu	Felidhe Atoll (V)	ND
Meemu	Mulakatholhu (M) (Mulaku Atoll)	14
Faafu	North Nilandhe Atoll (F)	9
Dhaalu	South Nilandhe Atoll (Dh)	0
Thaa	Kolhumadulu (Th)	25
Laamu	Hadhdhunmathi (L)	2
Gaafu Alifu	North Huvadhu Atoll (GA)	32
Gaafu Dhaalu	South Huvadhu Atoll (GDh)	22
Gnaviyani	Gnaviyani (Gn) (Foammulah Atoll)	ND
Seenu	Addu Atoll (S)	ND
Total		156

2.3.2 Canning and Canned Raw Material Processing and Exports

Figure 2-4 shows the items exported and the countries that imported the fisheries products from the Maldives in 2023. As noted earlier, most skipjack and small yellowfin caught by pole-and-line are exported to Thailand as raw material for canned tuna, accounting for 56% of total fishery export value in 2023. Canned tuna processed in the Maldives is also exported to Europe and the US. Exports to Japan exist but account for only 1% of the total value. Although not shown in the figure, Sri Lanka mainly imports traditional products such as Hikimas and salted fish, with total exports of USD 1,361,000 (0.9%, ranked 12th).



(Unit: 1,000USD)

Figure 2-3 Value of Maldivian fishery product exports by destination country (Fisheries Statistics (MoFOR 2023))

2.3.3 Tuna Processing and Export

Large yellowfin tuna are exported chilled or frozen to Europe (mainly France and Germany) for sashimi or cooked products. As mentioned earlier, yellowfin quality is graded into four categories, and raising this grade is essential for increasing export prices. With the global spread of Japanese cuisine, sashimi-grade yellowfin (A+) now commands high prices in EU markets. However, the proportion of A-grade yellowfin from major Maldivian processors remains below 25% (Figure 2-5).

One of the challenges in improving the assessment grade is the problem of 'Yake'. Yake is a phenomenon in which the central temperature in the body of the yellowfin tuna that has been caught during a fishing becomes extremely high, causing the muscle protein to denature and the flesh to turn a burnt white color. Such yellowfin tuna having Yake is traded at a lower grade. Fishers empirically understand that Yake often occurs in yellowfin tuna caught during high water temperatures and certain seasons (December to March), but no measures have been taken and this is still the cause of many Yake fish being landed. In the Maldives, it is common for fishers to sell low-grade fishes at a fixed unit price regardless of grade, based on the fisher's desire to sell even low-grade fish at a certain price. This is one of the reasons why fishers do not take measures to prevent scorching.

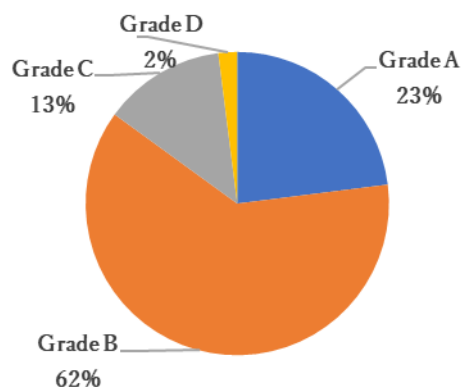


Table 2-4 Value of Maldivian fishery product exports by destination country (Fisheries Statistics (MoFOR 2023))

2.3.4 Domestic Fresh Fish Distribution

Within the Maldives, fresh skipjack, yellowfin, and reef fish are distributed. These are sold by fishers to the Malé fish market or to local middlemen, then sold to consumers and restaurants, or to resorts as mentioned earlier. Skipjack caught by small boats nearshore is often sold directly to households, restaurants, and small processors.

For yellowfin, as most are bought by major processing companies for export, those sold in the Malé market are often rejects not purchased by processors. However, in the local islands, yellowfin tuna are sometimes landed directly by fishing vessels, and therefore, non-reject yellowfin may also be distributed locally.

3.1 Achievement of the Activities

Table 3-1 Activities Comparison Table (April 2022 to June 2025)

Implement in Maldives Implement in Japan Implement continually (Japan / Maldives)

Although there are some differences in the implementation status of each planned activity compared to the start of the project period (June 2022), overall, there have been no major delays and progress is proceeding almost as planned.

In Output 1, all planned activities have been completed. Activity 1-1-1 was completed in August 2022. The surveys were conducted for ENSIS, Bigfish, MIFCO, and Horizon Fisheries to collect information on technical issues related to quality improvement and the current condition of fisheries products trade. Activity 1-1-2 involved producing two pamphlets on measures against YAKE, a pamphlet introducing histamine and the countermeasures, and two videos on on-board handling of yellowfin tuna (Ikejime and tuna ring). Activity 1-1-3 involved providing technical training for fishers on on-board handling using Irabu and Ikejime methods to a total of 136 persons (First period: 79 persons; Second period: 57 persons). Training on the tuna ring was also provided to 57 persons (First period: 42 persons; Second period: 15 persons). Activity 1-1-4 was to conduct monitoring of the quality of yellowfin tuna following the introduction of the on-board handling techniques. The project members visited Bigfish, a cooperation fisheries processing company, and collected grading data of yellowfin tuna. This activity was completed in May 2025. In Activity 1-2-1, the project shared information on the activities of Output 1 in a meeting with MAPEA (Maldives Seafood Processing Exporters Association) in November 2024. This activity was intended to establish a platform for inter-company collaboration. However, at the suggestion of the Maldivian side, it was changed to utilize existing channels held by MoFOR (meetings with MSPEA and fish processing companies, Fishermen's Day, etc.).

Regarding Output 2, all planned activities were implemented as scheduled, however, some activities, such as the bait cage experiment, were not fully completed, and continued testing is required.

In Activity 2-1-1, the activity started slightly earlier than planned, and in August 2023, the improved live-bait tank system unit (prototype) was completed and installed on the skipjack tuna fishing vessel "Kamana" to confirm its operation. During the second period, monitoring of the "Kamana" continued, and in September 2024, a dissemination version of the improved system unit (commercial model) incorporating the issues identified from monitoring was designed and manufactured. In October 2024, the improved live-bait tank system units were installed on the cooperating vessels "Safeena" and "Hudhuhudhu Emperor", and monitoring continued until the termination of the project. In Activity 2-1-2, in August 2023, a JICA expert boarded the "Kamana" and conducted training for the fishers on how to operate the improved live-bait tank system unit and use the Water Scoop Net while accompanying the vessel in its operations. In October 2024, similar training was conducted on the "Safeena" and "Hudhuhudhu Emperor", and additional training was provided to fishers landing at the cooperating company Bigfish. In Activity 2-1-3, the project was publicized at the Fishermen's Day Forum held in December 2024, while fishers on the "Kamana" conducted promotional activities for the improved live-bait tank system unit. Furthermore, a best practice guide explaining the concept and benefits of the improved system unit was prepared and used as promotional material at the final project seminar. In Activity 2-2-1, during the training in Japan in September 2023, discussions were held between fishers and the Maldivian counterparts (C/Ps) with reference to Japanese case studies, and the challenges to the

feasibility of establishing independent live bait fisheries were identified. This activity was completed in September 2023. In Activity 2-2-2, based on the findings of Activity 2-2-1, a live bait fishing device was selected as a measure to support the establishment of independent live bait fisheries. Preparations were carried out from May 2024, and trial operations were conducted between December 2024 and February 2025. In Activity 2-2-3, from March 2025 onward, the results of Activity 2-2-2 were compiled, and based on these results and previous studies, the “Assessment Report on the Feasibility of Independent Live-Bait Fisheries” was prepared. In addition, at the final seminar held in May 2025, the live-bait capture device and its related challenges were presented to fishers and discussed.

In Output 3, Activity 3-1-1 to 3-1-3 were completed in the first period. In the second period, business management training was carried out as Activity 3-2-4 (combining the former Activity 1-2-2 and 3-2-3) following the training conducted in the first period under the former Activity 1-2-2 on Dhiggaru Island (Meemu Atoll), Nilandhoo Island (Faafu Atoll), and Maduvvari Island (Raa Atoll), in accordance with the needs identified in Activity 3-2-3. Activity 3-2-5 began in January 2024 during the second period, and by August 2024, business plan drafts had been completed for the three target islands. In preparation for actual activities, efforts were made to organize a cooperative society as the operational framework, in parallel with the production of product samples. However, the registration of the cooperative society proved more difficult than anticipated, and by May 2025, only one island had completed the process, resulting in a disappointing outcome. The establishment of the cooperative society was not an end in itself but instead part of the effort to strengthen coordination and collaboration among small-scale processing communities. However, on Nilandhoo Island in the Faaru Atoll, sample production is progressing, and product preparation is advancing. Additionally, one of the fish processors from Nilandhoo Island who participated in the training, whose spouse is a member of the WDC, has begun manufacturing and selling products using the heat-sterilized vacuum-packed Valhoamas technology. While progress is gradual, the results of the activities are beginning to emerge.

3.2 Preparation and Discussion of Work Plan in Japanese

A work plan of the first period in Japanese was prepared as scheduled and submitted to the Economic Development Department of JICA on May 9, 2022, for discussion and approval.

A draft of the work plan of the second period in Japanese was submitted to the Economic Development Department of JICA on 4th January 2024. The final version was submitted to JICA on 28th May, 2024.

3.3 Preparation and Agreement on Work Plan

Based on the contents of the work plan described in the previous 3.2 section, a draft work plan of the first period in English was compiled. Using the work plan as a starting point, a revised version was prepared after repeated discussions with the Maldivian counterparts and the JICA Maldives office. The revised work plan was approved at the first meeting of the JCC held in Malé on June 20, 2022.

Based on the contents of the work plan described in the previous section 3.2, a draft work plan of the second period in English was compiled. Using the work plan as a starting point, the revised version was

prepared through repeated discussions with the Maldivian side and the JICA Maldives office. It was approved at the 3rd JCC meeting held in February, 2024.

3.4 Preparation of Monitoring Sheets

The project will be monitored with MoFOR approximately once every six months according to a monitoring sheet that defines common monitoring items that should be reported and discussed on a regular basis. Currently, the following monitoring sheets have been created: Version 1, which summarizes activities from April 2022 to September 2022; Version 2, from October 2022 to March 2023; Version 3, from April 2023 to September 2023; Version 4, from November 2023 to May 2024; and Version 5, from June 2024 to October 2024. Please refer to the respective monitoring sheets for the contents of Versions 1-5 for the first period of the project. In Version 1, the project proposed modifications to each of the indicators below regarding the project purpose of PDM agreed upon in R/D, and these were agreed upon within the project. However, several issues were raised at the 2nd JCC in October 2023, and modifications were requested. Other descriptions are mainly records of the progress of project activities.

3.5 Submission of the progress report (1st and 2nd period) and the final report in first period

The progress reports of the first period in Japanese and English were submitted to JICA on 20th January 2023. The final reports of the first period in Japanese and English were submitted to JICA on 31st October 2023.

The progress report of the second period in Japanese was submitted on 1st September 2024. The progress report in English was submitted to JICA on 11th October 2024.

3.6 Joint Coordinating Committee (JCC)

The JCC for the project was held four times: in June 2022, October 2023, February 2024, and May 2025. The outline of these meetings is as follows.

3.6.1 First JCC (1st period of the project)

The first JCC was held on June 20, 2022 at Solite Restaurant in Male. The Japanese side was represented by Ambassador Plenipotentiary Takeuchi of the Embassy of Japan, and the Maldivian side by Minister Hassan of the Ministry of Fisheries, Marine Resources and Agriculture (MoFMRA) and a total of 15 people joined the meeting. At the meeting, the project activities and work plan, including the plan for dispatching experts, were approved. At the JCC, it was also confirmed that the project implementation structure described in the R/D had not been changed, and additional explanations and confirmation of each component person were made regarding the contents to be addressed in this project.

As local cost limitation was a constraint on project activities in MASPLAN period, the Maldivian side's travel expenses (travel and daily accommodation), which had been a particular concern, were discussed between MoFMRA (MoFOR) and the JICA project team at the beginning of the project. As a result, it

was confirmed that the Maldivian side would cover the travel costs of MoFMRA staffs for the project activities.

3.6.2 Second JCC (1st period of the project)

The second JCC was held on October 3, 2023 at the MoFMRA meeting room. The main agenda items were the progress report on the activities of the first period of the project and discussion on the final report of the first period, confirmation and agreement on changes in the PDM (Version 2) and the activity plan for the second period of the project. The participants from the Maldivian side were Dr. Hussain Rasheed Hassan, the former Minister of Fisheries, Marine Resources and Agriculture, as JCC Chairperson, Mr. Adam Manik, Project Manager, and representatives of counterparts and related departments, Mr. Ahmed Shifaz, acting Project Director and others from MoFMRA. On the other hand, participants from the Japanese side were Ms. TAKEUCHI Midori, Ambassador of Japan, Mr. FUKUOKA Shuto, Second Secretary of the Japanese Embassy, Mr. TAKI Motoo, Resident Representative of the JICA Maldives Office, Mr. SAIGAWA Shuzo, JICA headquarters, and Dr. ECHIGO Manabu, JICA Expert Chief Adviser. In addition, Mr. Adam Ziyad was absent as he was studying abroad since the end of August 2023.

As a result of the discussions, no major changes or modifications to the project Final Report was observed, although several questions and comments were raised regarding the progress of activities and technical details. Regarding the PDM indicators, Minister Hussain pointed out the need to reconsider the indicator related to Output 1 of the Project Purpose, and it was decided to continue considering these indicators from that point on. Based on this, it was decided that the proposed revision would be discussed within the project team by the timing of the 3rd JCC in order to be agreed upon at the JCC.

On October 1, prior to the said JCC, a final vote for the presidential election was held and the candidate of the opposition party won, thus Minister Hussain resigned as of November 17, 2023. Shortly after the transition to the new administration, in line with the presidential election pledges, a reorganization of ministries was carried out, and MoFMRA was restructured into MoFOR.

3.6.3 Third JCC (2nd period of the project)

The third JCC was held on February 4, 2024 in the MoFOR conference room. The three main items on the agenda were (1) a presentation of the work plan for the second period of the project, (2) changes in the project implementation structure (change of project director), and (3) changes in the PDM and the establishment of project purpose indicators. Seven persons attended from the Maldivian side, including Mr. Mohamed, State Minister, Ms. Aminas, Permanent Secretary of MoFOR, Mr. Adam Manik, Project Manager, and representatives of other C/Ps, fisheries companies, and fishers' associations. From the Japanese side, Ms. Takeuchi, Ambassador of Japan, Mr. Fukuoka, Second Secretary, Mr. Taki, representative of JICA Maldives office, and Dr. Echigo and Mr. Nagashima, JICA experts, attended.

Regarding the workplan, the C/Ps made presentations on behalf of the project, and there was an active discussion based on questions from the State Minister and other attendees. In addition, the representative

of the fish processing company expressed appreciation for the past activities to improve yellowfin quality, and also expressed his willingness to continue cooperating with the project. As for the change in the project implementation structure, MoFOR nominated Dr. Hussain Sinan as the new project director as a successor of Mr. Adam Ziyad, and the nomination was approved at the meeting.

Regarding revisions in the PDM, it was found during the progress of activities that some of the activities in Output 1 overlapped with those in Output 3, so restructuring the PDM was proposed, which was approved. There was a discussion on the previous JCC's request to improve the setting of indicators for Output 1. The focus was on “what should be considered as strengthening the economic foundation of the fisheries sector with respect to the project purpose” and an understanding was reached that the improvement in “human resource capacity building” proposed by the project should be used as an indicator. However, it was pointed out by the permanent secretary that quantitative measures should be set for the indicator of project purpose. However, since the issue requires further consideration from a technical standpoint, it was decided to continue the discussion going forward. As described in “3.4 Preparation of Monitoring Sheet”, indicators of the project purpose and Output 1 were discussed and agreed upon at the project meeting held on 3rd June 2024, after further discussions within the project team and with JICA.

3.6.4 Forth JCC (2nd period of the project)

The 4th and final JCC was held on May 29, 2025, at the Solite Restaurant in Malé. On the Maldivian side, the participants included Ms. Aminas, Permanent Secretary of MoFOR, Project Director Dr. Hussain Sinan, Project Manager Mr. Adam Manik, other counterparts and related staff, as well as Mr. Umar Jamal, representative of the Maldives Seafood Processors and Exporters Association (MSPEA). On the Japanese side, the participants included Mr. Taki, representative of JICA Maldives office, Mr. Fujita of the Economic Development Department, JICA experts Dr. Echigo and Dr. Sano, and two additional staff members of the JICA Office. In total, 13 participants attended the meeting.

At the JCC, the session began with opening remarks and words of appreciation for the project from the Permanent Secretary of MoFOR, followed by greetings from representative Taki of the JICA Maldivian office. Subsequently, the Project Manager presented a summary of the project results. Afterward, the Project Director gave an outline of the remaining challenges of the project and the post-project activity plan. This was followed by a discussion among all participants regarding MoFOR's future policy direction, leading to the conclusions summarized below.

As for the achievement status of the project's performance indicators, discussions were held based on the content prepared in advance and attached to the JCC minutes, with support from the JICA Branch Office, and consensus was reached on those points. For details, please refer to Chapter 9.

(1) Achievement of project activities

In Output 1, among the techniques introduced to improve the quality of yellowfin tuna, neither the Irabu method to prevent Yake nor the Ikejime method was confirmed to have been disseminated through

the project. On the other hand, the tuna ring received high evaluation from fishers, and its future dissemination is expected. In Output 2, it was confirmed that the improved live-bait tank system unit and the introduction of water scoop net enabled the live bait to maintain vitality for a longer period in the tanks. Furthermore, as part of the support measures for establishing independent live-bait fisheries, the trial operation of a live-bait fishing device confirmed its functionality, and it was therefore deemed desirable to continue trial operations toward future dissemination. In Output 3, although the project inputs were completed, delays on the part of the site activities unfortunately prevented the achievement of the targeted results within the project period.

In summary, the overall project objective was only partially achieved.

(2) Future activity plan

MoFOR will continue activities to promote the dissemination of the techniques introduced through the project. In Output 1, they will focus efforts primarily on the dissemination of the tuna ring, utilizing opportunities such as landings delivered to fish processing companies and promotion through video materials on SNS. In Output 2, the dissemination of the system unit and the water scoop net will likewise be promoted through publicity efforts. In addition, under the World Bank project, initiatives will be undertaken to provide loans for vessels installing the unit and to develop next-generation fishing vessels reflecting the design concept. The live-bait fishing device will continue to undergo trial operations, with further information gathering conducted toward its practical introduction. In Output 3, the experience and results obtained through the project will be utilized for dissemination to other sites.

(3) Lessons learned from the project

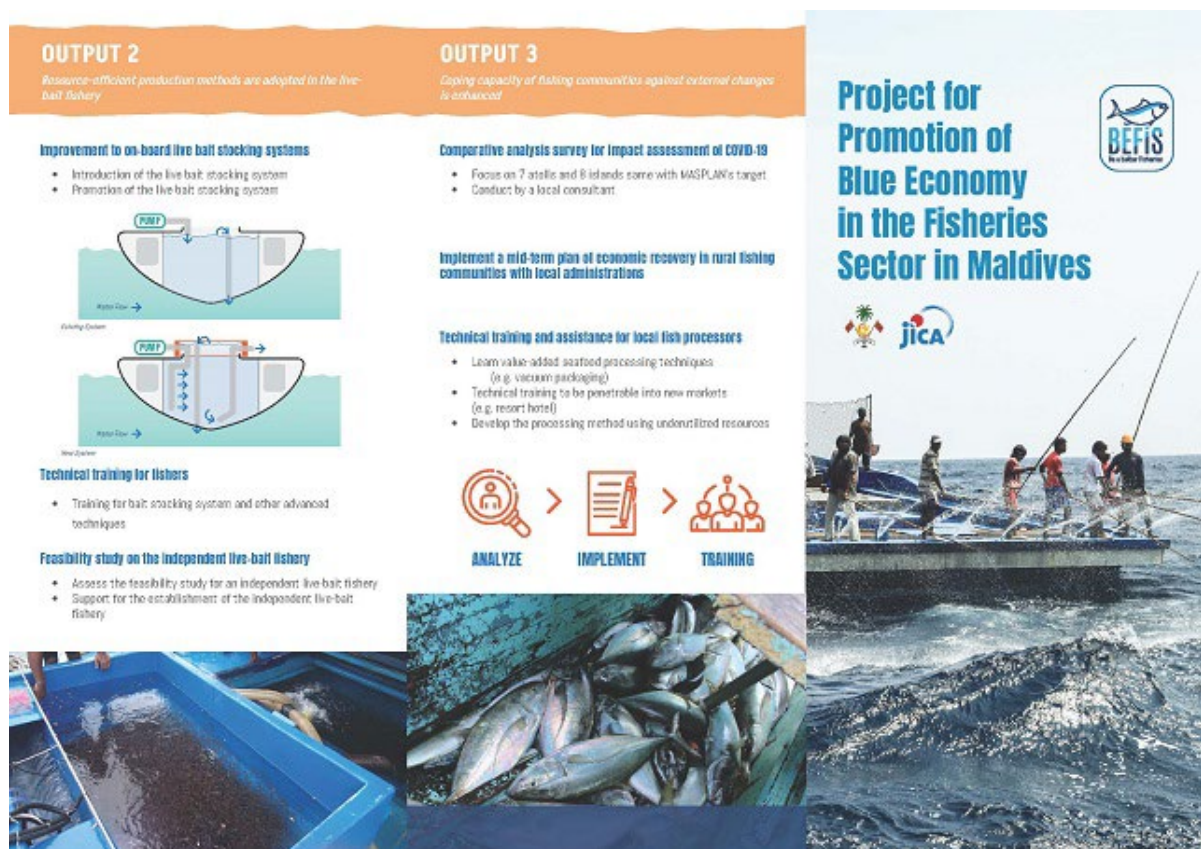
In Output 1, it was shared among stakeholders that video materials and the use of the internet and social media play an extremely important role in dissemination, and thus such tools should be actively used in future activities. It was also recognized that improvement of fish quality requires a pricing system that reflects quality, which is currently a bottleneck, and therefore this should be addressed as a future challenge. In Output 2, it was learned that the involvement and capacity of private companies are extremely important in the development and dissemination of new techniques and fishing gear, and that such cooperation frameworks should continue to be strengthened. It was also understood that communication networks among fishers play a significant role in dissemination. In Output 3, it was shared that dissemination activities in the outer islands should not rely excessively on island councils; that the selection of target sites should be based on clear criteria; and that dissemination targets do not necessarily need to be organized groups, but rather a mechanism should be established to select individuals or entities with the required capacity and motivation.

Finally, Mr. Fujita of JICA summarized the issues and expectations for the future, and Dr. Echigo as chief advisor of JICA expert provided an explanation of the process for preparing and submitting the project report.

3.7 Publicity

The project brochure (English and Dhivehi) was made as shown in the figure below (A4 double-sided printing, tri-fold) in the first period. This brochure is distributed to survey collaborators, training participants, and other interested parties. A project logo has also been created and used in publications such as the Best Practices Guide.

In the second period, best practice guide videos for Output 1 and Output 2 were produced. The project was publicized by presenting these videos at the final project seminar. In addition, at the “Fishermen’s Day Forum,” the largest fisheries-related event in the Maldives held in December 2024, the project was introduced by MoFOR.



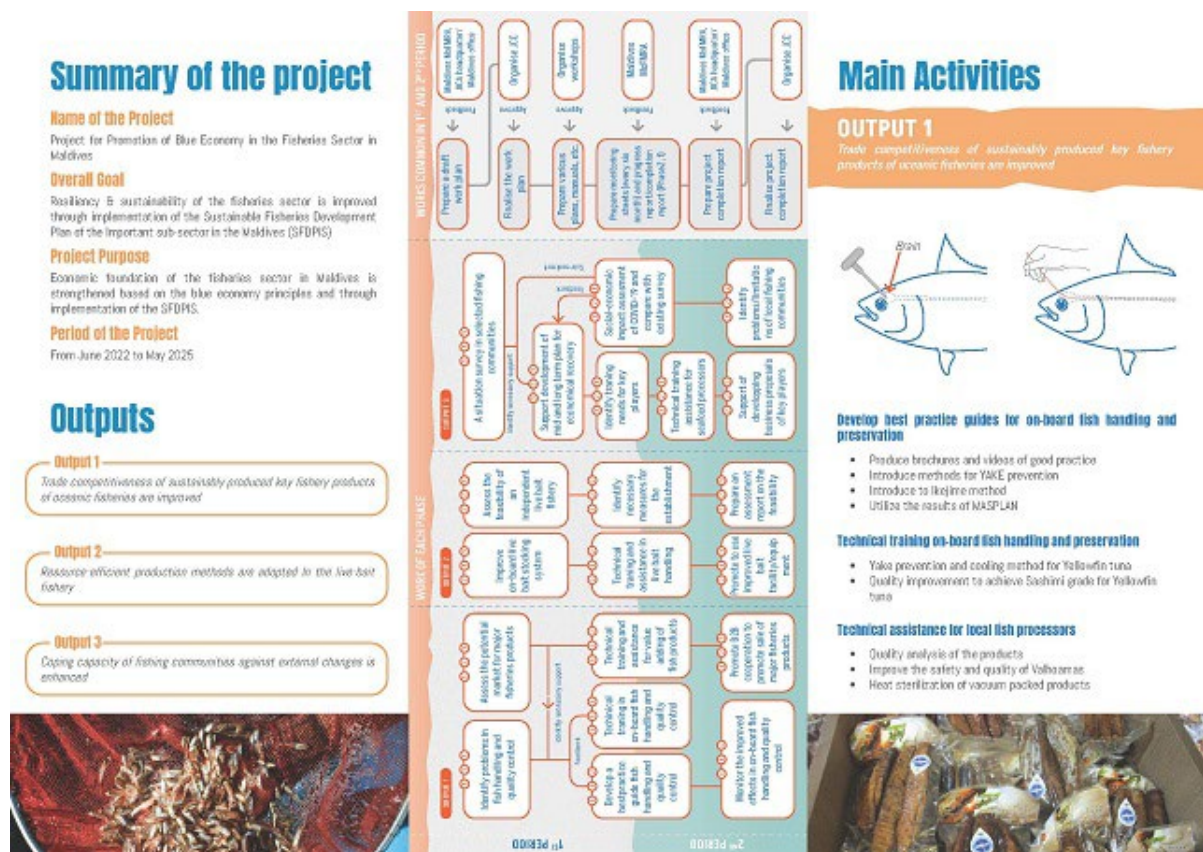


Figure 3-1 Project pamphlet (English version)



Figure 3-2 Project Logo

In addition, events were held in both Japan and the Maldives in November 2022 to commemorate the 55th anniversary of the establishment of diplomatic relations between Japan and the Maldives. The project provided photos for JICA's PR pamphlet for the Maldives and a video that was aired at the JICA Global Festa.

Resilient Economic and Social Structure through Regional Development

Economic diversification is a key for resilient economy and society in the Maldives. The fisheries sector is one of major sources of employment in the inhabited islands and the second largest industry in the country even which contributes only 3-4% to the GDP in the Maldives.

Project for the Formulation of Master Plan for the Sustainable Fisheries (2014-2017) supported the Government of the Maldives to formulate a Master Plan with aiming to make the fisheries sector more sustainable and efficient.



photo: ©INTEM Consulting, Inc./ Fisheries & Aquaculture International Co., Ltd.

Figure 3-3 JICA PR pamphlet for the Maldives (excerpts of photos provided by our consortium)



Figure 3-4 JICA Global Festa (October 2, 2022)²

Japanese training program "Technical capacity building training on skipjack and tuna fisheries" implemented in May 2023 of the first period and "Improving Capacity to support fishing communities" in February 2024 of the second period received cooperation from Kochi Prefecture, Okinawa Prefecture, Chiba Prefecture, Ehime Prefecture, and many other fisheries related parties for training lectures and observations. The project began to issue "Project News" two to three times a year to the Japanese fisheries cooperatives, prefectural fisheries departments, town and city offices, and others who cooperated in the training program in Japan. The content of the news is reporting on the project activities and the local situation in the Maldives. The publication status of the Project News is shown below. It was sent it to a total of 43 people by letter and e-mail.

² This video is provided by the joint venture

Table 3-2 Publication Status of the Project News

Issues	Date of issue
No.1	September 2023
No.2	January 2024
No.3	July 2024
No.4	August 2025

4. Output 1: Trade Competitiveness of Sustainably Produced Key Fishery Products of Oceanic Fisheries is Improved (Blue Trade)

4.1 To Identify Shortcomings of Current Practices of On-board Fish Handling and Preservation in Oceanic Fisheries (Activity 1-1-1)

The activity focused on yellowfin tuna and skipjack tuna, and issues related to on-board fish handling and quality maintenance were identified through visits and interviews with private fish processing companies (ENSIS, Bigfish, MIFCO, and Horizon Fisheries). A list of these companies is presented below.

Table 4-1 List of Interviewed Fish Processing Companies

Name of the company	Date	Contents	Place
ENSIS	12 th June 2022	Collection of information, observation of landing site and processing factory	Hulhumalé
	9 th August 2022	Collection of information, observation of landing site	Hulhumalé
	25 th August 2022	Discussion with staff of ENSIS	Malé
Bigfish	13 th June 2022	Collection of information, observation of landing site and processing factory	Himmafushi
	14 th August 2022	Collection of information, observation of landing site	Himmafushi
	25 th August 2022	Discussion with staff of Bigfish	Malé
MIFCO	14 th June 2022	Collection of information	Malé
Horizon Fisheries	18 th June 2022	Collection of information, observation of landing site and processing factory	Maandhoo In Laamu

4.1.1 Collected Information in ENSIS

ENSIS is a large scale of private fish processing company with a fish processing plant in Hulhumalé. As landings have decreased, the price per ton has increased. For example, around 2016, yellowfin tuna landings were typically around 25 t/day, but it is not uncommon to see the landings as low as 1 t/day at present. Due to the decrease of landings, the fish price per ton has increased.

The grader staff of ENSIS inspects the quality of the landed yellowfin tuna and classifies them into three grades (A, B, and C) in descending order of quality; those with poor quality (less than C) are rejected and either brought back by the fishing vessel or taken back by ENSIS free of charge. The majority of rejects are due to Yake (see the column shown in below), with ENSIS receiving less than 30% of its yellowfin tuna above grade A. The main export market for yellowfin tuna is

America and the European countries market. The demand of yellowfin tuna in those countries is still high.



Photo 4-1 Quality inspection by the grader



Photo 4-2 Reject grade by Yake (upper) and A grade (under)

What is Yake of yellowfin tuna in Maldives?

Yake, as it is called, is a phenomenon that occurs in the flesh of captured skipjack and other tuna species. When those fishes die after heavy exercise, the temperature at the center of the fish's body becomes too high, and the flesh becomes a white color like grilled fish. The Yake is particularly noticeable in the fish captured by hand-line fishing and in areas with high water temperatures. Yake meat cannot be sold for sashimi grade, and the price is low, which has been a major problem in the fisheries sector of the Maldives. MASPLAN proposed the introduction of the "Irabu method" developed by the Irabu Fishing Cooperative Association in Okinawa Prefecture as a countermeasure to this problem. The Irabu method involves placing the captured tuna in a cold water tank in the vessel while still alive, and using the circulation of cooled blood to cool the center of the fish's body.

In terms of on-board handling, there have been few cases of histamine food poisoning (see the column shown below) with yellowfin tuna, However with skipjack tuna, histamine control is an important issue. In ENSIS, yellowfin tuna and skipjack tuna purchased from fishing vessels are measured for histamine level in the company's own analysis laboratory. In some cases, a high level

What is histamine food poisoning?

Histamine food poisoning is a type of food poisoning that occurs mainly in skipjack tuna, mackerel, and tunas and causes allergy-like symptoms. When the fresh fish is left at room or ambient temperature for a long period of time, the bacteria produce histamine, which causes the symptoms. This histamine remains undecomposed even after heating, and histamine itself has no taste or odor. It is important to take measures such as refrigerating the fish immediately after catching.

of histamine is detected from a lot of skipjack tuna landed from a single fishing vessel. ENSIS recognizes that prevention of histamine food poisoning is an important point of improvement.

ENSIS believes that in order to improve the quality of yellowfin tuna, it is necessary to improve on-board fish handling methods, sanitary control in the factory, and quality control at the airport when the fish is exported. In particular, ENSIS's focus regarding on-board processing methods need to be improved, and since the captains and crews of yellowfin tuna fishing vessels lack basic knowledge, ENSIS requested that the project provide knowledge not only on how to process yellowfin tuna on-board handling, but also on basic information on the biology of yellowfin tuna and the meaning of keeping the fish cold.

4.1.2 Collected Information from MIFCO

MIFCO was established by a government-funded company. This is the oldest of the Maldivian fish processing companies. Its predecessor was a canning factory established in 1977 as a joint venture with a Japanese company, which was taken over by the Maldivian government in 1982. The facility was renovated and put into operation in 1986. In 1979, Maldives Nippon Corporation was established with Marubeni Corporation, and in the same year, Maldives Fisheries Corporation was established, and in 1993, MIFCO was established by merging these companies.

MIFCO, a government-affiliated fisheries corporation, handles frozen skipjack tuna. Currently, the company mainly exports frozen skipjack tuna to Thailand.

A problem for the skipjack tuna fishery is the insufficient supply of ice for refrigerating the captured skipjack tuna. MIFCO also conducts analysis of histamine in its own laboratory, and the number of detections of histamine is decreasing year by year. However, when ice for refrigeration is in short supply on a skipjack tuna fishing vessel during heavy catches, the captured skipjack tuna may be left on deck, and in such cases, histamine may be produced in the skipjack tuna. MIFCO requires that skipjack tuna be refrigerated to 15 degrees Celsius or less if landed within 24 hours of catch, and to 1 degree Celsius or less if landed more than 24 hours after catch. ENSIS promotes quality improvement by setting different purchase prices for the products that use ice and those that do not.

4.1.3 Collected Information from Bigfish

Bigfish is a relatively new fish processing company in the Maldives that began operations in 2016. Headquarters are located on Malé, and the company's processing plant is in Himmafushi Island, 15 km northeast of Malé, about 20 minutes by speedboat. Bigfish purchases skipjack tuna and yellowfin tuna and exports these products to Germany and France. The procedure for landing fish is almost the same as at ENSIS. At the landing site in the harbor by the processing plant, yellowfin tuna are graded, their body temperature is measured, weighed, and they are then transferred into the processing plant with a printed tag. Currently, about 30% of yellowfin landings are classified as Grade A.

During our observation of the yellowfin tuna landings, we found that of 36 yellowfin landed from one fishing vessel, 3 yellowfin tuna were rejected due to Yake, and from another vessel, 1 out of 15 yellowfin

was rejected.

Bigfish recognizes that Yake of the yellowfin is a problem for quality control. Currently, since the company purchases all captured yellowfin tuna of the fishing vessels, the purchase price does not vary depending on the grade (A, B, or C) of each individual fish. However, the company offers separate incentives (bonuses) as a surplus of 5 MVR/kg to skilled captains who catch high-quality yellowfin tuna. In addition, since the company is currently expanding its processing plant and needs to secure purchase volume, it is considering purchasing high-quality yellowfin tuna at a higher price. On the other hand, some captains also are more concerned about the quantity of yellowfin tuna they catch than the quality of the yellowfin tuna they catch, so the company believes that it is necessary to raise awareness and provide technical guidance to the captains and crews of yellowfin tuna fishing vessels.

Yake often occurs in yellowfin tuna caught inshore, and especially around FADs³. It is also believed to occur when fish are more violently handled by handline fishing. Handline fishing is also more likely to cause Yake because of the time it takes to catch the fish.

According to Bigfish, a Japanese technician who used to work in MIFCO taught yellowfin tuna fishing vessels how to perform the Ikejime method (nerve-tightening). Maldivian captains and other fishers who learned this technique have been using it, and as a result, the quality of the fish has improved greatly.



Photo 4-3 Staff of Bigfish on yellowfin tuna fishing vessel

4.1.4 Collected Information from Horizon Fisheries

Horizon Fisheries and its processing plant are located on Maandhoo, Laamu Atoll. The company produces canned and pouch skipjack tuna products, chilled yellowfin tuna, and fishmeal. The processing plant has a typical capacity of 35 t/day of yellowfin tuna and skipjack tuna, and can increase the production up to 70 t/day.

Histamine testing of landed skipjack tuna is conducted twice in its own laboratory, once after purchase

³ Similar opinions were heard at the Imaiyu Market in Itoman Fishing Port, Okinawa Prefecture. It might be that yellowfin tuna near floating reefs tend to swim in the warm surface waters, which is thought to cause their flesh to burn easily.

of the skipjack tuna and another after the fish has been processed into finished products. The histamine standard ranges from 40 to 100 ppm, depending on the region. The lack of ice, especially during the peak fishing season, can cause histamine problems.

4.1.5 Summary of On-board Fish Handling and Preservation in Oceanic Fisheries (Activity 1-1-1)

As a result of the survey, the problem faced by each fishery processing company was that in yellowfin tuna fishery it is difficult for fishers to produce high quality grades of yellowfin tuna due to Yake. And in the skipjack tuna fishery, there is a high risk of histamine poisoning due to fishers' lack of knowledge about histamine generation. Based on the survey results, the project discussed future action plans and reaffirmed that histamine poisoning of skipjack tuna and Yake in yellowfin tuna are still major problems.

On the other hand, as for countermeasures against histamine in skipjack tuna, each fish company is already giving guidance on keeping the fish in a cooled state by using ice as soon as possible after the fishing. They are also conducting Histamine inspections when landing skipjack tuna. In addition, each fish processing company is expanding the capacity of ice supply (freshwater or seawater) to skipjack tuna fishing vessels. The key point to instruct the fishing vessels is narrowed down to ice-cooling skipjack tuna immediately after catch. These companies can be expected to take measures and solve the problem through self-help efforts. In contrast, small-scale landings of skipjack for processing on local islands are not tested for histamine. Also, there are no personnel to provide guidance on these improvements. Therefore, some countermeasures for histamine control are needed not for large-scale fish processing companies, but for small-scale skipjack tuna fishing boats and the processors.

In yellowfin tuna fishing, the project focuses on preventing Yake. The project will raise awareness of the principle, the countermeasure, and reflection of the price and the grade among fish processing companies and fishers through the technical training programs and Japanese training programs. Yake is caused by various factors, such as; water temperature, time spent fishing, and whether or not the fish is treated on-board the fishing vessels after being caught. Therefore, MoFOR and large-scale fish processing companies suggested that when providing technical training to fishers through this project, it would be effective to provide guidance on understanding the mechanism of occurrence of Yake, improving fishing techniques, and improving on-board handling techniques. In addition, although yellowfin tuna are currently identified by grade from A to D when they are landed, the system is such that all individuals except for the reject level, which are of the poorest quality, are purchased at a uniform price. Under this system, there is no incentive for fishers to catch and land high grade tuna. It is necessary to establish a system that creates incentives for fishing vessels to produce high quality tuna. Bigfish pays incentives to certain fishing vessel that land large quantities of high-grade yellowfin tuna. Pricing based on quality and grade is considered effective in raising fisher's awareness of the importance of producing high-quality yellowfin tuna. The project recognized the need to encourage fish processing companies to offer price incentives to fishers.

In the training in Japan implemented in May 2023, the project introduced the price determination

process of the fish products and the case studies in Japan to Maldives government staff, skipjack tuna and yellowfin tuna fishers, and persons in charge in fish processing companies (Bigfish and ENSIS). For example, this includes the bidding and auction systems at fish markets, producing added value through the appropriate on-board processing, and efforts in Kochi and Okinawa Prefecture to deliberately keep catch low volumes in order to improve quality and branding. The introduction of a price differentiation based on the quality of yellowfin tuna has long been a challenge for the Maldives fisheries industry. However the new government that took office at the end of 2023 is currently discussing a review of the uniform price for yellowfin tuna.

4.2 To Develop a Best Practice Guide for On-board Fish Handling and Preservation (Activity 1-1-2)

The progress of the making of the best practice guide in the first period and second period is presented below. The best practice guides aim to be used for the teaching materials of the dissemination by the Maldivian side such as the fish processing companies after the termination of the project.

In terms of the videos, they are being broadcast in the break room for the yellowfin tuna fishers in Bigfish. They will also be disseminated through the MoFOR website and SNS platforms such as YouTube.

Table 4-2 The Progress of the Best Practice Guides

Date of preparation	Media	Contents	Remarks
First period	Brochure	1. Introduction of on-board handling for yellowfin tuna (Irabu and Ikejime method) - Distribution to fish processing companies (Bigfish, ENSIS) - Introduction of the MoFOR website - Distribution to participants on Fishermen's Day	A3 double-sided, folded in half, colour-coated paper, Approx. 500 copies (English and Dhivehi)
Second period	Brochure	1. Introducing of on-board handling for yellowfin tuna (Irabu and Ikejime method) revised edition (with additional information on the tuna ring) - Distribution to fish processing companies (Bigfish, ENSIS) - Introduction of the MoFOR website - Distribution to participants on Fishermen's Day	A3 double-sided, folded in half, colour-coated paper, Approx. 500 copies (English and Dhivehi)
	Brochure	2. Principles of histamine generation, methods of prevention and measurement of concentrations - Distribution to fish processing companies - Distribution to participants in the MoFOR-organized fish processing training	A3 double-sided, folded in half, colour-coated paper, Approx. 500 copies (English and Dhivehi)
	Video	3. How to conduct the Ikejime method and tuna ring in Japan - Distribution to fish processing companies (Bigfish, ENSIS) - Introduction of the MoFOR website and YouTube - Broadcasting to participants on Fishermen's Day	13 mins / edition, Dhivehi narration
	Video	4. Introduction of good practice of yellowfin tuna on-board handling by Maldivian fishers - Distribution to fish processing companies (Bigfish, ENSIS) - Introduction of the MoFOR website and YouTube - Broadcasting to participants on Fishermen's Day	7 mins / edition, Dhivehi narration

4.2.1 Best Practice Guide "1. Introduction of On-board Handling for Yellowfin Tuna (Irabu and Ikejime method)"

This Best Practices Guide was completed in July 2023. It was prepared based on the content of lectures given in "Activity 1-1-3: Technical Training for Local Fishers and Administrative Officials on On-board Handling and Quality Maintenance of Fish" . The pamphlets were prepared in English and Dhivehi

versions. The size of the pamphlet was A3 folded in the middle to make a four-page spread in A4 size. The pamphlet is distributed to Bigfish and ENSIS, who are cooperating with the project. This is being used for the promotion of the Irabu and Ikejime method to yellowfin tuna fishers through the persons in charge of two companies.

What is Irabu method?

The Irabu method is a technique developed by the Irabu Fisheries Cooperative Association on Miyako Island, Okinawa Prefecture, to reduce the Yake of yellowfin tuna. This method is to keep the alive yellowfin tuna in a tank filled with cool water at 8-15°C for 30 minutes. By this method, the temperature of the water cools the blood via the yellowfin tuna's gill breath, and this cooled blood circulates through the body of the yellowfin to lower the temperature in the center of the fish body, preventing the fish from Yake.

What is Ikejime method?

Ikejime means a process in which the brain and spinal nerves of the fish are destroyed on-board and the blood is removed to maintain the freshness of the fish. This process keeps the fish at sashimi grade freshness and enhances the flavor of the fish. In Japan, it is commonly used for aquaculture, hand-line fishing, fishing, and other marine fishes. It is also well known in Europe, where it is recognized as a method to produce high quality fish.

In relation to “1. Introduction of on-board handling for yellowfin tuna (Irabu and Ikejime method) revised edition (with additional information of the tuna ring) “, the information on the tuna ring was included, as it was introduced in the latter half of the project period. The tuna ring helps yellowfin tuna keep calm until being landed on-board after being hooked. It is expected that the tuna ring will contribute to preventing Yake. Its introduction was based on the favorable reputation it received from fishers.

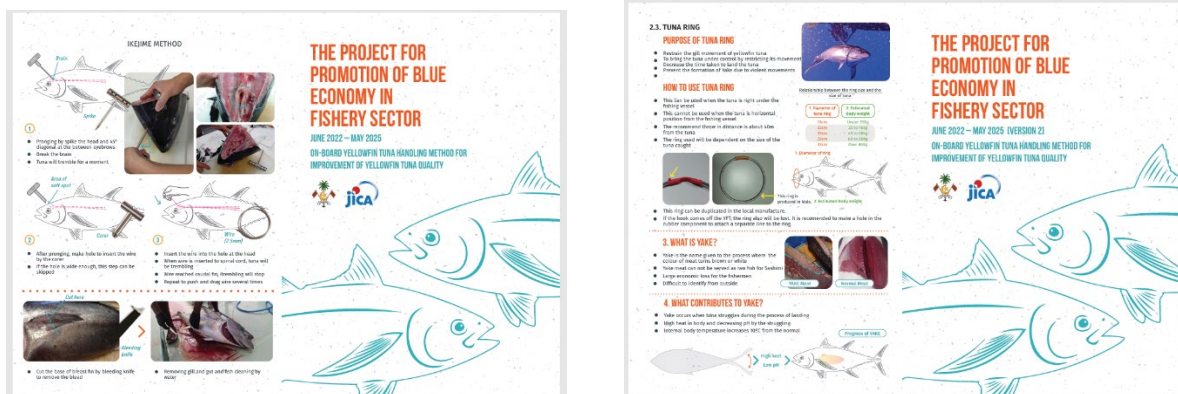


Figure 4-1 Brochures on introduction of on-board handling for yellowfin tuna
(English version, left: 1st edition, right: revised edition)

4.2.2 Best Practice Guide “2. Principles of Histamine Generation, Methods of Prevention and Measurement of Concentrations”

This Best Practices Guide was completed in March 2025. It introduces the principles of histamine generation, general prevention methods, and procedures for measuring concentration using test kits. The guide was developed based on the training materials prepared under Output 3. It is applicable not only to skipjack tuna but also to other tuna species. The guide will be utilized in fish processing training on the target islands of Output 3, as well as by skipjack tuna fishers, fish processing companies, and participants in MoFOR-organized training.

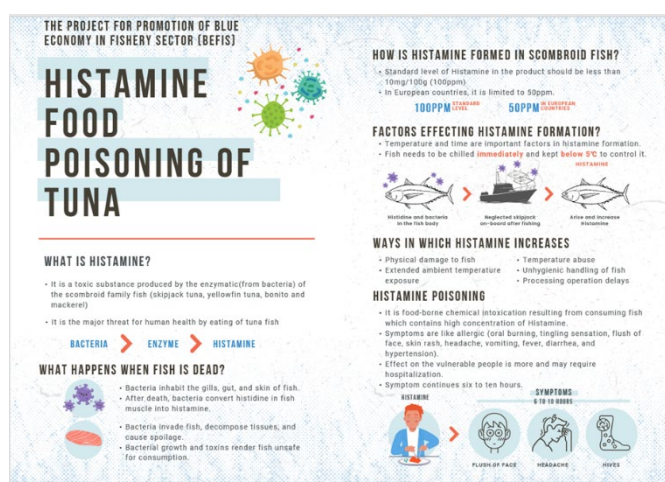


Figure 4-2 Principles of histamine generation, methods of prevention and measurement of concentrations
(English version)

4.2.3 Best Practice Guide “How to Ikejime Method and Tuna Ring (filmed in Okinawa Prefecture Japan)”

In July 2023, the project filmed the practices of experienced yellowfin tuna fishers, who are highly

skilled in on-board handling and who belong to the Itoman Fisheries Cooperative Association. The video introduces knowledge that fishers hope to learn, such as the optimal ratio of ice to seawater in storage, the use of the tuna ring, Ikejime method, and storage techniques, with narration and captions in Dhivehi. The content is presented in a clear and easily understandable visual format.

This video was finalized in May 2024 during the second period of the project. According to the review by the Deputy Minister of MoFOR and representatives of fish processing companies, the content of the video is easy to understand and received a high evaluation. The official distribution to fish processing companies will begin after its formal release by MoFOR. The video is currently being broadcast on monitors in the break rooms of yellowfin tuna fishers at fish processing companies. Fishers who come to Bigfish to land their catch typically stay in the break room for about 30 minutes to an hour after their work. It is expected that showing the video in the break room, which is visited by dozens of fishing vessels almost every week, will have a meaningful educational effect. In addition, the video is also being disseminated through the MoFOR website and online platforms such as YouTube.



Figure 4-3 A shot of introducing Ikejime in the video

4.2.4 Best Practice Guide “Introduction of Good Practice of Yellowfin Tuna On-board Handling in Maldives”

This video was completed in June 2025. It introduces the Irabu method, Ikejime method, and tuna ring method, along with those effects. The video, approximately seven minutes in length, was filmed and edited using footage from actual yellowfin tuna fishing vessels that received project training in Maldives. The initial plan was for the filming to be conducted by JICA experts and project counterparts on a cooperating yellowfin tuna fishing vessel. However, due to unexpected bad weather conditions and poor fishing, this was not possible. Instead, the project requested selected cooperating yellowfin tuna fishing vessels to record on-board handling using their smartphones. The final video was edited from materials provided by three vessels. The video is also being utilized for technical extension, through broadcasting on the internet and in the break rooms of fish processing companies.

4.3 To Provide technical Training on On-board Fish Handling and Preservation for Local Fishers and Government Officials (Activity 1-1-3)

Based on the findings of the Activity 1-1-1 summary of on-board fish handling and preservation in oceanic fisheries, from the first period of the project, the following training was planned for yellowfin tuna fishing vessels. The contents of the training were about on-board handling for yellowfin tuna. So, the targets were the main fish processing companies that trade in yellowfin tuna, Bigfish and ENSIS, and yellowfin tuna fishers who land the catches at these companies.

Table 4-3 Outline of Training for On-board Yellowfin Tuna Handling

Objective of the training	To learn basic knowledge of yellowfin tuna ecology and quality maintenance after fishing To learn new on-board handling methods.
Implementation site	Facility of Bigfish and ENSIS (Lecture room)
Participants	Captains and crews of yellowfin tuna fishing vessels Staff of fish processing companies
Lecture hours	About 2 hours/time (available waiting time for fish landing)
Contents	(1) Swimming behavior, feeding, reproduction, abundance and habitat of yellowfin tuna (2) Irabu method for Yake prevention (3) Ikejime method (4) Effect of the tuna ring (5) How to use the tuna ring (6) Questions and answers

The above training was conducted for a total number of 19 yellowfin tuna fishing vessels and 2 fish processing companies from November 2022 to November 2024. The total of the participants is 136 fishers (First period: 79 participants, Second period: 57 participants). In first period of the project, the training content did not include the tuna ring as (4)(5), however, from January 2024 in the second period, the introduction of the tuna ring was added. Initially, the project established the cooperation with Bigfish, the training was only conducted in the lecture room of Bigfish's processing factory located on Himmafushi Island. However, by the request of ENSIS, the training was also conducted at ENSIS located on Hulhumale from June 2024. Participants in the training are yellowfin tuna fishers recommended by Bigfish and ENSIS. The training is conducted when the yellowfin tuna fishing vessels are at the port to land the catches. In addition to the recommended captain and crews of yellowfin tuna fishing vessels, other yellowfin tuna fishers interested in on-board fish handling also participated. The record of the training participants is shown below.

Table 4-4 Participants of the 1-1-3 Training for the Irabu and Ikejime Methods

No.	Date	Vessel or fish processing company	Content			No. of participants	Place
			Irabu to prevent Yake	Ikejime	Tuna ring		
1	2022/11/8	Bigfish	○	○		2	Bigfish
		FAZA	○	○		9	
2	2022/11/8	R	○	○		2	Bigfish
3	2022/11/8	HASSA	○	○		11	Bigfish
4	2022/11/9	Mofa325	○	○		5	Bigfish
5	2022/11/9	Jarakaaku	○	○		1	Bigfish
6	2023/1/23	Asaree	○	○		14	Bigfish
7	2023/1/25	Tuna3	○	○		13	Bigfish
8	2023/1/25	Nafa	○	○		1	Bigfish
9	2023/1/25	Vilu Roachit	○	○		4	Bigfish
10	2023/1/25	Dhiraasa	○	○		6	Bigfish
11	2023/7/10	Kingfisher	○	○		11	Bigfish
12	2024/1/17	Bigfish			○	2	Bigfish
13	2024/1/17	Maafahi			○	5	Bigfish
14	2024/1/17	FRESH-01			○	6	Bigfish
15	2024/1/18	NIRU7			○	15	Bigfish
16	2024/1/28	ASURUMA3			○	14	Bigfish
17	2024/6/10	Kurimagu-2	○	○	○	1	ENSIS
18	2024/6/10	Zikura-3	○	○	○	1	ENSIS
19	2024/6/10	ENSIS	○	○	○	3	ENSIS
20	2024/11/16	Zoom Fisher			○	2	ENSIS
21	2024/11/16	NOORU			○	4	ENSIS
22	2024/11/18	Jihaad2			○	4	ENSIS
Total			15	15	11		

The project introduced the tuna ring from January 2024 as the second period. The yellowfin tuna fishers are highly interested in the tuna ring. At least, 4 yellowfin tuna fishing vessels that received the training on the tuna ring have already manufactured their own rings based on samples provided by the project. They utilized it. The project ordered the prototype in a factory in Male to aim at the mass-production of the tuna rings so that yellowfin tuna fishing vessels interested in the tuna rings could purchase them in the Maldives. Ten prototype samples were obtained on June 10, 2024. Although the part of the prototype where the line is threaded when a tuna is caught is slightly different from the original, the quality of the rings (stainless steel SUS316) and ease of use are comparable to those of the original. Some of these rings were provided to ENSIS and participants on Fishermen's Day to help promote the use of the rings on yellowfin tuna fishing vessels.



Photo 4-4 Tuna ring fits to the gill cover of yellowfin tuna



Photo 4-5 The original ring from Japan (left) and the prototype in Maldives (right)

According to the work plan, the training was originally scheduled to be conducted six times in total. However, it was already conducted 11 times by the end of the first period. It was held 8 times in the second period. The training is exceeding the expected number. As part of the dissemination effect, the initiation at ENSIS, and the revision of training contents, the training continued throughout the second period. In total, 22 times were ultimately conducted.



Photo 4-6 Training of Activity 1-1-3 (left: participants, right: A lecture by the JICA expert)



Photo 4-7 Training for yellowfin tuna fishers and fishing vessels at fishing port

4.4 To Monitor the Effect of Improved On-board Fish Handling and Preservation (Activity 1-1-4)

4.4.1 Implementation of Monitoring Activity

After the technical training Activity 1-1-3, the project obtained the grading data of one operation using the Irabu method from the participants via Bigfish. The grading data by the normal method of other vessels and the Irabu method were compared. It showed that the improved method resulted in a higher percentage of Grade A than the normal method. Due to the limited number of the sample, this data isn't to show appropriate evaluation. However, the person in charge of Bigfish is feeling the effect of the Irabu and Ikejime methods.

This activity to evaluate the activity 1-1-3 was conducted to establish the monitoring method in collaboration with the fishing vessels participating in the training of the Irabu and Ikejime methods. This activity doesn't target ENSIS, because the training in ENSIS was begun after the second period and also because its collected data was insufficient for analysis.

As a result of the discussion in the project, the monitoring method was planned shown below.

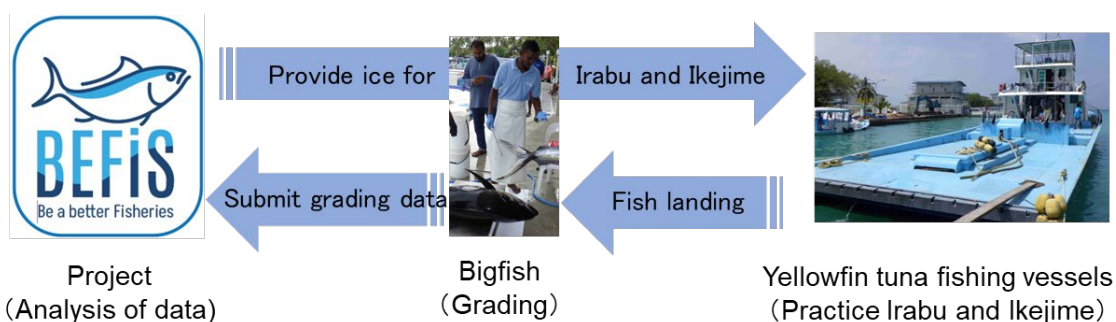


Figure 4-4 Picture of the system for monitoring the effects of improvements

The monitoring was designed to compare the grading data of yellowfin tuna using the Irabu method and the existing method on the same fishing vessel that participated in the training. The grading results were planned to be provided by Bigfish. However, the Irabu method requires more ice than the conventional method. Therefore, the project planned to supply the necessary ice to the target fishing vessels in order to prevent discontinuation of the Irabu method due to the economic loss.

An oral agreement was reached with the CEO of Bigfish, and the project began preparations. However, since an MOU with Bigfish wasn't signed as of July 2024, the project abandoned the implementation of this monitoring method.

Regarding the evaluation of grading for tuna rings and the Ikejime method, repeated requests were made to the staff of Bigfish to share the grading data from the landings of yellowfin tuna caught by the fishers who had received training under the project. However, since no data had been shared by September 2024, JICA experts and counterparts visited the Bigfish landing site and directly negotiated with the staff, and by doing so were finally able to obtain part of the grading data.

4.4.2 Results for Output 1 Indicator

Regarding the output 1 indicator “The grade of yellowfin tuna treated on-board with fish handling techniques learned through the project improves by 30% (fewer C-grade and rejected fish) in comparison with untreated yellowfin tuna caught under similar fishing conditions”, the effects of the Irabu method, Ikejime method, and the tuna ring were evaluated separately based on the monitoring data.

The monitoring utilized vessel and fish specific grading data obtained from Bigfish in November 2024. The target fishing vessels were Asaree, NIRU-7, ASURUMAA3, and JAVAHIRU. Among these, only Asaree practiced the Irabu method, the Ikejime method was applied on NIRU-7 and ASURUMAA3, and the tuna ring was used on NIRU-7, ASURUMAA3, and JAVAHIRU. In addition, NIRU-7 and ASURUMAA3 applied both the Ikejime method and the tuna ring in combination.

For the evaluation of effects, the Irabu method was assessed by comparing data from tuna catches treated with the Irabu method and those without treatment, both landed by Asaree in May 2023. For the Ikejime method and the tuna ring, the evaluation compared the data of tuna landed after the fishers received training under the project (November 2024) with data from the same period in the previous year, November 2023, before the training.

(1) Irabu method to prevent Yake

The table below compares the grading ratios of yellowfin tuna from a fishing vessel that applied Irabu method with those obtained without using the method. Both sets of data are from the same vessel and the same fishing period (May 2023).

Table 4-5 Comparison of the Results of the Irabu Applied Group and the Non-Applied Group

	Grade A	Grade B	Grade C	Grade D	Total
Yellowfin tuna with the Irabu method applied (Applied group, 15 fish)	20.0%	46.6%	26.7%	6.7%	100.0%
Yellowfin tuna without Irabu method (Non-applied group, 101 fish)	0.0%	61.3%	34.7%	4.0%	100.0%

As a result, the proportion of grade C and D tuna was 33.4% (C: 26.7%, D: 6.7%) in the group where the Irabu method was applied, and 38.7% (C: 34.7%, D: 4.0%) in the non-applied group, showing a difference of 5.3% points. This indicates a tendency for the applied group to have a lower proportion of lower-quality grades (C and D). Furthermore, as mentioned earlier, the fisher who practiced the Irabu method (captain of NIRU-7) reported that the flesh quality of yellowfin tuna treated with the method was very good, and he recognized its effectiveness. However, since the number of samples treated with Irabu method was only 15, the results were not used for the evaluation of the output 1 indicator.

(2) Ikejime method

Regarding the grading results of yellowfin tuna treated with the Ikejime method, the proportion of grade C and D was 31.8% (C: 31.8%, D: 0.0%) in the Ikejime group, compared to 40.0% (C: 33.2%, D: 6.8%) in the non-Ikejime group, showing a difference of 8.2% points. This indicates a tendency for the Ikejime group to have a lower proportion of lower-quality grades (C and D) (Table 4-6).

Although this result suggests the effectiveness of Ikejime, due to the limitations of the available data, the applied and non-applied groups were based on different vessels. Furthermore, both vessels had already been practicing Ikejime prior to receiving project training. Therefore, it cannot be concluded that the observed effect is attributable to the project. As the comparison was not appropriate, the results could not be applied to the evaluation of the output 1 indicator.

Table 4-6 Comparison of the Results of the Ikejime Applied Group and the Non-Applied Group

	Grade A	Grade B	Grade C	Grade D	Total
Yellowfin tuna applied Ikejime (Ikejime applied group, 319 fish)	18.8%	49.4%	31.8%	0.0%	100.0%
Yellowfin tuna without Ikejime (non-applied group, 439 fish)	17.0%	43.0%	33.2%	6.8%	100.0%

(3) Tuna ring

For the tuna ring, grading data were obtained from three vessels: NIRU-7, ASURUMAA3, and JAVAHIRU. Among these, JAVAHIRU was excluded from the analysis due to the imbalance in the number of samples between the applied and non-applied groups (439 vs. 150, respectively) and the fact that, unlike the other two vessels, it did not use the tuna ring in combination with Ikejime. Therefore, the analysis was conducted using data from NIRU-7 and ASURUMAA3, which had a balanced number of samples and applied the tuna ring together with Ikejime. The results are shown in Table 4-7.

In the tuna ring-applied group, the proportion of grades C and D was 33.2%, while in the non-applied group it was 71.8%, showing a difference of 38.6% points. This confirmed the positive effect of the tuna ring in improving the quality of yellowfin tuna. Based on this result, the target under Output 1 was assessed to have been partially achieved.

Table 4-7 Comparison of the Results of the Tuna Ring Applied Group and Non-Applied Group

	Grade A	Grade B	Grade C	Grade D	Total
Yellowfin tuna applied tuna ring (Applied group, 319 fish)	15.7%	51.1%	33.2%	0.0%	100.0%
Yellowfin tuna without tuna ring (not applied, 376 fish)	2.1%	26.1%	50.0%	21.8%	100.0%

4.4.3 Result of Monitoring for Output 1 in Project Purpose

To measure the Project Purpose indicator “The ratio of yellowfin tuna caught using on-board fish handling on fishing vessels supported by the project increases by 50%”, a survey was launched in November 2024, when the indicator was reset, to assess the extent to which the three on-board handling techniques for preventing Yake in yellowfin tuna - namely, the Irabu method, Ikejime, and tuna ring - were being practiced by the trained fishing vessels.

Initially, an interview survey was conducted using a Google Form prepared by the counterpart. However, despite repeated calls from MoFOR to the target fishers, no responses were received, and no data had been collected as of April 2025. Therefore, from 4th May 2024 onward, when the JICA expert in charge arrived in the field on the final mission, interviews were carried out directly at the fish landing site when the target fishing vessels were Bigfish and ENSIS. In parallel, telephone interviews with fishers were initiated by the counterpart.

As a result, responses were obtained from four out of the 20 target vessels. The collected results are presented below.

Table 4-8 Results of the Interview Survey for Output 1 Indicator

Name of fishing vessel	Ratio of yellowfin tuna applied by on-board handling techniques learned in the training (%)		
	Irabu method	Ikejime method	Tuna ring
Asuruma	0%	100%*	100%
NIRU-7	0%	100%*	100%
Javaahiru	0%	0%	61%
Tuna-3	0%	100%	0%

Asuruma and NIRU-7 had been practicing Ikejime method before learning it from the project.

According to the interview survey, all four respondent yellowfin tuna vessels were applying at least one of the three techniques learned through the project. However, no vessels were found to be practicing the Irabu method. Throughout the entire project period, only one case of applying the Irabu method was confirmed, involving just 15 yellowfin tuna. Fish processing companies pointed out the following factors as reasons for the extremely limited application of the Irabu method:

- Lack of space on deck to install a fish storage tank dedicated to the Irabu method
- Insufficient capacity to provide ice for cooling the seawater in the tank
- No available time to keep live yellowfin tuna in the storage tank for 15–30 minutes

According to the only fisher who practiced the Irabu method (captain of NIRU-7), when live yellowfin tuna were placed in a tank, they thrashed violently and damaged the tank, so only one operation was performed. However, he stated that the quality of the yellowfin tuna processed using the Irabu method was excellent. He would like to try it again if given the opportunity. Furthermore, three of the 4 vessels that responded indicated that they would like to learn more about the Irabu method through training, suggesting that there is considerable interest in the Irabu method among fishers.

Regarding Ikejime, three of four vessels reported that they were applying it, but two of these (Asuruma and NIRU-7) reported that they had been practicing Ikejime even before receiving training from the project. Only one vessel (Tuna-3) began applying it after learning from the project. The captain of the only yellowfin tuna vessel (Javaahiru) that does not perform Ikejime commented that the project primarily taught by lectures using slides and video materials. He would have preferred practical training on-board. Regarding Ikejime, three out of 4 vessels are practicing it, and the remaining vessel also expressed a desire for further training, indicating a high demand for this technique.

Regarding the tuna ring, three out of the four vessels had adopted it following the project's introduction. All three vessels understood how to use ring properly and indicated that no additional training was necessary. However, they pointed out that a problem arises when yellowfin tuna slips off the hook before being brought on-board, as the tuna ring is then lost. The three vessels applying the tuna ring were already purchasing the materials themselves and manufacturing the rings on board. Although the project provided guidance for production at a factory in Malé and enabled them to place orders, fishers continue to manufacture the rings themselves to obtain them at a lower cost. In this case, the cost per ring is 50 MVR (460 JPY), which is much cheaper than ordering from the Malé factory at 200 MVR (1,900 JPY). Interviews with fishers who manufacture their own tuna rings revealed that losing several rings per fishing operation is not a financial concern. This indicates that fishers have different perspectives regarding expenditures.

According to staff members in Bigfish and ENSIS, due to the poor yellowfin tuna catch since last year, many vessels have shifted from yellowfin tuna fishing to skipjack fishing, and some of the target vessels have even been decommissioned. They also noted that it has become difficult to contact some vessels, as they no longer answer phone calls. Among the 20 vessels that received training, four have been decommissioned, and another four cannot be reached due to reasons such as changing the company to which they land their catch. In total, contact with eight vessels is no longer possible.

The project promoted three on-board fish handling techniques—the Irabu method, Ikejime, and tuna ring—to improve the quality of yellowfin tuna. While the development of training materials and the training of yellowfin tuna fishing vessels proceeded smoothly, it was difficult to collect sufficient information through monitoring to analyze the effectiveness of these techniques. The Irabu method was

confirmed in only one case, and for Ikejime, half of the vessels that provided responses had already been using the technique prior to the project, making it difficult to conclude that the project successfully promoted its adoption. Regarding the tuna ring, some vessels applied it, and certain effects were confirmed, such as fishers producing the rings themselves.

Even today, yellowfin tuna purchases in Maldives are not differentiated by quality, and grades A through C are bought at the same price as a bulk purchase. In some fish processing companies, small incentives have been observed, such as offering an additional 5 MVR/kg for grade A or providing extra ice free of charge as a bonus. However, these minor incentives do not seem to motivate many yellowfin tuna fishers to improve quality. While the benefits of the Irabu method and Ikejime for preventing discoloration are well understood in Japan, the purchasing system in Maldivian tuna fishery is likely a barrier to their widespread adoption. Unless the yellowfin tuna purchasing practices in Maldives change, significant improvements in fish quality are unlikely without a major shift in fishers' awareness and behavior.

However, regarding the tuna ring, in addition to preventing Yake, it has the effect of controlling the movements of yellowfin tuna when they are hauled on-board. This allows the time required to bring the tuna aboard to be reduced to nearly half of the usual time, shortening the time needed to fill the vessel to capacity (i.e., increasing income opportunities) and reducing the labor required by fishers. For these reasons, the tuna ring has received positive recognition from yellowfin tuna fishers, and it was even showcased by fishers practicing it during Fishermen's Day last December. Thus, in addition to preventing Yake, it is desirable to promote the tuna ring by highlighting its benefits in improving catch efficiency in the future.

4.5 To Facilitate Business to Business Linkages for the Promotion of Key Fishery Products (Activity 1-2-1)

As part of business linkage activities, a meeting was held on November 19, 2024 with the MSPEA to share information aimed at promoting the dissemination of on-board handling technology for yellowfin tuna fishing vessels. The meeting included an overview of the project, an explanation of the principle, usage, and benefits of the tuna ring, as well as a Q&A session. In addition, an upcoming seminar scheduled for May 2025 was introduced as an opportunity to establish further business linkages for the dissemination of the technology, and cooperation for the seminar was requested. Furthermore, Project Director Dr. Sinan also requested MSPEA's cooperation in strengthening business linkages and promoting the adoption of on-board processing technologies. MSPEA responded positively, expressing their willingness to cooperate with future project activities and the broader dissemination of the technology.

Since the objective of this activity is to promote business linkages for the marketing of major fishery products, efforts were directed toward establishing a platform for business linkages. Therefore, at the final project seminar scheduled for May 2025, a plan was made for the Government of Maldives to take the lead in establishing a platform through which private companies could share information on on-

board handling technologies for yellowfin tuna and related topics. However, Dr. Sinan made a presentation explaining that MoFOR already has an existing platform for collaboration with fish processing companies—namely, a framework for information sharing between MoFOR, MSPEA, and fish processing companies. Therefore, it was decided to make use of this existing platform to promote future information sharing concerning on-board processing technologies and to encourage the establishment of appropriate pricing for yellowfin tuna.

4.6 Future Issues of Activities in Output 1

Based on the agreement of final JCC, Training and Extension section of MoFOR will continue to promote the on-board quality improvement technologies developed through the project. The specific methods of dissemination are outlined as follows:

- The best practice guide video materials (Ikejime and tuna ring) introduced during the project's final seminar will be made available on the MoFOR website and YouTube channel. These resources will also be shared widely with the fishing industry via MoFOR's social media platforms, including Facebook and Instagram.
- The video materials and outcomes of the project's activities will be publicized through Public Service Media (PSM), specifically via fisheries-related programs.
- In collaboration with various fish processing companies, the video materials will be shown in break rooms for fishers who land off their catches, ensuring broader exposure to the practices. With the continued support from the respective fish processing companies, MoFOR will provide ongoing training to fishers and monitor their application of the on-board quality improvement technologies. The existing platform between MoFOR and fish processing companies will be utilized to facilitate information sharing throughout the dissemination process.

5. Output 2: Resource-efficient Production methods are Aadopted in the Live-bait Fishery(Blue Production)

5.1 To Conduct Improvement of On-board Live Bait Stocking System and Facilitate its Adoption to Fishing Vessels

5.1.1 Background of the Activity

(1) The circumstances of the previous project (MASPLAN)

This activity is based on the results of efforts to improve live bait tanks and other activities that were demonstrated in the “PP-1: Technical development and verification of live bait catch and holding for improving their survival rate” Pilot Project of the Project for the Formulation of Master Plan for Sustainable Fisheries (MASPLAN), which was implemented from 2014 to 2018. MASPLAN conducted a detailed survey of the structure of live bait tanks and the utilization of live bait on Maldivian skipjack fishing vessels to identify problems, and then verified the effectiveness of modifications to the live bait tanks of project partner vessels to improve the live bait survival rate or extend the survival period.



Photo 5-1 Maldivian skipjack tuna Pole-and-Line fishery

The sprats (*Spratelloides spp.*) and cardinalfishes (Apogonidae), which are used as the main live bait, are essential and important resources for the Maldivian skipjack fishing industry. Each pole and line fishing boat catches these live baits around the reef with a lift net or scoop net (using fish-aggregation lights at night) and moves them into live bait tanks prior to the single-fishing operation. However, in today's Maldives, where fishing vessels are becoming larger and operating longer, live bait often dies within a short period of time compared to the number of days of operation, forcing fishers to suspend operations and go back to catch live bait in order to secure sufficient baits. This means that many live baits are thrown away without being used, leading to a waste of resources. In addition, as fishing vessels have become larger, the amount of live bait loaded at any one time has continued to increase, and the amount of live bait resources wasted has also increased, which is thought to be a cause of the resource problems that have emerged in recent years. Furthermore, frequent trips to live bait fishing grounds are a waste of fuel and time, which is also an economical problem for fishers.

Based on the above current situation, MASPLAN had found that the main causes of the low survival

rate and short survival period of live bait on Maldivian skipjack pole and line fishing vessels are (i) inefficient water circulation in the live bait tank, (ii) high tank water turbulence, (iii) no discharge mechanism for dirt accumulated in the tank bottom layer and (iv) damage to live bait when live bait is caught and placed in the tank. With regard to (i), many fishing vessels are constructed so that water is supplied from the tank surface layer and drained from the surface layer as well. This meant that water circulation took place only near the surface in many cases, and the water at the bottom of the tank was stagnant, leading to a decrease in dissolved oxygen and a deterioration of water quality due to feces and dead fish.

The reason for (ii) is that the water surface in the tank is below deck, so the tank water is structured in such a way that when the ship rocks, the tank water is also greatly turbulent. The Maldivian skipjack fishing vessels were originally designed with two large live bait tanks, and as the size of fishing vessels has increased in recent years, the live bait tanks have also tended to get larger, and it was assumed that this has led to greater tank water turbulence. This is thought to cause water turbulence that physically stresses the live bait, as well as causing the overall tank water environment to deteriorate as dirt that has settled at the bottom roils up with the sewage.



Photo 5-2 Existing live bait tank of Maldivian dhony

With regard to (iii), it was found to be a major factor in the deterioration of the water environment in the tanks. When large amounts of dead baits and other dirt accumulate at the bottom of the tank, a crew member with a suction hose dives into the tank to clean it, but this method leads to the deterioration of the water environment as it roils up sewage.

Regarding (iv), as live bait caught with a lift net is scooped up with a scoop net when it is moved to the live bait tank, the live baits in the lower part of the scoop net are damaged by the weight of the fish on top. Therefore, it was assumed that many of the live baits were already dead or unable to swim when they were placed in the tanks, and that many of the others had reduced vitality.

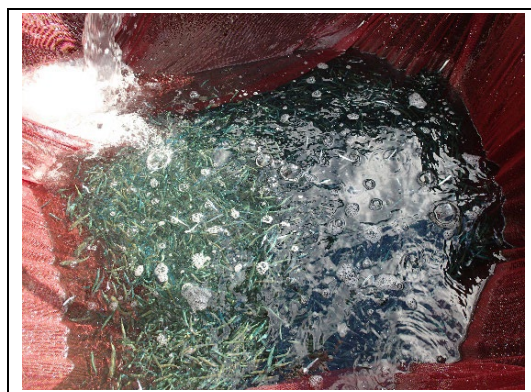


Photo 5-3 The live baits in the tank

To address the above issues, MASPLAN's pilot project tested the following technologies:

1) Improvements to live bait tanks

To address the problems identified above, the following functions were added to existing live-bait tanks on fishing vessels: (i) water supply into the middle and bottom layers of the tank; (ii) drainage from both the bottom and the surface; (iii) raising the water level by narrowing the opening to reduce sloshing; and (iv) discharge of dead fish and other settled material from the bottom.

Figure 5-1 shows a schematic. (Not shown in the figure, but measures included routing the inflow piping to the mid- and bottom layers and installing lines to maintain continuous bottom drainage, thereby improving circulation efficiency.) The modifications were confirmed to be effective.

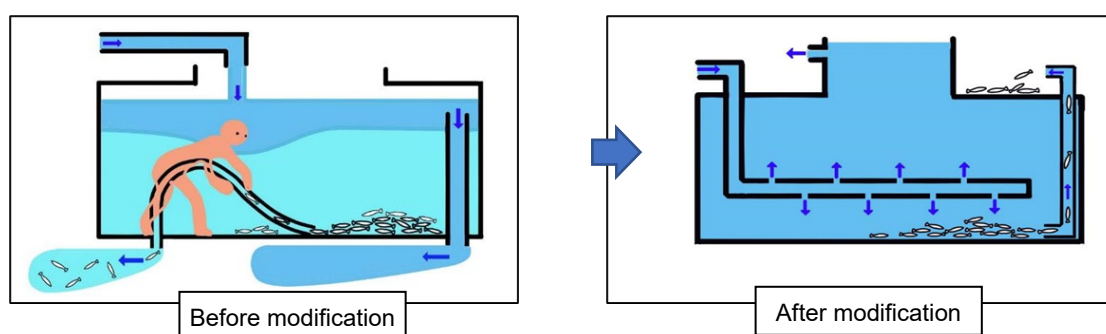


Figure 5-1 Schematic of live-bait tank modifications under MASPLAN

2) Introduction of the Water Scoop Net

A Water Scoop Net is a type of landing net designed to scoop fish together with water, preventing the fish from coming into direct contact with the mesh. When used to transfer caught live bait into the live bait tank, it was considered to reduce damage to the live bait. The basic structure involves attaching a waterproof fabric to the net frame instead of mesh, enabling it to hold water. Just below the frame, a mesh layer is installed to prevent fish from escaping together with the water when it overflows, allowing only the water to drain. Figure 5-2 shows the structure of the water scoop net introduced under MASPLAN. Results from the pilot project suggested that the basic structure of the water scoop net was

effective in reducing damage to live bait during capture compared to conventional landing nets.

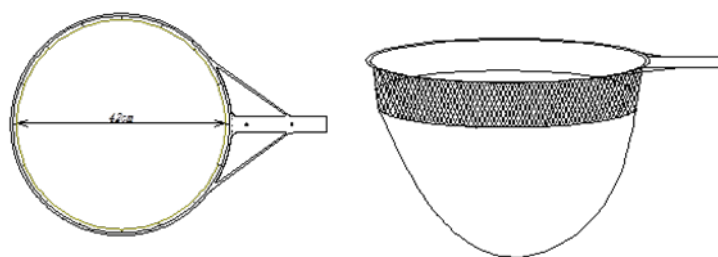


Figure 5-2 Structure of the water scoop net introduced under MASPLAN

(2) Project Policy for Improving Live Bait Tanks

The policy of this project, based on the MASPLAN results, was to promote dissemination of the technology. However, while MASPLAN identified the necessary improvements to enhance the survival rate, prolong the holding time, and maintain the vitality of live bait (hereafter referred to as “improvement of live bait”), it became clear that simply disseminating the improved live bait tank method developed under MASPLAN was difficult due to the following reasons:

<Live Bait Tank Modification Technology>

Under MASPLAN, modifications were carried out on cooperative Dhonies by JICA experts visiting their home ports, instructing local boatbuilders (FRP technicians) on how to perform the modifications. As a result, only one boatbuilder retained this knowledge, making it difficult for pole-and-line fishing vessels to independently improve their live bait tanks. Moreover, the live bait tanks developed under MASPLAN were custom-designed from scratch to fit existing vessels, making it difficult to introduce identical systems to other vessels. Therefore, there was a need to develop a system that could produce similar results by adding retrofit parts without changing the tank design itself.

<Prolonged Dissemination Period>

Even if the above technical issues were resolved, MASPLAN’s modification method required examining and designing a structure tailored to each vessel on site, taking at least about one week for construction. However, fishing vessels operate year-round, usually with 10–20 crew members, and suspending operations for a week would reduce fishers’ incentive to carry out modifications. Under MASPLAN, modifications were conducted during the long post-Ramadan holiday, but if such work were concentrated in that period during dissemination, it would still take a long time to spread.

For these reasons, this project aimed to address MASPLAN’s remaining technical challenges for dissemination and to shorten the dissemination period by developing and promoting an “improved live bait tank system unit” that upgrades existing tanks through retrofitting. The plan was to manufacture the improved units in an onshore factory, transport them to fishing ports, and install them on vessels with only minimal work such as piping and sealing. Figure 5-3 shows the current structure of local fishing

vessels' live bait tanks and the improved holding system.

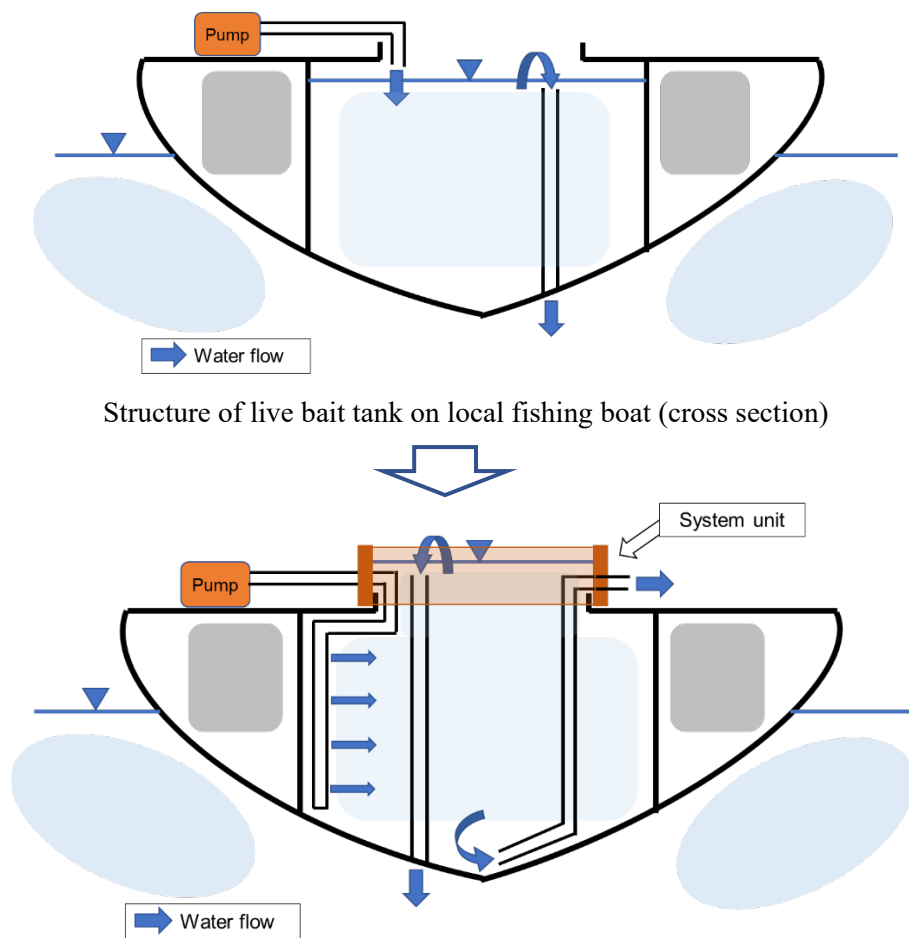


Figure 5-3 Improved live bait tank using a system unit

The typical live bait tank on a Maldivian fishing vessel has the water surface of the tank below the deck, with the inlet of the supply pipe above the water surface and overflow drainage mainly done through the cross-section of a PVC pipe standing inside the tank, leading to a hole opened at the bottom of the hull. The improved live bait tank using the system unit incorporates mechanisms such as a water-level raising device to prevent tank water agitation, shower-type supply piping that extends the supply pipe inside the tank and delivers water through multiple small holes, improved surface-level overflow drains, and water pressure-type drainage pipes from the bottom. Additional functions such as aeration are also considered if necessary. The bottom drainage pipe also serves as a mechanism for discharging dead bait.

(3) Procedure for the Development and Dissemination of Improved Live Bait Tanks

The development and dissemination of improved tanks were carried out in the following stages. As mentioned above, cooperation with private companies engaged in FRP processing and shipbuilding was essential for the development and dissemination of this system unit, and the goal was for the developed

system to be sold by such companies in the future.

- I. Selection of cooperating company to manufacture the system unit and Cooperative Dhonies for the project
- II. Design of the system unit by the project and the cooperating company
- III. Prototyping of the system unit by the cooperating company
- IV. Retrofitting of the prototype system unit to the cooperative dhony and modification work
- V. Trial operation by the cooperative dhony and improvement of identified issues
- VI. Design of the dissemination model system unit
- VII. Manufacture and sale of the system unit by the cooperating company

5.1.2 Current Situation Survey and Selection of Cooperating Company

(1) Current Situation Survey

In August 2022, a project team consisting mainly of JICA experts and MoFOR counterparts in charge of this activity conducted a survey on the current situation of fishing vessels and Live Bait Tanks.

Table 5-1 Overview of the Current Situation Survey on Pole-and-Line Fishing Vessels and Live Bait Tanks (2022)

Date	Survey Location	Survey Items
Aug 9	Hulhumale Fishing Port, Malé Atoll	Survey of vessels landing at ENSIS
Aug 11	Vilin'gili Island, Malé Atoll	Visit to factories of FRP processing and shipbuilding companies
Aug 14	Himmafushi Island, Malé Atoll	Survey of vessels landing at Bigfish
Aug 18	Malé City	Discussion with GFF Co. on building cooperative relations
Aug 19–20	Gemanafushi Island, Gaafu Alifu Atoll	Survey of vessels based in Gemanafushi; on-board observation of pole-and-line fishing and live bait capture operations
Aug 21	Gaddhoo Island, Gaafu Dhaalu Atoll	Survey of shipyards for pole-and-line fishing vessels
Aug 22	Malé City	Second discussion with GFF Co.

The survey confirmed that the structure of live bait tanks on many fishing vessels had not changed significantly from those identified in MASPLAN's survey. However, in the case of new vessels, some supply piping was designed with efficient water circulation in mind, and some had adopted the structure introduced by MASPLAN to raise the tank water surface above the deck. This suggested that fishers'

awareness of live bait improvement had increased. The raised-water-surface structure was referred to as the “JICA type” among local fishers, and the number of vessels adopting it was increasing. Although the structure only involved raising the water surface and lacked surface-level drainage mechanisms, the fact that the achievements of the previous project had been spreading in this way indicated a high likelihood that the improvements to live bait tanks through the system unit promoted in this project would also be positively accepted.

	
Dhony at Hulhumale	Factory of GFF
	
Survey of live bait tank at Himmafushi	The depth of tank is close to 3m
	
The live bait tank of the dhony in Gemanafushi	Boat building area at Gaddhoo



Photo 5-4 Existing Bait Tanks

(2) Selection of Cooperating Company

The development and dissemination of the improved live bait tank system unit required the cooperation of private companies engaged in FRP processing and shipbuilding. While MoFOR had facilities to make prototypes, it did not have the capability to overcome the above issues with live bait tanks and to manufacture and efficiently retrofit the units to fishing vessels. For sustainable dissemination in the future, it was necessary for private companies to commercialize and sell the system, and the project adopted the policy of selecting promising private companies and building cooperative relationships on this basis.

While consulting with MoFOR, the project searched for private companies capable of FRP processing and shipbuilding. However, Maldivian shipbuilders traditionally construct fishing vessels without using blueprints, making it difficult for them to apply detailed customizations, and thus collaboration with the project was challenging. In this situation, through arrangements by MoFOR, the project visited Vilin'gili Island in Malé Atoll on August 11, 2022, where several FRP processing companies were located, and visited three candidate companies for factory inspections. Among them, GFF⁴ had grown by developing, manufacturing, and selling large cool boxes for yellowfin tuna, and now manufactured small fishing vessels and pleasure boats in the traditional Maldivian hull form. Their cool boxes for yellowfin tuna had greatly contributed to the development of Maldivian tuna fisheries in the early 2000s by providing refrigeration capacity for vessels without large fish holds. Although the demand for cold boxes had declined due to the increasing number of vessels equipped with large fish holds for yellowfin tuna, GFF remained the only company visited that had a deep understanding of Maldivian fishing vessels and was eager to remain involved in fisheries development.

During the factory visit, the project explained the outline of the project and the idea of the live bait tank improvement system unit to GFF's representative, Mr. Mohamed Nabeel, who showed great interest. This led to concrete discussions at GFF's Malé office on August 18. Based on this process, it was decided to proceed with cooperation with GFF in designing and prototyping the unit and retrofitting

⁴ The FRP division of GFF became an independent company called Facture in 2025. Although this project was carried out with Facture after the split, for convenience, this report will uniformly refer to the company as GFF.

it to the cooperative dhony. Initially, it had been planned to design and manufacture the prototype unit in Japan, but with the establishment of the cooperative relationship with GFF, this work was carried out locally.

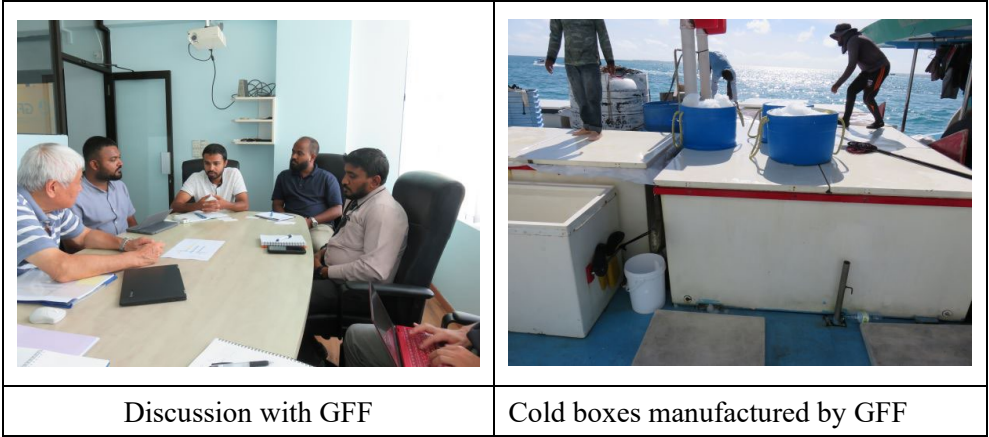


Photo 5-5 Discussion with GFF

5.1.3 Installation of the Improved Live Bait Tank System Unit (Prototype) on Cooperative Dhony (Activity 2-1-1)

(1) Selection of Cooperative Dhony

From August 2022, MoFOR began public recruitment of cooperative dhonies to collaborate in fitting the improved live bait tank system unit and verifying its effectiveness. Initially, recruitment targeted fishers on Gemanafushi Island—where MoFOR had a strong track record of cooperation through other projects—via the Island Council, but no applications were received by the end of August. Therefore, the target area was expanded to include the southern Maldives, where many pole-and-line fishing vessels operate. As a result, in September, an application was received from the *Kamana*, a vessel based in Madaveli Island, Gaafu Dhaalu Atoll, and approval was obtained within MoFOR at the end of September, confirming it as the cooperative dhony.

(2) Design of the Improved Live Bait Tank System Unit (Prototype)

Based on detailed information about the Live Bait Tank of the *Kamana*, the JICA expert conducted the basic design of the improved live bait tank system unit, while GFF Co. prepared the detailed design. The design for the prototype unit was completed in July 2023. Essentially, the improved live bait tank system unit consists of:

- I. The raised upper section of the tank,
- II. Drain flow control piping attached to it,
- III. A bottom drain unit that also functions as a dead-bait discharge outlet, along with its drainage piping.

Prior to this, in February 2023, GFF Co. fabricated a small-scale model of the improved unit based on

the basic design, to verify that the structure functioned as intended. This model is planned to be used for fishers' training and demonstration activities to promote dissemination of the improved unit.

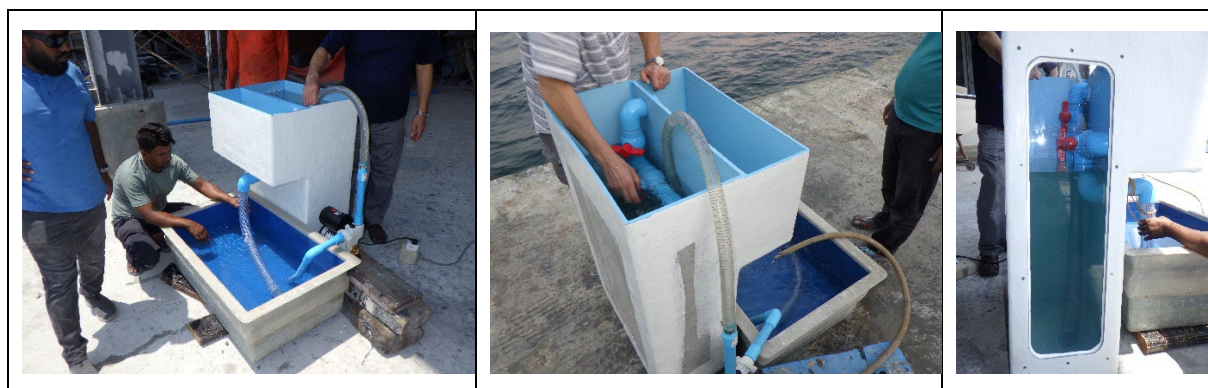


Photo 5-6 Small model for demonstrating the functionality of improved bait tank system unit

(3) Fabrication of the Improved Live Bait Tank System Unit (Prototype) and Fitting to the Cooperative Dhony

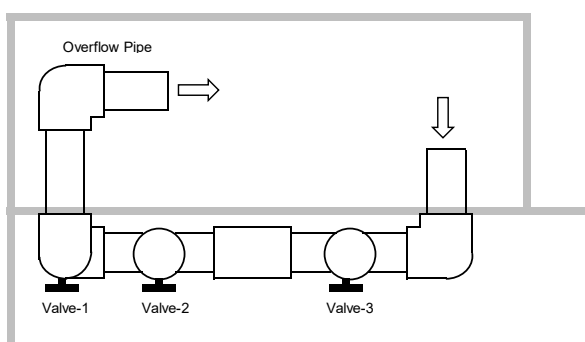
Based on the detailed design, the prototype improved live bait tank system unit was fabricated at GFF Co.'s factory on Thilafushi Island, Malé Atoll, in August 2023. The *Kamana* entered Thilafushi at the same time, and the installation work was carried out from August 16–19.

The installation proceeded generally as expected. The connection between the improved system unit and the existing live bait tank involved FRP-to-FRP bonding, and watertight integration was achieved through on-site fitting of the raised section. Connecting the piping to the existing drain at the bottom of the live bait tank required matching the location and diameter of the available drain outlet, and working in the limited space inside the tank, which was noted as a design challenge for the future. The installation was completed on August 19, and seawater was pumped into the tank to confirm that the unit operated as intended.

Figure 5-4 shows the drain flow control piping diagram for the improved unit. The design allows four modes of control combining piping and valve operations:

- Bottom drainage (overflow)
- Bottom drainage (siphon)
- Bottom drainage (pump-assisted)
- Surface drainage (overflow)

Piping Diagram



Drainage Control System

Drainage System	Valve			Drainage Route
	1	2	3	
Overflow Drainage	open	close	open	Bottom Suction - Overflow Pipe - Drain
Siphon Drainage	close	open	close	Bottom Suction - Drain
Drainage Pump	open	close	close	Bottom Suction - Overflow pipe - Drainage Pump - Discharge
Surface Overflow	close	close	open	Bait tank (surface water) - Overflow notch - Drain

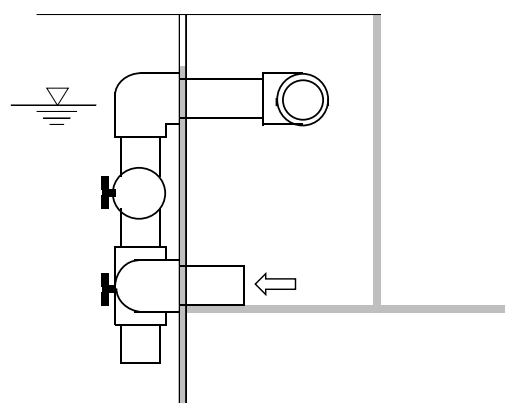
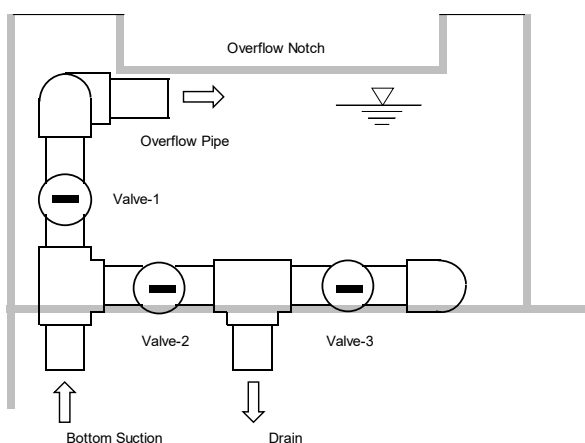


Figure 5-4 Drainage flow control piping diagram of the improved system unit

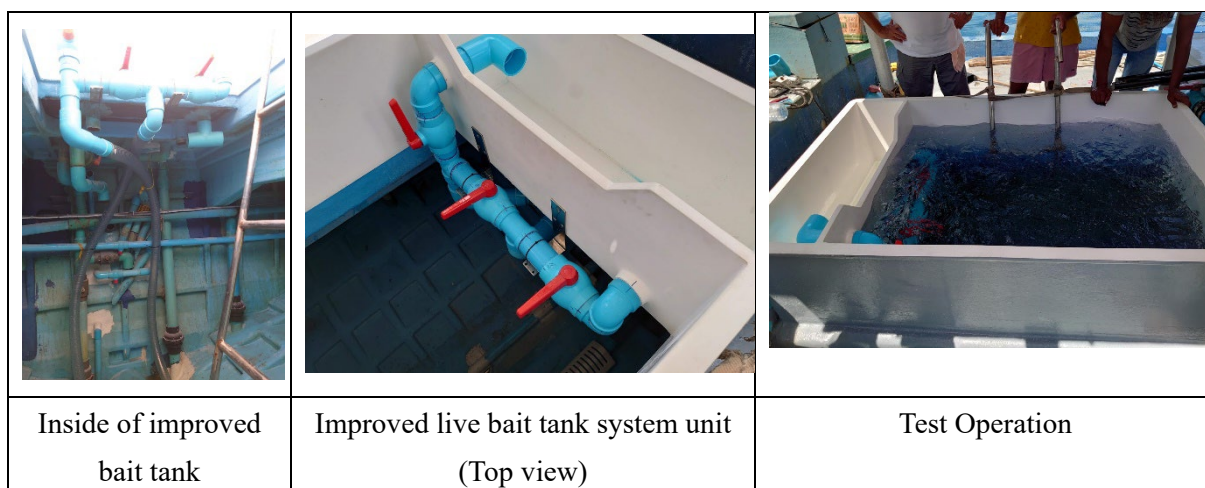


Photo 5-7 Improved live bait tank unit completed for installation on Kamana Dhony

(4) Trial Operation of the Improved Live Bait Tank System Unit

From August 19–21, 2023, JICA Expert Iwai boarded the *Kamana* to conduct training and trial operations on handling live bait using the installed improved live bait tank system unit and the water scoop net (described later). During the trial, live bait caught in two operations was all placed in the improved unit to confirm, together with the fishers, whether the reduction of water agitation and

discharge of dead bait from the bottom would decrease the number of dead fish and maintain stable water quality.

Table 5-2 Summary of Live Bait Fishing Operations Using the Improved Live Bait Tank System Unit and Water Scoop Net

	August 20	August 21
Time of anchoring	23:00	18:00
Time of light deployment	23:00	20:30
Time of live bait fishing start	5:00	5:00
Time of live bait fishing end	6:30	6:30
Type of scoop net used	Water Scoop Net	Conventional Scoop Net
Amount of live bait (number of scoops)	43	68
Species of live bait	Anchovy species (80%), Cardinalfish species (10%), Others (10%)	Anchovy species (80%), Cardinalfish species (10%), Others (10%)
Remarks	Few mortalities immediately after bait fishing.	Many mortalities immediately after bait fishing.

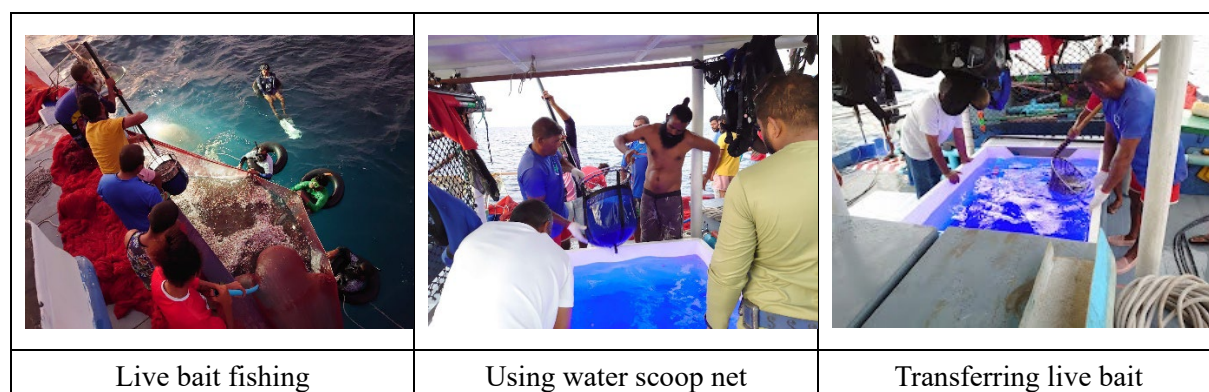


Photo 5-8 Training and trial fishing operation with fishers in Kamana

It was confirmed that dead baitfish that had sunk to the bottom of the live bait tank were discharged from the improved system unit as expected. It was also observed that water turbulence in the live bait tank was reduced during operation. However, when the bottom of the tank was inspected, a large number of dead fish remained, indicating that the discharge capacity was insufficient.

The improved system unit removes dead bait by suctioning water together with fish that have sunk to the bottom and discharging it. However, the suction part was installed at only one location inside the tank, with a length of 520 mm. Considering the tank bottom dimensions of approximately 2×3 meters, it was assumed that (i) the number of suction parts was insufficient, and (ii) the length of the suction part was too short.

Maldivian live bait fishing involves turning on lights at night to attract plankton, which in turn draws small fish that are caught in nets and used as live bait. While fish of about 5 cm are generally used as live bait, larger fish exceeding 20 cm are also often caught together. The improved system unit was

designed with a 3-inch drainage pipe, but such larger fish sometimes clogged the narrow 3-inch pipe, preventing drainage.

During operation, live bait stocked in the tanks is scooped out with a hand net and scattered toward schools of skipjack. This means nets are frequently inserted into the tanks. The pipes of the improved system unit were exposed inside the tank, making contact with the nets and interfering with the work. Furthermore, because the system design suppresses water turbulence by raising the water level and narrowing the surface area, the tank opening became smaller. Fishers commented that this made it more difficult to scoop bait out of the tank.

		
Observing dead fish	Dead fish removed from improved live bait tank system unit	Taking live bait from bait tank
		
Water drainage unit of inside of the bait tank system unit Dead fish are blocking the inside of the unit	Large bait fish blocked the inside of the improved tank system unit pipe	

Photo 5-9 Trial operation of the improved system unit

(5) Trial operation of the Improved System Unit on Kamana Dhony

The improved live bait tank system unit (Prototype) was installed in one of the two live bait tanks of the cooperative fishing vessel “Kamana,” and after conducting training on how to use the unit, it was put into actual operation. Hereafter, the live bait tank with the improved live bait tank system unit will be referred to as “Live Bait Tank 1” and the conventional live bait tank as “Live Bait Tank 2”.

After the outfitting of the system unit, a problem was identified on the Kamana where the suction unit

capacity of the improved live bait tank system unit (Bait Tank 1) was too small to fully discharge dead fish, and a new suction unit was added independently to the Kamana. Figure 4-1 shows a schematic diagram of the drainage system of the Kamana's Improved Live Bait Tank 1 and Figure 4-2 shows a schematic diagram of Bait Tank 2, a conventional live bait tank. During live bait fishing, fishers first put the live bait caught in Bait Tank 1, and when a sufficient amount of bait has been put into Bait Tank 1, the remaining fish are put into Bait Tank 2. This is because Bait Tank 1 is the main live bait tank and is designed to be easily accessible in terms of size and layout.

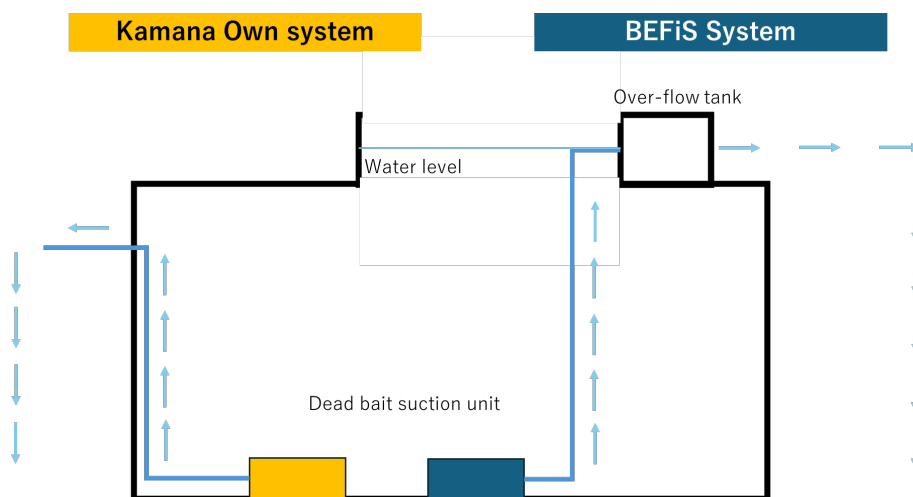


Figure 5-5 Overview of the drainage system of the live bait tank (Bait Tank 1) into which the improved live bait tank system unit is installed on the Kamana

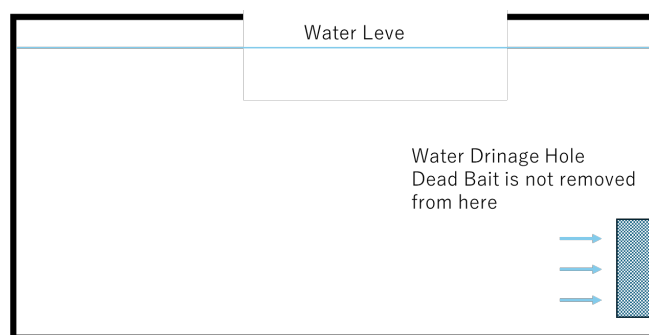


Figure 5-6 Overview of the drainage system of the Kamana's conventional live bait tank (Bait Tank 2)

(6) Evaluation of the improved live bait tank system unit by on-board survey

1) Survey Overview and Method

From January 6 to 11, 2024, an on-board survey was conducted to confirm the functions of the prototype improved system unit installed on *Kamana*, monitor its effects after installation, and collect data for dissemination activities.

The outlines of live bait fishing conducted during the survey are shown in Table 5-3. Three live bait fishing operations were conducted. The first and second catches were all stocked into Tank 1. In the third fishing, bait was first stocked into Tank 1, and once sufficient quantity was judged to have been

stocked, the remainder was placed into Tank 2.

During the survey, the vitality of bait and the turbidity of tank water were observed every 2–4 hours (excluding nighttime) and evaluated on a five-grade scale, as shown in Table 5-4. After the third fishing, bait was present in both Tank 1 and Tank 2, so vitality and turbidity were compared between the two tanks. However, since bait amounts and consumption during pole-and-line operations varied, results cannot be directly compared quantitatively. Instead, results should be interpreted as a relative comparison.

In addition, feedback was collected from *Kamana's* fishers regarding usability and points for improvement.

Table 5-3 Outline of Live Bait Fishing (January 2024 Survey)

	7 th Jan, 2024	8 th Jan, 2024	9 th Jan, 2024
Anchored time	22:30 (Previous Night)	7:45	20:30 (Previous Night)
Lighting time	22:30 (Previous Night)	No Light	22:30 (Previous Night)
Fishing beginning time	5:00	8:00	5:00
Fishing ending time	6:00	9:00	6:00
Type of Scoop net	Water Scoop Net	Normal Scoop Net	Normal Scoop Net
The Bait Amount each Tank (Number of Scoop)	Bait Tank 1. Water Scoop: 50 Normal Scoop: 41	Bait Tank 1: 21	Bait Tank1: 67 Bait Tank2: 101
Bait Species	Anchovies (50%), Cardinalfishes(40%), Other (10%)	Cardinalfishes(95%), Other (5%)	Anchovies (60%), Cardinalfish (30%), Other (10%)

Table 5-4 Evaluation Standards for Observation

	Bait Vitality	Water Turbidity
5 (Great)	Live bait swims well, and there are almost no fish dying.	The water is clear and there is no dirt or debris floating in the water.
4 (Good)	Live bait swims well, but only a few dead or weakened fish are seen.	The water is clear, but there is a small amount of debris floating in the water.
3 (Normal)	Weakened fish are also seen in the live bait, and dead fish are beginning to accumulate at the bottom of the live bait tank.	The water is a little muddy, but live bait is visible. There is a little debris floating in the water.
2 (Worse)	Many weakened fish are seen in the live bait, and the bottom of the live bait tank is accumulating a large number of dead fish.	Muddy water makes it difficult to see live bait. There is a lot of floating debris, which obstructs the observation of live bait.
1 (Worst)	Most of the live bait is weak, and the bottom of the live bait tank is obscured by the accumulated dead fish.	The water is completely muddy and live bait is not visible. There is also a lot of debris floating in the water, making it impossible to observe live bait.

2) Results and Consideration

Figures 5-7 and 5-8 show the evaluation results. Tank 1 maintained vitality and turbidity at level 5 until the third bait fishing. After the third fishing, many dead fish appeared and vitality dropped to level 4, but recovered to 5 within two hours due to proper water exchange and discharge of dead fish, supported by the independently installed suction unit.

In contrast, Tank 2 dropped to level 3 after the third fishing and did not recover even after two hours. Fishers later dove into the tank and discharged dead fish manually using a hose, after which vitality recovered to 5 at four hours post-fishing. However, by the next morning it dropped to 4 and turbidity also fell to 3. It was assumed that insufficient water exchange during nighttime anchoring caused mortality. Additionally, since Tank 2 did not have raised water level, water turbulence stirred up accumulated dead fish when the vessel moved, further reducing turbidity.

Overall, Tank 1 maintained higher vitality and turbidity compared to Tank 2, demonstrating the effects of the improved system unit in improving water circulation, automatically discharging dead fish, and reducing turbulence.

Fishers expressed satisfaction with both the dead fish discharge and turbulence reduction functions. The initial clogging problem with large bait was resolved as fishers intentionally removed large fish. However, they also noted that the raised tank opening, while effective in reducing turbulence, made it harder to scoop bait. For the dissemination model, adjustments were planned to lower the opening height.

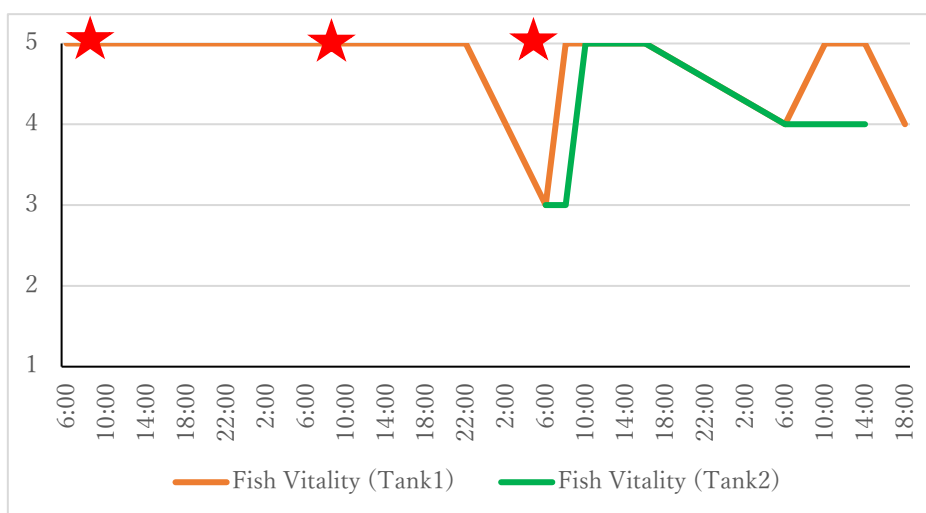


Figure 5-7 Vitality of live bait during operation (★ indicates bait fishing timing, the same applies below.)

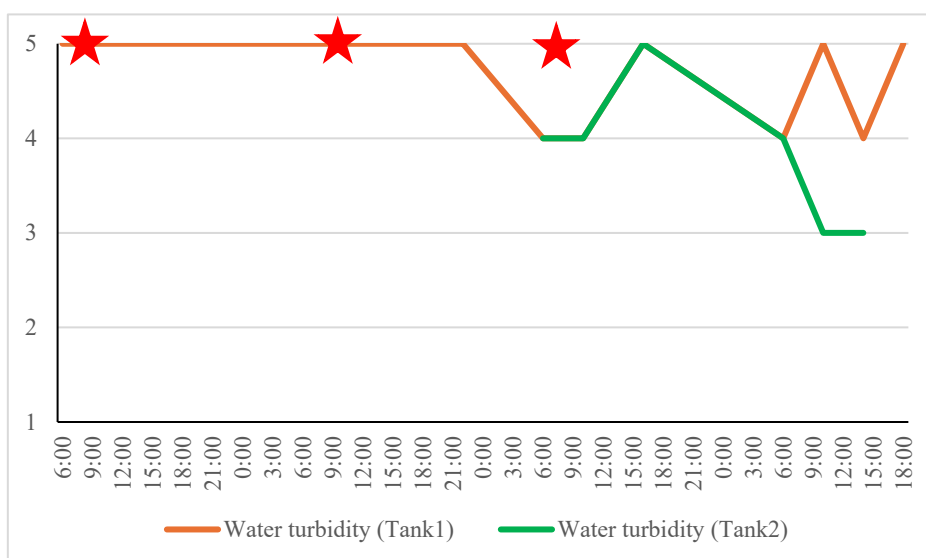


Figure 5-8 Water turbidity in live bait tanks during operation

	
<u>Improved live bait tank system unit (Bait Tank 1)</u> Bottom drainage piping was installed in the red circled area. The entrance area was raised to reduce the water surface agitation.	<u>Conventional live bait tank (Bait Tank 2)</u> Open directly to the deck and the water surface is lower than the deck, resulting in significant water surface turbulence due to ship swaying.
	
Bottom of Bait Tank 1 after live bait fishing. Dead fish are discharged and not many dead fish are seen.	Bottom of Bait Tank 2 after live bait fishing. Dead fish are stored.

Photo5-10 Differences between Tank 1 (with improved system unit) and Tank 2 (conventional)

(7) Development of the Improved System Unit (Promotion Model) (Activity 2-1-1)

The prototype improved live bait tank system unit introduced to *Kamana* was specially manufactured according to the size of the bait tank on the vessel. However, such a custom-made approach is unsuitable for dissemination purposes. In addition, the fishers of *Kamana* also pointed out that raising the opening of the live bait tank made bait handling more difficult.

For these reasons, in developing the promotion model, it was planned to manufacture it using a mold that would enable semi-customized production according to the dimensions of live bait tanks, and to lower the height of the raised opening.

In January 2024, a survey was conducted to collect data on the size of bait tanks on vessels that were landing skipjack tuna at Kooddoo Island in Gaafu Alifu Atoll, where the MIFCO tuna freezing factory is located, and at Vilingili Island located nearby.

Based on the survey results, as well as the findings from *Kamana*, discussions were held with GFF, and

draft designs for the Promotion Model were created. After that, once the cooperative dhonies were selected, the design was finalized.



Photo 5-11 Surveys and discussions for the design of the promotion model of the improved live bait tank system unit

5.1.4 Installation of the Improved Live Bait Tank System Unit (Promotion Model) on Cooperative Dhonies (Activity 2-1-1)

(1) Selection of Cooperative Dhonies

From July 2024, MoFOR began calling for applications from cooperative dhonies. Eligible vessels were those throughout the Maldives that had records of catch quantity and fishing frequency in 2023. By the end of August, two applications were received and approved. The selected cooperative dhonies are shown in Table 5-5 below:

Table 5-5 Basic Information of Cooperative Dhonies

Name of Vessel	Home Island	Length (feet)
Safeena	Ga. Kolamaafushi	108
Hudhuhudhu Emperor	Lh. Naifarur	88

These two cooperative dhonies were each equipped with the promotion model and cooperated in confirming its effectiveness. In August 2024, Mr. Yeser (GFF developer) and Mr. Iwai (JICA Expert) surveyed the detailed dimensions of the live bait tank openings, etc., on each vessel.

(2) Finalization of the Promotion Model Design and Prototype Testing (Activity 2-1-1)

The promotion model design was finalized based on the feedback received from the prototype installed on *Kamana* and the surveys conducted on the cooperative dhonies.

The design functions included:

1. Improving water circulation in the Live Bait Tank through bottom drainage
2. Discharging dead bait to suppress water quality deterioration

3. Raising the opening of the tank to reduce water turbulence by increasing the water level
4. Discharging surface water to remove floating debris

However, the following issues were raised:

- On *Kamana*, fishers pointed out that the raised opening made bait handling difficult.
- On *Hudhuhudhu Emperor*, the live bait tank opening was narrow, making it difficult to install an overflow tank.

Therefore, improvements were required in the design: lowering the raised opening, and modifying or eliminating the overflow tank.

As a result, the promotion model was redesigned as follows:

- The height of the raised opening was reduced from 50 cm (prototype) to 30 cm.
- The overflow tank was removed, and instead, a 3-inch pipe was installed at the top of the live bait tank for overflow discharge.
- This made it possible to compact the improved live bait tank system unit while maintaining the surface water discharge function.

On September 18, 2024, a simplified prototype using small pipes was manufactured to test the operation. The test confirmed that both bottom and surface drainage functions operated effectively.

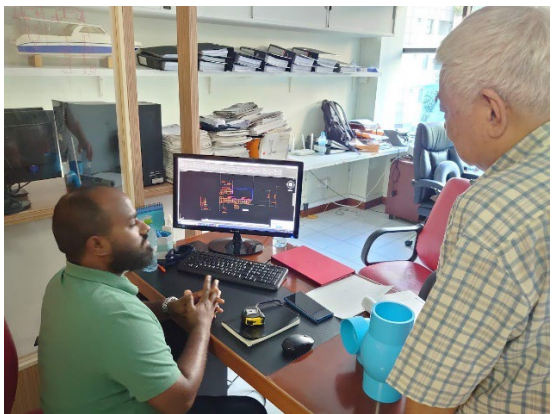
	
Discussion on drawing creation	Operation verification test using a simulation model

Photo 5-12 Simplified prototype of the promotion model of the improved live bait tank system unit

(3) Production of the Improved Live Bait Tank System Unit (Promotion Model) and Installation on Fishing Vessels

On September 23, 2024, the production of the improved system unit (promotion model) was initiated. The manufacturing process was carried out smoothly at GFF's Thilafushi factory.

1) Cooperative Dhoni Safeena

On September 30, 2024, the cooperative Dhoni *Safeena* was docked at the MTCC boatyard on Thilafushi Island, and the installation work of the improved system unit began. The installation was

completed on October 4.

After undocking, operational testing of the improved system unit was conducted at sea. When water was poured into the live bait tank, leakage occurred, which was assumed to be caused by pre-existing fine cracks on the deck around the unit's connection point. After confirming the leakage situation with *Safeena*, it was determined that the problem could be relatively easily repaired. It was agreed that repairs would be conducted after returning to Farethmathooda Island, after which normal fishing operations would resume.



Photo 5-13 Production of the improved live bait tank system unit (promotion model)

2) Cooperative Dhoni Hudhuhudhu Emperor

On October 8, 2024, the cooperative dhoni *Hudhuhudhu Emperor* was docked at the MTCC boatyard on Thilafushi Island, and installation of the improved system unit was initiated. Installation was completed on October 10, after which the vessel was undocked and operational testing was conducted at sea.

Unlike *Safeena*, *Hudhuhudhu Emperor* did not experience leakage. However, a malfunction occurred where air could not be expelled from the piping inside the improved system unit, preventing drainage. This was considered to have been caused by air being trapped at the time of the very first use after undocking. Once priming water was added, drainage began without issue. Therefore, guidance was

provided to prime the system whenever drainage fails at the start of operation.

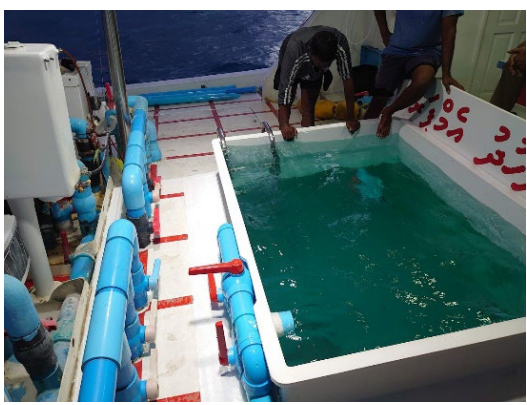
	
Improved live bait tank system unit installed on Hudhuhudhu Emperor	Test operation of improved live bait tank system unit

Photo 5-14 Installed improved system unit (promotion model) on *Hudhuhudhu Emperor*

(4) Monitoring of the improved system unit (promotion model) (Activity 2-1-1)

To evaluate the effectiveness of the improved system unit (promotion model), on-board surveys were conducted on the vessels *Safeena* and *Hudhuhudhu Emperor*.

1) Safeena

A) Survey Overview

The on-board survey was conducted during the period from 13 to 17 February 2025.

A summary of the live bait fishing operations conducted during the survey is shown in Table 5-6. Live bait fishing was carried out every morning during the operation period. On 14 February, live bait was placed into both Live Bait Tank 1 (equipped with the improved system unit) and Live Bait Tank 2 (conventional type without the improved system unit). From the following day onward, bait was stocked only in Live Bait Tank 1.

The measurement items were water temperature and dissolved oxygen (DO) in each live bait tank. Measurements started at 06:00 on 14 February, just before live bait fishing, and continued every 2–3 hours until 06:00 on February, when all live bait was consumed.

In addition, the vitality of the live bait and the water turbidity in the tanks were observed and evaluated on a five-grade scale, following the method used in the on-board survey of the *Kamana* (see Table 5-2). For Live Bait Tank 2, observations ended after 10:00 on 14 February, when all live bait had been consumed.

Table 5-6 Summary of Live Bait Fishing Operation on Safeen

	Live Bait Tank 1	Live Bait Tank 2
Operation period	13–17 Feb 2025	
Time anchor dropped	18:30 every evening	
Time lights switched on	23:00 every evening	
Start of live bait fishing	06:00 every morning	
End of live bait fishing	07:00 every morning	
Type of net used	Scoop net (standard)	
Quantity of bait stocked (kg)		
– 14 Feb	1,554	1,386
– 15 Feb	756	–
– 16 Feb	910	–
– 17 Feb	602	–
Bait species	Sprat species (60%), cardinalfish species (20%), others (20%)	

B) Results of Water Temperature Measurement

The transition of water temperature during the trial period is shown in Figure 5-9. Water temperature ranged from 28.1°C to 31.2°C throughout the operation period. On 15 February at 14:00, the water temperature temporarily rose to 31.2°C, likely because water inflow into the bait tanks was stopped during pole-and-line operations to facilitate bait handling.

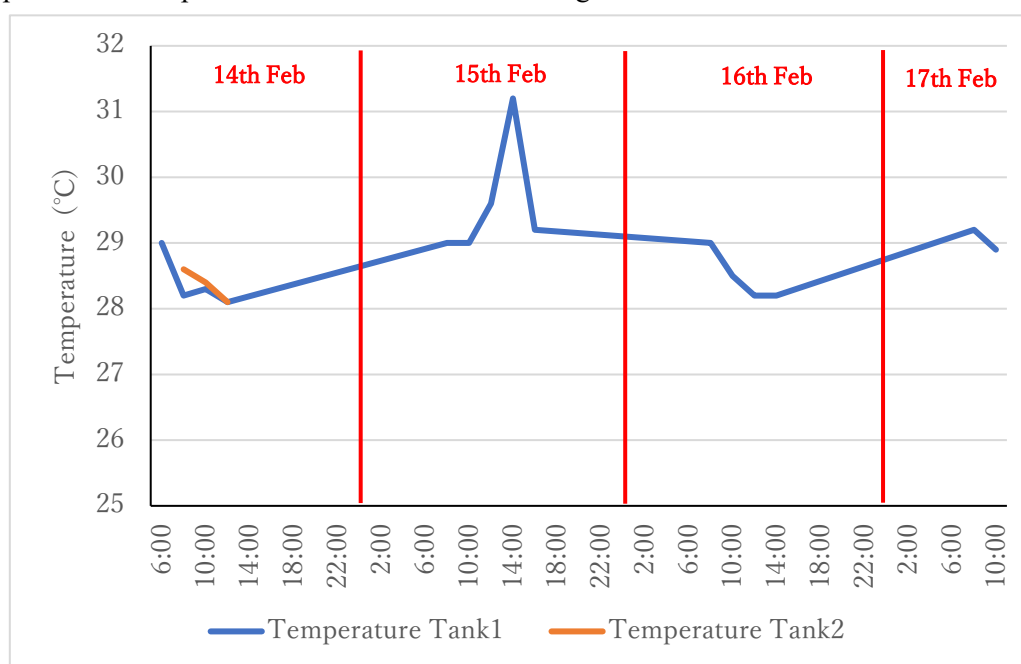


Figure 5-9 The transition of water temperature during the trial period

C) Results of DO Measurements (Surface and Bottom Layers)

The changes in surface DO and bottom DO in each bait tank are shown in Figures 5-10 and 5-11. DO decreased immediately after live bait fishing, then recovered by around 10:00, and gradually decreased again until the next morning's fishing. Compared to 14 February, higher DO values were observed on 15 and 16 February. Since the bait catch was largest on the 14th and smaller on the following days, it is

considered that bait density (and thus oxygen consumption) was lower on 15 and 16 February.

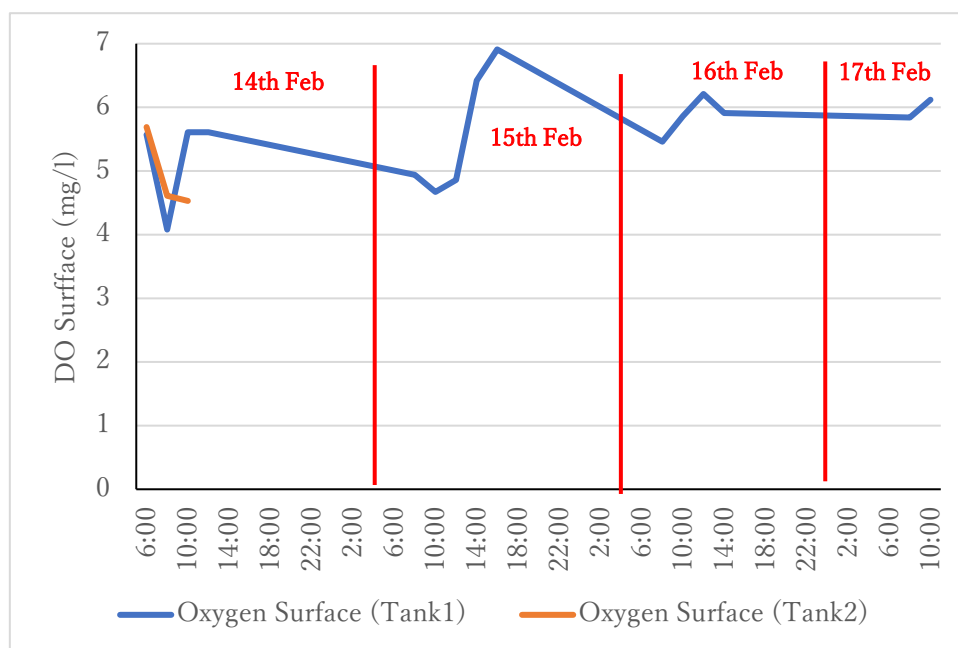


Figure 5-10 The transition of oxygen surface during the trial period

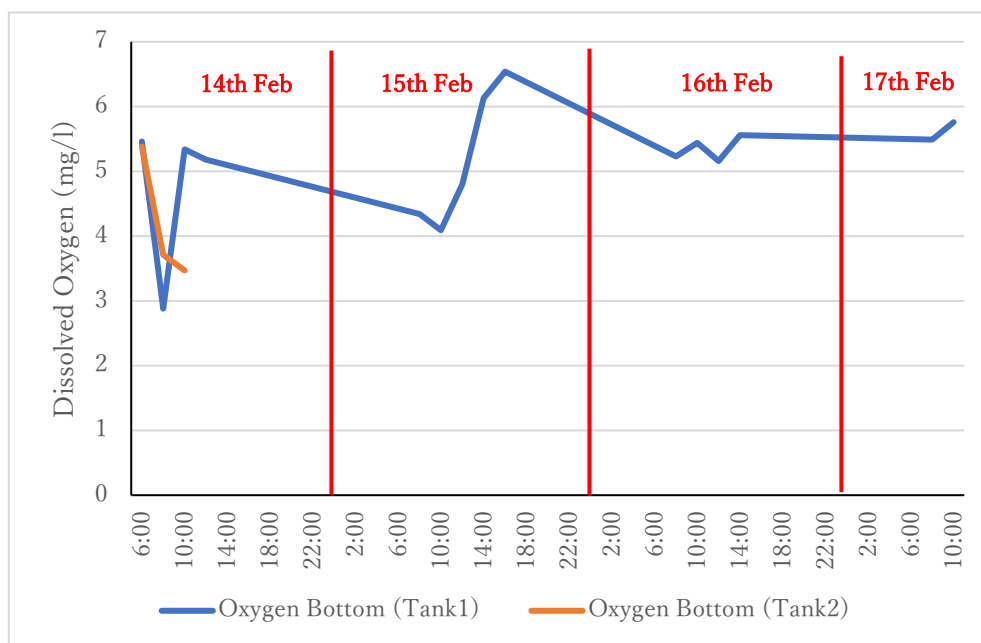


Figure 5-11 The transition of oxygen bottom during the trial period

D) Observation Results on Bait Vitality and Water Turbidity

The changes in live bait vitality during the trial are shown in Figure 5-12, and water turbidity in Figure 5-13. Both vitality and turbidity decreased after bait fishing. In Live Bait Tank 1, values recovered to 5 by noon and remained at 5 throughout the trial. In contrast, in Live Bait Tank 2, values remained low

until all bait was consumed at noon on the 14th.

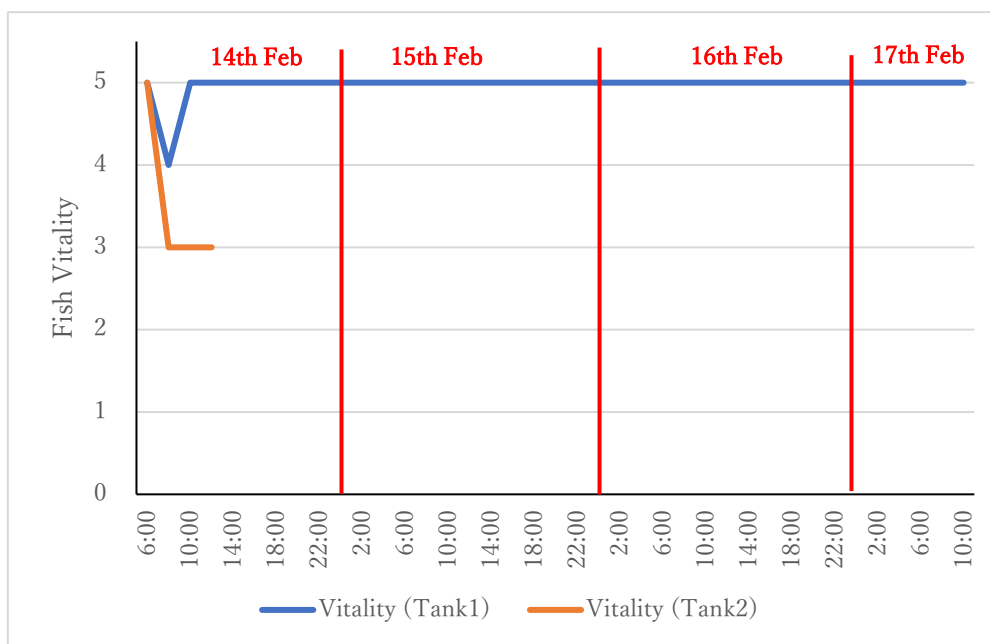


Figure 5-12 The transition of vitality during the trial period

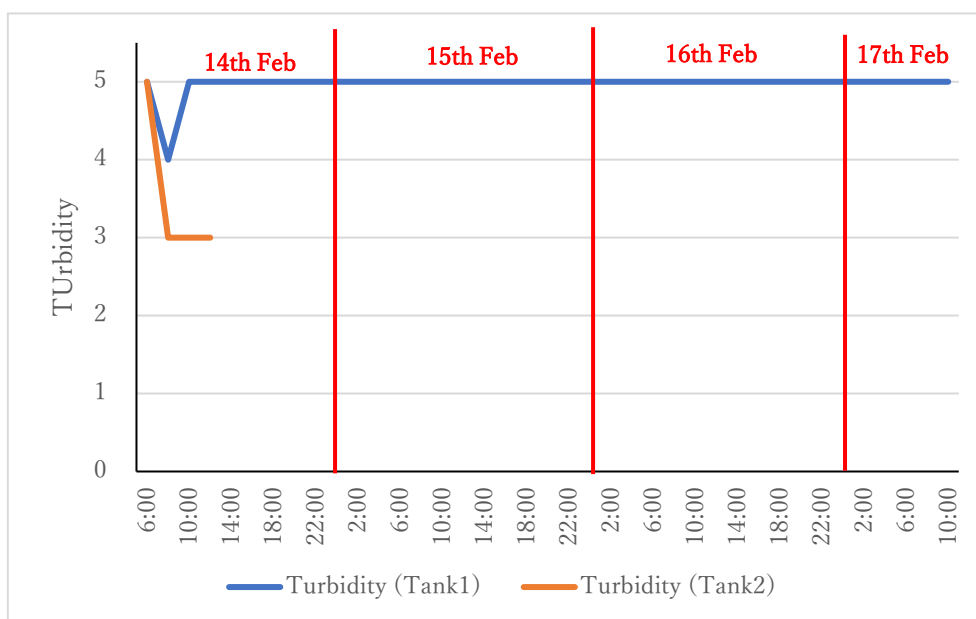


Figure 5-13 The transition of turbidity during the trial period

2) Hudhuhudhu Emperor

A) Survey Overview

The on-board survey was conducted from 21 to 26 February 2025.

The summary of the live bait fishing operation conducted on 23 February is shown in Table 5-7. Measurement items included water temperature and DO in each tank, starting at 06:00 on 23 February, when live bait fishing began, and continuing every 2–3 hours until 06:00 on 25 February, when all bait

was consumed.

Bait vitality and water turbidity were also observed and evaluated on a five-grade scale, following the method used in the on-board survey of the *Kamana* (see Table 5-4). During the operation, live bait was preferentially taken from Tank 2, and since all bait there was consumed after the 11:00 measurement on 24 February, subsequent measurements and observations were conducted only on Tank 1.

Table 5-7 Summary of live bait fishing operation on Hudhuhudhu Emperor

	Live Bait Tank 1	Live Bait Tank 2
Time anchor dropped	00:30	
Time lights switched on	00:30	
Start of live bait fishing	05:00	
End of live bait fishing	06:00	
Type of net used	Scoop net (standard)	
Quantity of bait stocked (kg)	194	215
Tank volume (m ³)	34.3	13.8
Bait density (kg/m ³)	5.7	15.6
Bait species	Sprat species (50%), cardinalfish species (30%), anchovy species (10%), others (10%)	

B) Results of Water Temperature Measurement

The transition of water temperature during the trial period is shown in Figure 5-14. Measurements for Tank 2 ended after 11:00 on 24 February, when all bait was consumed. Water temperature ranged between 28.8°C and 30.0°C throughout the operation, with Tank 2 showing slightly lower values than Tank 1.

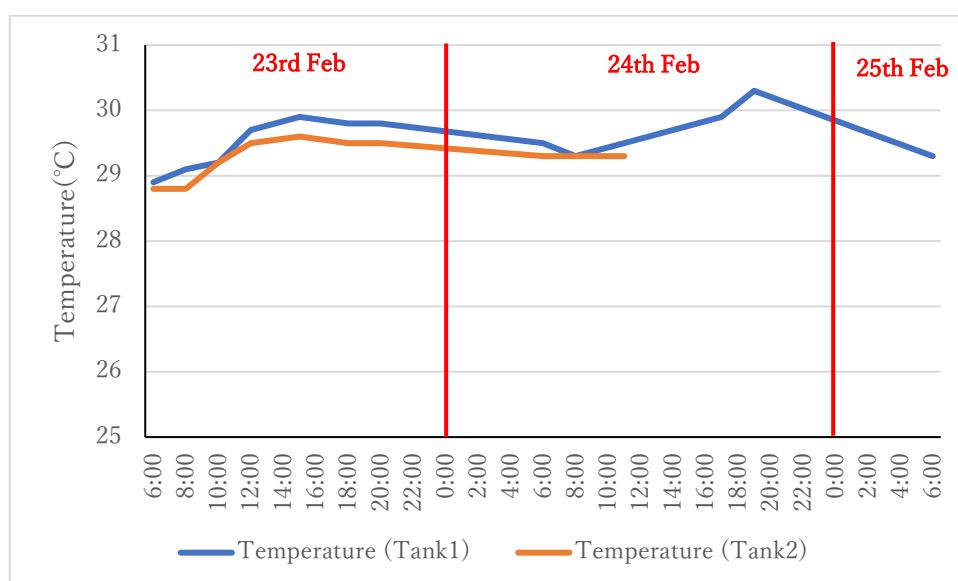


Figure 5-14 Transition of water temperature in each live bait tank

C) Results of DO Measurements (Surface and Bottom Layers)

The changes in surface and bottom DO in each tank are shown in Figure 5-15 and Figure 5-16. DO in both layers was low immediately after live bait fishing, then gradually recovered, reaching its highest value around 18:00 (12 hours after bait fishing). DO then decreased slowly overnight and began recovering again after 08:00 the next morning (26 hours after bait fishing).

Since Maldivian fishing vessels are designed to receive more water inflow during forward movement, DO levels in bait tanks generally decrease at night when vessels are anchored. This trend was also observed in the present survey.

Around 10:00 each morning, DO temporarily decreased and then quickly recovered. This was because the water level in the tanks was lowered at that time to make bait handling easier, temporarily reducing tank water volume.

Overall, higher DO levels were observed in Tank 1 compared to Tank 2. Although Tank 2 initially contained more bait, leading to higher oxygen consumption, Tank 1 maintained higher DO even after most bait in Tank 2 had been consumed (after the night of 23 February). This was attributed to the improved bottom discharge function of the improved system unit, which enabled more efficient water circulation than in Tank 2.

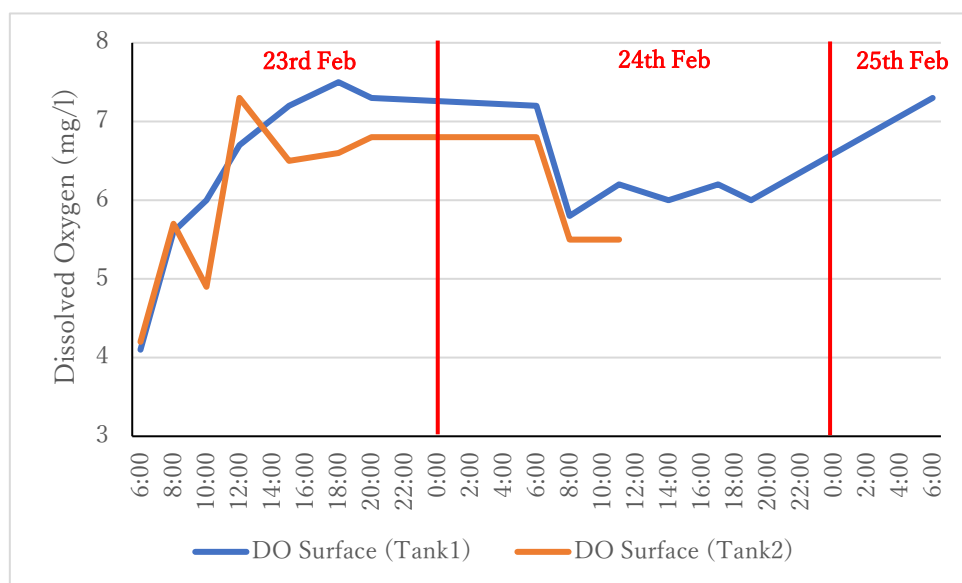


Figure 5-15 Transition of DO (surface) in each live bait tank

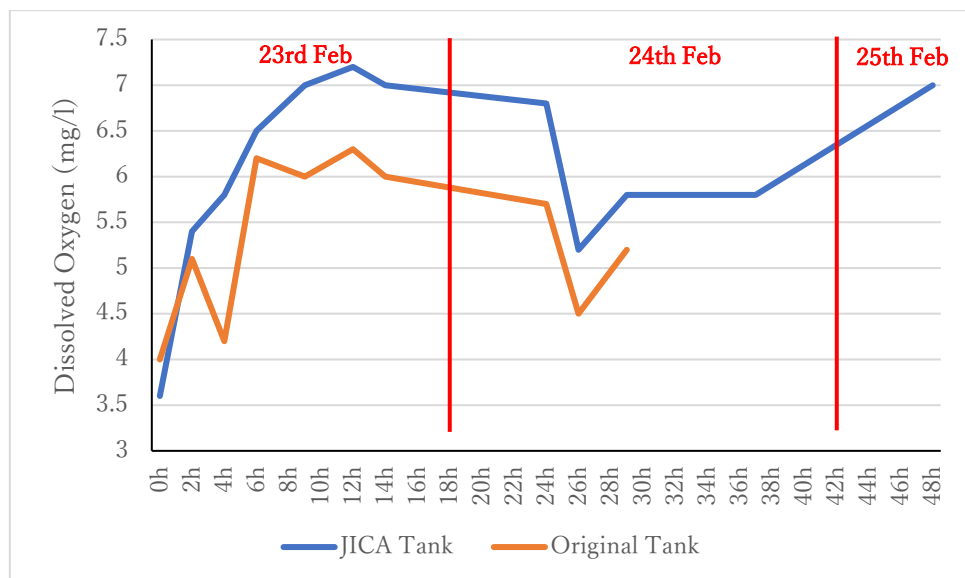


Figure 5-16 Transition of DO (bottom) in each live bait tank

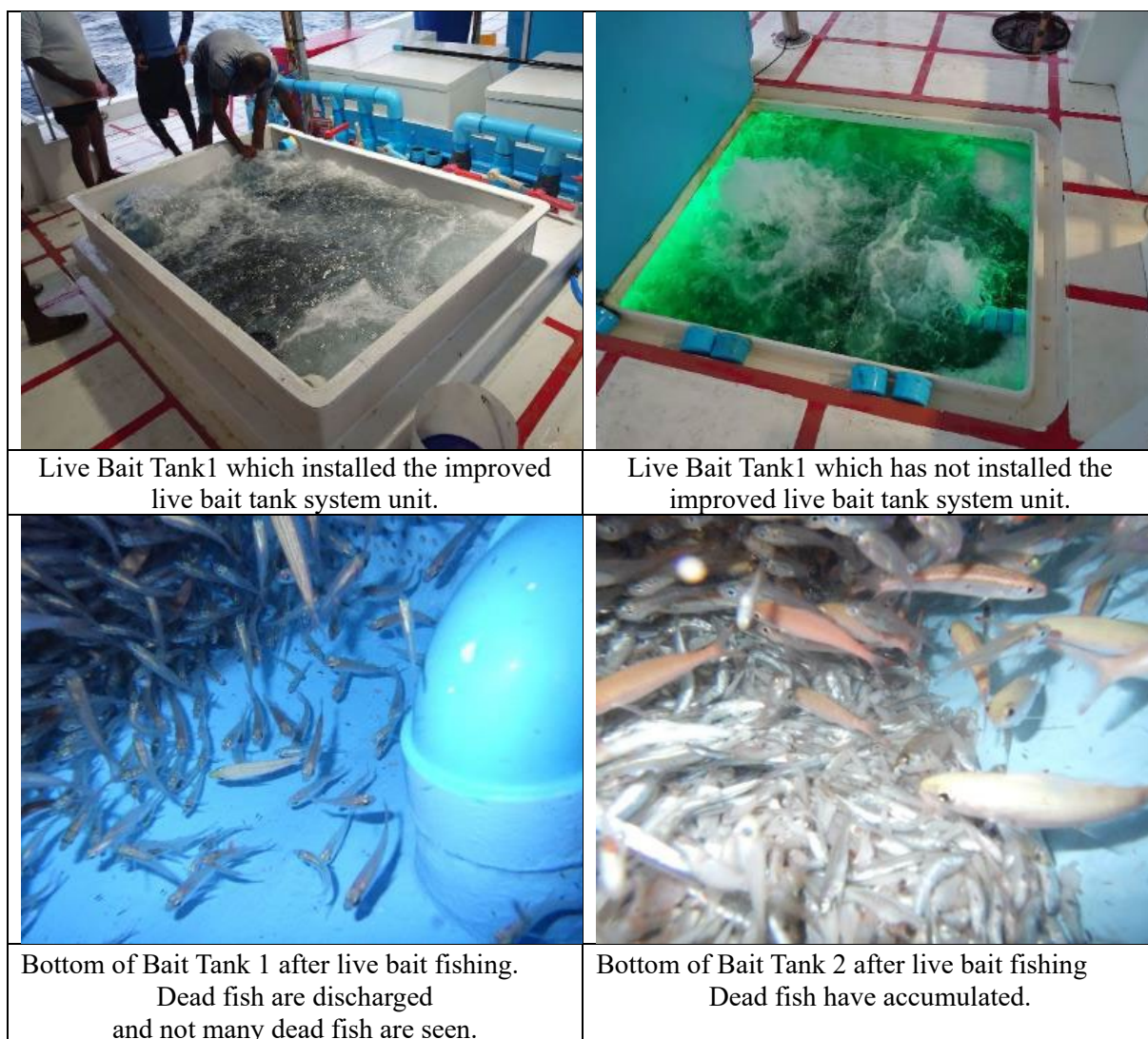


Photo 5-15 On-board survey on Hudhuhudhu Emperor

D) Observation Results on Bait Vitality and Water Turbidity

The transition of bait vitality during the trial is shown in Figure 5-17, and water turbidity in Figure 5-18. Immediately after fishing, bait vitality was rated at 3 in both tanks. Since a standard scoop net was used, stress on the bait was high, and mass mortality occurred right after fishing.

In Tank 1, vitality gradually recovered (similar to DO), reaching 5 by 10:00. It temporarily decreased to 3 at 14:00, when water inflow was stopped during pole-and-line operations, but returned to 5 overnight.

In Tank 2, vitality temporarily recovered to 4 after fishing, but soon dropped to 3, remaining there until nightfall. It recovered to 5 overnight, but fell again to 4 by the next morning, and to 3 by 10:00 when bait was exhausted. Since Tank 2 lacked a dead bait discharge mechanism, dead fish accumulated overnight, negatively affecting vitality.

Water turbidity followed the same trend as bait vitality.

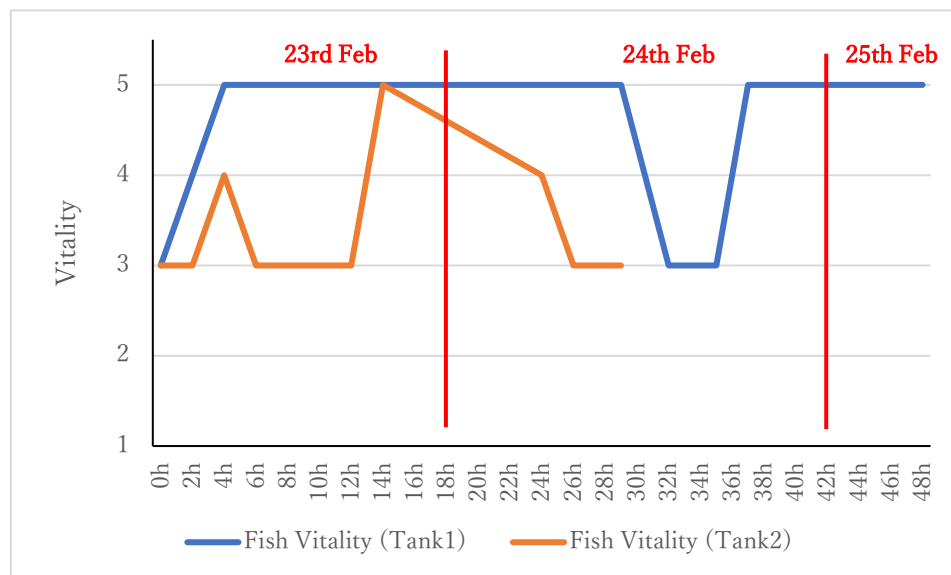


Figure 5-17 Transition of live bait vitality in each tank

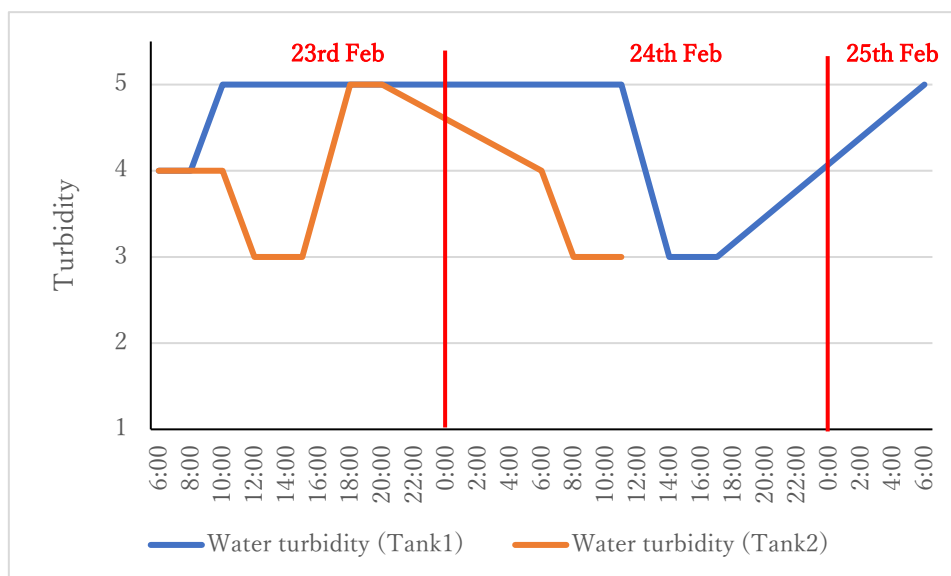


Figure 5-18 Transition of water turbidity in each tank

In summary, both the vitality of the live bait and the water turbidity were observed to be higher in Bait Tank 1 than in Bait Tank 2. This is considered to be due to the improved system unit's functions for discharging dead fish and sediments, as well as its water-motion reduction feature, which enabled effective water exchange in Bait Tank 1 and contributed to stabilizing the water environment inside the tank.

(5) Summary of the Monitoring of the Improved System Unit

From the results of the two cooperative dhonies, it was observed that in both vessels, the live bait tank equipped with the improved live bait tank system unit (promotion model) tended to show higher DO levels in the bottom layer compared to conventional live bait tanks. This shows that even during periods when the DO in the bottom layer tends to decrease, such as immediately after live bait fishing operations or during nighttime, the water circulation function of the improved system unit was working effectively, suppressing the decline in bottom-layer DO and promoting faster recovery.

Indicators of the water environment in the live bait tank, such as baitfish vitality and turbidity, also showed more favorable trends in the tanks equipped with the improved system unit. This is considered to be the result of the combined effects of the water circulation promotion function, the automatic discharge mechanism for dead fish, and the water motion reduction function of the improved system unit, which together contributed to stabilizing the live bait tank environment.

Based on these results, it was made clear that the improved system unit (promotion model) is an effective means of maintaining a favorable live bait tank environment and contributes to the preservation of baitfish quality and the improvement of survival rates.

5.1.5 Production of Water Scoop Nets and Training for Fishers (Activities 2-1-1, 2-1-2)

(1) Production of Water Scoop Net (First Model)

As mentioned earlier, the MASPLAN pilot project revealed that one of the causes of the low survival rate and short survival period of live bait was damage inflicted on the baitfish when transferring them into the live bait tanks. As a countermeasure, MASPLAN introduced trial use of water scoop nets, which received positive evaluation from fishers. Therefore, this project worked on promoting their use.

From February 2023, in consultation with domestic fishing gear and fishing equipment companies, the design of live bait water scoop nets was developed, and in July, 20 units were delivered to MoFOR. The basic design and the completed water scoop net are shown below. The manufactured nets were distributed to the cooperative dhonies such as Kamana, which were equipped with the improved live bait tank system unit, as well as to fishing vessels of fishers who participated in training in Japan, and feedback on their effectiveness was collected. They were also distributed to the fish processing companies Bigfish and ENSIS, who were requested to introduce them to fishers coming for landings.

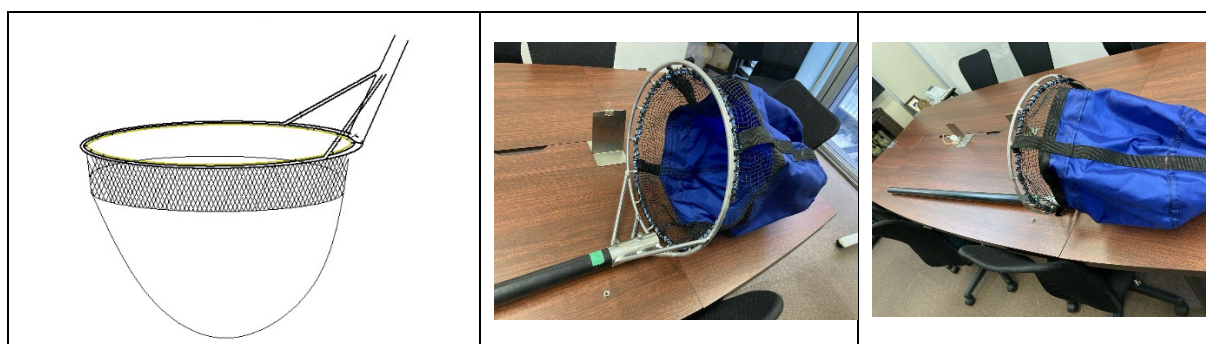


Figure 5-19 Structure of the produced water scoop net (first model)

(2) Verification of the Effectiveness of Water Scoop Nets

In August 2023, together with the prototype of the improved live bait tank system unit installed on the Kamana, the effectiveness of the water scoop net was verified. During the operations, several live bait fishing operations were conducted. In the first operation, the water scoop net was used, while in the second, it was not.

As a result, after the first operation, almost no dead fish were observed, while in the second operation, a considerable amount of mortality was observed. This confirmed the initial expectation that the use of the water scoop net had a significant effect in reducing live bait mortality. Although the fishers on-board acknowledged this effect, they also commented that because the water scoop net carries both fish and water, it is heavier than normal scoop nets and therefore more difficult to handle. In addition, the handle length of about 1.5 m was considered too short for scooping baitfish from the sea surface onto the vessel deck.

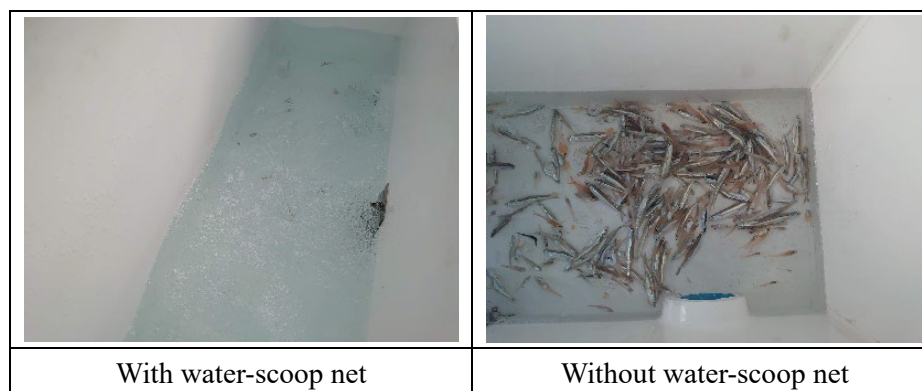


Photo 5-16 Difference in dead fish discharge by the improved system unit with and without use of the water scoop net

(3) Production of Improved Water Scoop Net

The water scoop nets (first model) manufactured during the first period of BEFiS were criticized by fishers, including those on the Kamana, as being “too heavy when scooping water, making operations difficult.” Due to their structure, water scoop nets inevitably become heavy since they scoop water together with live baitfish. However, the first model had issues such as the dip frame being double-layered and thick, and the net being deep enough to carry many fish, which also resulted in scooping excessive amounts of water, making it excessively heavy.

Therefore, in second period, improvements were made by changing the dip frame to a single layer and making the net shallower to reduce weight, and improved water scoop nets were designed and manufactured.

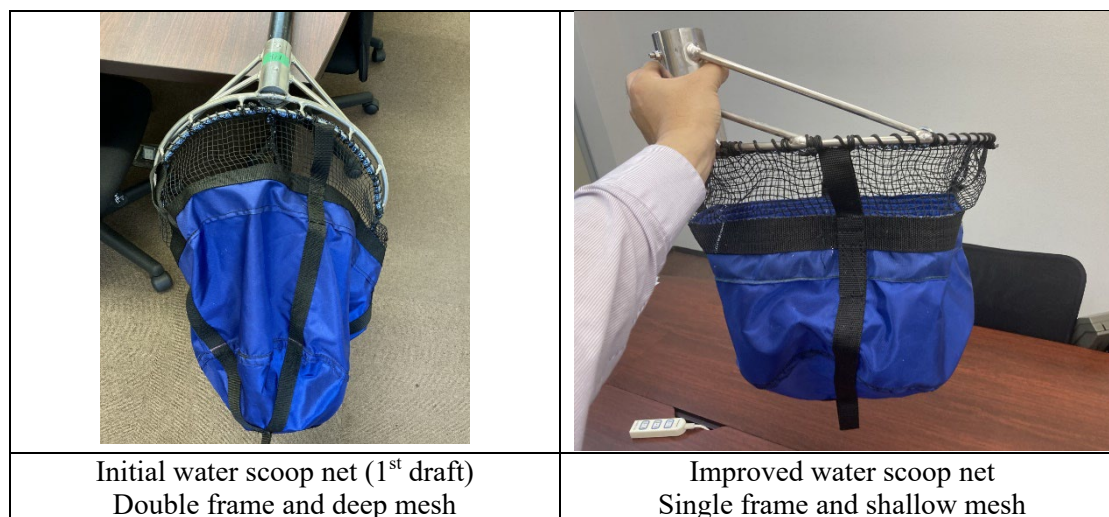


Photo 5-17 Conventional water scoop net and improved water scoop net

(4) Technical Training on Water Scoop Nets and Improved System Unit (Activity 2-1-2)

Regarding Activity 2-1-2 and Activity 2-1-3, bait handling training was conducted at Bigfish on October 9, 14–16, 2024.

The training was implemented using the training materials developed by the project, along with

demonstrations of the actual water scoop net and models of the improved live bait tank system unit. The training was also carried out during the operational checks of the improved system units installed on two cooperative dhonies, the Safeena and the Hudhuhudhu Emperor.

In total, training was conducted for seven fishing vessels (three skipjack tuna vessels and four yellowfin tuna vessels) in collaboration with Bigfish. Among these, six vessels were provided with the improved water scoop nets.

Through this training, Bigfish’s capacity to conduct training was also enhanced, making it possible for them to carry out training independently without the presence of JICA experts. In fact, during the absence of JICA experts, three training sessions were conducted by Bigfish, and water scoop nets were distributed. This demonstrated that a foundation had been established for the continuous dissemination of these technologies after the completion of the project.



Photo 5-18 Training for fishers on live bait handling using the improved system unit model and water scoop net

5.1.6 Efforts Toward the Promotion of the Improved System Unit and Water Scoop Net (Activity 2-1-3)

(1) Presentation at the Fishermen’s Day Forum

In December 2024, at the Maldives’ national fisheries-related event “Fishermen’s Day Forum,” a presentation was given on the new technologies introduced by this project (the improved system unit and water scoop net). This large-scale event is attended by the President of the Maldives and the Minister of Fisheries and Marine Resources, and gathers vessel owners, crew members, fish processors, and other industry stakeholders from across the country. It serves as a forum for discussing challenges, needs, and prospects of the fishing community.

The presentation was entrusted to Mr. Samrath, the fishing master of the cooperative dhoni *Kamana*, who explained the advantages and effects of the improved system unit and the water scoop net from the fishers’ perspective.



Photo 5-19 Explanation of the improved system unit and water scoop net by cooperative vessel fishers

(2) Production of Best Practice Guide Video

A Best Practice Guide video was produced to explain the live bait management technologies introduced in the project (use of water scoop net and the concept of the improved system unit). This video compiled footage and images taken during previous on-board surveys, as well as survey results, to visually demonstrate the effectiveness of live bait management technologies.

The video produced in this activity was presented during the project's final seminar and was used for explaining the new technologies to fishers and in dissemination activities. Going forward, it is expected that MoFOR will actively use this video at fisheries-related events, such as the above-mentioned Fishermen's Day Forum, for dissemination activities. In addition, Bigfish plans to continuously show the video in resting areas for fishers within its facilities, thereby continuing dissemination to fishers coming for landings.

(3) Project Final Seminar

At the project's final seminar held on May 26, 2025, presentations were given by fishers from the cooperative vessels and engineers from GFF regarding the effects of the improved system unit and the water scoop net. The purpose of this seminar was to report to participants on the activity results of each output and on the system for continuing activities after the project's completion, while also serving as an opportunity to communicate these achievements to stakeholders, including fishers and participants from outer island sites, and to promote dissemination.

Representatives from 12 fishing vessels participated and received explanations about the improved system unit and the water scoop net. Before the presentations, some fishers expressed doubts about the effectiveness of these technologies, but after the seminar, comments were received indicating that they were convinced of the effectiveness in maintaining the vitality of live bait for a longer period.

In addition, MoFOR decided to provide a 40% subsidy for vessels that adopt the units under the framework of the WB project, and some fishers expressed their intention to actively consider the introduction of these units.

5.1.7 Challenges After Project Completion

(1) Design of the Improved Live Bait Tank System Unit (Promotion Model)

Based on the feedback obtained from the *Kamana* cooperative dhony, the improved live bait tank system unit (promotion model) was designed with the opening of the live bait tank positioned as low as possible. Regarding the height of the opening, positive feedback was received from the *Hudhuhudhu Emperor* cooperative dhony, while the *Safeena* cooperative dhony determined that a slightly higher opening would be easier to use. In other words, it became clear that structural requirements of the system unit vary depending on the fishers.

Therefore, in the future dissemination of the system unit, it will be necessary to provide services that allow structural adjustments—including the height of the opening—according to the requirements of each vessel. When introducing the system unit into fishing vessels, it is necessary to conduct sufficient prior consultations and reflect the fishers' requirements in the structure of the unit. However, as the improved live bait tank system unit is a new concept, it is difficult for fishers to concretely imagine its final form. It is therefore desirable to hold consultations while providing fishers with actual photos of the system unit developed in the project or confirming items against a checklist to help them form a concrete image.

(2) Design and Manufacturing of the Water Scoop Net

Due to its structural nature of scooping live bait along with water, the water scoop net inevitably carries a certain weight, regardless of improvements made. While reducing its size could make it lighter, this would in turn decrease the amount of live bait scooped at one time, potentially affecting the efficiency of live bait fishing. Against this background, the challenge for future dissemination is how to improve the usability of the water scoop net, which remains heavy even after improvements.

Although fishers were instructed to handle the water scoop net with two or more people, there were still cases where some continued to use it alone without changing their methods. Going forward, dissemination efforts should include promoting the water scoop net via social media and widely communicating, together with reference videos, that it should be handled by two or more people.

In Japan, there are cases where the water scoop net is used with cranes or pulleys. In the future, introducing such equipment in the Maldives would help reduce the burden on fishers and further promote the use of the water scoop net.

(3) Implementation of Training on Live Bait Handling Techniques

As with Output 1, the dissemination of techniques to fishers is carried out by fish processing companies. The project conducted training for 10 vessels, but this is far too small in terms of the total of 614 fishing vessels in the Maldives. During the project period, a system was established in which the fish processing company (Bigfish) provided technical training to fishers who delivered their catch, and it will be essential that this training continues reliably after the project's completion.

However, training on live bait management techniques provides fewer visible benefits to fish

processing companies, which may hinder the continuity of such training. Therefore, MoFOR must take the lead in ensuring that each company continues the training and in building a system to monitor its effectiveness.

To ensure that training is continuously implemented, clear incentives for fish processing companies are indispensable. It will be necessary to explain in a clear manner to them that improvements in live bait management techniques will lead to more effective use of live bait, ultimately increasing catch volumes. MoFOR should also consistently emphasize to the companies that improved fishing efficiency by fishers will result in increased landings, which in turn will benefit the fish processing companies, thereby urging them to continue training and dissemination activities.

(4) Efforts for Dissemination of the Newly Introduced Technologies

The installation of the improved live bait tank system unit (promotion model) was delayed compared to the initial plan and was only completed just before the peak pole-and-line tuna fishing season in October 2024.

Since related publicity activities were carried out only after this installation, some vessels inquired about the system unit. However, because the inquiries coincided with the peak fishing season, operations could not be suspended, and introduction was not achieved. The delay in installation was due not only to uncontrollable factors such as weather but also to the fact that the on-board surveys intended to confirm the effects of the improved system unit (prototype) were not implemented by MoFOR as originally agreed. This contributed to the delay in dissemination activities. Although surveys progressed in the latter half of the project through the use of fisheries rangers, their involvement will also be required in dissemination activities.

Additionally, spillover effects from vessels already equipped with the system unit should be utilized as opportunities for dissemination. On Madaveli Island, the home island of the *Kamana* cooperative dhony, a fishing vessel under construction by the same owner has already been equipped with a dead fish discharge function using bottom drainage. Moreover, some fishing vessels that learned of the project have expressed their desire to install the improved live bait tank system unit and, as of June 2025, have entered discussions with Facture Co. (formerly GFF).

For future dissemination, in addition to continuous publicity by the government, it will be necessary to make active use of opportunities such as social media and Fishermen's Day to promote word-of-mouth among fishers—for example, by having fishers who have already introduced the unit share their experiences.

5.2 Feasibility Assessment and Support for Establishment of Live Bait Fisheries (Activity 2-2-1/2-2-2/2-2-3)

In the first period, the feasibility of an independent live bait fishery (Activity 2-2-1) and specific ways to support the establishment of an independent live bait fishery (Activity 2-2-2) were discussed based on the results of the training in Japan. In the second period, in Activity 2-2-2, specific support methods

will be finalized and their effectiveness verified, and a ‘Review report on the feasibility of converting live-bait fishery to an independent fishery’ (Activity 2-2-3) will be compiled based on the results of these activities.

5.2.1 Feasibility of Converting Live-bait Fishery to Independent Fishery (Activity 2-2-1)

(1) Background and Challenges

Currently, Maldivian skipjack tuna pole-and-line fishing vessels capture live bait such as sprats, cardinalfishes, and juvenile fusiliers on the reefs within the atolls prior to pole-and-line operations. They then place this live bait into live bait tanks on-board before heading to the pole-and-line fishing grounds. However, in recent years, live bait resources appear to be declining. This has made catching live bait difficult in many areas, often leading to operations shifting to deeper water zones or causing a concentration of vessels in specific fishing grounds. The primary method for obtaining live bait in recent years involves divers using fish-aggregating lights at night. In deep areas, divers routinely make multiple dives per night to depths of up to 50 metres without decompression stops. Consequently, an increase in decompression sickness among crew members has become a significant problem. Furthermore, the fishing grounds for skipjack tuna and live bait are often increasingly distant from each other. Depending on the season, it has become more common for vessels to spend two days travelling round trip due to the increasing distance between the skipjack tuna fishing grounds and the live bait fishing grounds. This has led to a marked increase in the operational costs associated with live bait harvesting.

Meanwhile, in Japan, a system has been established whereby purse seine fishers supply Japanese anchovies as live bait to skipjack tuna pole-and-line vessels, thereby contributing to the efficiency of pole-and-line fishing. Due to this, MoFOR is exploring the establishment of a system similar to Japan's, creating an independent live bait fishery to ensure stable supply to skipjack tuna pole-and-line vessels. This aims to enhance operational efficiency and reduce costs for fishers. This chapter summarises the feasibility of establishing an independent live bait fishery modelled on Japan's system in the Maldives.

(2) The State of the Live Bait Fishery in Japan

Due to the above background, it was decided to utilise the training opportunity in Japan provided by the project to observe examples of Japan's live bait fishery with MoFOR counterparts and Maldivian fishers. Discussions and considerations were held regarding the potential for introducing the Japanese model of live bait fishery to the Maldives and the associated challenges. The study tour in Japan was conducted over 21 days from 7 to 27 May 2023. Participants comprised a total of 10 individuals: two project officers from MoFOR and the Maldivian Marine Research Institute (MMRI), six fishers, and two employees from fish processing companies.

The live bait fishery inspection involved a visit to the facilities of the private company Taiga in Tateyama City, Chiba Prefecture, on 24 May.



Photo 5-20 Live bait fishery company Tiga's live bait preserves (left) and coastal purse seine fishing fleet

At Taiga, coastal purse seine fleets catch sardines and Pacific saury for use as live bait in the pole-and-line skipjack tuna fishery. These are then placed into live fish cages installed within Tateyama Port and sold to coastal and offshore pole-and-line skipjack tuna fishing vessels. The purse seine fleet comprises three groups, including affiliated companies, each employing approximately 20 crew members. The number of live fish cages deployed depends on live bait stock levels; at the time of the visit, 25 cages were installed. According to a Taiga representative, approximately 80 coastal and offshore skipjack tuna pole-and-line vessels currently operate in Japan, with 80% purchasing bait from Taiga. Fishing grounds are primarily within Tateyama Bay, just outside Tateyama Port, though operations have expanded to the coast of the Izu Peninsula in recent years. Operating in shallow waters of 10 to 30 metres depth with gravelly or sandy bottoms, the live bait caught is immediately transferred into live fish cages deployed at sea. These cages are then towed by motorised vessels to designated locations within the port. However, when fishing grounds are distant, pool vessels approximately 25 metres in length are used instead of cages. The depth of the live fish cage is typically 5 metres; for deeper locations, nets with a depth of 10 metres are used. The netting material utilises knotless netting, but due to its small mesh size, it quickly becomes clogged with fouling organisms, necessitating cleaning at least once a month. Additionally, the bottom features an opening for discharging dead bait. Sales are conducted by the bucket, with one 20-litre bucket costing JPY 4,000. A 200-300 tonne fishing vessel purchases 300 buckets (JPY 1.2 million) per trip, while a 400-500 tonne vessel acquires 1,500 buckets (JPY 6 million) in a single purchase.



Photo 5-21 Scooping live bait from the cage into a bucket (left) Transferring it into the live bait tank on the fishing vessel (right)

According to our interview with Taiga, geographical conditions were crucial to the company's ability to maintain such a large-scale operation. Firstly, it was due to the nearby prime fishing grounds for Japanese anchovy. While the Bōsō Peninsula has long been known for its fishing grounds for sardines, horse mackerel and other species, Taiga's representative stated that Tateyama Bay possesses ideal conditions for Japanese anchovy, including extensive shallow waters and suitable summer water temperatures.

Secondly, the harbour basin of Tateyama Port is well-suited for installing live fish cages. While Tateyama, located at the tip of the Bōsō Peninsula, is susceptible to open ocean influences, Tateyama Port lies deep within the bay and is protected from waves due to land reclamation.

Thirdly, it serves as a suitable port of call for pole-and-line fishing vessels. The offshore skipjack tuna pole-and-line fishery operates across the Pacific, from waters off Kyushu and Amami to the Tohoku region, following the seasonal migration of skipjack tuna schools from spring to autumn. Located midway along this route, Tateyama is considered to have a geographical advantage as a live bait supply point.

(3) The Advantages and Problems of the Japanese Model

Based on the findings from the above study tour in Japan, discussions were held with the participants regarding the advantages and challenges of introducing a Japanese-style live bait fishery model to the Maldives.

As a result, the following two advantages were identified i) it can reduce divers' operational costs and risks, and ii) it can create new employment opportunities. However, the following challenges were also highlighted.

- If large-scale live fish cages are to be installed as in Japan, a very extensive area of calm waters is required, but such suitable locations are limited in the Maldives.
- If feed costs become as high as in Japan, the cost of pole-and-line skipjack tuna fishing would increase significantly.

- Should costs rise to such levels, if live bait can be caught locally, they would choose to harvest it themselves rather than purchase it from others.
- In other words, even if a Japanese-style live bait fishery were introduced, there appears to be no market for the product at present.
- With such large-scale facilities, oversight becomes more difficult, raising concerns about theft.
- As sea temperatures are higher than in Japan, clogging from seaweed is likely to be a more serious problem.
- The cost of cleaning nets would be higher.
- Damage from predators such as sharks, feeding on the fish and damaging the live fish cage, is anticipated.

Based on the Japanese case, the following technical and economic issues should be considered in order to separate the live bait fishery from pole-and-line fishing.

(4) Anticipated challenges

< Technical challenges >

(a) Development of target resources and fishing grounds

To establish an independent live bait fishery, the presence of resources and fishing grounds capable of providing stable catches is an essential prerequisite. However, in the Maldives today, declining resource levels are a cause for concern, making it difficult to achieve sustainably stable catches. In Tateyama, the presence of favourable fishing grounds for Japanese anchovy has enabled sustainable catches. However, Japanese anchovy is not distributed in the Maldives. Furthermore, due to its atoll topography, extensive shallow waters with sandy or gravelly bottoms are scarce, making purse seine operations difficult. Moreover, establishing large-scale fish cages, as is done in Japan, would require extensive areas of calm water. However, such locations are limited in the Maldives. Even if they were installed, there would be a risk of theft. Consequently, directly introducing the Japanese model to the Maldives is impossible. The development of new resources and fishing grounds can be considered one of the major challenges towards establishing an independent live bait fishery.

(b) Development of Fishing Gear and Methods

The development of new resources and fishing grounds necessitates the introduction of suitable fishing gear and methods. In Japan, coastal purse seines are primarily used for live bait fisheries. This fishery involves multiple vessels with diverse roles operating as a single fleet, leading to large-scale operations. Consequently, the fishing gear is large-scale and the operational methods complex. Introducing this to the Maldives would necessitate significant investment, technology transfer, and the establishment of systems for maintaining fishing vessels, gear, and equipment. Furthermore, establishing a live bait supply system nationwide would require operating multiple fleets in various locations, making it an impractical option. There is a need to develop fishing gear and methods that can operate without

requiring large-scale investment or equipment, and without relying on existing resources or fishing grounds.

(c) Decentralised placement of live bait supply facilities

As pointed out during discussions at the training in Japan, the Maldives' atoll geography means there are few large, calm areas suitable for establishing extensive live fish cage farms like those in Tateyama. This necessitates the decentralized placement of small-scale live bait supply facilities across various locations. Furthermore, unlike the coastal and offshore skipjack tuna pole-and-line vessels sourcing live bait in Tateyama, Maldivian fishing vessels often operate near atolls. Therefore, rather than centralized facilities, it is preferable to have facilities distributed near fishing vessels' home ports or skipjack tuna fishing grounds to enable local bait supply. Therefore, key challenges include identifying suitable sites for live fish cages on relevant remote islands and promoting the establishment of live bait fishery by local fishers.

(d) Development of suitable live bait cages for the Maldives

In the Maldives, it is traditional to temporarily store surplus live bait from fishing operations in small live fish cages. However, during this process, nets can be torn by predators such as sharks and barracuda, leading to the bait being consumed or escaping. Furthermore, nets with small mesh sizes quickly become clogged with seaweed and other debris. Due to this, developing live fish cages with the strength and structure to deter predator intrusion, or live fish cages with a mechanism that facilitates net cleaning, is a challenge.

< Economic Challenges >

(e) Establishment of appropriate live bait unit prices

Fishers have traditionally caught live bait themselves, so they seem reluctant to purchase it. Even if systems for buying live bait become available in some areas, it's expected to be difficult to immediately reduce the labour force used for catching live bait. Consequently, the cost burden is likely to be significant, at least temporarily. Furthermore, if the price of bait were to rise to the same level as in Japan, the cost of pole-and-line fishing would increase significantly. The fishers would see little benefit in switching from conventional methods. Therefore, efforts are needed to keep live bait prices as low as possible, avoiding large-scale investments or high-cost operations in the live bait fishery.

(f) Developing new sales channels

To develop live bait fishery, profitability in fishery management is naturally a prerequisite. Due to the sustainability of live bait fishery, alongside the challenge of appropriate pricing mentioned above, developing and securing sales channels is also a critical issue.

(g) Low maintenance costs for live fish cages

The labour and expense involved in maintaining the live fish cage for storing live bait are unavoidable. Efforts to reduce the costs associated with cage maintenance, such as minimising the workforce, are necessary.

(5) Prerequisites for the development of an appropriate independent live bait fishery

Considering the above challenges, this report sets out the following prerequisites for establishing an independent live bait fishery that is appropriate for the Maldives.

- i) Develop new fishing grounds and resources for sustainable use of the resources (addresses challenges a and c)
- ii) Develop fishing gear, methods, and live bait cages suited to new resources, fishing grounds, and natural conditions (addresses challenges b and d)
- iii) Distribute small-scale live bait stocking facilities across relevant islands (addresses challenge c)
- iv) The operational scale should be such that it does not require significant investment or incur high operating costs (addresses challenges b, c, d and g)
- v) The operational model should ensure that sales are reliably secured (addresses challenges f and g)

Based on these prerequisites, the next section will examine the necessary measures to assist the establishment of independent live-bait fisheries that is appropriate for the Maldives by MoFOR.

5.2.2 To Identify Necessary Measures to Assist the Establishment of Appropriate Live-bait Fishery by MoFOR (Activity 2-2-2)

In this section, measures necessary to resolve the challenge identified in the preceding section and to support MoFOR in establishing and extension an independent live bait fishery that is appropriate for the Maldives will be examined.

(1) Consideration items for support measures

In accordance with the prerequisites for the independent live bait fishery development established in the preceding section, the specific considerations are organised as follows.

(a) Develop new fishing grounds and resources for sustainable use of the resources

In the Maldives, resources are declining in the major live bait fishing grounds within the southern archipelago, which is the primary skipjack tuna fishing area. Consequently, fishing pressure on live bait resources in the central and northern parts of the archipelago, such as the Rabiyan Atoll and Barbu Atoll,

which are intensively utilised during certain seasons, is increasing. Furthermore, the target fish species are predominantly concentrated among three types: blue sprat, silver sprat, and cardinalfish and others. The Maldives also possesses underutilised fish species suitable for live bait, such as bluestripe herring and anchovy species, which remain insufficiently developed. Diversifying fishing pressure across these grounds and resources to achieve sustainable use of the resources is a crucial element for realising the future sustainability of pole-and-line fishery. When considering support measures for the independent live bait fishery, attention should be given to developing new fishing grounds and resources.

(b) Develop fishing gear, methods, and live bait cages suited to new resources, fishing grounds, and natural conditions

The fishing method currently employed in the Maldives for harvesting live bait primarily involves lift nets utilised at night with fish-aggregating lights. Anchors are dropped on sandy bottoms near coral reefs within the reefs. Underwater fish-aggregating lights are used to gather bait fish. Once a sufficient quantity has gathered, the lift net submerged in the sea is hauled up for harvesting. The fish are then transferred into live bait tanks aboard the vessel using scoop nets. Divers assist with the lift net and net retrieval facilities. However, this method utilises large gear designed for use with pole-and-line vessels, requires a large crew, and lacks cost advantages for developing an independent live bait fishery. Furthermore, this method primarily targets existing major fish species and is considered unsuitable for developing underutilised species. Therefore, it is necessary to develop new fishing gear and methods suited to the target resources, fishing grounds, and environmental conditions, along with new stocking facilities to keep the harvested live bait alive until it is loaded onto the pole-and-line fishing vessel. Furthermore, as it is necessary to keep the stocked live bait alive within the stocking facilities for a certain period, it is anticipated that adjustments to acclimatisation and feeding may need to be made depending on the condition of the live bait after harvest.

(c) Distribute small-scale live bait stocking facilities across relevant islands

Live bait stocking facilities (live fish cages) for holding freshly caught live bait should ideally be located in various areas according to the fishing vessel's operational patterns. Particularly, because loading as much live bait as possible before departure is most advantageous for operational efficiency, it is desirable for these facilities to be located near each fishing vessel's home port.

(d) The operational scale should be such that it does not require significant investment or incur high operating costs

In the case of the Maldives, live bait is caught by the pole-and-line fishing boats themselves, due to the facts mentioned earlier, there is reluctance to purchase live bait from others. Furthermore, the current live bait catch incurs excessive costs, which is problematic. Therefore, in developing an independent live bait fishery, it is essential to minimize investment and operational costs as much as possible to prevent unit prices from rising.

(f) The operational model should ensure that sales are reliably secured.

As mentioned above, fishers are reluctant to purchase live bait from others, so the sales method requires careful consideration. If the catch remains unsold, the live bait they worked hard to catch will die unused, resulting not only in financial loss but also in the waste of resources. Therefore, an operational model that ensures the catch can be reliably used as live bait must be considered.

(2) Selection of Support Measures

Based on the above considerations, select MoFOR's support measures for establishing the appropriate live bait fishery.

< Development of Small-Scale Fishing Gear and Methods and Live Fish Cages >

As a technology meeting the prerequisites, a trial introduction of the Live-bait Fishing Device for skipjack tuna pole-and-line fishing, developed by the Okinawa Churashima Foundation, will be conducted. This device was developed to support the skipjack tuna pole-and-line fishery in Motobu Town, Okinawa Prefecture, which had become unable to operate due to a shortage of live bait. It was granted a patent in March 2019.

Unfortunately, since then, all skipjack tuna pole-and-line fishing operations in Motobu Town have ceased, so it has not been used in actual operations. However, during the development period, its effectiveness in the live bait fishery, primarily bluestripe herring, was confirmed.

Okinawa's skipjack tuna pole-and-line fishery differs from the offshore pole-and-line operations in Honshu and Kyushu, primarily operating on a day-trip basis with bait types similar to those used in the Maldives. In Motobu Town, as in the Maldives, pole-and-line vessels use lift nets with fish-aggregating lights before fishing operations. In Irabu, independent live bait fishery has traditionally harvested live bait through drive fishing involving diving operations. The lift net method is similar to that currently practised in the Maldives but adopts a fleet system. Furthermore, the drive fishing method uses operations requiring specialised skills and carries the risk of decompression sickness. Consequently, introducing these methods to the Maldives offers no advantage. Notably, in Irabu, live bait fishers contract with specific pole-and-line vessels (fleets) and sell bait exclusively to these designated partners.

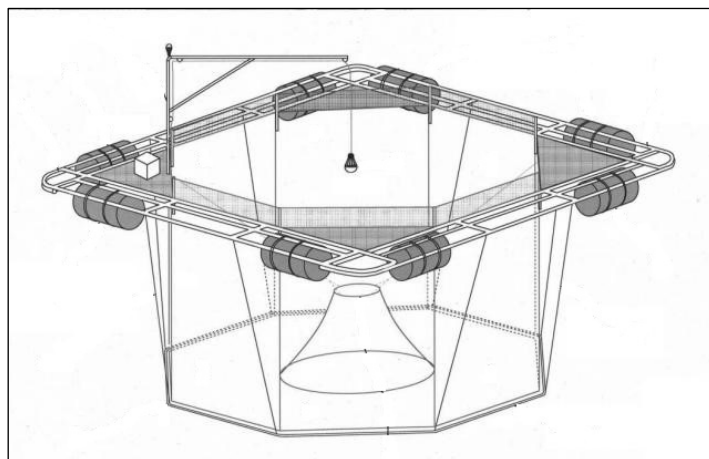


Figure 1: The Live-bait Fishing Device developed by the Churashima Foundation
(Adapted from patent documents of Japan, Patent No. 6498468)

The Churashima Foundation's Live-bait Fishing Device is a live fish cage-like fishing gear approximately 5 metres in diameter and 5 metres deep. Floated on the sea surface, it uses a fish-aggregating light to guide live bait into an opening at the bottom of the device for capture. After catching the live bait, the opening is sealed, allowing the device to be used directly as a live fish cage for rearing the bait (Prerequisite b). The primary target species in Okinawa are small pelagic fishes such as Japanese anchovy and bluestripe herring. As these species are also distributed in the Maldives, effective catching is anticipated (Prerequisite b). It is expected to contribute to the development of underutilised resources (Prerequisite a). Furthermore, as it is a small floating fixed fishing gear, simultaneous operation of the required number of units enables the development of fishing grounds in shallow waters previously unexploited (a) and facilitates deployment to individual islands (Prerequisite c). Moreover, being a small-scale gear, it does not require the large initial investment or operational costs associated with large-scale fisheries like Japan's purse seine fishing (Prerequisite d).

Based on the patent documentation acquired by the Churashima Foundation, a Live-bait Fishing Device for trial operations was fabricated and trial operations were conducted, as described in the following chapter. To fabricate, the main net body was assembled in Japan with guidance from the Churashima Foundation, while making the frame and installation of fish-aggregating light were carried out in the Maldives. Permission for the use of this patented device, granted free of charge, was obtained from the Churashima Foundation Research Institute.

The Churashima Foundation has not compiled quantitative verification results regarding the device's catch effectiveness, but it is reported that the catch species were generally bluestripe herring, with catches of 20–30 kg per night during operations⁵. Given that a pole-and-line operation in the Maldives is said to require 200–300 kg of live bait, a single device alone cannot provide a sufficient quantity. Therefore, it is necessary to simultaneously deploy and operate the number of fishing gear units expected to yield the required quantity.

⁵ Interview result with officer in charge who developed the device in Churashima Foundation

< Survey for the Development of New Resources and Fishing Grounds >

Using the aforementioned Live-bait Fishing Device, a survey will be conducted on the species and quantity caught, operational considerations, and areas requiring improvement. This will enable an assessment of the device's effectiveness and challenges. Trial operations are planned for remote islands near Male, with particular emphasis on selecting locations featuring calm conditions, consistent water depth, and gravelly seabeds.

As detailed in the next chapter, while the trial operations of the Live-bait Fishing Device implemented under the project confirmed a certain level of catch effectiveness, numerous technical challenges remain before this device can be widely adopted. MoFOR is required to continue this survey following the project.

< Support for the Specialisation of Live Bait Fishery through the Introduction of a Live-bait Fishing Device >

Should viable prospects emerge for developing new resources and fishing grounds using a live-bait fishing device, future challenges will necessitate MoFOR support to facilitate its adoption in relevant remote island regions. Support includes 'financial assistance for procuring equipment and materials' and 'technical guidance for installing and operating the device'. Regarding the former, MoFOR must provide all necessary equipment and materials as a complete set, and support such as low-interest loans for their procurement is required. For the latter, it is desirable to conduct technical training by engineers from the MMRI Maniyafushi Research and Training Facility, who participated in the project's trial operations. This training should cover methods such as fabricating the main net, assembling the procured equipment to build the device, selecting suitable fishing grounds, installing the device at the fishing grounds, maintenance and management, catch, and live-bait transfer to vessels.

In establishing and operating actual live bait fishery operations, it is considered reasonable for the pole-and-line fishing business entities themselves to directly operate and manage the live bait fishery, based on prerequisites ③ to ⑤. Even if the operational form becomes an independent fishery, skipjack tuna pole-and-line fishers can avoid operational risks by concurrently operating the live bait fishery. For a completely independent entity, there is always the risk of insufficient live bait catch failing to meet customer demand, or conversely, unsold live bait inventory remaining. However, if owned by each pole-and-line vessel/business entity, planned live bait catch and utilisation becomes possible, premised on supplying their own pole-and-line vessels, significantly reducing operational risk. This approach can be described as achieving efficiency through specialisation. It significantly contributes to reducing fishers' labour and creating employment opportunities, as live bait fishery operations can run concurrently while the pole-and-line vessels are at sea. Furthermore, having crew members or their families manage the live fish cages helps mitigate operational risks, such as when live bait cannot be caught. Similar views were expressed by fishers participating in the Japanese training programme.

Due to this, it is desirable to provide support for the division of labour between pole-and-line fishing

vessels and live bait fishery, targeting the owners of pole-and-line fishing vessels.

(3) Consensus-building on support measures

Following the above review, discussions between JICA experts and the Maldivian C/P resulted in the decision to conduct a demonstration trial of the proposed live bait fishing gear, with a view to its future adoption. This was agreed as an activity within the work plan for second period at the third JCC meeting held in February 2024.

5.2.3 Demonstration of the Effectiveness of the Live-bait Fishing Device

To demonstrate the effectiveness of the live-bait fishing device, prototype development and trial operations using the device were conducted for the support measures examined in the previous chapter: ‘Development of Small-Scale Fishing Gear and Methods and Live Fish Cages’ and ‘Survey for the Development of New Resources and Fishing Grounds’.

(1) Structure and Function of the Live-bait Fishing Device

The live-bait fishing device is composed of a main net for catching live bait, a frame for deploying it and keeping it afloat on the water surface, a set comprising a fish-aggregating light for gathering live bait and a battery/timer switch to power it, a protective net to shield the main net from large fish such as sharks, and an anchor/rope to fix the device to the sea surface. Its basic structure is similar to that fabricated by the Churashima Foundation (Figure 1).

The main net for the device fabricated for trial operations was ordered and manufactured by Nitto Seimo, a Japanese fishing gear manufacturer. It is a cube measuring 3 metres in length, width and depth, featuring a funnel-shaped opening at the bottom measuring 1.5 metres square at the lower end and approximately 50 centimetres square at the upper end. Like a set net, it is composed so that fish entering the interior are less likely to escape.

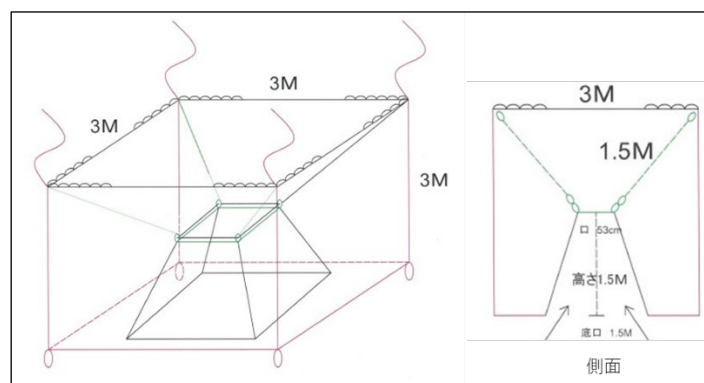


Figure 5-21 Structure of the main net of the live-bait fishing device

The framework utilised block-type live fish cage frames for sea aquaculture (manufactured in India) procured by MoFOR. These block-type live fish cage frames offer several advantages: they can be freely

assembled to any size using 50-centimetre cubic blocks that function as floats composed of them; they combine the functions of floats, frames, and scaffolding; and their flexibility in response to wave motion facilitates easy work when standing upon them. The interior of the frame was set to 3 metres square to match the main net size, with three sides measuring 1 metre wide and one side 2 metres wide, creating a structure conducive to installing fish-aggregating light control boxes and facilitating operations (see Photo 5-23). Note that the device developed by the Churashima Foundation is 5 metres square; however, its larger size results in higher net fabricating costs and requires considerable labour for operation.

Following discussions with the foundation's representatives, it was advised that a smaller size of approximately 3 metres square would be preferable for trial operations. The fish-aggregating lights are positioned both inside and outside the main net. After sunset, the outer lights are first illuminated to gather fish from a wide area. After a set period, the outer lights are switched off and the inner lights switched on, guiding the gathered fish into the main net. While the method developed by the Churashima Foundation involves alternating the lighting of the two fish-aggregating lights every hour, the project followed the live bait fishery method currently practised by Maldivian fishers, switching the lights only once per night.

Live bait entering the main net is gathered in one place by manually hauling up the net, then scooped out using a scoop net. During actual operations, it is preferable to collect the bait using buckets or water scoop nets. Furthermore, the device features a structure that allows the opening at the bottom to be closed. Once sufficient live bait has entered the net, it can be utilised as a live fish cage until loaded onto the fishing vessel.

(2) Fabrication and Installation of the Live-bait Fishing Device

From May 2024, the fabrication and preparatory work for the Live-bait Fishing Device was conducted. Based on the aforementioned findings, discussions were held regarding the specific dimensions, structure, necessary equipment and materials, procurement methods, installation location, and management system for the device. Furthermore, the procurement of required materials was carried out. The fabrication and trial operation policy for the live-bait fishing device is as follows. This activity was conducted with the full cooperation of the MMRI Maniyafushi Research and Training Facility located on Maniyafushi Island in South Male Atoll. This facility possesses the personnel and infrastructure necessary for developing and disseminating aquaculture techniques. Furthermore, the seabed topography and environment in the waters directly in front of the facility are well-suited for the habitat of fish species used as live bait. Additionally, grouper live fish cages, similar in structure to this device, are installed in the surrounding waters, and experience exists regarding their installation methods and maintenance. Due to this, it was determined that this location was optimal for conducting trial operations of this device.

i) The main net body of the live-bait fishing device was ordered from a Japanese fishing gear manufacturer with prior experience in such fabrication.

- ii) The fish-aggregating lights were procured within the Maldives.
- iii) The frame/floats and other materials for deploying the main net utilise materials procured by MMRI for promoting mariculture.
- iv) Peripheral equipment such as protective netting to safeguard the fishing device and live bait from predators like sharks, and weights to maintain net stability, will be fabricated at the Maniyafushi Facility.
- v) Installation of the device will be conducted in the waters in front of the Maniyafushi Facility.
- vi) Trial operations will be conducted by MMRI/Maniyafushi Research and Training Facility

The structure of the fishing device was developed in consultation with researchers from the Churashima Foundation and fishing gear manufacturers, with details confirmed throughout the process. The main net for this device was commissioned from Nitto Seimo in Japan. Nitto Seimo has extensive experience and expertise, having previously been contracted to manufacture live-bait fishing devices for a fisheries development project in Palau supported by the Overseas Fisheries Cooperation Foundation. Furthermore, the assembly and installation of the frame and floats were undertaken by technicians from the Maniyafushi facility. As these technicians are well-versed in fabricating aquaculture live fish cages, they were fully capable of replicating and fabricating the main net upon inspection of the net delivered from Japan. Moreover, having acquired the relevant skills during the device's fabrication process within the project, they are now able to provide technical guidance to fishers wishing to introduce the system in the future. This guidance covers the fabrication of the main net, the assembly of the entire device, and methods for its installation at sea.



Photo 5-22 MMRI Maniyafushi Research and training facility and its mariculture facility

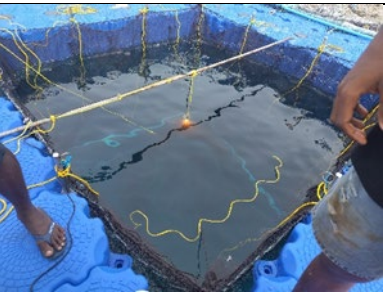
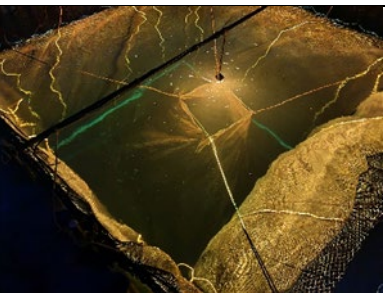
The fabrication and installation of the device were conducted at MMRI's Maniyafushi facility in late November 2024. Three main nets, including spares, were procured and arrived on site in mid-September. LED fish-aggregating lights for live bait fishing were procured from a Maldivian fishing gear shop. An 80W orange light was used inside the net, and a 100W green light was used externally. The fish-aggregating lights were controlled by timer switches and powered by automotive batteries. To ensure waterproofing, these components were housed within a cooler box. Protective netting, repurposed from

old grouper broodstock cages on Maniyafushi Island, was also installed to safeguard the nets and live bait from predators. Furthermore, the anchors and ropes used to secure the device to the sea surface were also supplied by MMRI, utilising those procured for the live fish cage.

The process for fabrication and installation is as follows: i) assembling the framework on the sandy beach, ii) making the protective netting, iii) installing the anchors, iv) towing the framework to shore and securing it to the anchors, v) attaching the protective net and main net to the framework, and vi) installing the fish-aggregating lights.

For steps iii) and iv), a somewhat larger workboat was chartered for the operation. For step v), to ensure the net structure remained stable even in tidal currents, a 3×3-metre frame-shaped weight, constructed from 1.5-inch diameter PVC pipes filled with sand, was installed at the bottom of the main net. Similarly, weights of 5kg each were suspended at the four corners of the protective net.

Following the installation of the live-bait fishing device, an underwater visual inspection confirmed that the net structure had been maintained and that the openings at the bottom of the main net were as intended. The fish-aggregating light and timer switch were also found to be functioning, and therefore the operation of the live-bait fishing device was verified from the night of 27 November 2024, when it was installed, through to the following morning. This included checking that the timer switch activated the fish-aggregating lights correctly.

		
Assembling the device frame	Installation on the sea	Completion of assembly at sea
		
Lighting device for fish-aggregating lights	Night-time conditions for the lights	Fish gathering within the net

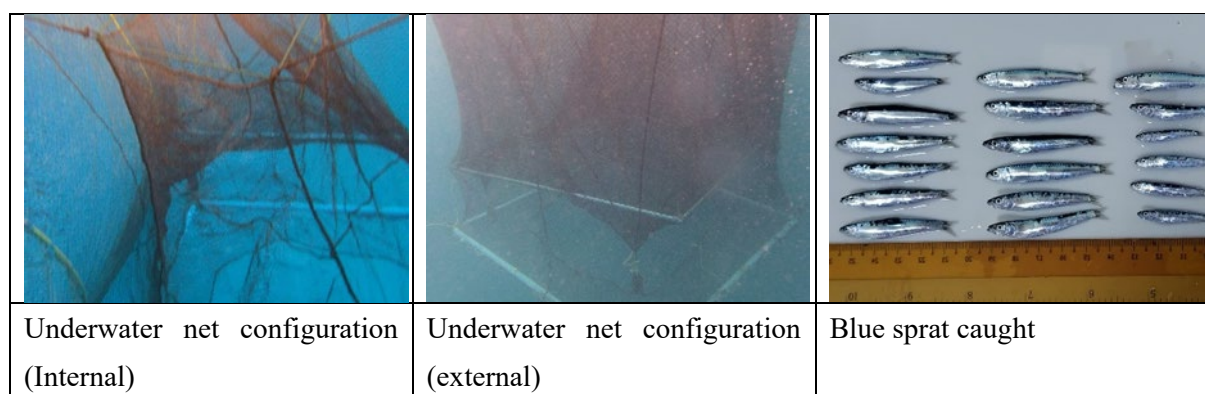


Photo 5-23 Status of the fabrication and installation of the live-bait fishing device

(3) Conduct trial operations

Having confirmed the functionality of the live-bait fishing device, trial operations commenced in early December to demonstrate its effectiveness. The three-month trial ran from 2 December 2024 to 28 February 2025, with operations managed by MMRI staff based at the Manyafushi Research and Training Facility.

The conditions for the trial were as follows (For details on the implementation status and results of the trial, refer to the attached document.):

< Fish-aggregating lights >

During operations, the fish-aggregating lights were generally switched on at 19:00 and off at around 04:00 the following day. For approximately one and a half months until mid-January, the lights outside the net were illuminated from 19:00 until around midnight, after which the lights inside the net were switched on and remained illuminated until dawn.

From 13 January onwards, due to issues with the battery and timer switch, it became impossible to switch between the two sets of lights, so only the lights inside the net were used. The colour, output and placement of the fish-aggregating lights are as follows:

Table 5-8 Fish-aggregating light placement during trial operation

	Inside		Outside	
	Color	Output	Color	Output
2 Dec - 15 Dec	Orange	80w	Green	100w
16 Dec - 5 Jan	Green	80w	Green	100w
14 Jan - 26 Feb	Green	100w	-	-

< Natural conditions >

Throughout December, the weather remained largely stable, with mild winds. Southwesterly winds dominated during this period, but the end of the year coincided with the monsoon transition, with northeasterly winds becoming prevalent from January onwards. The onset of the northeast monsoon season brought persistent inclement weather, resulting in many days that were unsuitable for operations. From February onwards, catches remained virtually non-existent.

The accumulation of floating organic matter on nets can affect the performance of the fishing equipment. However, unlike gradually deposited debris, this accumulation was found to vary depending on the direction and speed of the tide on any given day.

(4) Results of trial operations

The trial operation identified the following species of fish as being suitable for use as live bait: blue sprat, silver sprat, bigeye scad and bluestriped herring. Blue sprat is one of the most commonly used species of live bait in the Maldives, alongside silver sprat and cardinalfish. Excluding February, when operating conditions were extremely poor, there were 45 trial operation days from December to January. The total catch during this period was 114 kg, with an average catch per operating day of 2.5 kg. Although the main net used in the trial was smaller than that developed by the Churashima Foundation, meaning a large catch volume could not be expected, the device's effectiveness was considered to have been verified. The catch volume and proportion by fish species are shown in Table 5-9 and Figure 5-22.



Photo 5-24 Principal fish species caught (from left: blue sprat, silver sprat, cardinalfish, and bluestriped herring)

Table 5-9 Species and Catch Quantities from Trial Operations (December 2024 to February 2025)

Common name	Scientific name	Catches (g)
Blue sprat	<i>Spratelloides delicatulus</i>	98,527
Silver sprat	<i>Spratelloides gracilis</i>	3,495
Cardinal fish	Apogonidae	1,040
Bigeye scad	<i>Selar crumenophthalmus</i>	6,842
Bluestripe herring	<i>Herklotsichthys quadrimaculatus</i>	3,896
Silverside	Atherinidae	128
Shorthead anchovy	<i>Encrasicholina sp.</i>	16
Fusilier	<i>Pterocaesio sp.</i>	175
Total		114,118

Blue sprat accounted for 99 kg (87%) of the total catch of 114 kg, making it the dominant species in this trial operation. The next most abundant species were bigeye scad (6.8 kg), bluestriped herring (3.9 kg), silver sprat (3.5 kg) and cardinalfish (1.0 kg). Of these species, bigeye scad is utilised as live bait in yellowfin tuna handline fisheries due to its larger size, but it is not used in skipjack tuna pole-and-line fisheries. Bluestriped herring is used in pole-and-line fisheries, albeit not very commonly. When this device was developed in Okinawa, however, this species was frequently caught and considered a primary target species. In this project, it was anticipated that the device could catch these species as a

potential replacement for blue sprat, silver sprat and cardinalfish, the most common live bait species, whose populations are feared to be declining. Confirmation that this device can catch these species in the Maldives is a significant outcome.

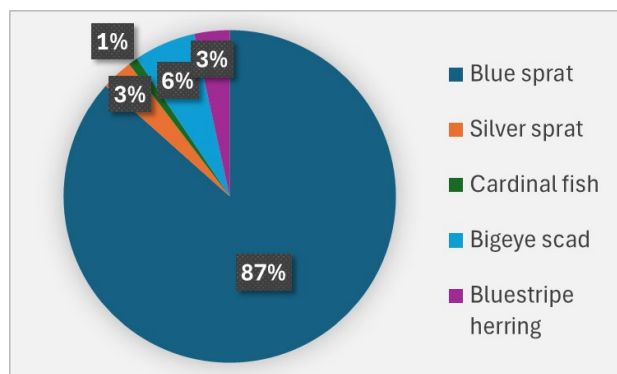


Figure 5-22 Catch proportion by fish species during trial operations

During the southwest monsoon period in December, the calm winds allowed operations and catches to proceed smoothly. However, as the northeast monsoon began in January, the winds strengthened, gradually worsening operating conditions and catches. By February, the waves had become so strong that no catches were recorded at all. However, the highest daily catch was recorded between 20th and 21st January (11 kg and 15 kg respectively), suggesting that if the location had been changed or a second bait cage installed, better results might have been obtained even during the northeast monsoon period.

Indeed, even on days when no catch was obtained in January and February, schools of blue sprat were observed near the grouper cages on the opposite side of Maniyafushi Island. This confirms that resources remain consistently present around the island.

Regarding the effectiveness of the modified fish-aggregating lights for fishing, a tendency toward higher catch volumes was observed when both the inner and outer lights were green, compared to using an orange inner light and a green outer light. From mid-January onwards, due to issues with the timer switch, only the inner green light was used. However, the catch volume on days with good weather and successful fishing remained comparable, with the highest daily catch volume being recorded during this period. In other words, the green light proved more effective than the orange light. Furthermore, no significant difference was observed when switching the lights on and off inside and outside the net, compared to using only the inner light.

However, the trial operation period was too short to draw definitive conclusions about the effects of seasonal or natural conditions, or of fish-aggregating light. Furthermore, changes in fishing grounds corresponding to the monsoon are anticipated even within the limited area of the foreshore off Maniyafushi Island. To explore effective high-catch fishing methods, it is desirable to increase the number of device installation sites and conduct trial operations throughout at least one full year. Additionally, to effectively utilise underutilised resources such as blue-striped herring, it will be necessary to explore the fishing ground conditions for these resources by varying environmental factors

such as water depth and horizontal distance from coral reefs. Additionally, when supplying live bait to the skipjack tuna pole-and-line fishery, it will be necessary to determine the most effective operational methods, including the location of the fishing grounds and the number of devices installed, in order to meet the required quantity.

5.2.4 Feasibility considerations regarding the specialisation of the live bait fishery

The results of the above verification suggest that promoting the installation of live bait fishing device and specialising in live bait fishery would improve the efficiency of pole-and-line fishery operations. Supporting this approach would therefore be an effective policy measure for MoFOR. However, it has also been confirmed that there are technical challenges that need to be overcome for this device to be used optimally. Once these challenges have been resolved, it is proposed that live-bait fishing devices be utilised in the following operational format, in order to establish a specialised live bait fishery alongside the pole-and-line fishery.

(1) Management Rationalisation of Pole-and-Line Fishery

As outlined in 5.2.1, 'Feasibility Study for an Independent Live Bait Fishery', there are several technical and economic challenges to establishing an independent live bait fishery. Given these challenges, it is impossible to introduce a Japanese model that is completely separate from the skipjack tuna pole-and-line fishery into the Maldives.

Therefore, this report proposes an operational model centered on three pillars to rationalise the management of pole-and-line fishing by specialising in the live bait fishery.:

- (i) direct operation of the live bait fishery by pole-and-line fishers;
- (ii) development of live bait fishing grounds near home ports; and
- (iii) simultaneous operation of multiple types of small-scale fishing gear.

< Direct operation of the live bait fishery by pole-and-line fishers >

During visits to Japan, the majority opinion among participating fishers was that, due to the cost of live bait being so high in Japan, they would choose to continue catching their own live bait as before. If they were to become independent business entities, as in Japan, it is clear that the selling price of live bait would be correspondingly high. Furthermore, maintaining a constant stock of bait sufficient to supply many fishing vessels would require substantial investment and development, which is unrealistic.

Therefore, it is desirable for each pole-and-line fisher to use the live-bait fishing device, the effectiveness of which has been confirmed, to specialise in live bait fishery and thereby improve operational efficiency. Specifically, it is proposed that each pole-and-line fisher prepares their own device, shifting to a model where live bait preparation runs concurrently with fishing operations. This approach eliminates the costs associated with live bait fishing, thereby enhancing efficiency. Furthermore, as live bait procurement would be self-managed, the high bait purchase costs seen in Japan could be avoided. Additionally, as each fisher would be responsible for their own live bait procurement,

it would continue to be viewed as part of the pole-and-line fishery itself. This eliminates the need to bear the operational risks associated with running a live bait fishery as a separate business. Additionally, entrusting the maintenance of the live-bait fishing device and catch operations to retired fishers or local residents could contribute to the revitalisation of the local economy.

< Development of live bait fishing grounds near home ports >

Depending on the season, fishing vessels have changed their operating patterns, moving from their home ports to distant waters where there are live bait fishing grounds. They obtain live bait there before proceeding to the skipjack tuna fishing grounds. The round trip to these live bait fishing grounds can take up to two days, resulting in high costs due to fuel expenses and lost opportunities.

To reduce these costs, live-bait fishing devices were tested so that they can be deployed in the waters surrounding the home ports of the pole-and-line fishing vessels operating them, based on the premise of direct management as described above. These devices enable operations in shallower waters than current methods allow, making it possible to develop previously largely unused shallow waters as fishing grounds.

Each fishing vessel will berth alongside a live-bait fishing device near its home port before setting out to sea, loading the stored live bait before proceeding directly to the pole-and-line fishing grounds. Furthermore, deploying the devices near home ports facilitates their maintenance and management while reducing the risk of bait theft.

< Simultaneous operation of multiple types of small-scale fishing gear >

The live-bait fishing device is smaller in scale than the lift net currently in use, and the expected catch per operation is also significantly lower. Consequently, it is necessary to deploy multiple devices simultaneously when using this device. As mentioned above, this device can operate in shallow waters, making it less dependent on specific operating conditions than the lift net. Consequently, a wider area of the reef can be used for fishing. The aim of operating multiple devices simultaneously within this area is to secure a consistent quantity of live bait.

(2) Achieving the Sustainable Use of Live Bait Resources

Specialising in the live bait fishery using the proposed live-bait fishing device can contribute to the sustainable use of live bait resources. Specifically, this involves two approaches:

- (i) dispersing fishing grounds to reduce fishing pressure on specific areas, and
- (ii) developing underutilised resources to reduce fishing pressure on specific species.

< Dispersing fishing grounds to reduce fishing pressure on specific areas >

In the Maldives, the quantity of live bait required per fishing trip continues to rise as pole-and-line fishing vessels become increasingly larger. Consequently, the prime live bait fishing grounds near home ports and the areas used for skipjack tuna fishing are experiencing heightened fishing pressure, leading

to significant resource depletion. While individual vessels are operating further afield in areas with abundant live bait resources, increased fishing pressure is also being exerted in these areas.

The current live bait fishing method involves seeking large catches in a short time at specific locations. In contrast, live bait harvesting devices use multiple devices over several days to catch bait across a wide area. This allows the required quantity of live bait to be acquired, even outside of prime fishing grounds where resources are concentrated.

This approach reduces the pressure on currently overfished grounds, where overexploitation is a concern. It facilitates the sustainable use of live bait resources and consequently contributes to the sustainable development of the pole-and-line fishery.

Furthermore, as mentioned above, the development of fishing grounds using live-bait fishing devices is planned for the waters surrounding the home ports of fishing vessels. This is because bait can only be loaded when departing from the home port. Consequently, during periods when operations continue without returning to the home port, the existing live bait fishing grounds remain equally important⁶.

< Developing underutilised resources to reduce fishing pressure on specific species >

The live bait used in the Maldivian skipjack tuna pole-and-line fishery comprises several species, primarily silver sprat, blue sprat and cardinal fish. Silver sprat is particularly favoured by fishers due to its long survival period in live bait tanks and its effectiveness in catching skipjack tuna. It is also considered abundant. However, as previously mentioned, increasing fishing pressure has led to resource issues emerging, necessitating countermeasures.

One such countermeasure is the dispersal of fishing grounds, as mentioned above. Additionally, developing resources beyond the three primary species and diversifying the target species for catch presents a challenge.

The results of trial operations with the live-bait fishing device mean that bluestripe herring, anchovy, silverside and fusilier are considered candidate species for development. However, given that the fishing grounds are within an atoll and coral reef, the bluestripe herring and anchovies, which are generally abundant, are likely to be the primary targets. Notably, the target species in the Okinawa case study, where the live-bait fishing device was developed, was bluestripe herring, and substantial catches were obtained at the Motobu Town site⁷. Although bluestripe herring accounted for only 3% of the total catch in this trial operation, the environment is similar to that of Okinawa's coastal areas. Therefore, substantial catches could be expected if suitable fishing grounds for bluestripe herring are identified. Furthermore, when promoting the live-bait fishing device, MoFOR must instruct target fishers to prioritise underutilised species such as bluestripe herring.

⁶ As Friday is an Islamic holiday, fishing vessels often return to port on Thursday and depart again on Friday evening. Consequently, when skipjack tuna fishing grounds are located far from the home port, it is anticipated that live bait can only be loaded at the home port on Friday evening.

⁷ According to Okinawa Churashima Foundation personnel involved in developing the device, a net measuring 5 metres in diameter and 5 metres in depth yielded approximately 20–30 kg of bluestripe herring per day.

(3) Economic Effectiveness of Introducing Live Bait Fishery using the Live-bait Fishing Device

Next, we will examine the economic effectiveness of introducing a live-bait fishing device as an alternative to the distant live bait fishing grounds currently used seasonally by pole-and-line fishers. This will be achieved by comparing the operational costs currently incurred by fishers for distant fishing grounds with the costs of introducing a live-bait fishing device, using the following formula:

$A1 = \text{Transport cost} = (\text{Time taken to reach distant live bait fishing grounds} \times \text{Fuel consumption} \times \text{Fuel unit price} \times \text{Annual operating days}).$

$A2 = \text{Opportunity cost} = \text{Daily skipjack tuna catch} \times \text{fish price} \times \text{days travelling to live bait grounds} \times \text{annual operating days}.$

$B1 = \text{Device procurement cost} = (\text{Material cost per unit of device} \times \text{Depreciation rate} \times \text{Number of units})$

$B2 = \text{Device management cost} = (\text{Number of days for device maintenance} \times \text{Number of workers} \times \text{Annual working days}) + \text{Other costs}$

Economic effectiveness of introducing live bait fishery using a Live-bait Fishing Device =
 $(A1 + A2) - (B1 + B2)$

< A1: Transport cost >

Transport costs are calculated by multiplying the time taken to travel to distant live bait fishing grounds by the average hourly fuel consumption rate and the unit price of fuel. This figure is then multiplied by the annual number of operational trips to estimate the annual transport cost. Travel time varies significantly depending on the home port and fishing grounds chosen. Here, we assume travel from Gaafu Alifu Atoll, home to the purchasing base of the Maldives Industrial Fisheries Company (MIFCO) and to many skipjack tuna pole-and-line vessels, to Lhaviyani Atoll. The latter has reportedly attracted numerous vessels in recent years as a live bait fishing ground. This distance is approximately 500 kilometres. Furthermore, as skipjack tuna fishing grounds are often located south of the archipelago, it is assumed that vessels return to the vicinity of Gaafu Alifu Atoll after procuring live bait. Travel time is influenced by the vessel's horsepower and weather conditions, but this journey generally takes a full day (approximately 24 hours) each way. Fuel consumption also varies with engine size and weather conditions, but it is typically around 100 litres per hour for an 80-foot fishing vessel⁸. Furthermore, the cost of diesel fuel for Maldivian fishing vessels is 19 rufiyaa per litre. That is to say, the fuel cost for the round trip to the distant fishing grounds is

$(24 \times 2 \text{ hours}) \times 100 \text{ litres} \times 19 \text{ Rufiyaa} = 91,200 \text{ Rufiyaa}.$

Furthermore, the Maldivian pole-and-line fishery typically operates on a weekly basis (with a maximum of five days of pole-and-line fishing per week), and it is estimated that vessels go to sea for approximately 40 weeks per year. According to MMRI researchers, from May to July, many fishing

⁸ Both figures are based on interviews with fishers.

vessels rely on distant live bait fishing grounds, with the number of trips estimated at around 20 per year. That is, assuming the above costs occur 20 times annually, the annual fuel cost associated with travelling to distant fishing grounds is as follows.

$$\underline{91,200 \text{ Rufiyaa} \times 20 \text{ trips} = 1,824,000 \text{ Rufiyaa/year}}$$

< A2: Opportunity cost >

When utilising the aforementioned distant live bait fishing grounds, departing in the evening and arriving the following evening, operating live bait fishing catch operations overnight and departing early the next morning, allows pole-and-line fishing operations to commence the following morning. This means the minimum period during which pole-and-line fishing cannot be conducted is two days. Furthermore, as of June 2025, MIFCO's purchase price for skipjack tuna is 16 Rufiyaa per kilogram⁹, with an average daily catch of approximately 4 tonnes¹⁰.

Therefore, the opportunity cost per operation when using distant live bait fishing grounds is:

$$4,000 \text{ kg} \times 16 \text{ Rufiyaa} \times 2 \text{ days} = 128,000 \text{ Rufiyaa.}$$

Assuming an annual frequency of approximately 20 trips to distant fishing grounds, the annual opportunity cost is as follows:

$$\underline{128,000 \text{ Rufiyaa} \times 20 \text{ trips} = 2,560,000 \text{ Rufiyaa per year}}$$

< B1: Device procurement cost >

The estimated cost per unit of equipment and materials related to the live-bait fishing device is as follows: These figures represent procurement prices obtained during trial operations in the Maldives and approximate estimated costs.

⁹ MIFCO website (<https://mifco.mv>)

¹⁰ Based on interviews with fishers.

Table 5-10 Estimated Procurement Cost of Materials and Equipment per Live-bait Fishing Device (in Rufiyaa)

	Quantity	Unit price	Amount	Remarks
Main net	1.5 set	5,000	7,500	Includes spare net (1 set comprising 2 units)
Frame, Floats	1 set	50,000	50,000	To be procured with support from MoFOR
Anchors, Ropes	1 set	10,000	10,000	ditto
Underwater Fish-Aggregating Lights	2	600	1,200	LED light 100w
Battery etc.	1	3,000	3,000	
Timer switches	2	200	400	
Waterproof case	1	3,000	3,000	
Total			75,100	

The minimum quantity of live bait required by Maldivian pole-and-line fishing vessels prior to commencing operations is typically around 200 to 300 kilograms. The pilot operation used a compact device measuring 3 metres by 3 metres by 3 metres for demonstration testing, resulting in an average daily catch of 2.5 kg. However, the Okinawa Churashima Foundation's device, which measures 5 metres in diameter and 5 metres in depth, yielded catches of approximately 20–30 kg. Although these figures provide useful reference data, they are based on limited trials and should be interpreted as preliminary findings. Therefore, for practical deployment, a size of approximately 5 metres high, 5 metres wide and 5 metres deep may be considered desirable, as this is expected, though not yet fully verified to yield a comparable catch volume. Furthermore, the live-bait fishing device can operate continuously until a certain amount of live bait has been caught. Once sufficient quantities have been obtained, the device can be used directly as a live fish cage to store the bait. Since live bait is loaded onto fishing vessels at least once a week, theoretically, if about 200 kg of bait are caught over the course of a week, this would suffice. In other words, if two units of the device can consistently catch 20 kg daily, the requirement would be met in five days. However, as stable catches cannot be guaranteed under current test conditions, further experiments are required before practical application. For this reason, it is assumed that each fishing vessel will operate around ten units.

As depreciation periods vary depending on the type of equipment and materials, the annual depreciation amount has been estimated as shown in the table below.

Table 5-11 Estimated Annual Depreciation Amount per Live-bait Fishing Device (Unit: Rufiyaa)

	Procurement Amount	Useful Life (Year)	Annual Depreciation Expense	Remarks
Main net	7,500	2	3,750	Replacing and cleaning the nets are required about once a month.
Frame, Floats	50,000	10	5,000	
Anchors, Ropes	10,000	10	1,000	
Underwater Fish-Aggregating Lights	1,200	2	600	
Battery etc.	3,000	2	1,500	Subject to appropriate maintenance
Timer switches	400	1	400	For non-waterproof models
Waterproof case	3,000	10	300	
Total	75,100		12,550	

The annual cost associated with procuring the Live-bait Fishing Device is as follows,

$$12,550 \text{ Rufiyaa} \times 10 \text{ units} = 125,500 \text{ Rufiyaa}$$

< B2: Device management cost >

Maintenance tasks involved in operating the Live-bait Fishing Device include replacing and cleaning the main nets, charging the batteries for the fish-aggregating lights, checking the nets for catches, and loading live bait onto fishing vessels. Since the main nets require replacement and cleaning approximately once a month¹¹, operating 10 units necessitates replacing the nets on two to three units per week. Therefore, some form of work is likely required nearly every day, excluding public holidays, and it is assumed that two workers will be engaged for 20 days per month, totalling 240 days per year.

The minimum wage set by the Maldivian government for 2025 is 21.63 Rufiyaa per hour for businesses in the 'small enterprise' category. Assuming the above tasks take five hours per day, the annual labour cost would be as follows:

$$21.63 \text{ Rufiyaa} \times 5 \text{ hours} \times 240 \text{ days} \times 2 \text{ people} = 51,912 \text{ Rufiyaa per year.}$$

Other anticipated expenses include maintenance of the small boats and outboard motors used for the management of facilities, their fuel, and minor consumables etc. Assuming these costs amount to approximately 50,000 Rufiyaa, the total annual cost for the maintenance and management of the live-bait fishing device would be as follows.

$$51,912 \text{ Rufiyaa} + 50,000 \text{ Rufiyaa} = 101,912 \text{ Rufiyaa}$$

¹¹ Frequency of live fish cage replacement and cleaning at the MMRI Manyafushi Research and Training Facility.

Based on the above estimates, the annual economic effectiveness of introducing live bait fishery using a live-bait fishing device on an average pole-and-line fishing vessel would be as follows.

A1: Transport cost = 1,824,000 Rufiyaa/year

A2: Opportunity cost = 2,560,000 Rufiyaa/year

B1: Device procurement cost = 125,500 Rufiyaa/year

B2: Device management cost = 101,912 Rufiyaa/year

Economic effectiveness of specialising in live bait fishery by using a live-bait fishing device

$$= (A1 + A2) - (B1 + B2)$$

$$= (1,824,000 + 2,560,000) - (125,500 + 101,912)$$

$$= (4,384,000) - (227,412)$$

$$= 4,156,588 \text{ Rufiyaa/year/vessel}$$

Based on the above calculations, the annual economic effectiveness per fishing vessel was approximately 4.1 million Rufiyaa. This figure is based on the assumption that distant live bait fishing grounds would be replaced by those near the home port. However, operational patterns vary considerably from vessel to vessel, so this calculation does not apply to all vessels. However, the substantial fuel and opportunity costs associated with utilising distant fishing grounds must be considered. If these costs could be reduced, it would be worthwhile to develop home port-adjacent fishing grounds and resources using the live-bait fishing devices.

(4) Conclusion

Based on the above verification results, it is possible to achieve both “management rationalisation of the pole-and-line fishery” and “sustainable use of resources” through the specialisation in live bait fishery when using the live-bait fishing devices under the following conditions: i) direct management by each fishing vessel; ii) fishing grounds centred around each vessel's home port; and iii) combined use with existing fishing methods. Furthermore, the economic effectiveness of this management rationalisation was estimated at approximately 4.1 million Rufiyaa per annum for a typical fishing vessel.

However, as outlined in Chapter 3, 'Demonstration of the Effectiveness of the Live-bait Fishing Device', the effectiveness of the live-bait fishing device has yet to be fully determined, and ongoing trial operations are necessary for its future widespread adoption. MoFOR must increase the number of installation sites for the device and verify optimal operational methods by varying conditions such as season, weather, water depth and the colour of the fish-aggregating lights. Once these conditions have been understood, it will be necessary to promote adoption by providing technical guidance and support for the procurement of equipment and materials to interested fishers.

In today's Maldivian skipjack tuna pole-and-line fishery, the significant decline in live bait resources

is placing pressure on fishers' businesses and challenging the future sustainability of the fishery. Live bait resources are the lifeline of the fishery, so achieving their sustainable use is crucial for the Maldives' economy and food security. MoFOR should continue to conduct demonstration trials of live-bait fishing devices, develop more concrete technical guidelines and continue to work towards future dissemination.

(5) Challenge for the future

Based on the above findings, the challenges that MoFOR should address going forward are organised as follows, in line with the 'Prerequisites for the development of an independent live bait fishery' set out in Chapter 1, 'Feasibility of converting the live bait fishery to an independent fishery'.

(a) Develop new fishing grounds and resources for sustainable use of the resources

Trial operations of the live-bait fishing device have only been conducted in one location: Maniyafushi Island. However, the distribution of live bait resources is expected to vary considerably depending on environmental factors such as seabed topography and tidal currents. It is also anticipated that these conditions may change with the seasons and the location of the atoll. It is therefore necessary to continue trial operations at locations with differing environmental conditions around Maniyafushi Island and to conduct surveys on the distribution of underutilised fish species and promising fishing environments. In the future, it would also be desirable to conduct trial introductions at each atoll, for instance by securing the cooperation of willing fishers, and to attempt the development of resources and fishing grounds specific to each atoll.

(b) Develop fishing gear, methods, and live bait cages suited to new resources, fishing grounds, and natural conditions

In relation to the above, it is necessary to continue conducting trials to establish the effectiveness of live-bait fishing devices. Specifically, comparative trials should be conducted on the colour and illumination duration of the lights inside and outside the device, methods for long-term live bait storage and the effectiveness of large nets for catching fish, in order to inform the design of a more effective device.

(c) Distribute small-scale live bait stocking facilities across relevant islands

Following the results of the above-mentioned trial, if it is decided to encourage fishers to use live-bait fishing devices, support will be provided to help them specialise in live bait fishing. As previously stated, this support includes 'financial assistance for procuring equipment and materials' and 'technical guidance for installing and operating the device'. Regarding the former, MoFOR will provide the necessary equipment and materials as a complete set. Support in the form of low-interest loans will be required for their procurement. Regarding the latter, technical training should be conducted by MMRI technicians from the Maniyafushi Research and Training Facility who participated in the trial operations of the project. This training should cover methods such as fabricating the main net, assembling the device

using the provided equipment and materials, selecting suitable fishing grounds, installing the device at these grounds, maintenance and management, and catching and loading the catch onto the vessel.

(d) The operational model should ensure that sales are reliably secured

Advice is provided to fishers wishing to introduce the live-bait fishing device on business methods and monitoring in relation to specialising in the live bait fishery. While specific business conditions vary between individual businesses, guidance on efficient management will be provided by standardising procedures such as device maintenance rotations and the timing for replacing or procuring machinery and materials. Furthermore, guidance on monitoring effectiveness is desirable, such as recording the quantity of live bait caught and supplied to pole-and-line vessels and the number of fishing trips undertaken, and comparing this with the number of occasions on which distant live bait fishing grounds were used.

6. Output 3: Strengthening the Resilience of Fishing Communities to External Change (**Blue Community**)

6.1 Situation Survey in Selected Fishing Communities (Activity 3-1-1)

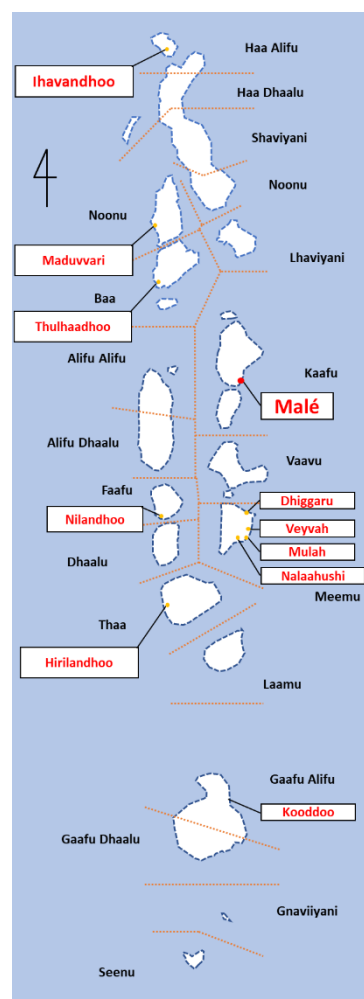
To understand the current status of fishing activities in the remote islands of the Maldives and to select sites for pilot activities related to Output 3 (Activity 3-2-2 to 3-2-4), a situation survey was conducted in the first period. This chapter summarizes the process of selecting the project sites.

In the situation survey for Activity 3-1-1, it was initially planned to conduct surveys on eight islands in seven atolls. However, during discussions with MoFOR, it was pointed out that the number of islands was too large to manage effectively. Therefore, it was requested that MoFOR pre-select five atolls and five islands (Ihavandhoo Island in Haa Alif Atoll, Maduvvari Island in Raa Atoll, Thulhaadhoo Island in Baa Atoll, Mulah Island in Meemu Atoll and Hirilandhoo Island in Thaa Atoll) for the situation survey. By November 2022, surveys were completed on four islands (Ihavandhoo Island in Haa Alif Atoll, Maduvvari Island in Raa Atoll, Thulhaadhoo Island in Baa Atoll and Hirilandhoo Island in Thaa Atoll). Among these, Ihavandhoo Island in Haa Alif Atoll was excluded from the list of potential project sites following discussions with MoFOR, as there is little processing activity there.

Additionally, regarding Thulhaadhoo Island in Baa Atoll and Hirilandhoo Island in Thaa Atoll, it was discovered that the relationship between the Island Council and fish processors was poor, as fisheries processors protested to the Island Council that they had not been allocated sufficient land for their operations during the process of creating an action plan and advancing subsequent activities. Therefore, since it was not feasible to select fish processors as target beneficiaries or to secure their cooperation in activities led by the Island Council or WDC, both islands were excluded from the project sites.

As the only remaining candidate site was Maduvvari Island in Raa Atoll, after consultation with MoFOR's C/P, new site surveys were conducted in May 2023 on Nilandhoo Island in Faafu Atoll, and in August 2023 on Naalafushi, Mula, Vayva and Dhiggaru Islands in Meemu Atoll. As a result, site surveys were conducted on a total of 7 atolls and 9 islands.

Based on the results of the current status surveys, three islands—Maduvvari Island in Raa Atoll, Nilandhoo Island in Faafu Atoll and Dhiggaru Island in Meemu Atoll were selected as the activity sites for Activity 3-2-2 and beyond from among the surveyed sites.



6.2 Impact Assessment of COVID-19 in Rural Fishing Communities (Activity 3-1-2)

For Activity 3-1-2, “Assessment of the Socio-Economic Impact of COVID-19 and Comparison/Analysis with Previous Survey Results”, a selection process for local consultants for on-site subcontracting was conducted. A shortlist of local consultants in the Maldives was created. Draft Terms of Reference (ToR) and questionnaires were sent to five companies, and they were requested to submit quotations. After comparing the survey track records and prices of the two companies that submitted quotations, Land and Marine Environmental Resource Group Pvt Ltd was selected as the contractor, and a contract was signed in August 2022.

In September 2022, a census was conducted throughout the Maldives, so the survey was postponed to avoid creating confusion among the residents. However, the survey began in October, and the final report was compiled in January 2023 (see attached document 9).

The survey revealed that the fishing communities surveyed did not suffer significant economic negative impacts during the COVID-19 pandemic, except for the effects of temporary lockdowns. This was due to the following factors: (1) the demand for processed products such as fresh tuna, Valhoamas, and Rehaakuru in the Maldives had been high since before the pandemic, so sales were not significantly affected, (2) the importance of tuna processed products as food increased due to the pandemic, (3) those engaged in yellowfin tuna handline fishing, which is the main export, temporarily switched to skipjack tuna fishing to ride out the crisis, and (4) the fishing sector, which was facing a labor shortage, was able to support those who temporarily lost their jobs due to the closure of resort hotels. Therefore, when considering activities related to fish processing at the project site, rather than focusing on the development and promotion of products targeted for export, it was deemed more effective to identify and target markets for fish processing products that still have development potential in the region. This approach was adopted as a guideline when creating action plans and business proposals, as it is believed to contribute to enhancing the resilience of remote island areas during emergencies.

6.3 To Identify the Issue and Constraints of Rural Fishing Communities in Enhancing Their Economic Resilience (Activity 3-1-3)

In the first period, based on a situation survey and an impact assessment of COVID-19, the challenges faced by key stakeholders in the fishing communities on the islands were analyzed. The challenges faced by the main stakeholders of the fishing community (skipjack tuna and tuna fishers, reef fishers and processors) on the local islands are as follows.

6.3.1 Skipjack and tuna fishers

The survey found that fishers engaged in the skipjack and tuna fisheries face the following challenges.

(1) Issue on the buyers’ purchasing capacity

Major fishing companies (MIFCO, ENSIS, Horizon Fisheries) and other buyers of skipjack and tuna have not kept pace with the capital investment required to expand purchasing in line with the larger, better-equipped vessels operating today. As a result, refrigeration and freezing facilities remain

inadequate, which prolongs the time fishers need to sell their catch and limits the amount these companies can purchase.

(2) Issue on the purchase price

For skipjack tuna, major fishing companies set the purchase price by size and according to the international market price in Thailand, but as the price is set based on the catch from purse seiners, for Maldivian fishers who only catch skipjack using pole and line fishing, the purchase price of skipjack is relatively low compared to the cost of the catch.

For yellowfin tuna, there is demand in EU countries that prefer eco-friendly products, but the purchase price tends not to increase due to high tariff rates in the EU, and the fact that the yield rate during the processing of loins remains low due to Yake problems as discussed in 3.5.1 of this report.

(3) Difficulties in securing labor

During COVID-19, the proportion of young people who lost their jobs in the tourism industry and became engaged in the fishing industry increased, but as COVID-19 subsided, young people left the fishing industry again, making it a challenge to secure labor. In addition, the Government of Maldives temporarily allowed migrant workers from Bangladesh to work on fishing boats in order to secure labor. However, the labor shortage has not improved because the government has since restricted the acceptance of migrant workers from Bangladesh.

(4) Difficulty in obtaining live bait

The availability of live bait is a problem, especially in the skipjack tuna fishery, due to the fact that fishing grounds for live bait fisheries are being lost year by year and are becoming increasingly remote.

(5) Deterioration of operating income and expenditure

Although expenditure has increased due to the recent rise in fuel costs, this has not been reflected in the purchase price of the fish, resulting in a deterioration in the income and expenditure of the operation compared to previous years.

6.3.2 Reef fisheries

The survey found that fishers engaged in the reef fishery face the following challenges.

(1) Declining markets

The main market for reef fishers is resort hotels, but there have been cases of loss of resort markets due to the growing share of suppliers who arrange food in bulk in Malé and the cancellation of deals due to lack of agreement on payment methods.

(2) Competition with the tourism industry

As fishing is prohibited in the waters surrounding resort hotels, some have expressed concern that the increase in such hotels will result in the loss of fishing grounds and a decline in reef fisheries.

6.3.3 Fish processors

The survey found that processors face the following challenges

(1) Declining market prices

The Maldives and Sri Lanka are the main markets for Hikimas, a typical processed product manufactured by the Maldivian fish processing industry, but the market price of Hikimas has been declining in recent years due to the economic crisis in Sri Lanka and the efforts to curb imports to protect its products. In addition, the market price of Valhoamas, for which the Maldives is the primary market, have been dragged down by the high availability of cheap products of poor quality. In addition, many fish processors own vacuum-packing machines, but some of them feel that producing vacuum-packed Valhoamas is not worth the effort since vacuum packing is labor-intensive. However, as there is a steady demand for Rehaakuru, which is made by boiling down the broth from the production process of Valhoamas, fish processors are selling the Rehaakuru to ensure profit.

(2) Unstable procurement of raw materials

In recent years, as skipjack fishing vessels have become larger and equipped with refrigerated sea water (RSW) equipment¹², they are landing on islands where there are major fishing companies (such as MIFCO, ENSIS and Horizon Fisheries) that can sell at high prices, rather than in local ports. As a result, there are fewer landings on the islands, and in some cases, the procurement of raw materials is more unstable on some islands than in the past.

In addition, processors have so far managed to process small skipjack tuna, which are not often purchased by major fishing companies, as they cannot make a profit if they purchase raw materials at the prices at which major fishing companies would buy them. However, some of these major fish processing companies have also started to produce processed fish products such as Valhoamas and Rehaakuru, and have started to purchase small skipjack tuna, which they had not purchased in the past, making it more difficult for small-scale fish processors to secure raw materials.

(3) Land allocation issues for fish processing industries

On the islands surveyed, fish processors pointed out the inadequate support provided by the Island Council, particularly with regard to land allocation. Whereas processing used to be possible at home or in local neighborhoods, legislation now prohibits processing within 100 m of residential areas. Many island councils have responded to this by allocating other land, but fish processors some have complained that the land is too far from their dwellings or the port and have illegally carried out

¹² Seawater cooling circulation device for cooling fish caught in fish tanks

processing on the side of their dwellings. In addition, even when land is allocated, fish processors feel that the land is not allocated correctly, for example, being right next to the boatyard or not large enough. Cases have been seen where this has led to poor relations between the Island Council and fish processors.

(4) Difficulty in securing labor

In the past, many Bangladeshis came to work as migrant workers to provide labor for fish processing. However, as Bangladeshis are now allowed to work on fishing boats, and the Maldivian Government has imposed restrictions on Bangladeshi workers, the number of Bangladeshis engaged in fish processing has decreased, and labor is in short supply.

Processors tend not to employ many residents, as the high labor costs of Maldivians reduce the profits of fish processors, and local Maldivians also tend to work on fishing boats if the work is the same difficulty, making the fish processing industry chronically short of labor and making it difficult to increase production.

(5) Lack of access to high-value-added markets

Except for some direct trade, the markets in Malé are traded by a few middlemen, and because products come from many islands, it is difficult to differentiate products from those of other islands, as they are usually not labelled with their place of origin, etc. In addition, although there is demand for reef fish in resorts, which are seen as a high value-added market, direct sales of processed fish products are complicated because there are suppliers in Malé who arrange foodstuffs, including processed fish products, in bulk, and even if direct sales are successful, they are requested to sell on credit, and it is difficult without a certain amount of capital. There have also been cases where transactions have been terminated due to claims made to the resort for delays in payment, etc.

Fish processors of some islands in Meemu Atoll have attempted to differentiate themselves by applying labels to Rehaakuru bottles, but this has not been successful enough, with problems such as the appearance of fake products with copied labels and labels being replaced with products from other islands.

Based on these results, it has become clear that small-scale seafood processors in the target regions identified in Output 3 face the following challenges: (1) falling market prices for processed products, (2) unstable raw material procurement, (3) insufficient land allocation for fish processors, (4) difficulty in securing labor, and (5) lack of access to high value-added markets. However, it is difficult for this project to directly address many of these challenges. Therefore, when creating action plans and business proposals, it has been decided to focus our activities on strengthening the domestic market sales of fish processed products, which aligns with the Island Council's medium- to long-term plan and contributes to improving economic resilience, as revealed by the COVID-19 impact assessment analysis. Specifically, it was planned to focus on the development and sales of high-value-added products, including products that meet market needs and highlight their unique features (such as those that have

conduct heat sterilization), the production of new processed products not manufactured on other islands, promotional activities to support sales in new markets such as Male, and branding support through trademark registration.

6.4 To Identify Training Needs for Key Players in the Local Economy (Activity 3-2-3)

In this activity, the Island Council, Women's Development Committee (WDC) and fish processors were identified as the key players for fish processing development in each of the sites selected in Activity 3-1-1, and needs were identified with these key players through the development of action plans and business proposals.

6.4.1 Selection of Key Players

At the start of the project, it had been planned to select fish processors on the island as key players, but many of them were elderly and lacked the incentive to start something new, being satisfied with their daily work. They were reluctant to introduce new technologies and products such as heat sterilization and vacuum packing, and when interviews were conducted with fish processors on the island we surveyed, it was found that they had little interest in the project. Despite efforts to encourage them through the Island Council to participate in training programs on hygiene management and business management, there was little incentive for them to take time off from their busy work schedules to support the project, resulting in minimal participation in the training. As a result, no fish processors willing to collaborate centrally with the project were identified at the target site.

While no fish processors were willing to cooperate for the above reasons, the technology for heat sterilizing Valhoamas developed by MASPLAN was being practiced by one fish processor on Maduvvari Island and had received some positive feedback from customers, confirming the potential usefulness of the technology. Based on this, an agreement was reached for the Island Council and WDC to take the lead in the activities. The Island Council and WDC were regarded as key players -potential entrepreneurs- and it was decided to add value through activities such as purchasing cooked Valhoamas and Rehaakuru and performing labelling, bottling, and vacuum packing using this technology. Through this activity, it was considered that adding value by packaging the processed products with vacuum packing and labelling before selling them to Male would benefit the community.

6.4.2 Preparation of Action Plans

Action plans were developed in Maduvvari Island, Raa Atoll and Nilandhoo Island, Faafu Atoll in the first period, and in Dhiggaru Island, Meemu Atoll in the second period. It should be noted that, based on the results of the research and analysis in Activities 3-1-1 to 3-1-3, the policy for formulating the action plan is (i) strengthening sales of processed fish products in the domestic market that contributes to improving economic resilience, with a particular focus on accessing high value-added markets, (ii) not relying solely on Valhoamas and Hikimas through product diversification, (iii) support for branding through trademark registration, etc.

The action plan development was conducted from 11th to 14th January 2024 in Dhiggaru Island, Meemu Atoll, from 1st to 3rd November 2022 in Maduvvari Island, Raa Atoll and from 17th to 19th July 2024 in Nilandhoo Island, Meemu Atoll. The action plan was created by dividing participants into four groups, each drafting a proposal, and then having representatives from each group discuss and compile the proposals into one action plan.



Photo 6-1 Guidance of preparing an action plan



Photo 6-2 WDC members in Maduvvari Island



Photo 6-3 Preparation of an action plan in Nilandhoo Island



Photo 6-4 Preparation of an action plan in Dhiggaru Island

In addition, the training required to start the activities was discussed during the business plan discussions on Activity 3-2-5. The training requested on each island included the following.

Table 6-1 Training Needs in Maduvvari, Nilandhoo, and Dhiggaru Island

Maduvvari Island	Training on new processed fish products (refresher training to review previously conducted training for fish processing in November 2022) Training on long-term storage of processed products (heat sterilization methods) Small business management training (bookkeeping, cash management, marketing, etc.)
Nilandhoo Island	Training on quality control of processed seafood products and production of new processed products Packaging training on targeted planned processed products Training on book-keeping and business management
Dhiggaru Island	Training on business management Training on hygiene management Training on fish processing

During the process of developing the above action plans and business proposals, the training needs for key players in the local fish processing industry were identified as follows.

Table 6-2 Training Needs Identified

Training area	Items for training
Hygiene management	Hygiene management of general fish products such as Valhoamas Hygiene control during the Valhoamas production processes Basics of histamine food poisoning Quality analysis of Valhoamas
Product development	Development of new processed skipjack products Introduction of Japanese processed skipjack products Vacuum packaging technology Production methods for heat-sterilized Valhoamas
Business management	Accounting management (bookkeeping and cash management) Marketing

In addition to the training in fish processing, which had already started in the first period as former Activity 1-2-2, it was decided to provide training and technical guidance in the production of prototypes of the products decided to be manufactured in the business proposals.

6.5 To Provide Technical Training and Assistance for Impacted Local Processors to Transition into New Production Methods and Markets (Activity 3-2-4 *ex. 1-2-2 and 3-2-3)

6.5.1 Training for Fish Processing

At the start of the project, this activity envisaged efforts to increase the value addition of Valhoamas and Hikimas. However, from the findings of Activity 3-2-1 (former Activity 1-2-1), some processors in the Maldives had stopped processing and producing Hikimas because the economic situation in Sri Lanka, the export destination of Hikimas, was still stagnant. Given this situation, it was decided, after consultation with the key players at each site, to provide value-adding technical training for local WDCs and fish processors, including quality control of Valhoamas and introduction of new processed skipjack products to replace Hikimas. An overview of the training is given below. It should be noted that the islands of Hirilandhoo and Thulhaadhoo, which were trained in the first period of the project, have since left the project as mentioned in 6.1 Situation Survey in Selected Fishing Communities. See 6.1 above for details.

Table 6-3 Outline of Training of Fish Processing

Objective of training	To provide fish processors and prospective processors with knowledge of processed skipjack tuna products and quality control, and to improve the quality of Valhoamas and learn quality analysis methods.
Implementation site	<First period> - Maduvvari in Raa Atoll (1st to 3rd November 2022) - Hirilandhoo in Thaa Atoll (6th to 9th November 2022) - Thulhaadhoo in Baa Atoll (5th to 8th February 2023) - Nilandhoo in Faafu Atoll (17th to 19th July 2023) <Second period> - Dhiggaru in Meemu Atoll (11th to 14th January 2024) - Nilandhoo in Faafu Atoll (1st to 3rd June 2024) - Dhiggaru in Meemu Atoll (4th to 8th August 2024)
Participants	- WDC and - Fish processors
Training period	3-4 days
Contents	1. Hygiene control of fish processing products 2. Hygiene control during Valhoamas production process (lecture and group discussion) 3. Basic knowledge of HACCP (lecture and group discussion) 4. Basic knowledge of histamine food poisoning (lecture) 5. Quality analysis of Valhoamas (lecture and hands-on practice) 6. New processed skipjack tuna products (lecture, practice, tasting) 7. Introduction of Japanese processed skipjack products (lecture and tasting) 8. Vacuum packaging technology 9. Production methods of heat-sterilized Valhoamas

On the four islands in the first period and on Dhiggaru Island in the second period, training was conducted on items (1) to (7) above. The training lecturers were Mr Adam Manik, C/P, and Mr Seema, research assistant and food management specialist, while the JICA experts were in charge of lectures and practical training on the analysis of processed fish products. See Appendix 8 for the teaching materials used in the training.

In May 2024, during the second period of the project, the procurement of materials and equipment necessary for pilot activities for the development and marketing of processed products described in each business proposal was completed, and training for the development of processed products described in (8) to (9) above has been conducted since June of the same year. training on Nilandhoo Island was completed in June and training on the remaining two islands from August onwards will also be conducted as required. The equipment and materials procured for the pilot activities in each site are as follows.

Table 6-4 Equipment and materials for pilot activities at each site (common to all islands)

Name of items	Specification	Quantity
Vacuum packing machine	Width 26cm, 2 time/minute	1 unit
Vacuum Bag 1	20×1500 cm、 Thickness 100 μm	10 rolls
Vacuum Bag 2	25×1500 cm、 Thickness 100 μm	10 rolls
Heat sealing machine	Width 300mm	1 unit
Electric scale	Weighting capacity 30kg	1 unit
Bottle 1	200ml	500
Bottle 2	400ml	500
Disposal gloves	100/box	5 boxes
Disposal cap	100/box	5 boxes

6.5.2 Training for Business Management

A business management training, which was in high demand during the preparation of the business proposal in Activity 3-2-3, and a business management training was conducted in the second period. In Dhiggaru Island, Meemu Atoll, the training was provided to the Dhiggaru Island WDC (Women's Development Committee) and fish processors on bookkeeping, cash management and marketing for small businesses. The training was held at a school building on the island from 27 to 29 May with 20 trainees. The lecturer was Mr Abdullah Shakir, a local consultant and former Ministry of Fisheries official, who is now a local employee of a fair trade company (BlueYou).

The business management training in Maduvvari Island, Raa Atoll, was mainly led by counterparts and took place from 26 to 28 June. Twenty-five participants attended on the first day, 17 on the second day, and 10 attended the entire course. The instructor was Mr. Shakir, a local consultant, who managed the training together with C/P during the absence of JICA experts.

Regarding Nilandhoo in the Faafu Atoll, a business management training program was conducted from 3 to 8 August 2024, led by the counterpart and local consultant, targeting fish processors and WDC members. Twenty-four participants attended the training, learning about business management, financial management, and marketing in the seafood processing industry. The overview of the training is as follows.

Table 6-5 Outline of Training for Business Management

Objective of training	Teach the basics of business management to those engaged in the fish processing industry.
Implementation site	- Dhiggaru in Meemu Atoll (27 th to 30 th May 2024) - Maduvvari in Raa Atoll (26 th to 28 th June 2024) - Nilandhoo in Faafu Atoll (3 rd to 8 th August 2024)-
Participants	- WDC - Fish processors
Training period	3-6 days
Contents	1. Basics of Small Business Management 2. Fund Management and Utilization 3. Business and Product Marketing



Photo 6-5 Explanation by Mr. Adam Manik, counterpart (Left) and photo of lecture (Right) in the training on business management



Photo 6-1 Photo of training on business management in Maduvvari Island

6.6 Supporting Key Players in Formulating the Business Proposals Based on the Economic Recovery Plan (Activity 3-2-5)

6.6.1 Preparation of Business Proposals

In order to transform the action plans created for each project site during the first period into more concrete business proposals, visits were made to Maduvvari Island in Raa Atoll from 21st to 24th January 2024, Nilandhoo Island in the Faafu Atoll from 29th January to 1st February 2024, and Dhiggaru Island in Meemu Atoll from 4th to 8th August 2024.

In conducting this activity, efforts were made to ensure the sustainability of future activities through

practical initiatives, taking into consideration the following points: (1) keeping the format of the business proposal to the bare minimum necessary, and (2) providing support for equipment provision, prototype manufacturing, and related training based on the actual business proposal drafts created.

In creating the business proposal, a market research was first conducted to understand the market situation. For Maduvvari Island in Raa Atoll, on-site visits were conducted to retail stores on the island in collaboration with JICA experts, while for Nilandhoo Island in Faafu Atoll, a survey was conducted solely with local members based on prior online training.

Subsequently, discussions were held on training related to the creation of the business proposal, the details and selling points of the products to be manufactured, the business operation method, the target market, and the necessary training. Based on the results of these discussions and the market research, the first draft of the business proposal was compiled (see attached document 11). Going forward, WDC will take the lead in advancing processed product manufacturing activities based on this content. Additionally, prior to the project's conclusion, a review of the final business proposal will be conducted with JICA experts, followed by reflections and dissemination regarding future business proposal development and updates.

		
Market survey by WDC members in Maduvvari Island	Training for preparation of a business plan in Maduvvari Island	MIFCO's Valhoamas sold in Maduvvari Island Mold present
		
Production of boiled sterilized Valhoamas as practiced by one of the processors on Maduvvari Island	Training for business plan development on Nilandhoo Island	Valhoamas sold at a retail outlet on Nilandhoo Island (was??) purchased from Malé, but origin unknown

Photo 6-7 Business plan training in Maduvvari and Nilandhoo Island

The business proposals for each island are outlined below.

(1) Maduvvari Island, Raa Atoll

1) Main business actors.

The Maduvvari Island Council and the Women's Development Committee will be the main actors in the implementation. Cooperative societies will be organized for implementation.

2) Targeted products

- a) Rehaakuru mas (sliced Hikimas, covered with Rehaakuru and dried).
- b) Heat-sterilized vacuum-packed Valhoamas
- c) Rehaakuru
- d) Terloui Rehaakuru (Rehaakuru with dried onions, etc. added to Rehaakuru)
- e) Mas mirus
- f) Rehaakuru chips

3) Funding sources required

Equipment and training will be supported by the project. Capital will be secured through fundraising, donations from hotels, etc. and sales of cooperative shares.

4) Target markets.

In the first year, the project will target the island of Maduvvari. As business progresses, the project will target other islands in Raa Atoll and eventually the Malé market.

5) Business outlook

The business outlook is assumed to be as follows.

Table 6-6 Business Outlook of Maduvvari Island Based on the Business Plan

		2024	2025	2026
(1)	Net sales (MVR)	308,320	1,429,791	1,774,913
(2)	Cost of the primary product (MVR)	215,765	1,000,500	1,242,000
(3)	Cost (MVR)			
	Labor cost ¹³	0	0	0
	Cost of fuel and lighting	7,146	33,147	41,148
	Cost for packaging and labelling	31,623	146,682	182,088
	Cost for advertisement	0	0	0
	Cost of communication	0	0	0
	Depreciation	3,969	6,804	6,804
Total ((1)-(2)-(3))		49,817	242,658	309,677

¹³ At this stage, the organising of cooperatives has not been confirmed, but the C/P also recognises the importance of this activity and intends to monitor progress through monitoring by the C/P and exchange of information as necessary.

(2) Nilandhoo Island, Faafu Atoll

1) Main business actors.

Nilandhoo Island Council and Women's Development Committee will be the main actors.

2) Target products.

- a) Heat sterilized vacuum packed Valhoamas
- b) Rehaakuru
- c) Vacuum-packed mas foshi (sliced Valhoamas)
- d) Rehaakuru Tarafana (sliced and fried breadfruit covered with Rehaakuru and dried).

3) Funding sources required.

Equipment and training will be supported by the project. Capital will be secured by the Women's Development Committee¹⁴.

4) Target markets.

In the first year, the project will target the island of Nilandhoo. As the business progresses, the project will target other islands in Faafu Atoll and eventually the Malé market.

5) Business outlook

The business outlook is assumed to be as follows.

Table 6-7 Business Outlook of Nilandhoo Island Based on the Business Plan

		2024	2025	2026
(1) Net sales		209,372	329,013	394,815
(2) Amount for purchasing raw materials (primary products)		126,945	199,485	239,382
(3) Cost	Labor cost	15,190	23,870	28,644
	Cost of fuel and lighting	5,425	8,525	10,230
	Cost for packaging and labelling	18,410	28,930	34,716
	Cost for advertisement			
	Cost of communication			
	Depreciation	3,969	6,804	6,804
	Others			
Total ((1)-(2)-(3))		39,433	61,399	75,039

(3) Dhiggaru Island, Meemu Atoll

1) Main business actors.

Dhiggaru Island Council and Women's Development Committee will be the main actors. Organize a cooperative association to implement the project.

¹⁴ Although labor costs are not included in Maduvvari Island's business outlook, this is because the policy is to distribute money to participants from what is raised as profit, instead of providing labor free of charge.

2) Target products.

- a) Rehaakuru
- b) Heat sterilized vacuum packed Valhoamas
- c) Fish powder using skipjack tuna

3) Funding sources required.

Equipment and training will be supported by the project. Capital will be secured by the Women's Development Committee.

4) Target markets

Rehaakuru and vacuum-packed Valhoamas are mainly purchased directly from processors on the island, so they will be targeted at other islands in the Meemu Atoll. Fish powder will be sold on Dhiggaru Island. As the business progresses, it will target other islands in the atoll and eventually the Male market.

5) Business outlook

The business outlook is assumed to be as follows.

Table 6-8 Business Outlook of Dhiggaru Island Based on the Business Proposal

		2024	2025	2026
(1) Net sales		82,241	272,430	292,995
(2) Amount for purchasing raw materials (primary products)		47,075	154,650	165,390
(3) Cost	Labor cost	10,640	36,120	39,480
	Cost of fuel and lighting	7,600	25,800	28,200
	Cost for packaging and labelling	3,810	12,480	13,320
	Cost for advertisement			
	Cost of communication			
	Depreciation	2,835	6,804	6,804
	Others			
Total ((1)-(2)-(3))		10,281	36,576	39,801

6.6.2 Support for the Establishment of Cooperatives at Each Site

Based on the business proposal, it was agreed to establish a cooperative led by the Island Council and WDC as the business operator. To support its establishment, Mr Shakir, a local consultant, took the lead, and from 22nd to 26th September 2024, he visited Dhiggaru Island in the Meemu Atoll, from 20th to 24th October 2024 Maduvvari Island in Raa Atoll, and from 4th to 7th November 2024 Nilandhoo Island in Faafu Atoll. The main activities included providing guidance on the procedures necessary for establishing a cooperative and assisting with the completion of application forms. Regarding registration, it is necessary to submit documents below online to the Onegov portal (<https://one.gov.mv/submissions/64817592-c071-a441-6979-64079415e93f/new>) operated by the Maldivian government and the business proposal created for this project was also used as one of the submission documents.

- By-Law of Cooperative Society
- Memorandum of Society
- Business Plan and Financial Plan
- Copies of the national identity cards of the members.
- A list of names of the Steering Committee members.
- Tax responsible Person Information Form_V1_2023.



Photo 6-8 Workshop for establishing a cooperative on Nilandhoo Island

Regarding the application process, on some islands, the Island Council, counterpart organizations, and local consultants formed an SNS group and continued their efforts to provide support around the clock. However, even after more than six months of establishment support (as of June 2025), the establishment of cooperatives had not been completed on any of the islands. The status of each island at the end of the project is as follows.

(1) Maduvvari Island in Raa Atoll

On Maduvvari Island, support for the establishment of the cooperative was provided in October 2024, including explanations on how to prepare the necessary documents, and the application for the establishment of the cooperative was submitted in March 2025. The delay in submitting the application was due to the fact that some of the 10 members who had initially agreed to join the cooperative decided not to join, necessitating the search for new members. The preliminary application was completed under the name “Raa Maduvvari Women’s Cooperative Society”, and there were no rejections of the application based on the name of the cooperative. However, after the application was submitted, it was pointed out that the scanned copy of one member’s ID card was unclear and unreadable, so it had to be resubmitted. The resubmission was made by the end of April 2025, and as of June 2025, approval from the Maldives government (Ministry of Economic Development and Trade) is pending.

(2) Nilandhoo Island in Faafu Atoll

On Nilandhoo Island, support for the establishment of a cooperative was provided in November 2024, and an application was submitted in March 2025. For Nilandhoo Island, the application was smoothly completed under the name “Mageyringe Cooperative Society”, and there was no rejection of the application due to the cooperative’s name. However, one member's ID card had expired, so the application had to be resubmitted. The application was resubmitted by the end of April 2025, but as of June 2025, it is still awaiting approval from the Maldives government (Ministry of Economic Development and Trade).

(3) Dhiggaru Island in Meem Atoll

In Dhiggaru Island, support was provided for the establishment of a cooperative in September 2024, but the registration application process was not completed due to the following issues. First, the application documents, which had been filled out with the assistance of a local consultant, were lost, causing a delay in the application. Additionally, when establishing a cooperative, it is necessary to decide on a name, but the three names initially considered “Dhiggaru Cooperative Society”, “Dhiggaru Meehunge Cooperative Society”, and “Mas Dhiggaru Cooperative Society” were rejected each time due to prior reservations of similar names. Ultimately, the name “Dhiggaru Marketing Cooperative” was approved, but the application was rejected again because the required documents were changed midway through the process. From late March to early April 2025, the application process was suspended due to the Ramadan holiday and Eid holiday, but the application was resubmitted in mid-April 2025 and registered in late May 2025.

As a result of the significant delay in establishing the cooperative, it was not possible to manufacture and sell the products at all sites by the end of the project.

6.6.3 Manufacturing and Sales Status of Products Proposed in the Business Proposal

Due to delays in establishing the above cooperatives, manufacturing and sales of the products had not yet commenced by the end of the project in June 2025. The only exception was the completion of a prototype product on Nilandhoo Island in the Faafu Atoll. A tasting session was held within MoFOR based on this prototype, and the results were provided as feedback. Improvements were made based on these results, and product samples were presented at the final seminar held in May 2025.

Furthermore, the impact of the project activities has also been confirmed on Nilandhoo Island. One of the local fish processors who participated in the training on heat-sterilized vacuum-packed Valhoamas for product prototyping in August 2024, who is also the spouse of a WDC member (Mr. Ibrahim Musa), has begun manufacturing and selling products using this technology. He used to sell about 10% of the Valhoamas he produced in vacuum-packed form, but now all of his vacuum-packed Valhoamas are heat-sterilized. Currently, he is selling his products directly to retail stores on several islands in the Haa Alif Atoll, Haa Dhaalu Atoll, and Raa Atoll, in addition to Nilandhoo Island. In a market survey conducted at the retail store in the photo, products from other islands were previously sold, but this is a good example of them being replaced by products from Nilandhoo Island. However, this has led to competition with the products of the cooperative supported by this project, and the cooperative now needs to find new sales channels outside of Nilandhoo Island.



Photo 6-2 Product samples produced in Nilandhoo Island

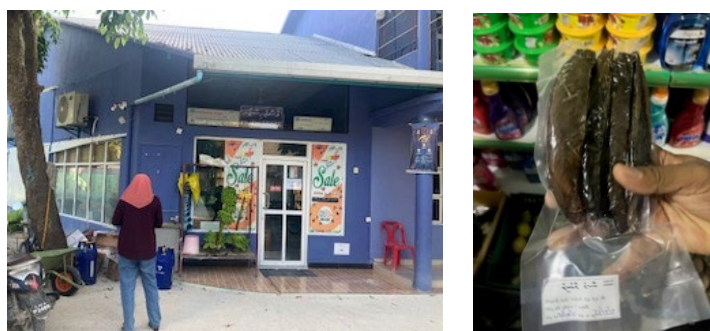


Photo 6-3 Retail store on Nilandhoo Island (left) and heat-sterilized Valhoamas on sale (right)

6.6.4 Holding a Meeting to Assess the Current Status of Activities Proposed in Existing Business Proposals and Provide Feedback for Future Activities

Representatives from the target sites for Output 3 participated in the final seminar held on 26th May 2025 and gave presentations. In preparation for this, a meeting was held to assess the current status of activities and provide feedback for future activities, while also providing support for the creation of presentations. During the meeting, discussions were held on lessons learned and future plans regarding “operational organizations”, “project funding”, “support from MoFOR”, “products”, and “input support (equipment, training, etc.)”, as well as the support framework provided by MoFOR during and after the implementation of the project.

Table 6-1 Status of Meetings Held to Assess Current Activities and Provide Feedback for Future Activities

	Date	Place	Participants
Maduvvari Island Raa Atoll	22 nd April 9:00 to 10:30	Meeting room in Island Council	Island Council 2 members, WDC 4 members
Nilandhoo Island Faafu Atoll	18 th April 20:00 to 21:30	Meeting room in WDC	Island Council 4 members, WDC 2 members
Dhiggaru Island Meemu Atoll	12 th April 20:00 to 21:30	Meeting room in Island Council	Island Council 3 members, WDC 5 members

(1) Maduvvari Island in Raa Atoll

A meeting was held on Maduvvari Island on 22nd April 2025. It was confirmed that the establishment of a cooperative, as described in 6.6.2, was causing delays in all activities. As the establishment of the cooperative has not been completed, the product label design cannot be finalized. In addition, the Island Council staff responsible for label design were on holiday and absent.

Going forward, the plan is to establish a system to begin manufacturing and selling products as soon as possible after the cooperative is established.

Regarding the “operating organization”, it was initially planned that WDC would take the lead, but during the process of establishing the cooperative, seven fish processors were involved in the activities. This will allow the cooperative to focus on branding Maduvvari by specializing in adding value to packaging and labels, while utilizing the existing markets of the fish processors.

Regarding “project funds”, WDC has already allocated MVR50,000¹⁵ from the Island Council’s budget to purchase shares after the establishment of the cooperative.

Regarding “support from MoFOR”, it was agreed that the frequency of visits and technical level were sufficient.

Regarding “products”, through the connections of the WDC president, who is also a member of the cooperative, two supermarkets in Male (Ihusaan Fihaara and VB Mart) have already agreed to sell the products. Additionally, the cooperative members who are fish processors can also sell processed products to employees at resorts around Maduvvari Island (Furaveri Island Resort, Alila Kofhafaru Island Resort, Dhigali Island Resort), and WDC stated that there are no issues regarding the market. Negotiations for price increases are planned in conjunction with value-added initiatives. However, concerns exist regarding the motivation of WDC members for cooperative activities, which may pose challenges to the sustainability of future activities.

Regarding “input support (equipment, training, etc.)” there were issues with the quality of the bags used for the vacuum packaging machines that were provided, but alternative bags have been supplied. Regarding training, the training on fish processing was beneficial, and the recipes learned are being continued at the household level, with opinions expressed that they would like to add them to the product lineup in the future. On the other hand, regarding business management training, since the content was general and targeted at fish processors, there was a request for practical management training for the executive committee that operates the cooperative.

(2) Nilandhoo Island in Faafu Atoll

A meeting was held on Nilandhoo Island from 17th to 19th April 2025. It was confirmed that the delay in all activities is due to the issue of establishing a cooperative, as described in 6.6.2. Since the establishment of the cooperative has not been completed, the design of the product label cannot be finalized. There is an intention to promptly commence product manufacturing and sales once the cooperative is established, but due to competition with other fish processors, as described in 6.6.3, efforts to develop new markets will also be advanced concurrently.

There were no particular issues regarding the “operating organization”, and it was agreed that the current Island Council would supervise and the cooperative would proceed with the project.

Regarding “project funds”, the Island Council has already budgeted MVR50,000 and WDC has budgeted MVR50,000, and any shortfall will be covered by selling shares in the cooperative, so there are no issues.

Regarding “support from MoFOR”, it was noted that the frequency of visits and technical level were sufficient.

Regarding “products”, the cooperative purchases primary products from local producers and adds value through packaging and labelling. While the business proposal includes four products, it is currently possible to manufacture 15 products. In addition, the cooperative intends to utilize the knowledge gained

¹⁵ MVR1 = JY9.825980 (JICA rate of April 2025)

from training in Japan to expand its business by selling not only processed seafood products but also local specialty sweets and other items in response to demand.

Regarding “input support (equipment, training, etc.)”, there was an issue with the quality of the bags used for the vacuum packaging machine that was provided, but alternative bags have been supplied. Regarding training, comments indicated that many topics were covered through both on-island and training in Japan, including hygiene, standardization, the importance of labelling, packaging, maintaining fish freshness, and new product ideas. Regarding business management training, while the knowledge gained was useful, there was a desire to learn more deeply and specifically about marketing.

(3) Dhiggaru Island in Meemu Atoll

A meeting was held on Digal Island on 12th April 2025. Here too, it was confirmed that delays in establishing the cooperative were causing delays in all activities. At this point, the cooperative had not yet been established, so the product label design could not be finalized. After the cooperative was established, a tender to select a fish processor as a raw material supplier was scheduled to be held in early May 2025, with plans to begin manufacturing and selling products from mid-May 2025. However, no progress had been made by the project’s completion date.

Regarding the “operating organization”, initially, Mr. Ziyan, an employee of the Island Council, served as the focal point and supported the project activities, but due to his busy schedule with other tasks, delays occurred in the project activities. As a result, the vice president of the Island Council was appointed as the new focal point. Additionally, there were opinions that an NGO, rather than the Island Council or WDC, would be preferable for the operating organization, but no information was available on NGOs engaged in related activities in the local area.

Regarding “project funds”, the Island Council has already budgeted MVR50,000 and WDC has budgeted MVR35,000, and the shortfall will be covered by the sale of cooperative’s shares, so there are no issues.

Regarding “support from MoFOR”, the frequency of visits was sufficient, and they expressed gratitude for the support provided around the clock through the creation of an SNS group.

Regarding “products”, although there was a proposal for a new product called skipjack powder on Dhiggaru Island, the action plan proposed the more common products of Valhoamas and Rehaakuru. When asked if product diversification was possible, it was stated that ideas had been obtained through training in Japan and samples of Japanese processed fish products, but that the first priority was to establish the brand of the products to be produced, and then diversify the product lineup.

Regarding “input support (equipment, training, etc.)”, there was an issue with the quality of the bags used for the vacuum packaging machine that had been provided, but after testing alternative bags, no further issues were identified. Regarding training, hygiene training and business management training were conducted with local consultants at the center, and there were opinions that understanding improved through lectures in Dhivehi. However, regarding business management training, the level was

set for WDC, and since the fish processors already knew the content, their participation could not be secured. Setting training content appropriate to the participants' level has become a future challenge.

6.7 MoFOR Support System for Output 3 after Project Completion

Based on requests from the Island Council, MoFOR will continue to provide training related to fish processing on each remote island. As part of MoFOR's 2025 Work Plan, training sessions on the themes of fish processing and value addition are planned for islands such as Kudafare Island (Noonu Atoll), Kuldahushi Island (Haa Dhaalu Atoll), Ihavandhoo Island, Uthim Island (Haa Alif Atoll), and Nilandhoo Island (Gaafu Alif Atoll), with actual implementation beginning in May 2025. In addition to fish processing and hygiene management, some sites also include activities related to the establishment of cooperatives, as implemented in this project. MoFOR plans to develop simple guidelines based on the results and lessons learned from this project, such as market research and business plan creation, with the intention of utilizing them in future training programmes.

Additionally, separate from these training programmes, technical support will continue to be provided for the three sites of this project based on requests from the islands, using the World Bank's project budget.

6.8 Lessons Learned and Challenges from Main Activities

As described in Chapter 9, activities related to Output 3 did not achieve sufficient results to measure the indicators against the initial plan. The main reason for this is thought to be the community mobilization mechanisms in remote islands. However, there is a growing need for fisheries promotion through efforts to improve fish processing and added value in remote islands, and MoFOR is now actively working to address this issue. In order for MoFOR to continue similar activities in the future, it is desirable to consider countermeasures based on the lessons learned from this activity. For this reason, the main technical lessons learned from this project are summarized here.

6.8.1 Selection of Activity Sites

The local islands of the Maldives are small communities with complex human relationships, so careful consideration is required when selecting sites. Initially, sites were selected based on their fisheries potential, but it was later discovered that two of the three selected sites had no intention of participating in the activities, resulting in the need to reselect sites.

For example, in the case of fish processing, some island councils prohibit fish processing on private property, as the land for fish processing is designated from the perspective of separating residential areas from industrial areas. In such cases, the island council may allocate new sites for fisheries processing in areas such as reclaimed land away from residential areas. However, fish processors who wish to continue processing near their homes may continue to do so, leading to conflicts between fish processors and the Island Council. In such sites, even if the area is known for its thriving fisheries industry, cooperation from fish processors cannot be obtained, making it extremely difficult to carry out activities. Therefore,

it was necessary to thoroughly confirm the relationship between the Island Council and the fish processors. Additionally, due to the high level of interest in politics within the community, when stakeholders support different political parties, it can be difficult to achieve sufficient coordination. In the future, when selecting new sites, it will be necessary to conduct detailed preliminary survey to confirm that there are no potential sources of conflict within the Maldivian community.

In addition, it is necessary to thoroughly confirm the utilization status of fish processing sites. As mentioned above, since fisheries processing sites are decided by the Island Council, new businesses cannot enter the market if there are no vacant sites. If activities such as starting a new business are planned in the future, it is necessary to obtain information in advance from the Island Council regarding the availability of fisheries processing sites and the possibility of new allocations, and to obtain permission.

6.8.2 Selection of Beneficiaries to be Targeted by Activities

As a prerequisite for Output 3 of this project, from the perspective of technical cooperation that utilizes the results obtained from MASPLAN, this technical project will continue the flow of MASPLAN's "Pilot Project for Improving the Quality of Traditional Fish Products" and promote the technology for heat sterilizing, and vacuum-packing Valhoamas that was developed at that time as one of its themes. In terms of how the project was conducted, a current situation survey was first carried out, sites were selected, and activities were initiated. Based on the analysis of the survey results, it was concluded that adding value to domestically oriented products with high demand would be useful.

Based on the above prerequisites, the project was implemented in a manner as consistent as possible with the PDM content; however, several drawbacks were observed in this approach. First, after selecting the target site, entrepreneurs in the fish processing industry who could cooperate with the activities were sought, but none were found. Since no experienced fish processors were available to cooperate, the activities were carried out by the Island Council and WDC. However, they lacked business experience and funds, so it became necessary to establish a cooperative association as the operating entity and to conduct frequent monitoring. Furthermore, new product ideas did not expand, and with the exception of some specialty products such as Rehaakuru mas and snacks, the proposals were similar.

In the future, when conducting activities at the community level, it seems that it will be necessary to change the conventional method of deciding on the site in advance. Specifically, the following methods could be considered: (1) first select candidates from across the country who are enthusiastic about making new proposals, and (2) based on marketing research, select promising product candidates and then select enthusiastic fish processors who can respond to them. This could be achieved through means such as business recruitment by MoFOR. After selecting candidate businesses, an approach could be taken to survey the current state of their communities and then select final site candidates.

6.8.3 Training Methods and Content

Regarding the lecture level of the fish processing training and business management training, it was recognized that the fish processing training utilized local experts who are also fish processing specialists and have practical experience at fish processing companies, while the business management training utilized experienced local experts. The training was not limited to lectures but also included technical training, and was technically tailored to the local demand level.

Regarding fish processing training, interviews conducted at the target sites revealed that, initially, due to the lack of equipment such as vacuum packaging machines, training was conducted on new processed products using fish as raw materials, such as fish burgers, as well as hygiene-related training. Participants commented that they gained useful knowledge on hygiene management, standardization, the importance of labelling, packaging, maintaining fish freshness, and new product ideas. Additionally, after equipment was provided to each island, training on the production of prototype products such as heat-sterilized vacuum-packed Valhoamas was conducted, with some fish processors participating. Recognizing the quality improvements achieved through the introduction of new technologies, the heat-sterilization technique was applied to actual product production on Nilandhoo Island in the Faafu Atoll following the training, and it was confirmed that the products are being sold not only within the island but also to other atolls. If MoFOR had possessed equipment such as vacuum packaging machines that could be used in the project at the initial stage, it might have been possible to engage seafood processors in concrete product manufacturing activities from the outset of the project.

When interviews were conducted at the target sites regarding business management training, it was found that the content was general in nature and targeted at island councils and WDC members, and did not meet the level required by processors. There were opinions that they wanted to learn more about marketing and the management of newly established cooperatives. In this project, the period was short and there was only one opportunity for business management training, but if the effects of the first training session had been monitored and evaluated at an early stage, and if the second and subsequent training sessions had included more in-depth content and practical activities focused on specific topics in line with the progress of the project, the training would have been more useful.

6.8.4 Implementation Structure

(1) Degree of Involvement of the Island Council

In the Maldives, relations between the Island Council and fish processors are often poor due to disputes over land allocation, and it was difficult to obtain direct cooperation from fish processors at the target sites. Therefore, the Island Council and WDC were used as the main counterparts on the island side for the activities. However, the Island Council is busy with various projects unrelated to fisheries, and there were islands where sufficient involvement could not be obtained. In future similar projects, the Island Council should be limited to a focal point role and should not be designated as one of the main counterparts.

(2) Monitoring system on the target islands

In this activity, ownership of WDC's projects was low, and it was more difficult than expected to obtain participation in project activities. This was partly because the experts' M/M was short to begin with, and it was often difficult to travel to each island due to other events on the islands and bad weather, making it impossible to visit for a sufficient period or number of times, and it was not possible to sufficiently encourage the development of ownership. For this reason, hiring assistants to supplement the activities of JICA experts in the field was considered, but despite the support of MoFOR, it was not possible to find suitable candidates. In the future, when conducting similar activities targeting remote island communities, it would be desirable for MoFOR to assign a dedicated counterpart or to assign extension workers at the island (or atoll) level. It would also be desirable to conduct monitoring through on-site visits by counterparts at least once every six months, even when experts are not present.

(3) Working capital

Securing operating funds was a challenge in this activity. During discussions on each island, the Island Council and WDC found it difficult to directly secure the necessary funds, so they decided to organize a cooperative and raise funds by selling shares as a solution. However, registering the cooperative took a long time, so it was not possible to start manufacturing and selling products within the project period. When conducting similar activities in the future, it is necessary to consider how to secure working capital for the project from the outset and to determine the implementing entity (such as a fish processor) that can secure a certain amount of working capital.

(4) Establishment of a cooperative association

The selected beneficiaries do not necessarily need to be formally organized. The process of forming an organization takes time and does not necessarily guarantee sustainability. However, training and information should be distributed fairly among individual businesses so that each business can independently manage its activities to ensure its long-term survival.

Additionally, if the establishment of a cooperative society as the implementing entity for the project is to continue in the future, it is possible to reduce the time required for registration if the following points are confirmed in advance: reserving the cooperative society name before using the registration portal site, ensuring that all members' IDs are within their validity period, and confirming that copies of submitted documents are clear and legible. When conducting such activities, it is necessary to create a checklist of important notices.

7. Project Final Seminar

On Monday, 26th May 2025, from 9:00 to 15:00, the project final seminar was held at the conference hall of the Meeruma Hotel in Malé. The purpose of this seminar was to present to participants the results of each project activity and the framework for continuing activities after the termination of the project, while also using the occasion as an opportunity to disseminate and promote these achievements to relevant fishers and participants from island sites. The seminar program is shown in the table below.

Table 7-1 Program of the project final seminar

9:00 – 9:05	Recitation of Holy Quran	
9:05 – 9:35	Opening remarks and project results	Dr. Hussain Sinan, Project Director
9:35 – 9:40	Address by the Japanese Ambassador	H.E. ISHIGAMI Rumiko, Ambassador Extraordinary and Plenipotentiary
9:40 – 9:45	Address by Minister of Fisheries and Oceanic Resources	Hon. Ahmed Shiyam, Minister of Fisheries and Oceanic Resources
9:45 – 9:50	Closing remarks of the opening session	Dr. Aminath Shafia, Permanent Secretary of MoFOR

Program 2: Introduction of New Technologies for Sustainable Use of Live-Bait Resources

10:00 – 10:25	Introduction of new technology and practices of the improved live-bait tank and water scoop-net	Mr. Samrath Hassan, Representative of Kamana dhoni
10:25 – 10:45	Question and answer	
10:45 – 11:10	Feasibility study for introduction of independent live-bait fishery	Dr. Ahmed Riyaz Jauhary, Maldives National University Mr. Ismail Haleem, MMRI
11:10 – 11:30	Question and answer	

Program 3: Progress and Future Plan of the Improving Fish Produces in Islands

11:30 – 12:00	Progress and future challenges of the project sites	Ismail Mahid - Dhiggaru, Ahmed Shareef – Nilandhoo, Aishath Shahdhah - Madduvari
12:00 – 12:15	Experience in formulating and managing organizations	Mr. Adam Manik, MoFOR
12:15 – 12:30	Question and answer	

< Lunch Time: 12:30 – 13:30 >

Program 4: Establishment of a Cooperation Platform for Improving Yellowfin Tuna Quality

13:30-13:50	Lecture on “Current condition of Yellowfin tuna natural resource” and “International trade of Yellowfin tuna”	Dr. Mohamed Shiham Adam, Vice Chair of Working Party on Tropical Tuna
13:50-14:00	Question and answer	
14:00-14:20	The improvement of On-board fish handling of Yellowfin Tuna	Mr. Ahsan Mohamed, MoFOR Mr. Ahmed Shareef, Representatives of Niru 7

Program 5: The Future Plan of Activities after Completing the Project

14:20-14:30	MoFOR’s Future Plan of Activities	Mr. Adam Manik, MoFOR
14:30-14:45	Discussion on possible pathways to establish business to business linkages	
14:45-15:00	Closing remarks of the seminar	Dr. Hussain Sinan, MoFOR

Participants included representatives from the Government of Maldives, private-sector stakeholders such as fish processing companies and FRP/ship building companies related to Output 1 to Output 3, stakeholders from the three target islands of Output 3, tuna (skipjack and yellowfin) fishers, as well as JICA representatives. From the Maldivian government side, key members of MoFOR attended, including Minister Ahmed Shiyam, three Deputy Ministers, and one State Minister, among others. From the Japanese side, attendees included H.E. Ishigami Rumiko, Ambassador Extraordinary and Plenipotentiary, Embassy of Japan, Mr. Taki Motoo, Resident Representative, JICA Maldives Office, and Ms. Fujita Akiko, Deputy Director, Economic Development Department, JICA, among others. The list of seminar participants is shown in the table below.

Table 7-2 List of participants

#	Full Name	Designation
1	Hon. Ahmed Shiyam	Minister, MoFOR (Ministry of Fisheries and Ocean Resources)
2	Dr. Aminath Shafia	Permanent Secretary, MoFOR
3	H.E. Ishigami Rumiko	Ambassador Extraordinary and Plenipotentiary, Embassy of Japan
4	Mr. Fukuoka Shuto	Head of Economic Cooperation, Embassy of Japan
5	Ms. Fujita Akiko	Deputy Director, Economic Development Department, JICA
6	Mr. Taki Motoo	Resident Representative, JICA Maldives Office
7	Mr. Yamasaki Hideyuki	Project Formulation Advisor, JICA Maldives Office
8	Ms. Haleemath Najula Ahmed	Project Officer, JICA Maldives Office
9	Dr. Ahmed Riyaz Jauharee	Dean of Dean of College of Fisheries and

		Ocean Sciences
10	Dr. Echigo Manabu	Chief adviser of JICA expert (BEFiS)
11	Dr. Sano Kosuke	JICA expert (BEFiS)
12	Dr. Hussain Sinan	Director General, MoFOR
13	Mr. Ahmed Yaamin	DG, MoFOR
14	Mr. Mohamed Shimal	DG, MMRI (Maldivé Marine Research Institute)
15	Mr. Aminath Hussain Shareef	State Minister, MoFOR
16	Mr. Adam Manik	Deputy Director General, MoFOR
17	Mrs. Aminath Nazima	Director, MoFOR
18	Mr. Musthafa Abdul Ghafoor	Senior Policy Officer, Ministry of Economic and Development and Trade
19	Ms. Aishath Shiyaza	Administration Officer, Ministry of Transport and Civil Aviation
20	Ms. Umaira Ahmed	Senior Environment Analyst, Minister of Tourism and Environment
21	Ms. Aminath Madheeha	Food Quality Assurance Coordinator, Maldives Food and Drug authority
22	Ms. Aishah Riyaza	Local Sales and Marketing General Manager, MIFCO
23	Mr. Hussain Shareef	Secretary General of MSPEA (Maldives Seafood Processors and Exporters Association)
24	Mr. Ismail Rasheed	General Manager, BIGFISH
25	Mr. Ahmed Yasir	Facture Pvt Ltd
26	Mr. Hamdhan Saeed	Facture Pvt Ltd
27	Mr. Ibrahim Hamdhoon	Deputy Manager / Operations, Ensis Fisheries
28	Mr. Shafeega Naeem	Deputy Minister, MoFOR
29	Mr. Hammadh Abdul Kareem	Deputy Minister, MoFOR
30	Mr. Mohamed Inan Ali	Deputy Minister, MoFOR
31	Mr. Ahsan Mohamed	Fisheries Officer, MoFOR
32	Ms. Maryam Ruva Rasheed	Ass. Extension Fisheries Officer
33	Mr. Abdulla Shakir	Consultant
34	Mr. Ahmed Shareef	Senior Council Officer, Nilandhoo
35	Ms. Naseeba Ali	WDC President, Nilandhoo
36	Mr. Mohamed Sadhiq	Council President, Maduvvari
37	Ms. Aishath Shahdhaa	WDC Member, Maduvvari
38	Ms. Aminath Saama	Fish Processor, Maduvvari
39	Mr. Ismail Mahidh	Council Vice President, Dhiggaru
40	Ms. Hawwa Zahira	WDC President, Dhiggaru
41	Mr. Mohamed Naseer	Fish Processor, Dhiggaru
42	Mr. Ismail Saamir	Fisher (Javaahiru)
43	Mr. Ahmed Shareef	Fisher (NIRU-7)
44	Mr. Ali Moosa	Fisher (Fahidhuveli)
45	Mr. Ibrahim Imaam	Fisher (Raasthaa 2)
46	Mr. Moosa Safraaz	Fisher (Fahiraastha)

47	Mr. Ismail Hammaz	Fisher (Aaroadhi)
48	Mr. Azuwaad Farooq	Fisher (Sea Sun)
49	Mr. Haamid Abdulla	Fisher (Malaha 2)
50	Mr. Inaz Abdul Wahid	Fisher (Vindhu)
51	Mr. Ali Mohamed	Fisher (MIAREN)
52	Mr. Munzir Abubakuru	Fisher (MAAHOARA 3)
53	Mr. Abdulla Rauf	Fisher (RAASTHAA)
54	Mr. Samrath Hassan	Fisher (Kamana)



Photo 7-1 Photos shown in Facebook of MoFOR
(Japanese Ambassador and Minister of MoFOR at the top left)

In the seminar, persons in charge of each Output gave explanations to the participants in Dhivehi, using slides prepared in advance. The seminar proceedings were also publicized through MoFOR social media accounts by photos and videos.

In the section on Output 1, a lecture was delivered by Dr. Adam Shiham as former Director General of MMRI, and currently serving as a consultant and one of the Maldivian representatives to the Indian Ocean Tuna Commission (IOTC) Scientific Committee, on the status of yellowfin tuna resources in the Indian Ocean. Participants raised questions on trends in demand in international trade as well as the recent decline in domestic prices of yellowfin tuna in Maldives.

As part of the activities in Output 1, explanations were provided concerning on-board handling techniques for yellowfin tuna that the project has been promoting—namely, the Irabu method to prevent Yake, Ikejime, and the tuna ring, along with their respective benefits. These were explained by Mr. Ahmed Shareef, a yellowfin tuna fisher (NIRU-7), who has been practicing these techniques.

Participants asked questions about the effectiveness of each method and about the price of the tuna ring. Regarding the cost, Mr. Shareef explained that he fabricates the rings himself on-board, making them significantly less expensive than purchasing them.

In Output 2, the presentation of results was divided into two parts: activities related to the introduction of the improved live-bait tank system unit and scoop net, and activities concerning the “study and support for independent live-bait fisheries.”

For the former, Mr. Yaseer from Factice Pvt. Ltd. (formerly GFF Pvt. Ltd.), which co-developed the system unit with the project, explained its basic structure and the procedures for installation work. In addition, Mr. Samrath Hassan, a fisher operating the Kamana and one of the prototype users, presented his observations on the operational benefits and challenges experienced during actual fishing operations. Prior to the presentation, some participating fishers expressed doubts about the effectiveness of the unit; however, they acknowledged its value in maintaining the vitality of live-bait for longer periods.

MoFOR has decided to provide a 40% subsidy under the framework of the World Bank project for vessels introducing the unit. Some fishers also expressed their interest in actively considering the adoption of the system.

Regarding the live-bait fishing device, Mr. Riyaz, currently Dean of the Faculty of Fisheries, Maldives National University, who had participated as a C/P in the activities on the study of independent live-bait fisheries, reported on the process of examination. In addition, Mr. Ismail Haleem, a technician of MMRI, who was responsible for the field trials of the live-bait fishing device selected as a measure to support the establishment of independent live-bait fisheries, presented the methods, structure of the device, and the results of the trials.

From the fishers’ side, questions were raised about more efficient ways of utilizing live-bait, and opinions were voiced regarding the necessity of designating fishing grounds exclusively for live-bait. It was explained that the outcomes of this activity could serve as a step toward addressing these concerns. Furthermore, MoFOR reported that in order to promote the dissemination of this technology, more detailed trials would be conducted, and that in the future support in terms of materials, funding, and technical training was under consideration.



Photo 7-2 Explanation of live- bait system unit by Mr. Yaseer from Factice Pvt. Ltd. and Mr. Samrath Hassan, a fisher operating the Kamana in terms of system unit

In Output 3, Mr. Adam Manik, the project officer, presented on the challenges faced in activities within island communities. He explained that although cooperatives had been established under the project, participation by small-scale processors wasn't active, and that with regard to hygiene management of processed products, it was necessary to conduct training sessions, including those concerning legal requirements. With respect to the achievements on each island, presentations were made by representatives from either the Island Council or WDC.

For Maduvvari Island, it was reported that while the application for establishing a cooperative had been completed, government approval had not yet been granted, which has delayed the planned development of fishery products such as Rehaakuru chips and sterilized Valhoamas. For Nilandhoo Island, it was explained that the WDC had already completed trial production of more than 15 types of fishery products, but similar to Maduvvari, the cooperative had yet to receive government approval. For Dhiggaru Island, while the cooperative had been approved, development of prototype products had not yet begun.

During the Q&A session, the effectiveness of attaching labels and logos to products was highlighted, and participants also proposed ideas such as including a QR code of the producer on product packaging.



Photo 7-3 Presentation by WDC member in Maduvvari island

In the final session, Dr. Hussein Sinan, Project Director, presented the post-project directions for each output.

For Output 1, he explained that the best practice guide developed under the project would be actively disseminated through the Maldives government website, social media (including public broadcasts and YouTube), Fishermen's Day, and various other opportunities. He also stated that training concerning on-board handling techniques for yellowfin tuna would continue to be supported through fish processing companies, and that consultations would be conducted in collaboration with fishery-related businesses to establish fair pricing based on the quality of catches.

Regarding Output 2, he mentioned that investigations into the effectiveness of the improved live-bait system unit would continue, outreach to fishers regarding the unit would be conducted, and support for

adoption would be provided under the framework of the World Bank project. Concerning the establishment of independent live-bait fisheries, it was stated that trials of the live-bait fishing device would continue at the facility of MMRI, and that information on the results would be shared, along with conducting feasibility assessments to establish live-bait fisheries as independent operations.

For Output 3, he explained that, using government-funded budgets, value addition of fishery products and training for small-scale processors would continue for new communities, and that the heat-sterilization technique for Valhoamas would be promoted. He further made a commitment that future training for fish processors would incorporate food safety and hygiene measures, and that continued support would be provided to enable cooperatives in the project target islands to market their processed products.

At the seminar venue, tuna rings and scoop nets introduced by the project, brochures on on-board handling techniques, and prototypes of fishery products produced on the target islands were exhibited. It should be noted that the prototypes of processed fishery products received some inquiries from processing companies at the venue on the day of the seminar. Progress toward concrete commercialization of these products is expected in the future.

8. Outline and outcomes of Training in Japan

The project has conducted two training sessions in Japan “Technical capacity building training on skipjack and tuna fisheries” and “Capacity Building Training for Supporting Fishing Community”. These trainings have already been conducted in May 2023 and in February 2024. Below is a report on the results of the “Capacity Building Training for Supporting Fishing Community” conducted in the second period of the project.

8.1 Technical Capacity Enhancement Training for Skipjack tuna Fishery

8.1.1 Contents and results of the training

A summary of the Japanese training program " Technical capacity building training on skipjack and tuna fisheries " is shown in Table 8-1 below. The actual training schedule is shown in Table 8-2. The details of the training program were submitted in June 2023 as an implementation report based on the contract.

The trainees stayed in Tokyo for two days after their arrival in Japan, where they received lectures on the overview of Japanese fisheries and food processing, skipjack tuna fishery, etc. In Kochi Prefecture, the participants learned about coastal skipjack tuna fishing and processing in Nakatosa Town, Takaoka County. In Okinawa Prefecture, the team visited Itoman City, Uruma City, and Okinawa City. In Okinawa, the participants learned about tuna fisheries and quality control of catches at a fishery cooperative and the Okinawa Prefectural Fisheries Research and Extension Center through lectures and observation tours. In Katsuura and Tateyama City, Chiba Prefecture, the participants learned about Japan's approach to inshore skipjack tuna fishing, especially live bait fishing. Although this training course was physically demanding, starting early morning with a visit to a fish markets, the trainees completed the course without any ill effects.

Three commentators, Mr. Nagumo from JICA's Economic Development Department, and Mr. Sugiyama, a JICA expert, participated in the presentation of results on the final day. The presentations summarized the knowledge and techniques gained from the training in Japan in three areas (skipjack tuna fishery, fish processing products distribution, and fishery cooperatives). The presentation also examined in detail which of the knowledge and techniques learned from the training could be applied to the Maldives, focusing on four areas: introduction of bait fish fishery, on-board quality improvement of yellowfin tuna, fish markets, and value-added fishery products. In addition, the results of in-depth discussions among the trainees regarding specific problems, points to be strengthened, and implementation methods for the introduction of yellowfin on-board fish handling for the quality control, value-added fishery products, and improvement of bait fish were presented. Furthermore, with respect to on-board quality management of yellowfin tuna, value addition of fishery products, and improvement of baitfish, the trainees presented the results of in-depth discussions on the specific issues, areas requiring strengthening, and implementation methods for introducing these measures in the Maldives. The key points are shown below:

- **On-board handling of yellowfin tuna:** It was reaffirmed that the methods currently promoted

by the project, namely the Irabu method and the ikejime (neural spine cutting) technique, are effective. However, the lack of price differentiation based on the quality of yellowfin tuna in the Maldives is a major issue.

- **Value addition of fishery products:** With regard to value addition, particularly the promotion of sales to resorts, the relationship between fish processing companies and resorts is weak. Furthermore, there are few value-added fishery products, and fish processors have little experience or knowledge in developing new products. As a countermeasure, government agencies will conduct market surveys and provide fish processing training to processors.
- **Baitfish for skipjack tuna fisheries:** There are no appropriate live bait tanks, and fishers also lack sufficient knowledge. In addition, there is no space near the islands where skipjack tuna vessels call to install cages for holding baitfish, nor are there suppliers of baitfish. Therefore, it is necessary to develop and disseminate new live bait tanks, to conduct basic studies and trials on baitfish holding, and to carry out surveys of suitable sea areas for cage installation.

With regard to the dissemination of on-board handling methods for yellowfin tuna, the trainee who participated from a Maldivian fish processing company suggested that when high-quality yellowfin tuna is landed, incentives such as monetary rewards or free provision of ice should be given to the fishing vessels by the processing company. Many of these points are consistently made.

In addition to lectures and site visits, the trainees also had the opportunity to interact with about 20 residents of Nakatosa Town, introducing them to Maldivian cuisine. The participants also made a courtesy visit to the Mayor of Nakatosa Town and the Mayor of Katsuura City, Chiba Prefecture.

Table 8-1 Outline of the “Technical Capacity Building Training on Skipjack and Tuna Fisheries” (Draft)

Objective:	To learn about the use of live bait and improved on-board quality control techniques in the Japanese skipjack tuna and tuna fisheries, as well as advanced cases of value added fishery products, and to contribute to solving problems in this area in the Maldives.
Host Organisation:	JICA Yokohama
Participants:	10 Maldivian
Training period:	7 th May 2023 to 27 th May 2023 (21 days)
Expected outcomes:	
(i) Learn about the Japanese fisheries administration and fisheries cooperative initiatives.	
(ii) Learn about skipjack tuna and tuna fisheries including live bait fisheries and on-board quality control in Japan.	
(iii) Learn about the fish processing methods and examples of the value addition.	

Table 8-2 Actual Training Schedule

Day	Content	Location
7 th May	Arrive at Japan	Tokyo
8 th May	Briefing of the training Program orientation Lec*: Fisheries management in Japan and role of government Lec: Quality control methods of fresh fish	Tokyo
9 th May	Lec: Fishery Cooperative Association (FCA) in Japan Lec: Overview of skipjack tuna and tunas fisheries	Tokyo
10 th May	Move: Tokyo - Kochi Prefecture Lec: Coastal pole-and-line skipjack tuna fishing in Nakatoso Lec: Explanation of fishing gear and the method of pole-and-line vessel for skipjack tuna	Nakatoso town Kochi
11 th May	Obs*: Fish market and preparation of auction Obs: Skipjack tuna auction, transportation and preservation Obs: Introducing the fish processing using skipjack tuna Obs: Tsunami Evacuation Tower etc. Obs: Skipjack tuna processing and sale in Taisho Market Obs: Quality control at Tanaka Fish Store	Nakatoso town Kochi
12 th May	Pres*: Cooking practice Maldives dishes with Nakatoso town people Obs: Skipjack tuna landing at Kure fishing port Obs: Pole-and-line fishing vessels for skipjack tuna	Nakatoso town Kochi
13 th May	Dis*: Installation and application of pole-and-line skipjack tuna fishing techniques of Japan Move to Matsuyama City from Nakatoso Town	Nakatoso town Kochi
14 th May	Move to Okinawa from Matsuyama City by airplane	Okinawa Prefecture
15 th May	Lec: Overview of Okinawa Prefecture and Okinawa Prefectural Fisheries Research and Extension Center Lec: Outline of fisheries industries and skipjack tuna and yellowfin tuna fishing in Okinawa Lec: Quality control on-board and fresh control of tunas Lec: Leading Professional Fisher Certification and the Activities of Okinawa Leading Professional Fishers Association Obs: Facilities of Fisheries Research and Extension Center Lec: Fishery and Fish Processing in Kesennuma	Okinawa Prefecture
16 th May	Dis: Tuna fishers of Ishikawa FCA Obs: Facilities of Ishikawa FCA	Okinawa Prefecture
17 th May	Obs: Okinawa Peace Memorial Park Museum Dis: Tuna fishers of Okinawa City FCA	Okinawa Prefecture
18 th May	Obs: Imaiyu hygiene control fish wholesale market Lec: Operations of Itoman FCA Obs: Facilities of Itoman FCA (FADs etc.)	Okinawa Prefecture

	Obs: Facilities of Itoman FCA (Dock, Ice making facility etc.)	
19 th May	Move to Tokyo from Okinawa	Tokyo
20 th May	Analyzing the data	Tokyo
21 st May	Analyzing the data	Tokyo
22 nd May	Obs: Toyosu market (wholesale fish market in Tokyo) Move to Katsuura City from Tokyo Courtesy visit to the mayor of Katsuura City Lec: Migration trends of skipjack tuna around Japan and the analysis methods	Katsuura City Chiba
23 rd May	Obs: Skipjack tuna landing and the auction Obs: Pole-and-line fishing vessels for skipjack tuna Lec: Explanation of fishing gear and the method of pole-and-line vessel for skipjack tuna	Katsuura City Chiba
24 th May	Obs: Live-bait fishery for pole-and-line fishery for skipjack tuna Dis: Installation and application of live-bait fishery of Japan	Tateyama City Chiba
25 th May	Preparation of study report	Tokyo
26 th May	Study report presentation Evaluation and certification of the training	Tokyo
27 th May	Departure from Japan Arrive at Maldives	Tokyo

*Lec: Lecture, obs: Observation, Pre: Presentation, Dis: Discussion



Photo 8-1 Taisho Market in Nakatosha Town



Photo 8-2 Kure fishing port



Photo 8-3 Okinawa Prefectural Fisheries Research and Extension Center



Photo 8-4 Facilities of Itoman FCR



Photo 8-5 Courtesy visit to the mayor of Katsuura City



Photo 8-6 Observation of selling live-bait

8.1.2 The Effect After the Training

In this training program conducted in Japan, the training was structured with a focus on the application to skipjack and tuna fisheries in the Maldives as well as to project activities, and the following effects were obtained.

This training included lectures and site visits related to small-scale one-day skipjack pole-and-line fisheries landing in Nakatosa Town, Takaoka District, Kochi Prefecture, as well as coastal skipjack pole-and-line fisheries landing in Katsuura City, Chiba Prefecture. The purpose of this was not only to learn about the current situation of these two types of skipjack pole-and-line fisheries in Japan, but particularly to study the live bait holding systems on skipjack pole-and-line fishing vessels, in order to use this knowledge as a reference for improving the live bait holding systems being implemented in the project. In addition, during the training, Project Expert Echigo served as facilitator, and discussions and deliberations were held on the possibilities and challenges of introducing the Japanese-style live bait fishery to the Maldives. Details of this are described in Section 5.2 of this report, Support for the Evaluation and Establishment of the Feasibility of Live Bait Fisheries (Activities 2-2-1/2-2-2).

The yellowfin tuna fishery in Okinawa Prefecture tends to place importance not only on catch volume but also on improving on-board processing techniques in order to increase the unit price of landed

yellowfin tuna. Many yellowfin fishers use techniques such as Ikejime and are making efforts to improve quality management on-board. As on-board processing techniques are also increasingly emphasized in the yellowfin tuna fishery in the Maldives today, lectures and exchanges of opinions with fishers at the Ishikawa Fisheries Cooperative Association, Okinawa City Fisheries Cooperative Association, and Itoman Fisheries Cooperative Association in Okinawa Prefecture helped the trainees to reaffirm the importance of such practices. Comments from trainees included: “The yellowfin tuna in Okinawa showed very little burn and its freshness was far superior compared to that in the Maldives” and “Now that I understand the effects of Ikejime and the Irabu method, I would like to try putting them into practice.”

Furthermore, through this training, even ENSIS, which had not actively participated in project activities up to now, expressed its desire to implement training on Ikejime and the Irabu method under Activity 1-1-3 of this project. Although in this training it was not possible to observe the actual on-board processing techniques of Okinawan yellowfin tuna fishers, the counterparts and fishers who participated strongly requested to see case study materials on advanced practices by Okinawan yellowfin tuna vessels. Therefore, the project requested the Itoman Fisheries Cooperative Association in Okinawa Prefecture to arrange coverage of a yellowfin tuna vessel, and developed teaching materials including footage of fishers with excellent on-board processing skills. Details of this are provided in Section 4.2.3 of this report.

In addition, counterparts who once again recognized the importance of on-board processing of yellowfin tuna through this training proposed a monitoring method to promote the dissemination of Ikejime and the Irabu method, which are being introduced through the project. This method is described in Section 4.4.1 of this report. Specifically, grading data would be obtained from monitoring target vessels that implemented Ikejime and the Irabu method through Bigfish, and the ice used in the demonstration would be provided free of charge. In this way, the active engagement of participants in this training with the project has been demonstrated.

As described above, as a result of this training in Japan, both direct and indirect effects were observed, mainly with respect to Project Output 1 and Output 2.

8.2 Training in Japan “Capacity Building Training for Supporting Fishing Community”

8.2.1 Contents and Results of the Training

The outline of “Capacity Building Training for Supporting Fishing Community” is shown in Table 6-1 below, and its time schedule is shown in Table 6-2.

After the trainees' arrival in Japan, JICA Shikoku conducted a two-day training briefing and program orientation in Takamatsu City, Kagawa Prefecture, followed by lectures on the “Current Status and Issues of Small-Scale Fishery Processing Industry by Rural Women in Japan” and “Fisheries and Fish Processing Industry in Japan”. The participants then traveled to Uwajima City, Ehime Prefecture, for lectures and practical training on examples of women-led fish processing at Akoyahime Corporation and the Yusu Branch Office of the Ehime Prefecture Fisheries Cooperative. They also had a hands-on

learning experience in making Jakoten at Yasuoka Kamaboko Co. In Nakatoso Town, Takaoka County, Kochi Prefecture, the participants attended lectures by the Nakatoso Town Community Development Department and Kikaku Dokuremon, and visited Tanaka Sengyo which is fish processor including skipjack tuna, to learn about the expansion of the “skipjack tuna business. A Maldivian food cooking class was also held with the participation of 12 residents of Nakatoso Town, and participants exchanged their knowledge and experiences through this event. The event was broadcast on NHK Kochi. In Kochi Prefecture, the participants visited Niya Shoten in Tosashimizu City and Yoshinaga Katsuobushi in Tosa City, where they were briefed on the production methods and product development ideas for skipjack tuna and the processed products. In Kochi Prefecture, they stopped by several roadside stations (Fusegasaka, Kawauso no Sato in Suzaki City, Mejika no Sato in Tosashimizu City, Nabura no Sato in Tosa Saga, Bios Okata in Kuroshio Town, and Hirome Ichiba Market in Kochi City) to observe how products made from skipjack tuna are displayed and sold. In the final week of the training, the participants returned to Takamatsu City, Kagawa Prefecture, and gave presentations on what they had learned during the training in Japan and how they would apply what they had learned to their respective islands at a training presentation in 27th February. The presentations were commented on by the commentators, and the participants discussed how they would apply the results of the training in their respective islands.

Table 8-3 Outline of the Capacity Building Training for Supporting Fishing Community

Objective:	To improve the capacity of the Maldivian fishing communities to develop their capacity for problem solving through examples of activities of Japanese fishing communities
Host Organisation:	JICA Shikoku
Training period:	12 th Feb 2024 to 28 th Feb 2024 (17 days)
Participants	8 persons (2 C/Ps, 3 island council officers, 2 Women’s Development Committee member, and 1 fish processor)
Expected outcomes: (i) Improve problem-solving capacity to support fishing communities (ii) Increase capacity for fish processing techniques and development of new fish products (iii) Improve ability to enhance value-added seafood products	

Table 8-4 Actual Training Schedule

Date	Content	Place
2/12 (Mon)	Arrival to Tokyo Move: Tokyo to Takamatsu	Takamatsu, Kagawa
2/13	Training Briefing and Program Orientation	Takamatsu,

(Tue)	Lecture: Current Situation and Challenges of Small-Scale Seafood Processing Industry by Women in Fishing Villages in Japan Lecture: Japanese Fisheries and Seafood Processing Industry	Kagawa
2/14 (Wed)	Move: Takamatsu, Kagawa to Uwajima, Ehime Inspection: Kisaiya road side station	Uwajima, Ehime
2/15 (Thu)	Lecture: Akoyahime Operation Practice: Fisheries Processing Practice Practice: Accessory Processing Practice	Uwajima, Ehime
2/16 (Fri)	Lecture: Outline of Yusu Branch Office of Ehime Fishery Cooperative Practical training: Marine products processing practice Practice: Handmade EM soap production	Uwajima, Ehime
2/17 (Sat)	Inspection: Tour of Jakoten factory (Yasuoka Kamaboko) Practice: Jakoten manufacturing experience (Yasuoka Kamaboko)	Uwajima, Ehime
2/18 (Sun)	Move: Uwajima, Ehime to Nakatoso, Kochi	Nakatoso. Kochi
2/19 (Mon)	Courtesy: Courtesy call on the Mayor of Nakatoso Town Hall Lecture: Skipjack fishing in Nakatoso Town Lecture: Product development of skipjack tuna industry	Nakatoso, Kochi
2/20 (Tue)	Inspection: Visiting a seafood processing company (Tanaka Sengyo) Practice: Maldivian cooking class (exchange event with local people) Move: Nakatoso, Koch - Tosashimizu, Kochi Inspection: Roadside Station Mejika no Sato	Tosashimizu, Kochi
2/21 (Wed)	Inspection: Visiting a seafood processing company (Niya Shoten) Move: Tosashimizu, Kochi - Kochi, Kochi Inspection: Road side station Tosa Saga Nabura no Sato and Kuroshio Town Bios Ohkata	Kochi, Kochi
2/22 (Thu)	Inspection: Seafood processing company tour (Yoshinaga Katsuobushi) Inspection: Hirome Ichiba Market	Kochi, Kochi
2/23 (Fri)	Move: Kochi, Kochi to Takamatsu, Kagawa	Takamatsu, Kagawa
2/24 (Sat)	Document works	Takamatsu, Kagawa
2/25 (Sun)	Document works Preparation of presentation	Takamatsu, Kagawa
2/26 (Mon)	Lecture: Recovery of Fishery Industry in Iwate Prefecture after the Earthquake	Takamatsu, Kagawa

	Preparation of presentation	
2/27 (Tue)	Training Presentation Training Completion Ceremony	Takamatsu, Kagawa
2/28 (Wed)	Move: Takamatsu, Kagawa to Tokyo	Tokyo
2/29 (Thu)	Leaving Japan	

		
Fish processing training in Yusu Branch Office of Ehime Fishery Cooperative	Practical training on handmade EM soap using waste oil from fried food (Jakoten)	Jako-ten (fish cake) production training at Yasuoka Kamaboko
		
Courtesy visit to the Mayor of Nakatoso Town	Dokuremon cooperative in Nakatoso Town	Tasting of raw skipjack tuna at Tanaka Sengyo in Nakatoso Town
		
Holding Maldivian cooking classes in Nakatoso Town	Inspection of Niya Shoten in Tosasimizu, Kochi	

Photo 8-7 The activities on the training in Japan

8.2.2 The effect After the Training

This training program will contribute to the achievement of the objectives of Outcome 3 of BEFiS, as it aims to improve the capacity of the Maldives to solve problems for the development of fishing communities through fish processing development and other activities. Output 3 activities 3-2-1 to 3-2-4 are: (1) based on the development plan of the fishing community, (2) identify the training needs of core local personnel, (3) provide technical training and technical assistance to fish processors, and (4) support the preparation of business proposals. BEFiS has already started a series of these activities, and in future local operations, BEFiS will consider ideas for processed products to be developed and

improved in the future based on the Japanese case studies obtained through this training program, and the content of local training and technical assistance based on these ideas. In other words, we plan to reflect the knowledge and ideas gained from the training in Japan in the development of specific products in the future. It is expected that the developed/improved processed products and the results obtained from the local training and technical assistance will be fed back into the business proposal currently being drafted. On the last day of the training, the trainees from each island organized and presented how they would reflect the results of the training in the development of local processed products and business proposals.

Based on the results of the tasting of Japanese processed skipjack products in the Maldives, the manufacturers of processed products that were highly evaluated by the participants were actively included in the visiting schedule. The participants' interest in the visits and practical training was therefore very high, the enthusiasm of the trainees was conveyed, and the recipients of the visits, etc., had a very favorable impression.

In this project, the Women's Development Committees (WDCs), which are organized on each target island, are actively involved as the core actors under Outcome 3. For this reason, the training program in Japan was designed with a focus on women who are playing active roles in Japanese fishing villages, so as to serve as a reference for them.

Specifically, the program included an introduction to the activities of Akoyahime Co., Ltd., which was established as an enterprise originating from the women's division of a fisheries cooperative, as well as the activities of the women's division of the Yusu Branch of the Ehime Prefecture Fisheries Cooperative. The introductions of these activities, along with the practical training and exchanges, provided strong inspiration to the WDC members who participated in the training.

As one example of the outcomes, the leader of the WDC on Nilandhoo Island, who participated in the training, has taken a central role in the establishment of a cooperative and the development of new products on the island, as described in Section 6.6.3.

After returning to Japan, the participants reported the content and results of the training to the MoFOR. Each participants also reported to the island councils of their island. Currently, as part of Project Outcome 3, the WDC took the lead in the improvement and development of processed fish products on each of the target islands. These activities are being led by the participants of this Japanese training program. For example, in the fish processing training (vacuum packing and heat sterilization of Valhoams) using equipment provided by BEFiS, those who participated in this training have begun to actively instruct other participants. On the islands of Dhiggaru and Nilandhoo, which were visited after the training in Japan, the Island Council staff who participated in the training considered ways to organize cooperatives, including not only WDCs but also local processors, as the recipients of the project activities on each island, based on the Japanese approach. As the fish processing activities progress in earnest, it was expected that the participants will take the lead in developing new ideas for processed

products, marketing methods, and new packaging for the products that they learned from the training in Japan, and that this will be reflected in the activities on each island.



Photo 8-8 Participants after the training in MoFOR



Photo 8-9 Participants teaching the fish processing technique in a local island

9. Achievement of the Project Purpose and Output 1-3

9.1 Output 1: Trade Competitiveness of Sustainably Produced Key Fishery Products of Oceanic Fisheries is Improved. (canned/frozen skipjack tuna, fresh/chilled yellowfin tuna loin/whole fish)

The indicator of Output 1 is “The grade of yellowfin tuna treated on-board fish handling learnt by the project improves by 30% (fewer C grades and rejected fish) in comparison with the yellowfin tuna grade untreated and caught in the similar fishing condition”. Based on the collected grading data, the analysis of effect of the Irabu method, Ikejime method, and tuna ring were evaluated. The number of data samples of yellowfin tuna treated by the tuna ring was 758, those by the Ikejime method was 319 and those by the Irabu method was 15. As for the Ikejime and Irabu method, the respective sample size was insufficient to assess the achievement of this indicator of Output 1. As for the tuna ring, it was estimated that there was an improvement by 38.5% points based on the limited samples size. Based on this observation, it was assessed that this indicator of Output 1 was partially achieved.

9.2 Output 2: Resource-efficient Production methods are Adopted in the Live-bait Fishery (Blue Production)

The indicators for Output 2 were set as follows:

- At least half of the pre-defined evaluation indicators for the effectiveness of the introduction of live bait tank will receive a rating of three or more.
- A workshop is conducted to review and discuss the contents of the review report on the feasibility of converting live-bait fishery to an independent fishery.

With regard to the former, in the monitoring surveys conducted on three cooperating vessels equipped with new live bait management technologies (the improved live bait tank system unit and the water scoop net), observations were made on the vitality of live bait in the tanks (including the number of mortalities) as well as the turbidity of the water inside the tanks. As a result, in the live bait tanks equipped with the improved system unit, all evaluation items scored three or higher on a five-point scale, thereby achieving the indicator. In particular, regarding vitality (mortalities), as observed on the Kamana and Hudhuhudhu Emperor, the dead fish discharge function of the improved system unit ensured that hardly any mortalities were observed. Furthermore, due to the effect of reducing water turbulence in the improved system unit, surface agitation was suppressed, making it easier to observe the interior of the tank. In addition, cases were confirmed where newly constructed fishing vessels had been equipped with the improved tank or were considering its installation, indicating that dissemination of the improved live bait tank system unit had already begun. It was also confirmed that the Ministry of Fisheries, Marine Resources and Agriculture (MoFOR) has decided to promote dissemination under the World Bank project.

With regard to the latter, at the final project seminar held in May 2025, presentations and discussions with fishers were conducted on the results of the study concerning the transition to an independent live

bait fishery, the results of trial operations of live bait harvesting devices as a supporting measure, and also on the issues to be addressed in the future. Therefore, this indicator has also been achieved.

9.3 Output 3: Coping Capacity of Fishing Communities Against External Changes is Enhanced. (Blue Community)

Based on the status of the following indicators, the achievement of Output 3 is considered low.

Indicator 3-1: More than five local entrepreneurs become competent in fishery related business planning/management.

At the end of the cooperation period, Indicator 3-1 had not been achieved.

Regarding the activities of Output 3, through training in business proposals supported by the project, a total of 70 people acquired the ability to develop business proposals, and implementation was completed at all three project sites. However, since the businesses had not yet commenced by the end of the cooperation period, it was not possible to evaluate their management capabilities.

This was due to a) the selection of target islands and beneficiaries taking longer than anticipated, and b) the difficulty in establishing appropriate organizations to carry out activities within the community.

On the other hand, it was confirmed that the Island Council and the Women's Development Committee (WDC) are continuing product development and attempting to establish new cooperatives based on the business proposals formulated with project support.

Therefore, continued support from MoFOR will be necessary until product sales are firmly established and contribute to improving community livelihoods. Additionally, MoFOR plans to continue providing technical support to the community under the framework of a project supported by the World Bank.

9.4 Achievement of Project Purposes

9.4.1 Project Purpose : Economic foundation of the Fisheries Sector in Maldives is Strengthened Based on the Blue economy principles and through implementation of the SFDPIIS

At the termination of the cooperation period, the achievement of the project purpose was limited to partial outcomes and was evaluated as being of a moderate level.

Techniques introduced through the project such as improvements in on-board fish handling and design modifications to live bait tank system to extend the survival period of live bait, have been valued by some leading fishers. Therefore, with future financial support, technical training, and dissemination activities, these techniques are expected to gradually spread.

On the other hand, in remote islands where support was provided for small-scale fish processing, the creation of new income sources, which had been set as a project objective, was not realized by the termination of the cooperation period. However, future potential has been confirmed, as progress has been made in areas such as prototype production and package design.

The degree of achievement of the indicators related to the project purpose is as follows:

- (1) Indicator 1 : The ratio of Yellowfin tuna caught used the on-board fish handling*2 on fishing vessels supported by the project increases 50%.

This indicator was established in November 2024. Subsequently, a questionnaire and interview survey with fishers were conducted in line with this indicator. However, the number of responses from fishers was insufficient for the final evaluation at the termination of the cooperation period. Due to the limited sample size, it was not possible to assess the level of achievement.

Out of the 20 fishing vessels that received training through the project, only 4 vessels (20%) responded to the questionnaire survey. Among these 4 vessels, 2 reported that they used the tuna ring for every catch (100%), and 1 reported using it for 61% of catches. The remaining vessel reported having started to use the Ikejime method. On the other hand, none of the vessels reported having introduced the Irabu method.

Nevertheless, there were signs that the use of tuna rings could spread among fishers, if MoFOR continues to promote the dissemination of this method even after the completion of the project.

- (2) Indicator 2: Improved live bait tank system is demonstrated with the private sector in the Maldives.

The project jointly developed the improved system unit with a private boatbuilding company, and the owner of a project cooperative fishing vessel equipped with this unit has also installed it on a newly constructed vessel. In addition, since June 2024, the same company has begun discussions with a fishing vessel based on Thulhaadhoo Island in Baa Atoll regarding the introduction of the unit. Based on these developments, this indicator is assessed as having been achieved.

- (3) Indicator 3: More than three new community-based income generation activities are initiated.

Selection of fish products for processing, technical support and necessary equipment and materials were provided to communities on the project's three target islands, but it was unable to implement the manufacture and sale of processed products by the end of the cooperation period. Therefore, this indicator is considered not to have been achieved.

10. Issues at the Project Termination and Lesson for the Future

At the conclusion of the project in June 2025, several outstanding issues were identified, and valuable lessons were learned for MoFOR to continue activities independently. The following outlines the future challenges and lessons learned, categorized by each Outputs.

10.1 Output 1

10.1.1 To Develop a Best Practice Guide for On-board Fish Handling and Preservation (booklet and videos) (Activity 1-1-2)

(1) Issues at the project termination

Further efforts will be required to continuously improve the quality of captured fish. Even after the completion of the project, MoFOR should continue updating and expanding the Best Practices Guide.

(2) Lesson for the future

It was considered that training materials such as the Best Practice Guide would have a greater impact if delivered primarily as video content rather than in print, since such materials could be shared more effectively through fishers' social media networks. For example, one possible approach would be to upload video materials to YouTube and disseminate the links through these networks. In addition, since fishers already record and share videos of their own fishing activities, establishing fisher groups on locally used social media platforms such as Viber or WhatsApp could also serve as an effective way to exchange information on on-board handling techniques through group chats.

10.1.2 To Provide Technical Training Concerning On-board fish Handling and Preservation for Local Fishers and Government Officials (Activity 1-1-3)

(1) Issues at the project termination

It is necessary for MoFOR to continue disseminating and updating on-board handling techniques for quality control staff of fish processing companies. Specifically, MoFOR is expected to establish a clear internal structure for these activities and develop a plan for continuous follow-up with processing companies. Furthermore, to facilitate information sharing among companies, MoFOR should take the lead in sustaining the inter-company collaboration platform established under Activity 1-2-1.

(2) Lesson for the future

Under the system of bulk purchasing, the promotion of on-board handling techniques to prevent fish discoloration (such as Ikejime and the Irabu method) had limited impact, as there were no incentives for fishers to adopt them. Addressing this issue, it should be considered a future challenge for MoFOR. On the other hand, the tuna ring was well received by fishers. This acceptance was due not only to its effectiveness in preventing discoloration but also to its ability to shorten the time required to haul yellowfin tuna, thereby improving fishing efficiency. This not only increases the catch opportunities per unit of time but also contributes to better labor efficiency for fishers.

When promoting such technologies, it is desirable to emphasize these economic and labor efficiency benefits to the fishers. Furthermore, when considering the introduction of new tools or techniques in the future, ensuring that they contribute to operational efficiency will make them more readily accepted by fishers.

10.1.3 To Monitor the Effect of Improved On-board Fish Handling and Preservation (Activity 1-1-4)

(1) Issues at the project termination

After the completion of the project, it will be difficult for MoFOR to continuously obtain quantitative grading data from fish processing companies. However, since it is necessary to monitor the outcomes of the training conducted under Activity 1-1-3, a simpler method for doing so needs to be developed. For example, information on the vessels that participated in the training could be provided by fish processing companies to MoFOR. MoFOR could then conduct follow-up interviews by phone immediately after the training, and again one month and six months later, in order to assess the training's effectiveness and any issues, and provide feedback to the processing companies. Additionally, this data collection and feedback process could utilize the platform established under Activity 1-2-1.

(2) Lesson for the future

Measuring quality improvements using grading data provides the simplest and most straightforward basis for evaluation. However, obtaining such data from fish processing companies is a highly challenging task. Therefore, for continuous monitoring of the project's effects after its completion, qualitative methods should be considered. For example, surveys using a rating system could be conducted among fishers to assess changes in grading or improvements in operational efficiency.

10.1.4 To Facilitate Business to Business Linkages for the Promotion of Key Fishery Products (former activity 1-2-3) (Activity 1-2-1)

(1) Issues at the project termination

At the conclusion of the project, based on an agreement between MoFOR and MSPEA, MoFOR will need to convene regular meetings with MSPEA and the fish processing companies.

(2) Lesson for the Future

None.

10.2 Output 2

10.2.1 Further Improvement for Improved Live Bait Tank System Unit (Activity 2-1-1)

(1) Issues at the project termination

Based on feedback from Kamana, which was equipped with the prototype improved live bait tank system unit, the dissemination model was designed with the live bait tank opening as low as possible.

However, feedback from the vessel Safeena indicated that a slightly higher opening would be more user-friendly. In other words, the structural requirements of the improved system unit vary depending on the fishers. For future dissemination of the improved system unit, it will be necessary to provide services that can adjust the structure, including the height of the opening, according to the requirements of each vessel.

After the completion of the project, Facture Co., a cooperative company, is expected to independently carry out dissemination activities, while MoFOR is expected to conduct public outreach to promote the technology.

(2) Lesson for the future

When introducing the improved system unit to each fishing vessel, the manufacturing company must conduct thorough prior consultations with fishers to reflect their requirements in the design of the unit. However, since the improved system unit is a new concept, it is difficult for fishers to visualize its final form. It is therefore desirable to present photos of the actual improved system unit and videos of its operation, based on the information obtained from the project, to help fishers form a concrete image before consultations. In addition, simpler methods should also be considered, such as preparing several options in advance (e.g., regarding the height of the opening) and allowing fishers to make their choice.

10.2.2 Training for Fishers Concerning Live Bait Handling (Activity 2-1-2)

<Design and Manufacturing of the Water Scoop Net>

(1) Issues at the project termination

Due to its structural nature of scooping live bait together with water, the water scoop net inevitably involves a certain amount of weight, regardless of improvements made. While it is possible to reduce the capacity in order to make it lighter, this would decrease the amount of live bait that can be scooped at one time and could negatively affect the efficiency of live bait fishing. Even after modifications, how to improve the handling of the still relatively heavy water scoop net remains a challenge for its future dissemination.

In addition, MoFOR is expected to cooperate with fish processing companies to conduct public outreach for the dissemination of the water scoop net.

(2) Lesson for the future

Through this activity, it was demonstrated that the water scoop net is effective in prolonging the survival of live bait. Continued dissemination of this tool is required. However, the weight issue remains an obstacle to wider dissemination. For this reason, fishers were instructed to handle the water scoop net with two or more people, but in practice, some fishers continued to use it alone without changing their methods. Going forward, promotion should stress that the water scoop net must be handled by two or more people, supported by reference videos and other materials.

In Japan, there are examples of using water scoop nets with cranes or pulleys. In the future, introducing such equipment in the Maldives would help reduce the burden on fishers and further promote the use of

water scoop nets.

10.2.3 Promote Use of Improved equipment for Live Bait Handling (Activity 2-1-3)

<Implementation of Training on Live Bait Handling Techniques>

(1) Issues at the project termination

As with Output 1, the dissemination of techniques to fishers is carried out by fish processing companies. During the project, training was conducted for 10 fishing vessels; however, this number is far too small compared to the total of 614 fishing vessels in the Maldives. During the project period, a system was established in which fish processing companies provided technical training to fishers who landed their catch at the company's facilities, and therefore it is essential that such training continues even after the completion of the project.

Training on live bait management techniques has less visible benefits for the processing companies, which could become a factor hindering the sustainability of training implementation. For this reason, it is necessary for MoFOR to take the lead in ensuring that each company continues to provide training, while at the same time creating a system for monitoring its effectiveness.

(2) Lesson for the future

In order to ensure the continuous implementation of training, it is indispensable to provide clear incentives for the fish processing companies. It is necessary to clearly explain to them that by improving live bait management techniques, live bait can be used more effectively, which in turn leads to an increase in catch volume. MoFOR must continuously convey to each company that improved operational efficiency among fishers will result in increased landings, thereby benefiting the processing companies as well, and must request the continuation of training and dissemination. Furthermore, the information-sharing platform agreed upon between MoFOR and the industry under Output 1: Activity 1-2-1 can be utilized within this framework.

10.2.4 Promote Use of Improved Equipment for Live Bait Handling (Activity 2-1-3)

<Creation of Best Practice Guide Videos>

(1) Issues at the project termination

The video teaching materials produced are required to be used continuously and effectively even after the completion of the project. Although MoFOR has posted various publicity materials on Facebook, past posts tend to be buried over time and will not come to the attention of fishers unless they actively search through them. Therefore, it is necessary to establish an environment where fishers can access them at any time, such as by creating a YouTube channel. In addition, these materials should also be utilized by fish processing companies when conducting training sessions for fishers as part of Activity 2-1-2.

(2) Lesson for the future

Some training materials and publicity resources previously created by MoFOR have not been sufficiently utilized and have been left unnoticed. Therefore, MoFOR should promptly implement publicity through SNS, YouTube, and fish processing companies. In this project, a system was established in which training was conducted under private-sector leadership by involving fish processing companies, and this demonstrated effective methods for utilizing training materials and teaching tools. MoFOR should continue to focus on collaboration with private companies to ensure that the materials produced are effectively used.

10.2.5 Promote Use of Improved Equipment for Live Bait Handling (Activity 2-1-3)

<Implementation of Publicity Activities at Various Events>

(1) Issues at the project termination

The installation of the improved system unit (dissemination model) was delayed from the original plan and was carried out just before the peak fishing season for skipjack pole-and-line (October 2024). At publicity events such as the Fishermen's Day Forum, some fishing vessels inquired about the improved system unit. However, since these inquiries coincided with the peak pole-and-line fishing season, vessels could not suspend operations, and in some cases, the units were not introduced. Continuous publicity activities are therefore required to promote the future use of both the improved system unit and the water scoop net.

(2) Lesson for the future

The delay in starting publicity for dissemination was partly due to unavoidable factors such as weather, which delayed the installation work on cooperating vessels, but also because the on-board survey to verify the effectiveness of the improved system unit (prototype) was not carried out by MoFOR as initially agreed. Although progress was made in the latter half of the project through the use of fisheries rangers, it will also be necessary to utilize such personnel in future dissemination activities.

In addition, the ripple effect from vessels already equipped with the system unit should be used as an opportunity for further dissemination. On Madaveli Island, the home island of the cooperating vessel Kamana, the owner of another vessel under construction adopted the structure of the system unit based on information obtained from the fishers of the Kamana.

For future dissemination, in addition to continuous government publicity activities, efforts should be made to promote word-of-mouth among fishers—for example, by actively encouraging information sharing from fishers who have already introduced the units through SNS and opportunities such as Fishermen's Day.

10.2.6 To Identify Necessary Measures to Assist the Establishment of Independent Live-bait Fishery (Activity 2-2-2)

(1) Issues at project termination

In trial operations using a live-bait harvesting device—implemented as a measure to support the establishment of an independent live-bait fishery—catches were confirmed primarily for blue sprat (*Spratelloides* spp.), one of the principal live-bait species. To reduce fishing pressure on specific species, the project also aimed to harvest species that had not commonly been used as bait; among these candidates, *Sardinella* spp was also caught. These results demonstrated that the gear functioned effectively as a fishing device in the local context.

At the same time, the test device had a small bunt, which limited the catch per operation; daily variability in catch was large; and there were periods—presumably due to environmental factors—when fish schools disappeared from around the gear. To enable future dissemination, it will be necessary to continue practical trials to address these issues and move toward operationalization. For specific technical challenges, see “5.2.4 Examination of the Feasibility of Dividing Roles within the Live-Bait Fishery,” (5) Future Issues.

(2) Lessons for the future

None.

10.2.7 To Compile a Review Report on the Feasibility of Converting Live-bait Fishery to an Independent Fishery (Activity 2-2-3)

(1) Issues at project termination

While the objective of this activity was to assess the feasibility of an independent live-bait fishery, further efforts will be required for future dissemination. First, MMRI should take the lead in continuing practical trials to operationalize the harvesting device noted above. Subsequently, extension activities targeting fishers will be necessary. In addition, establishing an enabling procurement environment for materials and equipment needed to fabricate the device is a prerequisite for dissemination.

(2) Lessons for the future

As this activity is the first of its kind in the Maldives, adequate publicity and extension, as well as preparation of the introduction environment, will be essential for dissemination. Because extension will require both technical guidance and managerial/operational guidance, an extension framework centered on MMRI members should be established. Preparing the introduction environment primarily means enabling domestic procurement of device materials. Although the bunt net used in demonstration trials was procured from Japan, fabrication is feasible using nets available locally. Other materials and equipment have been confirmed as procurable locally or from India.

10.3 Output 3

10.3.1 To Conduct a Situation Survey on Selected Fishing Communities (Activity 3-1-1)

(1) Issues at the Project Termination

None.

(2) Lesson for the future

In this project, delays in site selection became a major factor that pushed back subsequent schedules, including procurement of necessary equipment and processing training. When sites were selected based on their perceived potential for fish processing and activities proceeded on that basis, it became clear that, due to dissatisfaction over the allocation of fish-processing land, relationships between Island Councils and fish processors were far worse than anticipated. Of the initial three selected islands, two (Hirilandhoo and Thulhaadhoo) ultimately offered no cooperation, necessitating a re-selection of target islands. Site selection should therefore be based on prior information gathering regarding the relationship between the Island Council and fish-processing stakeholders on the island, and this factor should be incorporated explicitly into the selection criteria.

10.3.2 To Identify Training Needs for Key players in the Local Economy (Activity 3-2-3)

(1) Issues at Project Termination

Following amendments to legislation on hygiene management, future extension activities by MoFOR will need to supplement the project trainings with additional technical training aligned with the new legal requirements.

(2) Lessons for the Future

None.

10.3.3 To Support Key Players to Formulate the Business Proposals Based on the Economic Recovery Plan (Activity 3-2-4)

<Support for creating business proposals>

(1) Issues at the project termination

There is a low level of ownership of activities on the target islands, and it is unclear whether new businesses will actually be launched based on new business proposals created using the technologies acquired during this project. It is necessary to incorporate this activity into the fisheries processing support activities planned by MoFOR for remote islands after the project ends and continue regular monitoring support.

(2) Lesson for the future

In the Maldives, there are often poor relations between the Island Council and fish processors due to land allocation issues, and it was difficult to obtain direct cooperation from fish processors at the target

site. Therefore, activities were conducted with the Island Council and WDC as the main counterparts. However, the Island Council was busy with projects in all areas other than fisheries and was unable to provide sufficient involvement. In addition, in this activity, WDC's ownership of the project was low, resulting in less involvement in project activities than expected.

Therefore, when conducting similar projects in the future, the Island Council and WDC should be limited to a focal point role and should not be used as main counterpart organizations. In addition, when selecting target communities and beneficiaries, it is desirable to use a public recruitment process based on the technical themes of the activities, rather than selecting them on an Island Council basis.

10.3.4 To Support Key Players to Formulate the Business Proposals Based on the Economic Recovery Plan (Activity 3-2-4)

<Organization of project management entities>

(1) Issues at the project termination

It is unclear whether the cooperatives will be organized and function after the project ends. First, MoFOR needs to follow up on the applications already submitted by each island until they are approved by the relevant ministries and the cooperative is officially established. Once the cooperative is established, MoFOR will need to continue monitoring and supporting its operations.

(2) Lesson for the Future

Due to the limitations of JICA's technical cooperation, this project was only able to provide technical and equipment support, and securing the most important operating funds was a challenge in implementing the project. During discussions on each island, one of the proposed solutions was to organize a cooperative and raise funds by selling shares, which led to the decision to organize a cooperative. However, it took a long time to register the cooperative, and it was not possible to make it operational within the project period. When undertaking similar activities, it is necessary to consider how to raise working capital for the project from the start and decide on the implementing entity.

10.3.5 To Support Key Players to Formulate the Business Proposals Based on the Economic Recovery Plans (Activity 3-2-4)

<Monitoring the implementation of business proposals>

(1) Issues at the project termination

It is necessary to monitor the implementation of the manufacturing and sales of products proposed in the business proposals. It is also desirable to incorporate this into MoFOR's planned activities to support fisheries processing in the islands and to conduct regular monitoring and support.

(2) Lesson for the future

This project was designed so that entrepreneurs would start their businesses by securing their own funds and equipment through support for the creation of business proposals and training, and activities

such as support for production and sales were not included in the initial activity and input plan. Therefore, although no changes were made to the PDM/PO, these activities were added independently. However, since the beneficiaries of this activity did not have sufficient ownership, and project support for production and sales was an important factor in achieving reliable results, it can be said that sufficient input in such activities was necessary from the beginning.

Given that the fish processing industry is considered “hard and dirty” and is shunned by young Maldivians, and that the workforce is ageing, it is difficult to find new entrepreneurs in the fisheries processing industry in a short period of time. Therefore, with the cooperation of the Island Council and WDC, the project adopted an approach of first trying out the business through the creation of business proposals and the addition of value to existing fish products, with the aim of discovering talent interested in starting a business in the future. However, as mentioned above, this approach also has its problems. It is not easy to identify individuals who are interested in entrepreneurship and can run a business through a few days of a preliminary survey. Therefore, MoFOR needed to identify such individuals in advance and propose candidates from MoFOR at the start of the project. If MoFOR was unable to propose candidates at the island level in advance due to a shortage of talent, it was necessary to consider options such as changing the scope of activities.

Appendixes

1. Assignment of JICA experts
2. List of the equipment
3. PDM (Version 1 to Version 4)
4. Minutes of Meeting JCC (1st to 4th JCC)
5. Presentation of JCC (1st to 4th JCC)
6. Monitoring sheet (Version 1 to Version 4)
7. Best Practice Guide of on-board fish handling)
8. Report on the Feasibility of Converting Live-bait Fishery to Independent Fishery
9. Survey Report: Socio-economic impact assessment of COVID-19 and comparison and analysis with previous survey results of the targeted fisheries communities (Revised version)
10. Teaching materials for Fish Processing Training
11. Teaching materials for Business Management Training (Dhivehi version)