

**KENYA FISHERIES SERVICE (KEFS) MOMBASA,
THE STATE DEPARTMENT OF BLUE ECONOMY AND FISHERIES,
MINISTRY OF MINING, BLUE ECONOMY AND MARITIME AFFAIRS,
REPUBLIC OF KENYA**

**KENYA
MARINE FISHERIES
PROMOTION ADVISOR**

WORK COMPLETION REPORT

JANUARY 2025

**JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
OAFIC CO., LTD.**

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- Appendix 12: Video Book
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Abbreviation Table

Abbreviation	Full text
AICS	Italian Agency for Development Cooperation
BAQF	Broodstock Acclimation and Quarantine Facility
BCD	Buoyancy Control Device
BOQ	Bill of Quantity
BFAR-8	Bureau of Fisheries and Aquatic Resource, Region 8 (Philippines)
BMA	Bandari Maritime Academy
BMU	Beach Management Unit
CAMOES	Instituto da Cooperracao e da Lingua (Portuguese)
CBO	Community Based Organization
CDA	Coastal Development Authority
CDF	County Director of Fisheries
CEC	County Executive Council
CG	County Government
CPUE	Catch Per Unit Effort
Co-management	Co-management
DFAD	Department of Fisheries and Aquaculture Development
DMC	Department of Marine Conservation
DSFA	Deep Sea Fishing Authority
DWFN	Distant Water Fishing Nation
EACC	East African Coastal Current
EEZ	Exclusive Economic Zone
EMCA	Environmental Management and Co-ordination Act
EMS	Electronic Monitoring System
FAD	Fish Aggregating Device
FAO	Food and Agriculture Organization of the United Nations
FDA	Food and Drug Administration
FIDECO	Fishing Developing Company
FIMS	Fishery Information Management System
FLTF	Fish Levy Trust Fund
FMDA	Fisheries Management and Development Act
F/P	Focal Person
FRP	Fiber Reinforced Plastic
G/I	General Information
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (German)
HACCP	Hazard Analysis and Critical Control Point
HDPE	High-Density Polyethylene
ICT	Information and Communication Technology
IOTC	Indian Ocean Tuna Commission
IUU	Illegal, Unreported and Unregulated (Fisheries)
IBEAC	Imperial British East Africa Company
IMS	Institute of Marine Science, University of Dal Es Salaam
JKP	Jumuiya ya Kaunti za Kwani (Swahili)
KCDP	Kenya Coastal Development Project
KCGS	Kenya Coastal Guard Service
KeFS	Kenya Fisheries Service
KES	Kenya Shillings
KFMA	Kenya Fish Marketing Authority
KEMFSED	Kenya Marine Fisheries and Socio-Economic Development (Project)
KFIC	Kenya Fishing Industry Corporation
KFS	Kenya Forest Service
KMA	Kenya Maritime Authority
KMFRI	Kenya Marine and Fisheries Research Institute

Abbreviation	Full text
KNSL	Kenya National Shipping Line
KPA	Kenya Port Authority
KWS	Kenya Wildlife Service
KWSTI	KWS Training Institute
LAPSSET	Lamu Port-South Sudan-Ethiopia Transport
MMBEMA	Ministry of Mining, Blue Economy and Maritime Affairs
MCS	Monitoring, Control and Surveillance
MTWH	Ministry of Tourism, Wildlife, and Heritage
NAMARET	National Mariculture Resources and Training Center
NEM	North Eastern Monsoon
NEMA	National Environmental Management Authority
NFRDI	National Fisheries Research and Development Institute (Philippines)
NKB	North Kenya Bank
n. mile	Nautical Mile
QIP	Quick Impact Project
P/A	Project Assistant
PDCA	Plan, Do, Check and Action
PFO	Provincial Fisheries Officer (of the Philippines)
PPP	Public Private Partnership
PS	Principal Secretary
SAGA	Semi-Autonomous Government Agency
SDBEF	State Department for the Blue Economy and Fisheries
SAM	Strategic Adaptation Management
SEC	South Equatorial Current
SECC	South Equatorial Counter Current
SEM	Southeastern Monsoon
SFA	Seychelles Fishing Authority
SC	Somalia Current
SIFA	Seychelles Industrial Fishing Authority
SolCoolDry	Solar-Powered Cooling and Drying
SCR	Seychellois Rupee
STCW	Standards of Training, Certification and Watchkeeping for Seafarers
TAFIRI	Tanzania Fisheries Research Institute
TOT	Training of Trainers
TVETA	Technical and Vocational Education and Training Authority
VMS	Vessel Monitoring System
W/G	Working Group
WIOMSA	Western Indian Ocean Marine Science Association
WWF	World Wildlife Fund
ZAFICO	Zanzibar Fisheries Corporation
ZAFIRI	Zanzibar Fisheries Research Institute
ZASCO	Zanzibar Seaweed Corporation
ZMHL	Zanzibar Marine Hatchery Limited

Acknowledgement

The project has been carried out by the Japanese consultant team in close collaboration with the Working Group (W/G), which was established as the de facto counterpart organization for the project. We would like to extend our deepest appreciation to the Government of Kenya for their substantial efforts as a counterpart to this project. These efforts were effectively delivered through the W/G, which assumed significant responsibilities in planning, coordinating, evaluating, and reviewing project's various activities. The W/G's active engagement and expertise ensured that the project was aligned with local needs and objectives, contributing to its overall success.

We are particularly thankful for their dedicated support during our on-site activities, which played a critical role in the smooth implementation of both the Third Country Training in Seychelles and Zanzibar, and the In-Country Training, the latter of which was conducted on four separate occasions. The W/G was instrumental not only in selecting relevant themes that addressed the practical needs of the participants but also in identifying suitable candidates for the training programs. Moreover, their assistance in developing detailed and efficient schedules allowed the training sessions to run seamlessly.

Their ongoing cooperation throughout the entire project timeline has been invaluable, ensuring that the project's objectives were met with high standards of professionalism and dedication. We sincerely honor and appreciate the immense contributions made by the W/G, whose efforts have been key in driving the project forward and ensuring its long-term impact on the sector. Their support has been, without a doubt, a cornerstone of the project's success, and we look forward to continued collaboration in the future.

The Working Group consists of representatives from the following institutions. The details are shown in Appendix 1a:

1. The State Division for Blue Economy and Fisheries
2. The Kenya Fisheries Service
3. The Kenya Marine and Fisheries Research Institute
4. The Kenya Fishing Industries Corporation
5. The County Government of Mombasa, Fisheries Division
6. The County Government of Kwale, Fisheries Division
7. The County Government of Kilifi, Fisheries Division
8. The County Government of Tana River, Fisheries Division
9. The County Government of Lamu, Fisheries Division

Special acknowledgement is due to BFAR-8, NFRDI Guiuan, INCA Philippines Inc. and other Philippine nationals listed in Appendix 1b. Their online lectures and demonstration training on Philippine fisheries technology using locally manufactured equipment (banca fishing boats and HDPE aquaculture fish tanks) had a great impact on the stakeholders.

Disclaimer

This document is an English translation of the original Japanese version of the project final report submitted to JICA by the consultant responsible for supervising the implementation of the project. The views and opinions in this document may not necessarily reflect the official views and opinions of the Kenyan counterpart organizations or JICA. Neither organization accepts responsibility for the accuracy of the English translation, and in the event of any inconsistency with the Japanese version, the Japanese version shall prevail.

1. Project Overview (Background, History and Objectives)

1.1. Project Background and History

The Kenyan government has identified the development of the blue economy as one of its key economic development policies in the national development plan, "KENYA VISION 2030," and the Third Medium-Term Development Plan. The marine sector and fisheries promotion are positioned as important development goals. However, while Kenya's fisheries sector holds significant potential to contribute to the national economy, its current GDP contribution remains at just 0.5%. With increasing attention on blue economy policies, the government has significantly expanded the recruitment of new staff in key institutions to achieve the effective and sustainable use of marine and fishery resources. Nonetheless, there is no structured training program for new recruits, making human resource development a critical issue. This project aims to implement training programs to support human resource development in the blue economy, with the key counterpart institutions being State Department of Fisheries and Blue Economy (SDBEF) of the Ministry of Mining, Blue Economy, and Maritime Affairs (MMBEMA)¹, and Kenya Fisheries Service (KeFS) Mombasa Office, and five coastal counties (Kwale, Mombasa, Kilifi, Tana River, and Lamu).

1.2. Project Overview

(1) Project name

Marine Fisheries Promotion Advisor

(2) Project Objectives

The project aims to strengthen the capacity of human resources supporting marine and fisheries sectors by developing and implementing training programs for fisheries administrators and public institution staff. This will contribute to the development of the blue economy.

(3) Expected Outcomes

Outcome 1: The system for conducting training in the government fisheries sector is organized.

Outcome 2: The training needs for fisheries administrators are identified.

Outcome 3: Training programs are developed through this project.

Outcome 4: Training programs are implemented through this project.

Outcome 5: Mutual learning (knowledge sharing) with neighboring African countries is achieved through third-country training.

Outcome 6: The system for conducting training at counterpart institutions is strengthened.

(4) Target Areas

The target areas² are Mombasa County, surrounding coastal areas (Kwale County, Kilifi County), and

¹ Due to administrative reforms just before the start of the project, the Kenya Fisheries Service (KeFS) was transferred from the Ministry of Agriculture, Fisheries and Cooperative to the current ministry. The name of the department was also changed from the State Department of Fisheries and Blue Economy to its current designation.

² After the project commenced, upon request from the Kenyan side, it was proposed and approved to expand the target area to five coastal counties, including Lamu and Tana River counties. However, due to security measures, the Japanese consultant did

Nairobi County. However, the project may limit its activities in accordance with JICA's safety measures.

(5) Related Authorities and Institutions

- State Department of the Blue Economy and Fisheries, Ministry of Mining, Blue Economy and Maritime Affairs
- Kenya Fisheries Service Mombasa
- Coastal Counties (Lamu County, Tana River County, Kilifi County, Mombasa County, Kwale County)

(6) Activities Overview

1) Outcome 1: The system for conducting training in the government fisheries sector is organized.

- Activity 1-1: Confirm curriculum, budgets, and systems for the development of human resources to support marine fisheries in C/P organizations
- Activity 1-2: Extract the contents of training (training themes, frequency of implementation, training methods, subjects, evaluations of participants, etc.) conducted by government officials (at the central and local levels) in the fisheries sector as instructors in the last three years.

2) Outcome 2: The training needs for fisheries administrators are identified.

- Activity 2-1: Extract the content of training conducted for government staff in the last three years.
- Activity 2-2: Implement training needs assessments for the central government staff (in charge of fisheries policies at Nairobi Head Office) such as young, mid-career and experienced staffs in accordance with work experience.
- Activity 2-3: Implement training needs assessments for staff at local area (central government, KeFS, local fisheries staff assigned to coastal areas) such as young, mid-career and experienced staffs in accordance with work experience.

3) Outcome 3: Training programs are developed through this project.

- Activity 3-1: Prioritize training themes based on the results of activities 2-2 and 2-3.
- Activity 3-2: Based on the results of Activity 3-1, ideal comprehensive training program proposals will be established for work experience, area of activity, and short-and medium-to long-term.
- Activity 3-3: Based on the results of activity 3-2, draft training programs to be implemented during the project period will be established for central-level staff and local-level staff, respectively.
- Activity 3-4: Select appropriate methods for conducting each training session, including trainers, training formats (face-to-face, online, lectures, practical training), and training locations.
- Activity 3-5: As an appropriate implementation method, training in Japan (specific issue training course, study abroad system, etc.) will also be profited to support to select participants and dispatch to Japan. TOT based on activities 3-3 will be provided to Kenyan resource personnel selected in activities 3-4.
- Activity 3-6: Develop training materials for the training selected in Activity 3-3 as necessary.
- Activity 3-7: If necessary, the pilot projects implemented in the preceding project will be used as

not visit the two northern counties.

the contents of the training program and as a place for the training.

- 4) Outcome 4: Training programs are implemented through this project.
 - Activity 4-1: Implement the training program developed in Activity 3.
 - Activity 4-2: Improve the training program by reviewing the implementation status and results (details contents, methods, results of trainees returning from Japan, etc.) as appropriate.
 - Activity 4-3: Evaluate and monitor training content, including reports by training participants on how they use it in their own work.
- 5) Outcome 5: Mutual learning (knowledge sharing) with neighboring African countries is achieved through third-country training.
 - Activity 5-1: Plan third-country training for neighboring countries (several times).
 - Activity 5-2: Select promising participants (about 5 persons each time).
 - Activity 5-3: Seminars on fishery will be held in the countries where they will visit. The training in third countries should be meaningful to the host countries.
 - Activity 5-4: Hold a debriefing meeting.
- 6) Outcome 6: The system for conducting training at counterpart institutions is strengthened.
 - Activity 6-1: Training materials should be prepared in accordance with the capabilities of C/P organizations and TOT should be provided by C/P organizations independently after completion of this project.
 - Activity 6-2: Based on activities 1 to 5, propose measures to contribute to the capacity building of marine fishery personnel (including specific training items, training contents, and the utilization of medium-to long-term Japanese training, etc.)

2. Activities

This project was implemented through a total of eight on-site work.

Table 1. Overview of On-Site Work for this Project

On-Site Work	Period	Main Activities
1 st	October 29, 2022 – December 18, 2022	Local situation survey and training needs assessment
2 nd	February 14, 2023 – April 6, 2023	Establishment of training implementation systems and development of training programs
3 rd	May 30, 2023 – June 28, 2023	Implementation of the 1 st domestic training session
4 th	August 22, 2023 – September 9, 2023	Implementation of the 1 st third-country training (Seychelles)
5 th	October 20, 2023 – November 26, 2023	Implementation of the 2 nd domestic training session
6 th	April 16, 2024 – May 25, 2024	Implementation of the 2 nd third-country training (Zanzibar) and the 3 rd domestic training session
7 th	June 16, 2024 – July 13, 2024	Implementation of the 4 th domestic training session
8 th	August 18, 2024 – September 15, 2024	Wrap-up Seminar

2.1. Development and Discussion of the Work Plan

Based on the work plan created prior to the 1st on-site work, the project's activity plan was explained to the SDBEF in Nairobi and the KeFS in Nairobi. During this explanation, a request was made to include Lamu and Tana River counties, which are coastal areas, as target regions for the project, despite the fact that Japanese experts could not visit these areas due to safety concerns. In response to this request, it was decided to discuss and consider the matter with relevant stakeholders after assessing the current situation.

Following the explanation to the stakeholders in Nairobi, the project's activity plan was also explained to the counterpart institutions, KeFS Mombasa and SDBEF Mombasa. At this stage, the content discussed in Nairobi was shared, and preparations were made to proceed with the planned surveys related to the assessment of the current situation.

2.2. Assessment of the Current Situation

The objective of this activity, related to Outcome 1 “The system for conducting training in the government fisheries sector is organized” is to identify the current issues and areas for improvement within counterpart institutions. Comprehensive information was collected from relevant institutions, and visits were made to organizations involved in the training and development of marine and fisheries support personnel. Additionally, a survey was conducted using Google Forms. Based on the survey results, explanations were provided regarding the current state of marine fisheries administration and marine fisheries development.

2.2.1. Marine Fisheries Administration

Visits were made to public institutions, including counterpart organizations (SDBEF, KeFS, and the fisheries departments of coastal counties) as well as public institutions responsible for shipping and tourism (5 ministries and 8 agencies as shown in Fig. 1). Hearings related to the fisheries and blue economy were conducted. The basic functions are explained below. In parallel with visits to central government institutions, local fisheries departments in three coastal counties and several Beach Management Units (BMUs) were also visited to gather information on the local situation. The results of these visits to county government institutions are explained in the subsequent section on the state of the marine fisheries industry.

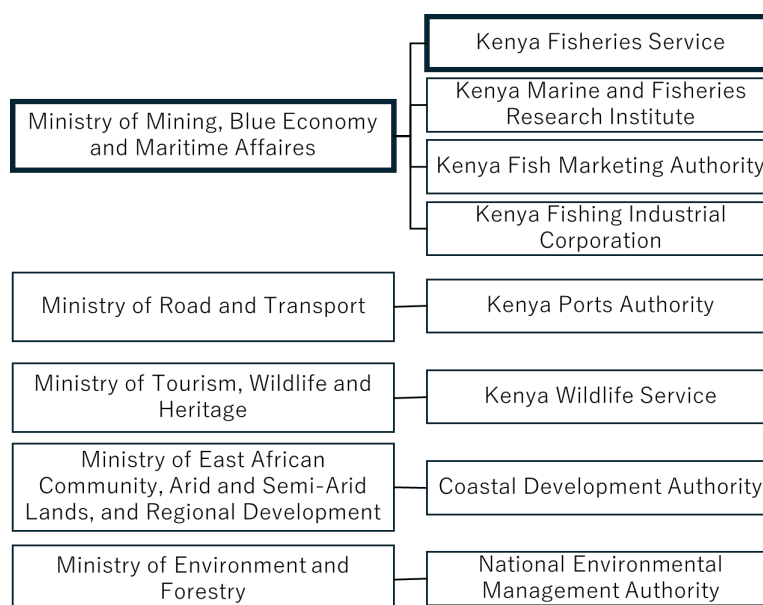


Figure 1. Fisheries Blue Economy Organizations visited in this survey

The thick bordered box indicated C/P institution of this project.

(1) Ministry of Mining, Blue Economy and Maritime Affairs

The primary ministry responsible for fisheries administration in Kenya is the Ministry of Mining, Blue Economy, and Maritime Affairs (MMBEMA). This ministry comprises three departments: the State Department of the Blue Economy and Fisheries (SDBEF), the State Department of Mining, and the State Department of Shipping and Maritime Affairs. The SDBEF holds the administrative responsibility for activities related to the fisheries sector. The responsibilities of the SDBEF, as outlined in the Executive Order No.1 of 2022 issued by the current administration, are as follows:

- | | |
|---|--|
| ① Co-ordinate development of national oceans and blue economy strategy and policy, | ⑩ Fish quality assurance, |
| ② Fisheries and aquaculture policies, | ⑪ Enhancement of technical co-operation with partner state, |
| ③ Co-ordination of the development of policies, legal, regulatory and institutional frameworks for fisheries industry and blue economies, | ⑫ Management and licensing of local and foreign fishing trawlers in Kenyan waters, |
| ④ Drive sustainable transformation and diversification of the ocean's economy by promoting research and innovation, | ⑬ Overall policy for exploitation of Agro-based marine resources, |
| ⑤ Increase local participation and investment in the blue economy through private sector engagement and partnerships, | ⑭ Policy on development of fishing ports and associated infrastructure, |
| ⑥ Fishery marketing policies, | ⑮ Capacity building for sustainable exploitation of Agro-based marine resources, |
| ⑦ Fishing licenses, | ⑯ Protection of aquatic ecosystems, |
| ⑧ Development of fisheries, | ⑰ Promote of Kenya as the center of aquaculture, |
| ⑨ Promote fish consumption, | ⑱ Economic Development oriented Fisheries Research |

SDBEF has a branch office in Mombasa (located in the same building for Mombasa branch of KeFS) as a base for activities related to marine fisheries and marine aquaculture. Since this project covers only five coastal counties facing the Indian Ocean and sea areas including the Exclusive Economic Zone (EEZ), the fisheries activities covered by this project are within the scope of SDBEF Mombasa Branch, and this branch became a substantially main C/P organization. In close collaboration with SDBEF Headquarters in Nairobi, the two offices of SDBEF Mombasa and KeFS Mombasa took the initiative in formulating and implementing training plans together with the consultant team.

(2) Kenya Fisheries Services (KeFS)

In the Fisheries Management and Development Act (FMDA) Chapter 378 of 2016 (No. 35) with the latest revision in 2022, which is positioned as the basic law on fisheries for the country, the Kenyan Fisheries Administration has been granted to KeFS a broad range of authorities for the conservation, management and utilization of fishery resources in Kenya (detailed in Section 9³ of FMDA, covering the

³ KeFS shall perform the following functions of service by FDMA Cap. 378 (2016):

(a) ensure the appropriate conservation development of standards on management, sustainable use, development and protection of the fisheries resources; (b) formulate and monitor the implementation of policies regarding the conservation, management and utilization of all fisheries resources within the scope of this Act; (c) develop standards for the management of all fisheries and aquaculture activities and fishing related activities within the scope of this Act; (d) develop guidelines for the preparation of fisheries specific management plans for the Kenya fishery waters; (e) provide education to create public awareness and support for fisheries conservation, management, development and sustainable use; (f) set and meet goals for fisheries conservation, management, development and sustainable use; (g) in consultation with the Kenya Marine and Fisheries Research Institute, approve and co-ordinate research activities in relation to matters falling within the scope of this Act; (h) collect and

overall functions described in the above section for SDBEF). The fisheries administration is implemented by KeFS under the supervision of SDBEF. The law stipulates that KeFS is one of the Semi-Autonomous Government Agency (SAGA), the half-public and half-private sectors, and is a permanent institution with a legal personality, and is responsible for appealing and being sued like a private enterprise. In other words, the present Kenyan Fisheries Administration is fundamentally different from the era in which it was ultimately governed by the Director of the Fisheries (Fishery Act in 1991) or by the ministers assisted by the Chief Fisheries Officer in the previous era, and is implemented by the enforcement of the powers strictly stipulated by the law. SDBEF is a supervisory authority and KeFS is an administrative institution under its supervision.

The Kenyan Fishing School in KeFS Organization Chart (Fig. 2) shows Sagana School (Sagana, Kiringaya County), Kabonyo School (Kabonyo, Homa Bay County), and Mombasa School, but only the Sagana School, which mainly deals with inland fisheries, inland aquaculture, and quality & safety of fisheries products, is actually in operation. The Kabonyo School (Kabonyo Fisheries Aquaculture Service and Training Centre) on the shore of Lake Victoria, which was approved by the new administration, is also a center for the study and training of inland aquaculture. The Mombasa school is planned to become a training center for marine fisheries and aquaculture, but it is only at the conceptual stage. Therefore, at present, there is virtually no in-house training organization within the KeFS structure for marine fishery personnel.

analyze data in relation to resources and activities falling within the scope of this Act; (i) identify manpower requirements and recruit manpower at all levels for the Service; (j) liaise as appropriate with agencies and persons, including stakeholders, industry, government agencies, regional and international organizations and experts, whether local or foreign, on matters falling within the scope of this Act; (k) act on behalf of the government, subject to the Treaty Making and Ratification Act, 2013 in relation to any domestic or international agreement relating to fishing, fishing related activities or any matter falling within the scope of this Act, to which Kenya is or may become a party; (l) administer and co-ordinate international protocols, conventions and treaties regarding fisheries in all its aspects in consultation with the Cabinet Secretary pursuant to the Treaty Making and Ratification Act, 2013, Cap 242; (m) subject to the Public Health Act and the Food, Drugs and Substance Act, Cap 254 control and regulate fish safety and quality; (n) raise revenue through levies, fees, investments and other means in accordance with this Act and the Constitution, including solicitation by public appeal or otherwise, and accept and receive subscriptions, donations, devices and bequests, whether of movable or immovable property and whether absolute or unconditional for the general or special purposes of the Service or subject to any trust; (o) undertake the development of appropriate fisheries infrastructure, that relates to its mandate under this Act and the Constitution; (p) facilitate investment in commercial fisheries, in collaboration with relevant agencies, persons or bodies, including Government departments; (q) promote development and introduction of appropriate technologies in aquaculture production, processing and preservation in collaboration with relevant agencies, county governments and stakeholders; (r) identify and promote construction of any works deemed necessary for the sustainable development and economic utilization of fisheries resources; (s) in collaboration with county government and the Fish Marketing Authority established under section 201, identify opportunities and promote all aspects of fisheries marketing; (t) arrange and enter into joint ventures or any other forms of investment arrangement for purposes of performing any of its functions; (u) co-ordinate fish quality assurance and operations of the marine and coastal fisheries, aquaculture and inland and riverine fisheries; (v) coordinate and or undertake monitoring, control and surveillance of all activities within the scope of this Act; and (w) perform such other duties and functions consistent with the provisions of this Act as may be necessary to carry out the objectives and provisions of this Act.

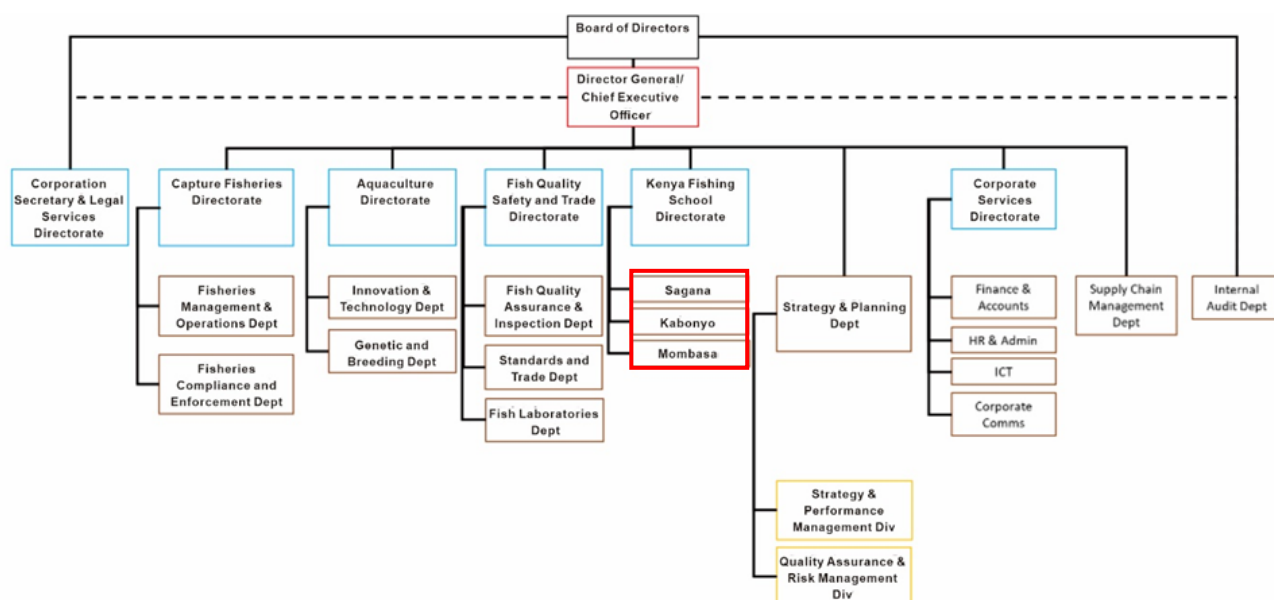


Figure 2. Organization Chart of KeFS (red frame: Fisheries Schools)

Source: KeFS, 2020

In addition to KeFS, there are other statutory agencies under the jurisdiction of SDBEF, Kenya Marine and Fisheries Research Institute (KMFRI), Kenya Fish Marketing Authority (KFMA) and Kenya Fishing Industrial Corporation (KFIC). KeFS executes the above functions in collaboration with the other agencies. These agencies can be understood as public corporations which deal with fields requiring high-level expertise for implementation of the KeFS's broad fisheries administrative functions. Each of them is established under the laws and regulations listed in Table 2. In addition, FMDA (2016) includes the establishment of the Fisheries Fund (Fish Levy Trust Fund: FLTF). Currently, the financial resources of KeFS are fully funded by the central government. In the future, however, the fisheries administration aims to have financial autonomy by using licensing fees and other financial resources through FLTF.

Table 2. Statutory Organizations of Ministry of Mining, Blue Economy, Fisheries and Maritime Affairs

Name	Functions	Establishment Law
Kenya Fisheries Service (KeFS)	Conservation, management and use of fishery resources	FMDA 2016 (35)
Kenya Marine and Fisheries Research Institute (KMFRI)	Fishery, aquaculture, environmental and ecological studies of sea and inland waters	Science and Technology Act 1979 replaced by 2013 (28)
Kenya Fish Marketing Authority (KFMA)	Domestic distribution and export of marine products	FMDA 2016 (35)
Kenya Fish Industry Corporation (KFIC)	Efficient Use of Fishery Resources in Kenya and the Public Sea through Private Partnerships	2018 Legal Notice No. 214, Kenya Fishing Industries Corporation Order
Fish Levy Trust Fund (FLTF)	Provision of supplementary funds for sustainable conservation, management and utilization of fishery resources	FMDA 2016 (35)

(3) Kenya Marine and Fisheries Research Institute (KMFRI)

The establishment of the Kenya Marine and Fisheries Research Institute (KMFRI) is based on the Science and Technology Act of 1979 (revised in 2013), earlier than the enactment of FMDA in 2016. Under the current law, the function of KMFRI is to conduct research on inland and marine fisheries and aquaculture in order to provide scientific data/information for sustainable development under the coordination and cooperation of KeFS. Specific areas of activity stipulated under the above act are to:

- Conduct multidisciplinary and collaborative research on fish ecology, population dynamics, stock assessment and general aquatic ecology
- Collect and disseminate scientific information on fisheries and other aquatic resources and related natural products
- Study and identify suitable species for culture including development, adoption and transfer of rearing technology and procedure
- Study chemical and physical processes that affect productivity of aquatic ecosystems
- Monitor water quality and pollution in fresh and marine water environments
- Carry out socio-economic research on aspects relevant to fisheries, environment and other aquatic resources
- Establish a marine and freshwater collection for research and training purposes
- Offer training facilities to aquatic scientists
- Conduct research on fish quality control, post-harvest preservation and value addition technologies
- Conduct research on Blue Economy

KMFRI has 12 offices nationwide. The headquarters is in Mombasa, and in the coastal area there is National Mangrove Research Centre in Gazi, Kwale County. In addition, National Mariculture Resources and Training Centre (NAMARET, Fig. 3) is currently being constructed in Shimoni, Kwale county as a part of the World Bank-financed Kenya Marine Fisheries and Socio-Economic Development project (KEMFSED).



Figure 3. National Mariculture Resources and Training (NAMARET) at Shimoni, Kwale County
Main building under construction (left) and Hatchery partially opened (right)

The facilities of Shimoni NAMARET hatchery is constructed in two phases in the total budget of KES 413 million (KES 120 million and KES 293 million), consisting of live feed production facilities (algal stock cultivation, algal intermediate cultivation, outdoor algal mass cultivation, rotifer cultivation, nutrient intensified rotifer culture, Artemia production), fish farming facilities (quarantine tank, brood fish tank, spawning and hatchling tank, larvae cultivation tank, juvenile fish cultivation tank, and research and administration building (rearing experiment tank, analytical room, feed production facility, and algae cultivation facility)). The site (6 ha) is located 1.3 km west of the existing paved road in Shimoni (about 6 km from the pier) and 300m from the shoreline. Seawater is piped in from offshore and fresh water is pumped from wells inside the premises. According to the seed production plan, the following multi-species aquaculture fingerlings are to be produced, 6.5 million in one production cycle for all species, and 19.5 million in three cycles per year, in addition to the production of fish feeds for aquaculture (1 ton/day) algae and artemia.

- Mangrove crab: 1.5 million crablets from 100 crab brooders per 3-month production cycle
- Fish: 1.5 million fingerlings from 80 parent fish per 3-month production cycle
- Sea cucumber: 1 million seeds from 50 brooders of sea cucumber per 3-month production cycle
- Shrimp: 2.5 million seed shrimps from 100 prawn brooders per 3-month production cycle

The indoor cultivation of live feeds necessary for the early development of marine fish and crustaceans in the hatchery facilities is a technology that is generally unnecessary for the fingerling production of freshwater species, and has little experience in practice in Kenya. There is no clear specification for fish species in the NAMARET seed production plan at this time, and thus, it is necessary for seed production expert of each species to develop and establish a seed production protocol with setting up of a set of production facility, which is expected to take a long period before NAMARET becomes able to produce the target numbers of seed and fingerlings. Furthermore, the expected aquaculture production based on the projected number of fingerlings production would be only a few hundred tons (in case of milkfish, for example, 1,500,000 fingerlings x 0.5kg/fish x 50% mortality = 375,000kg = 375 tons), just enough for experimental trials and needs more time for the developed seed production technology to be extended into private sector hatcheries.

(4) Kenya Fish Marketing Authority (KFMA)

Kenya Fish Marketing Authority (KFMA) was approved to be established by FDMA that came into effect in 2016, the same year as KeFS, but the actual operation was delayed until 2020. The organization is currently developing human resources. At the time of the visit to the KFMA office in this study, full-scale activities such as regulations and support for the marketing of fisheries products, or provision of information on market prices and import/export statistics have not yet begun.

(5) Kenya Fishing Industrial Corporation (KFIC)

Kenya Fishing Industrial Corporation (KFIC) is a state corporation established under the Legal Notice No. 214 of State Corporation Act (Kenya Fishing Industrial Corporation Order, 2018) to exploit fish and other marine resources and products in the Kenyan fishery waters and high seas by promoting the

establishment and efficiency of businesses engaged in fishing and fishing-related activities. Specifically, as one of the pillars of Kenya's fishery Blue Economy development policies, supervision and management of the operation of the fishing port-processing complex (Fig. 4), which is under construction at Liwatoni Port in Mombasa to promote offshore fishery development, is now the main operation of KFIC.

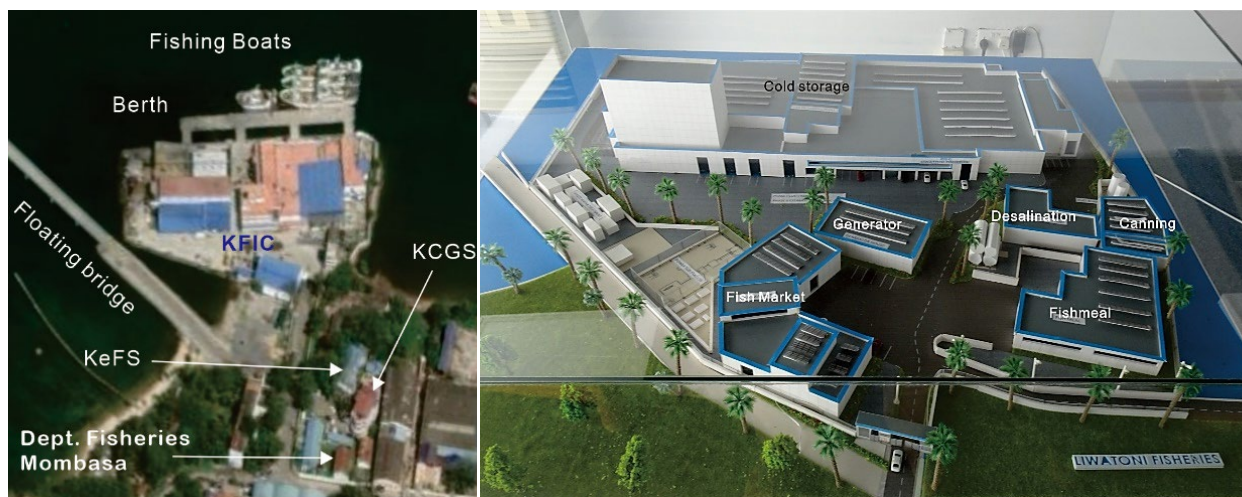


Figure 4. Liwatoni Fisheries Processing Complex Fisheries Facility (Mombasa)

The Liwatoni Fisheries Processing Complex is equipped with a quay where large fishing vessels (including foreign-registered vessels) engaged in fishing in the Kenyan EEZ can unload catches. The facility is located in the Likoni, the southernmost part of the Kilindini estuary (where KeFS, Kenyan Coast Guard, and the Mombasa County Fisheries Direction gather, and also the place of Mombasa Island side starting point of the Likoni floating pedestrian bridge⁴). Construction began in November 2018 in two phases. With construction interrupted and delayed due to an investigation by Ethics and Anti-Corruption Commission (EACC) on the builder's contract, the construction was delayed but the first phase was completed in November 2021, and the second phase construction was underway at the time of our visit. The fish processing plant was not yet operational without equipment installed, although the large fishing boats at the quay were unloading their catch, which was being loaded out in cold storage vehicles without being processed.

The Liwatoni Fisheries Processing Complex built as one of the main marine Blue Economy projects in Kenya is planned to obtain 90% of the raw material fish from the industrial fishing vessels operating in EEZ of Kenya high seas as frozen fish preserved at -25, -45 or -60°C in whole round or headed & gutted forms, and the remaining 10% from the semi-industrial boats operating in the near seas as fresh fish iced at 0°C. The facility will be equipped with the following main facilities to process 150,000 tons of fish per year and to be able to ship 100 tons of products daily (70% canned and other cooked products, 30% fresh and frozen fish). Seventy percents (70%) of the products are planned to export to EU, Japan, the U.S., Africa as the major expected destination, and the remaining 30% is planned to be shipped to the domestic markets.

⁴ Likoni Floating Pedestrian Bridge: A temporary bridge that is completed in 2020 in six months and is used until the Mombasa Gateway Bridge, which will be the largest bridge in Africa, is completed in 2025 with Japanese loan. When the bridge is completed, access from the north-south coast to the Liwatoni fishing port becomes very good.

Table 3. Outline of the Liwatoni Fisheries Processing Complex Facility

Equipment	Capacity
1. Pier	150,000 tons/year catch loading and unloading capacity (improvement of existing 124m quays)
2. Ice-making plant	300 tons/day
3. Frozen storage facilities	-25°C: 14 units total 7,000 tons, -60°C: 2 units total 500 tons, -45°C: 3 units total 1,500 tons, -4°C: 2 units total 1,000 tons
4. Fresh and frozen fish processing plants	100 tons/day material fish processing (80% tuna, 20% other)
5. Canning plant	100 tons/day material fish processing
6. Fish meal manufacturing plant	50 tons/day material fish processing
7. Fish auction market	500m ² (spaces for 20 units fish vending stands and auction area)
8. Fishing gear repair space	500m ²
9. Refueling facilities	2 million liters diesel refueling storage
10. Other	Wastewater treatment facilities, water treatment and storage facilities, internal and external power supply facilities, management and administration office

Source: State Department of Public Works, 2021

(6) Blue Economy Agencies under SDBEF

State Department of Maritime Affairs of the Ministry of Mining, Blue Economy and Maritime Affairs has the following three statutory organizations to execute maritime administration in Kenya (Table 4). Of these, the two organizations listed at the bottom (Kenya Maritime Authority and Bandari Maritime Academy) are particularly relevant to the fishery Blue Economy.

Table 4. Statutory Organization under SDBEF visited in this Survey

Name	Function	Establishment Law
Kenyan National Shipping Line (KNSL)	Maritime transportation, maritime logistics, and overseas agency services	Company's Act Cap 486 (1987)
Kenya Maritime Authority (KMA)	Regulation, coordination and supervision of maritime affairs	Kenya Maritime Act No.5 (2006)
Bandari Maritime Academy (BMA)	Provide maritime education necessary for the sustainable growth of the Blue Economy	Presidential Order No. 233 of 2018

1) Kenya Maritime Authority (KMA)

It is the maritime regulatory agency in Kenya and has jurisdiction over maritime policy planning and coordination, vessel navigation safety, maritime environment protection and utilization, seafarer working environment, shipbuilding and ship repair, and seafarer licenses. Regarding fishery-related operations, KeFS works for the appropriate use and management of fishery resources, while KMA works for the safety of fishing vessels and the improvement of working conditions for crew. All commercial fishing vessels including fishing vessels need to be registered with the Maritime Authority in addition to KeFS.

As a result of the above-mentioned intended improvement in the processing capacity of catches by the completion of the Liwatoni fisheries processing complex of KFIC, large foreign flagged fishing vessels operating in the Kenyan EEZ will be able to unload the catches at the fishing port. At the same time, the number of commercial fishing vessels of the Kenyan registry will be increased to contribute to the creation of jobs for Kenyan crew. Therefore, KMA, in collaboration with Kenya Institute of Curriculum

Development, Technical and Vocational Education and Training Authority (TVETA) and Ministry of Education, Science, and Technology, developed curriculums for national qualifications on seafarer training and maritime transportation logistics. Kenyatta University, Moi University, Technical University of Mombasa and Bandari Maritime Academy currently provide national certificates (craft certificates, diploma and degree) in navigation and marine engineering through the developed curricula.

2) Bandari Maritime Academy (BMA)

In 1980 after the collapse of East African Railway and Harbour Corporation, which operated railway and shipping networks in the inland East Africa starting from the Port of Mombasa from 1948 to 1977, Bandari College (“Bandari” is Port in Swahili) was established as an in-house training institution of Kenya Port Authority (KPA) to ensure the continuity of the Mombasa port operation and the railway network. Since then, in order to respond to the technological development and diversification associated with the expansion of sea and inland transportation in East Africa, the educational scope of this school has been continuously expanded to the present. In 2018, it was positioned as a major institution for the seafarer human resources development in line with the implementation of the Blue Economy policy, and reorganized into Bandari Maritime Academy (BMA) by No. 233 of laws in the same year.

BMA currently provides the marine technical courses for two-year completion Craft Certificate and three-year completion Diploma courses in marine engineering, nautical science, and marine transport operation, short-term training courses (from 2 days to 20 days) on Standards of Training, Certification, and Watchkeeping (STCW) basic safety, STCW revalidation, Coxswain Level III, elementary first aid, personal survival techniques, fire prevention & fire fighting, personal safety and social responsibility, and security awareness, and port equipment operation courses (from 30 days to 50 days) for forklifts & empty container handler and terminal tractor driving (BMA, 2022). BMA is equipped with training facilities, equipment, training buildings, libraries, etc. required to provide these courses (Fig. 5).



Figure 5. Part of Facilities Owned by BMA

BMA has been cooperating with KeFS since two years before the time of the survey to provide fisheries courses for the training of crew members of industrial fishing vessels, aiming to produce 5000 graduates in five years. Training includes fishing methods, fishery management, STCW basic training practices on fishing gear and fishing methods, and 10-day onboard training.

(7) Other Fisheries Blue Economy Organizations

In general, the Blue Economy covers all available resources in water, both living or nonliving, and covers a very wide range of industrial sectors. Further, the implementation of Blue Economy policies requires consideration for social, economic, and environmental sustainability at the national and international levels. Therefore, in addition to cooperate with the usual fisheries administration executing agencies, it is necessary to cooperation with government agencies in charge of security, defense, maritime transportation, environment, etc. In the First Site Work period, the consultant team visited the following five organizations, which are particularly relevant to KeFS activities.

Table 5. Other Fisheries Blue Economy-Related Statutory Organizations visited in the First Site Work

Organization Name	Main function	Establishment Law
Kenya Ports Authority (KPA)	Maintenance, operation, improvement, and regulation of all domestic ports and waterways, including inland ports	Kenya Ports Authority Act, 1979
Kenya Coast Guard Service (KCGS)	Enforcement of laws on security, safety, and protection of marine resources in domestic waters, including inland waters	Kenya Coast Guard Service Act, 2018 (No. 11)
Coastal Development Authority (CDA)	Formulation, coordination, and implementation of integrated development plans for the Kenyan coastal areas	Parliament Act No. 20 of 1990 (Cap 449), revised 1992
Kenya Wildlife Service (KWS)	Conservation and management of wildlife in Kenya and enforcement of related laws	Parliament Act (Cap 376) of 1989, replaced by Wildlife Conservation and Management Act of 2013
National Environmental Management Authority (NEMA)	Principal organization implementing all environmental policies	Environmental Management and Co-ordination Act No. 8 of 1999 (EMCA)

1) Kenya Ports Authority (KPA)

Kenya Ports Authority (KPA) was established by Kenya Ports Authority Act in 1978 to manage and regulate all domestic ports, including inland ports, and waterways. The organization's history dates back to 1890, when Imperial British East Africa Company (IBEAC) managed the British Imperial Protectorate, including present day Kenya and Uganda, and was established as the operation and management agency of the Port of Mombasa, the starting point of the Kenya-Uganda Railway. KPA is under the supervision of Ministry of Roads and Transport along with Kenya National Shipping Line (KNSL) and Kenya Ferry Service.

The Port of Mombasa is the largest port in East Africa and is a critical infrastructure hub for the region's economy, commerce, and logistics as a starting point for the Northern Corridor to improve access to the inland African region. In addition, LAPSSET Corridor Project is underway starting from Lamu port in the north, connecting Sudan-Ethiopia and crossing African continent to reach the West African region. Kenya will be a maritime country with two major distribution hub ports in East Africa, and the marine transportation industry accounts for a large share of the development of the Kenyan Blue Economy.

Regarding the development of the fishery industry, the national government is modernizing fishing vessels so that they can operate in offshore fishing areas where fishery resources are considered to be in abundance. As a part of this efforts, KPA is planning to construct seven local fishing ports in five counties

where semi-industrial fishing vessels can berth. Some of the fish unloaded at these local fishing ports will be sent to Mombasa by land and used as raw materials for the Liwatoni processing complex.

The construction of Shimoni fishing port (Fig. 6) in Kwale county was approved as the first fishing port and was due to start in April 2022 but construction was delayed owing to problems with land acquisition and tendering for contractors⁵. The new pier (30m×150m) to be built parallel to the existing pier will be a dedicated fishery pier where large-sized industrial fishing vessels can berth. Existing piers are used continuously for cargo. Auction market, refrigerators, ice making facilities, and fish treatment facilities are constructed in the fishing port.



Figure 6. Shimoni Port Jetty Under Construction

2) Kenya Coast Guard Service (KCGS)

Kenya Coast Guard Service (KCGS) is a new institution established by the Coast Guard Act of 2018. The main reason for the establishment is to prevent the estimated annual loss of KES10 billion equivalents due to illegal fishing in the Kenyan waters through proper security and policing, and thus the establishment of KCGS is strongly linked to the promotion of Blue Economy policy. National maritime security is also included in the missions, but since the KCGS have only been established in a short period of time, it has not yet been fully organized. It is managed by a council consisting of representatives of several related ministries (defense, finance, transportation, fisheries, environmental, legal, and police), under which a Technical Committee operates. Currently, KCGS has only one fishery patrol vessel (MV Doria).

KCGS is located on the same premises as KeFS Branch in Mombasa and has senior officials seconded from KeFS to provide training on marine laws and regulations, Monitoring, Control and Surveillances (MCS), and Illegal, Unreported, and Unregulated (IUU) fisheries to coast guards and KeFS officials. These training materials could also be useful as a training resource for this project.

3) Coastal Development Authority (CDA) and Jumuiya ya Kaunti za Kwani (JKP)

The Coastal Development Authority (CDA) is one of the six regional development authorities under the jurisdiction of the state department of Regional Development and Northern Corridor Development of Ministry of East African Community, Arid and Semi-Arid Lands, and the Regional Development. Coastal

⁵ The first phase of construction work (budgeted at KES 2.6 billion) at the Simoni port started in April 2023 and is expected to be approximately 80% complete as of the end of this project in October 2024, with the port expected to open by June 2025 (source: MARTIMAFRIA, 2024).

areas (including the southern part of Garissa County) and Kenyan EEZ should be the regions where CDA is in charge of development. The headquarters is located in Mombasa, and a County Coordinator is located in each county.

CDA was established in 1990 by No.20 of Congress Act (revised in 1992). Prior to the introduction of decentralized administrative system established with introduction of counties by the 2010 Constitutional Amendment, the entire coastal region was divided into eight Provinces and 26 Districts along the river basin systems, and governed by Provincial Commissioners appointed by the President in the centralized administrative system.

The six coastal counties (Mombasa, Kwale, Kilifi, Tana River, Lamu and Taita Taveta), which now have broad autonomy, signed a regional economic cooperation agreement in 2015 and established Jumuiya ya Kaunti za Pwani (JKP: “Coastal Regional Bloc” in Swahili). With JKP as their central coordination body now, regional economic development is carried out by the Governor's Council, the Sector Working Group, and the Secretariat.

CDA's recent activities include the Kenyan Climate Change Response Project (mangrove planting and coral reef regeneration and conservation activities) and EEZ Fisheries Project (provision of fishing boats), both of them are small-scale community-level activities. JKP, on the other hand, is active as the main coordinating body for Go Blue projects supported by EU with a total of 2,75 million euros funding. In other words, many of the regional economic development-coordination functions of CDA under the centralized system are now implemented by JKP launched by the six autonomous coastal counties under the present decentralization system.

4) Kenya Wildlife Service (KWS)

Kenya Wildlife Service (KWS), originally established by the Congress Act (Cap 376) of 1989 (amended by the Wildlife Conservation and Management Act of 2013), is a semiautonomous public agency or SAGA for conservation and management of Kenya's wildlife and their habitats. Specifically, it manages and operates 23 National Parks, four National Reserves and four Sanctuaries covering 8% of the national land area. It is the foundation of Kenya's third-largest economic sector after agriculture and manufacturing sectors, which accounts for 21% of foreign currency revenue and 12% of GDP. It is estimated that 90% of safari tourism and 75% of national tourist revenue are attributed to the KWS related activities.

Regarding the Blue Economy, four National Marine Parks and six National Marine Reserves are designated on coastal waters to protect marine life apart from the land-based protected areas. In Marine Parks, fishing is prohibited and only commercial activities for recreational purposes are allowed. Fishing activities can take place in the Marine Reserves, but KWS rangers work with KeFS and KCGS to control illegal fishing gears and fishing methods. KWS, like KCGS, has law enforcement power and can arrest illegal persons. They conduct environmental conservation training and beach cleaning activities with fishermen (BMU members) and residents (Community Scouts) in the protected areas. They also carry out SAM (Strategic Adaptation Management), a science-based animal-protection activity in which ecological environmental parameters of beaches and mangrove forests are continuously examined and monitored.

Kenya's coast is lined with beautiful beaches (e.g., Lamu Island, Che Chale, Mambrui, Malindi, Watamu, Kilifi, Kikambala, Mtwapa, Nyali, Diani, Gazi, etc.) with facilities capable of accommodating international

tourists and providing fishing (trolling) and other marine sports activities. In Kenya Tourism Development Strategy 2030, marine tourism “Beach & Marine” is positioned as a higher priority sub-sector along with safari tourism. The Mombasa Marine Park (Fig. 7: 12km² of coastal waters from the Mombasa port to the county border of Mtwapa), which the consultant team visited, appeared to be a swimming beach, with many domestic tourists from inland areas such as Nairobi. KWS belongs to Ministry of Tourism, Wildlife, and Heritage (MTWH). In the interviews with KeFS staff and county fisheries officers, there are no project that actively encourages fishermen to engage in tourism promotion activities (e.g., promoting employment in the sports fishing industry) with the reason mentioned that they are under different ministry responsibilities.



Figure 7. Mombasa National Marine Park

KWS operates Kenya Wildlife Training Institute (KWSTI) as an in-house educational institution in Naivasha (90km northwest of Nairobi). It is accredited as a vocational training institute that can offer professional degrees and certificates (Diploma and Craft Certificate) in fisheries and aquaculture in addition to wildlife and environmental management and tourism hospitality. KWSTI was established in 1975 to develop human resources in line with the policy-shift in wildlife conservation management and became operational in 1980. Fisheries and aquaculture training courses were included because the fisheries administration at that time was implemented under the Department of Wildlife and Fisheries. Based on the present administrative division, it would be more reasonable to integrate it into Kenya Fishing School Directorate under KeFS.

5) National Environmental Management Authority (NEMA)

National Environmental Management Authority (NEMA) is a SAGA established by Environmental Management and Co-ordination Act of 1999 as a leading agency for the environment conservation of Kenya.

Regarding the Blue Economy, NEMA mainly performs two functions: (1) Environmental Assessment: it conducts environmental impact assessment and issues certificates in cooperation with all stakeholders, including relevant organizations and residents for fisheries, aquaculture, and harbor development projects above a certain scale. NEMA has the authority to cancel projects if adverse impact on the environment and society is large, and (2) Effluent Water Quality Assessment: NEMA conducts water quality inspections of industrial effluents discharged into the aquatic environment, and issues licenses to permit to conserve aquatic life and the environment.

2.2.2. State of Marine Fisheries

(1) Overall marine fisheries and production (in comparison with inland fisheries)

The recent total fishery production in Kenya peaked in 2014, declined and bottomed through 2017, and has been increasing since then (Fig. 8). The inland fisheries production was by far larger, accounting for 90% of the total production until 2014, but in recent years it has been about 80%. Although the fishery resources on the inland water are overutilized, the marine fishery resources (especially in offshore waters) are said to be still under-utilized due to underdeveloped small-scale fisheries.



Figure 8. Changes in Fishery Production
in Kenya
(Source: KeFS, 2022)

(2) Status fisheries in each county

Article 69 of the Constitution of Kenya (2010) obligates the nation to achieve sustainable development, use, management and conservation of the natural resources and their environment, including the ocean, and equitable sharing of benefits through public participation. Chapter 4, Parts 1 and 2 of the same Act, which set out administrative devolution, provides for the co-sharing and devolution of these natural resources between the national and county governments, thus allowing each of 47 counties to use, manage and protect the fishery resources in cooperation with national administrative agencies.

Specifically, each county prepares a County Integrated Development Plan (CIDP) in line with the national medium-term development plan through a process involving residents and private sector operators (Public Finance Management Act. 2012), and submits it to Ministry of Finance (MF) with priorities set. In regards to fisheries project development and implementation, SDBEF of Ministry of Mining, Blue Economy and Maritime Affairs formulates fisheries policies, each county prepares fisheries development projects in accordance with the policies and applies them as a part of CIDP to Ministry of Finance. And SDBEF scrutinizes the projects, the Ministry of Finance approves the budget for the project, and the county implements the projects that are approved.

During the First Site Work period, the consultant team visited and interviewed with the directors of Fisheries Departments in three coastal counties (Kwale, Kilifi, and Mombasa) and several BMUs in each county (Table 6).

Table 6. Fisheries Departments and BMU of Coastal Counties visited during the First Site Work period

Organizations visited	County	Main area of interest for the visit
Kilifi County Fisheries Department	Kilifi	County fisheries situation
Takaungu BMU	Kilifi	Previous pilot-project (FRP vessel donation)
Watamu BMU	Kilifi	BMU activities
Mtwapa BMU	Kilifi	Inspection of semi-industrial fishing boats
Kwale County Fisheries Department	Kwale	County fisheries situation
Gazi BMU	Kwale	Previous pilot-project (Dagaa processing)
Kibuyuni BMU	Kwale	Previous pilot-project (Seaweed farming)
Mombasa County Fisheries Department	Mombasa	Local fisheries situation
Mombasa Old town BMU	Mombasa	Mombasa fish market, offshore fishing activity

The fisheries catch of five coastal counties (Lamu, Tana River, Kilifi, Mombasa and Kwale) are shown in Fig. 9. Kilifi county accounts for 51% of the total catch and the largest catch (12,211 tons/year). Kwale (5,011 tons/year) and Lamu (4,666 tons/year) are the next two highest counties, and these three counties produce 90% (21,888 tons) of the total catch, making them the centres of the Kenyan marine fisheries. Fig. 9 also shows the numbers of county fisheries officers and KeFS officers working in the counties.

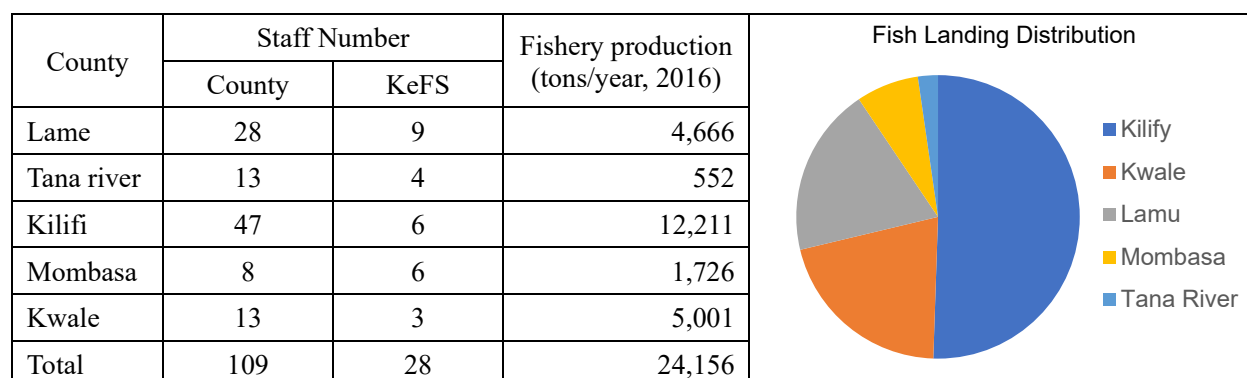


Figure 9. Marine Fishery Catch of Five Coastal Counties in Kenya

Source: Fishery catch (SDBEF 2016)
Number of Fisheries officials (This study)

(3) Kenyan Marine Zones

In addition to Exclusive Economic Zone (EEZ) of 142,400km², Kenya claims ownership of the extended continental shelf 103,320km², for a combined total of 245,720km² (Fig. 10). This is an area equivalent to 42% of the national land of 580,000km², and the scale of the development potential for marine fisheries products, marine trade, and undersea mineral resources that lie underneath this area is enormous, and much of this potential has not been used for the benefit of the people. Therefore, the public has great expectations for Blue Economy Policy, which is regarded as the next-generation development frontiers for the country.

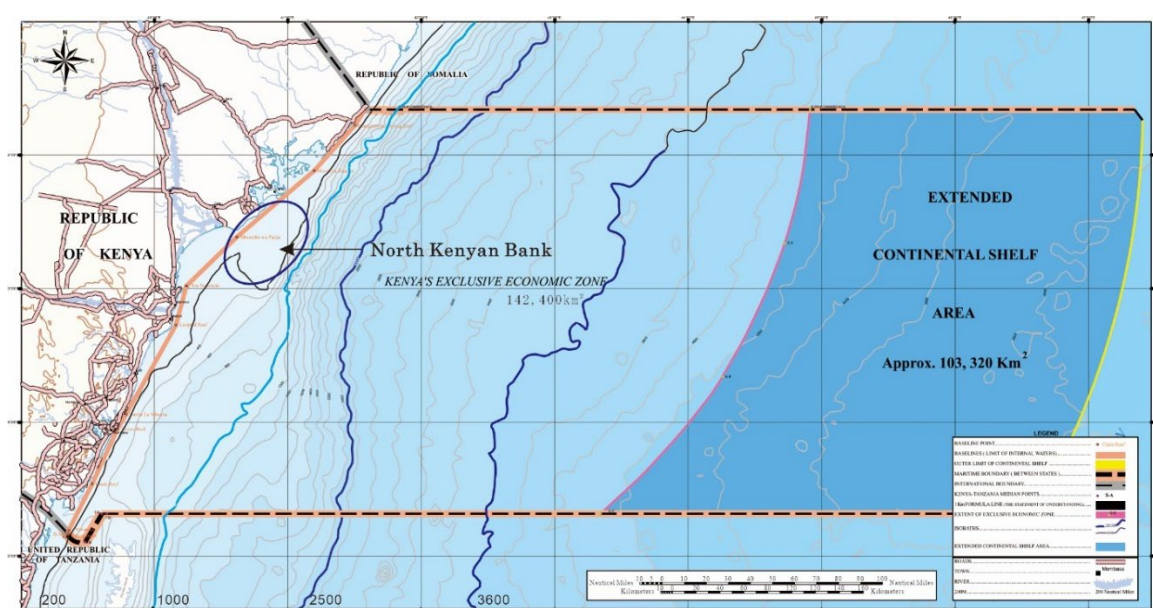


Figure 10. Kenya's Exclusive Economic Zone (including Extended Continental Shelf Area)

Source: Survey of Kenya, 2009

(4) Climate and Condition of Kenyan Marine Water

The climate and sea conditions along the Kenyan coast are greatly influenced by seasonal winds. In West Indian Ocean, the surface water (to the depth 100m level) forms clockwise circulations of South Equatorial Current (SEC) and South Equatorial Counter Current (SECC) (Fig. 11) (KMFRI, 2018). The East African Coastal Current (EACC), connecting the two currents in West Indian Ocean (SEC and SECC), is constantly flowing northward along the Kenyan coast. During the northeast monsoon (NEM) season from October to April ("Kaskazi" in Swahili), when a northeastern wind is prevailing against the current, the current slows down and the sea conditions are moderate. When EACC meets Somalia Current (SC) flowing southward along the coast of Somalia, they merge each other and flow eastward as SECC. In the sea area where this surface SECC flows away from the continental shelf area (called 'North Kenya Bank: NKB'), upwelling occurs as deep water is dragged up to fill the void in the seawater. In NKB, the shallow continental shelf extends from the coast to the offshore area (as shown by the 200m bathymetric contour line in Fig. 10), which causes deep water to rise to the surface layer along the seafloor profile. Between May and September ("Kusi" in Swahili), the southeastern monsoon (SEM), which is the tailwind for EACC, prevails and the current speed exceeds 2m/sec and goes northward beyond NKB, and join SC to start moving northward in the reverse direction of NEM season. Since the SC's transportation energy enhanced by the SEM is greater, although the eastward flow does not occur over NKB area, the volume of seawater from the deeper layers rushing up along the seafloor profile at the NKB is greater during this period, which functions similar to upwelling.

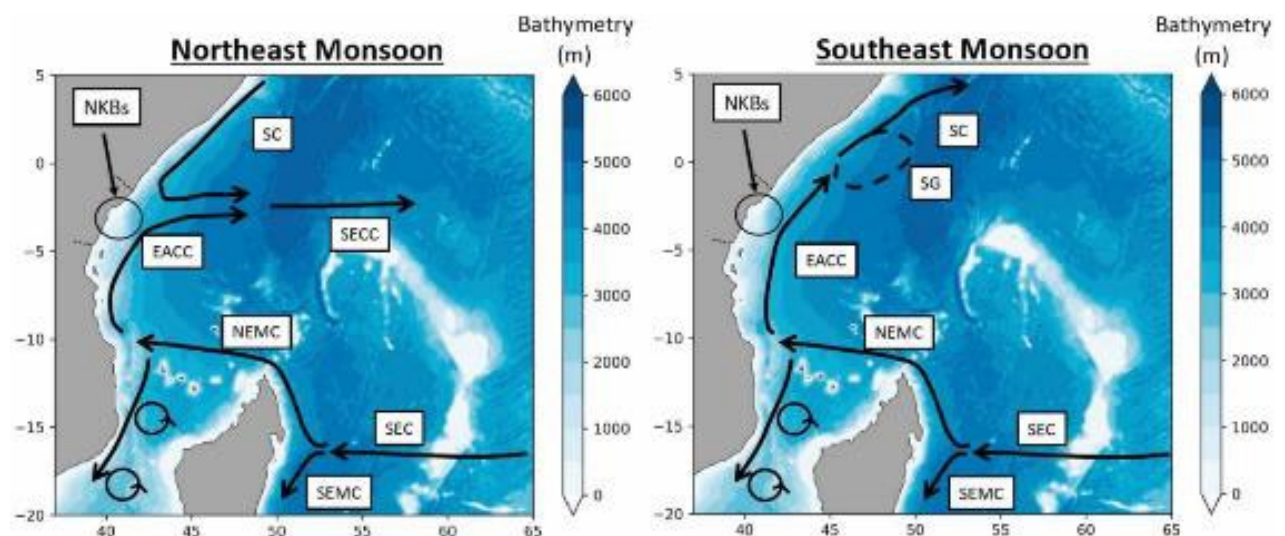


Figure 11. Current Situation in the Northeast and Southeast Monsoon Seasons in the West Indian Ocean

SEC: South Equatorial Current, SECC: East African Coastal Current, SECC: South Equatorial Reverse Current, NEMC: North East Madagascar Current, SEMC: South East Madagascar Current, SC: Somalia Current, SG: Southern Gyre, NKBs: North Kenya Bank

Source: Kamau, et al. 2021

The upwelling brings abundant minerals and nutrient salts in the deep layer to the surface, enhances the primary productivity of the seawater through photosynthesis with solar energy, and forms rich fishing grounds. In fact, in the West Indian Ocean, about 20% of the global tuna like fishes (yellowfins, bigeye, marlins, etc.) are captured, and it is estimated that there is an annual catch potential of 150,000 to 300,000

tons in the Kenyan EEZ (KMFRI, 2018). However, Kenya's marine fisheries suffer from a variety of problems (as discussed below), and have only been able to land a fraction of this potential production.

(5) Catch in Marine Fisheries

In recent years, Kenyan marine fishery production (FAO statics) remained below 10,000 tons until 2014, but it has suddenly risen to about 25,000 tons since then (Fig. 12, left). However, the fish catch did not suddenly increase, but this happened due to a change in the statistical treatment of catch (KMFRI, 2018). A new method based on Catch Per Unit Effort (CPUE) and estimated number of fishermen increased 2.5 times the volume previously reported to FAO (Fig. 12, right-hand, Manach et al. 2015). According to the KMFRI report (2018), many of the fishing vessels from the foreign nations (Distant Water Fishing Nation: DWFN) operating in the Kenyan EEZ are underreporting, and if Monitoring Control and Surveillance (MCS) is strengthened, it is predicted that the statistically calculated catch will increase further. Fish catch statistics are the basic data for the fishery development planning, and since all the plans are affected, the improvement is an urgent issue which is a premise for the Blue Economy development.

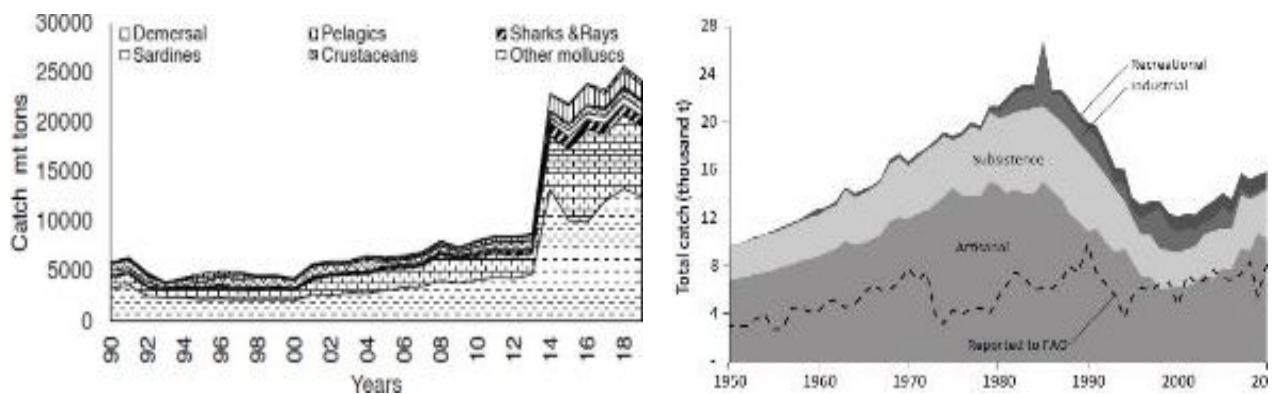


Figure 12. Trends in Kenyan Marine Fishery Production based on FAO Fishery Catch Statistics (left, Nijru et al. 2021) and Recalculated Fishery production (right, La Manach et al. 2015)

Even the recalculated marine fishery production of 25,000 tons/year is only about one-tenth of the 150,000 to 300,000 tons/year that can be sustainably caught in EEZ, and it is reasonable to actively strengthen fishing capacity by modernizing the fishery while keeping resources condition in mind. The following can be inferred from an examination of annual catch of small-scale fisheries and industrial fisheries during NEM and SEM seasons when the sea conditions are mild and stormy, respectively. The catch of small fisheries with poor navigation capacity is higher in NEM season than in SEM season (Fig. 13, left). However, according to the catch efficiency data of the long-line fishery with high navigational capacity, the Catch Per Unit Effort (CPUE) is higher in April to May (SEM season) when sea conditions are rougher than in October to December (NEM season) when the sea conditions are milder (Fig. 13, right). Although it is somewhat problematic to directly compare small scale fisheries and industrial fisheries, it can be seen that if a fishing boat with higher navigation capability can go out to reach the offshore sea area even in SEM season, more fishing catch could be possible than in NEM season.

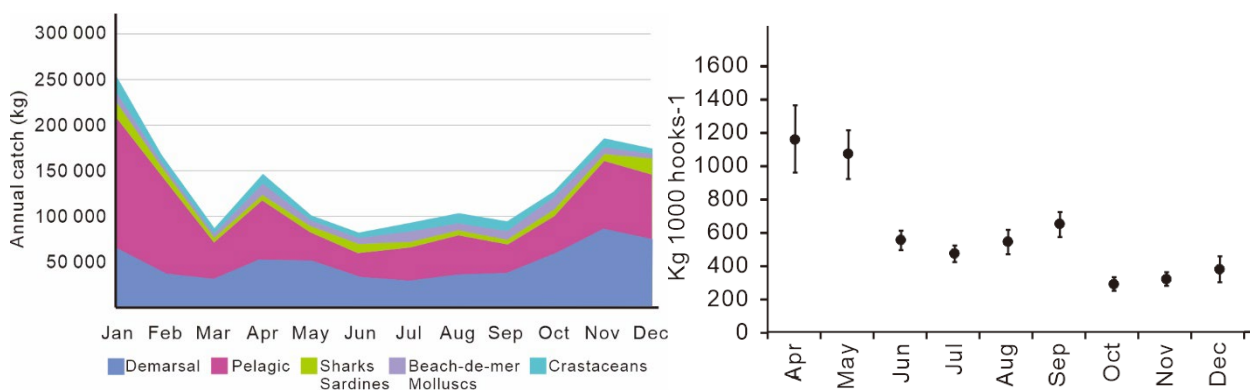


Figure 13. Changes in the annual catch of Kilifi County in 2021 (left), and changes in the catch rate (kg/1000 hooks) of long-line fish boats operated in the Kenyan EEZ (right)

Source: Obtained from Kilifi County in this survey(left), KMFRI 2018 (right)

Kenyan marine fisheries are divided into small-scale fisheries (10m and below), semi-industrial fisheries (10~20m) and industrial fisheries (20m and more) according to the size (length) of the fishing vessels used. Eighty percent (80%) of the total marine fishery catch, which is estimated to be about 25,000 tons, is produced by small-scale fisheries, and the remaining 20% is produced by semi-industrial and industrial fisheries. Since there are 197 landing sites over the entire 640km of the Kenyan coastline (Fig. 14), it averages one site per 1.7km and is extremely dense. The density is even higher in Lamu, Kilifi, and Kwale counties, as the majority of landing sites are located in these three counties.

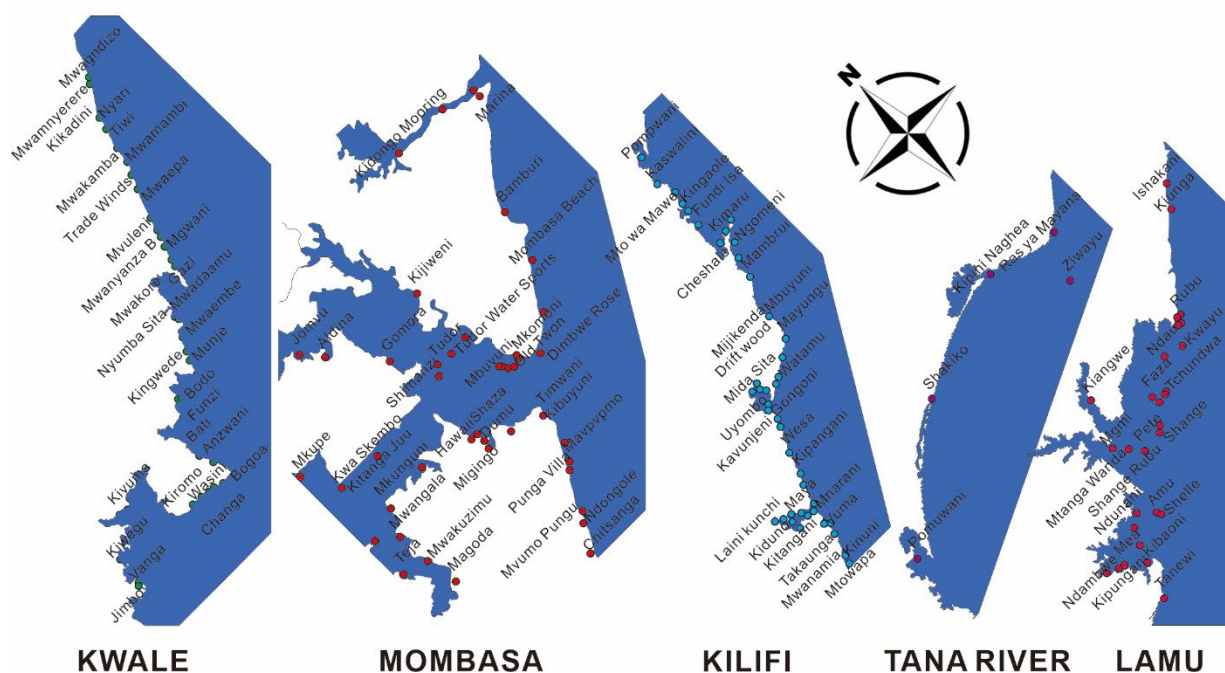


Figure 14. Kenyan Coastal Landing Sites

Source: KMFRI, 2018

The Fisheries Ordinance (Beach Management Units, Cap.378, enacted in 2007 and revised by FMDA 2016) stipulates that the Government (national and county) should establish a BMU at each landing site to promote the management and enhancement of landing sites, fishery resources, aquatic environment, to

promote the sustainable development of fisheries, to improve the quality of fishery products, and to prevent and reduce fishery conflicts. Therefore, the Kenyan fisheries administration is enforced through BMUs, but only 84 BMU are established in five coastal counties, which are less than half of the total number of landing sites, and there are many landing sites that are out of reach of management or supervision by government. This is a factor that leads to unreliability of the fish catch data and inadequate IUU control. According to the fishery officers interviewed in Kwale County, in order to avoid the fishing levy (KES5/kg) set by the county, fishermen generally tend to underreport their catch, which is a reason for the statistical catch being lower than the actual catch.

(6) Artisanal Fisheries

According to the 2016 Fisheries Annual Bulletin (SDFBE, 2016), 13,413 people are employed in Kenya's small-scale fisheries, 17% of whom are fishermen who do not own any fishing vessels but are engaged in gathering seafood products from the coast. There are 3,000 registered fishing vessels, 73.4% of which are small canoes (average 4 m long), 22.1% are wooden vessels (average 7.5 m) and 3.1% are FRP fishing vessels (average 7.5 m long) (Fig. 15). However, from what the consultant team observed at the landing sites of Kwale Mombasa and Kilifi countries, the team had an impression that the numbers of FRP boats and outboard engines had increased since the time the above statistics were collected.

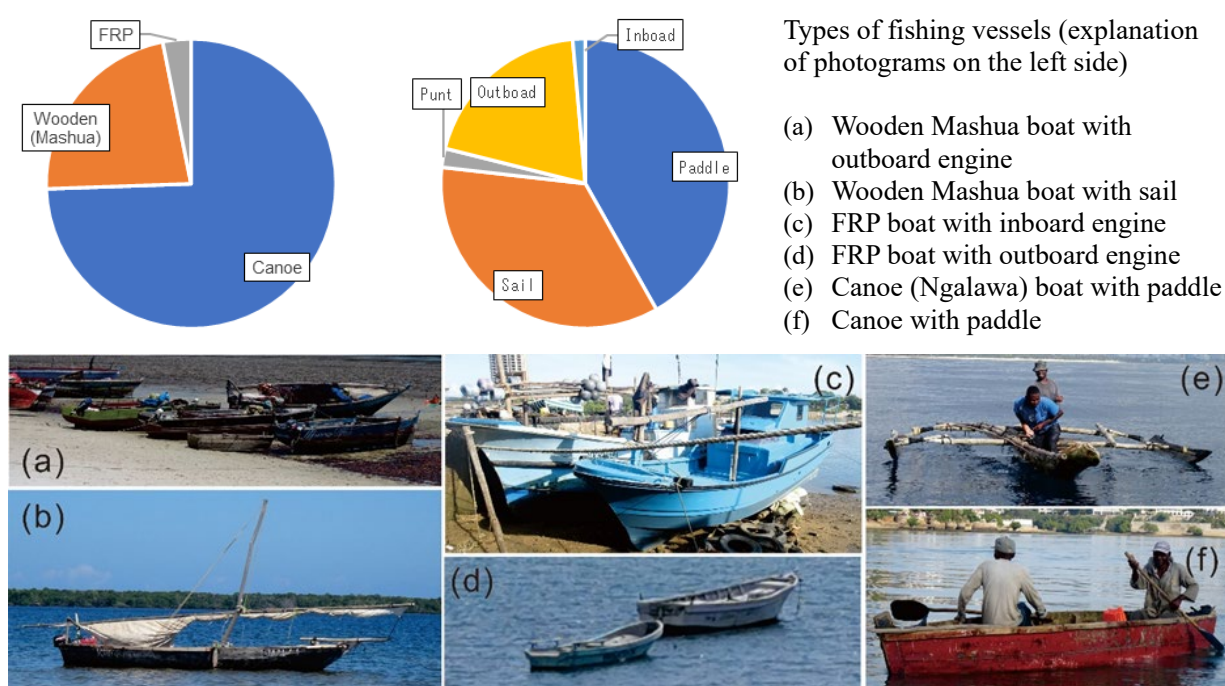


Figure 15. Distribution of fishing boat types on the Kenyan coast (upper left pie chart), distribution of fishing boat driving force (upper middle pie chart), and fishing boat observed during the First Site Work Period (lower photographs with upper left explanation)

Source: The graphs are prepared from SDBEF 2016

Fringe Reefs exist within several kilometers from the Kenyan coastal shoreline (particularly in the three southern counties) and serve as natural breakwaters (Fig. 16 left). Inside the reef are shallow sandy beaches ranging below 1.5, to approximately 25m depth. Seagrass beds and mangrove forests extend along the coast

(particularly in Lamu and Tana River Counties). A series of white sand beaches and sand dunes formed by weathered corals make the beach an important tourist resource. The sea area where the complex ecosystem of reef and rock is formed becomes the home fishing ground of the artisanal fishery.

The water rapidly deepens from the edge of the reef, reaching a depth of 1000m at a distance of 50 - 100km from the coast, and the outer edge of EEZ (200 nautical miles =370km) is closer to the 4000m isobath. Artisanal fisheries are supposed to be able to operate in the sea area of 15 nautical miles (27km) from the shore without competing with industrial fishing vessels, but because the reef is formed very close to the shore, and the outer reef faces the Indian Ocean, where the wave condition is much worse than on the inside, in reality, it is not easy for many artisanal fishermen with small boats to operate fishing outside the reef. Furthermore, the isobath at a depth of 200m, which is considered the outer edge of the continental shelf, is also just 10 - 20km away from the shore, and there are no demersal fishes that are the main targets of the artisanal fishery in the outer reef area because of the depth. Therefore, many artisanal fishermen who own small fishing boats of 4 - 5m in average length are only engaged in fishing in the waters very close to the coast (see Fig. 16 right: the seafloor cross section from Kilifi to the outer edge of EEZ (between A-B) at right angles to the shore). Assuming that the width of the real fishing area is within 4 -5 km from the shoreline and total coastline length is 640km, 3000 fishing vessels and 13,400 fishermen are crowded in a narrow coastal strip of around 3000km² (= 640km x 4 - 5km), harvesting 80% of the total catch of the Kenyan marine fisheries, and struggling to sustain their livelihoods. In the southeastern monsoon season (Kusi) when the sea is rough, even fishing inside the reef becomes difficult, and because good fishing grounds are concentrated in certain areas such as North Kenya Bank where the continental shelf is exceptionally extended or in the Kilifi and Kwale Counties where the reef & rock ecosystems are well developed, there are even severer resources constraints in certain seasons and in certain locations where artisanal fishermen are facing.

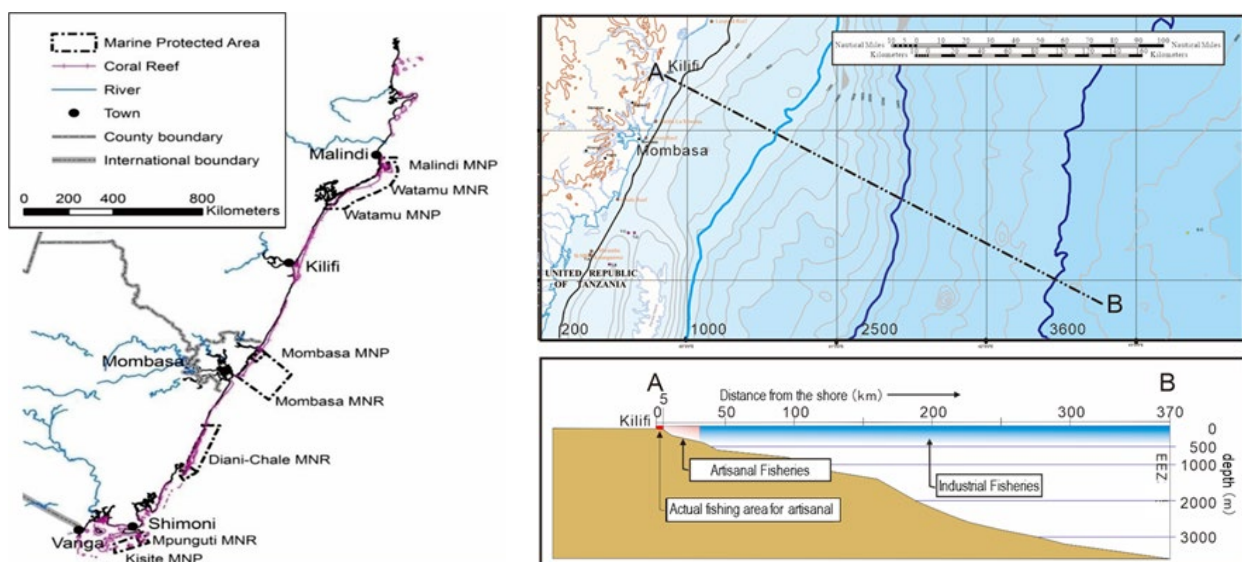


Figure 16. Southern coast of Kenya showing location of coral reef (left, Source: NEMA, 2017) and the seafloor cross section showing actual operating area of artisanal fisheries (right)

Artisanal fishing typically targets rabbitfish and wrasse species living over shallow sandy beaches and seagrass beds within the reef, or small and medium-sized demersal fishes (such as seabreams) living in reef & rock zones. The fishing methods used include gill nets, handlines, small-scale trawling, small-scale purse seine (ring net), speargun, and longline (Fig. 17). Note that monofilament nets are prohibited and therefore are classified in a separate category from standard gill nets made of multifilament twine material. Basket fishing which was often seen in this survey is classified in the other category.

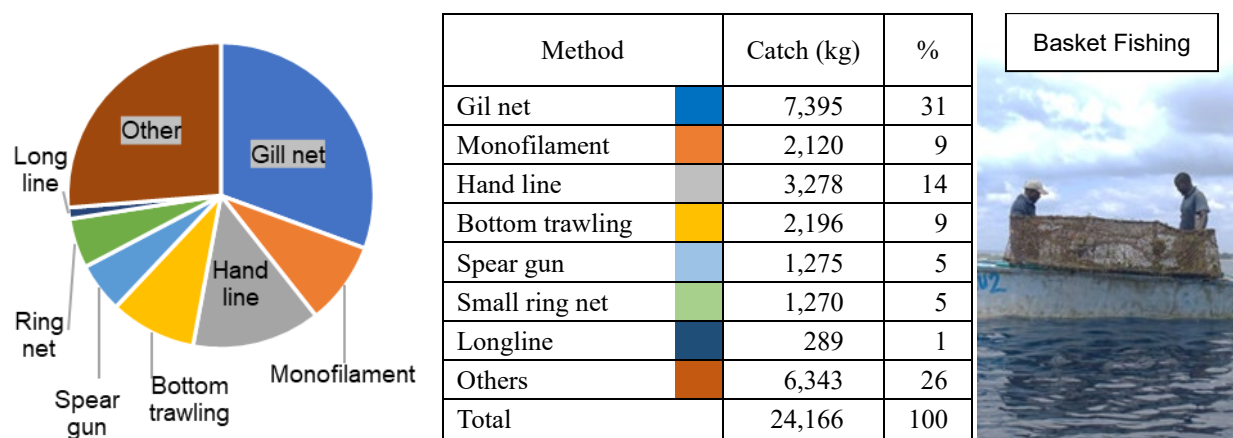


Figure 17. Fishing methods for artisanal fisheries (2016) in Kenya

Source: Prepared from SDBEF, 2016

(7) State of resources of fishery target species

The Status of Kenya Fisheries (KMFRI, 2018) summarizes the resource status of the main fish caught in the Kenyan marine fishing grounds (Table 7). As is assumed from the above explanation that the very high density of artisanal fishermen in the nearshore waters, the signs of overfishing such as reduction of catch, declining fish size, and reduction in species diversity have been observed in surveys over the years for small reef fishes (e.g., rabbitfish *Siganus sutor*, parrotfish *Leptoscarus*, and emperor fish *Lethrinus lentjan*) caught by handline fishing and basket fishing in the reef ecosystems.

Table 7. Resource Status of Major Target Species in Kenya Marine Fisheries

Target fish group	Indicator species	Resources status	Remark's
Small-scale reef fin fish fisheries	<i>Siganus sutor</i> , <i>Leptoscarus vaigiensis</i> , <i>Lethrinus lentjan</i>	Overfishing	Declining yield, declining sizes, declining species
Tuna and large pelagic species	<i>Katsuwonis pelamis</i> , <i>Thunnus albacares</i> , <i>Euthynnus affinis</i> , <i>Thunnus obesus</i> , <i>Xiphias gladius</i> , <i>Tetrapturus audax</i>	Skipjack is overfished and other species within MSY	There is a large variation in catches across years, status unknown for most species
Shallow water prawn	<i>Penaeus indicus</i> , <i>P. monodon</i> , <i>P. semisulcatus</i> , <i>Metapenaeus monoceros</i>	Unknown	Other environmental factors may impact the fishery
Shallow water lobster	<i>Panulirus ornatus</i> , <i>P. longipes</i> , <i>P. versicolor</i> , <i>P. Homarus</i> , <i>P. penicillatus</i>	Optimally exploited	Reservoir stock may exist in deeper reefs
Small and medium pelagics	<i>Rastrelliger kanagurta</i> , <i>Sphyrnaena flavicauda</i> , <i>S. jello</i> , <i>S. obtusata</i> , <i>Hemiramphus far</i>	Overfishing	Large temporal and special variations occur.

Target fish group	Indicator species	Resources status	Remark's
Mangrove crab	<i>Scylla serrata</i>	Optimally exploited	
Marine aquarium	<i>Amphiprion allardi</i> , <i>A. akallopisos</i> , <i>Pomacanthus imperator</i> , <i>P. chrysurus</i> , <i>P. maculosus</i>	Overfishing of some species	Evidence of over exploitation of some species, high special variations influenced by recruitment patterns
Sea cucumber	<i>Holothuria scabra</i> , <i>H. nobilis</i> , <i>H. fuscogilva</i>	Overfishing	Needs regulations to recover
Octopus	<i>Octopus cyanea</i>	Optimally exploited	More active fishing in the south coast (Vanga and Shimoni)

Source: KMFRI, 2018

Small and medium-sized pelagic fish in shallow waters (such as mackerel *Rastrelliger*, barracudas *Sphyraena flavicauda*, *S. jello* and halfbeak *Hemiramphus far*) are also the main objects of fishing by artisanal fishermen with hand line and gill net, and are judged to be overfished, although there are large differences depending on the fishing season. On the other hand, large-sized pelagic fishes that migrate offshore in coast waters, the main target species of long line fishing, which are not widely caught and accounting only about 1% of the total catch by artisanal fisheries, are evaluated to have still sufficient resources with the exception of skipjack. Since these large fish (e.g., yellowfin *Thunnus albacares*, swordfish *Xiphias gladius* and marlin *Terapturus audax*) are marketed at high price, the long line fishing is a highly efficient method that can generate high profit even with small catches, but it is difficult to reach the offshore fishing grounds with the small fishing boats currently used by artisanal fishermen.

Based on these resource conditions and the above discussions, the following two directions are considered as basic strategies for the promotion of Kenya's artisanal marine fisheries.

- 1) Regulatory fisheries management: Reduce fishing pressures in high-pressure coastal waters by regulating fisheries with implementations of MCS and of IUU fishing control, establishment of marine protected areas (Marine Park and Marine Reserve), and joint fisheries management of BMU and governmental fisheries agency (Co-management), etc.
- 2) Expansion into offshore fisheries: Improve the ability of fishing vessels to go offshore outside of the reef and catch fish species that are in surplus in terms of resources by introducing appropriate fishing method.

(8) Shift from artisanal fisheries to semi-industrial fisheries

Of the above two directions, the first direction (1) is a coping strategy to avoid further deterioration of the resource conditions by lowering the fishing pressure in the narrow fishing area 5km from the shoreline, where fishing pressure is already excessive, and where most of the frontline fisheries officers are already engaged in their daily work. This is an urgent countermeasure, but it is logically difficult to increase total fishery production by this kind of regulatory control of fishing activities.

The second direction (2) is an attempt to harness unused fishery resources by improving the capacity of fishing boats and introducing appropriate fishing techniques, and it is a fundamental solution which can lead to the increase in total fisheries production. To this end, it is necessary to change the main types of

fishing vessels currently used in the artisanal fishing in Kenya from small wooden boats (canoes, average 4m length) to Mashua-type large wooden boats and semi-industrial FRP boats (above 10m length). Among the main fishing methods (Fig. 18) used in artisanal fisheries, small-scale ring net and longline fishing methods are attracting attention, and the government is promoting proper dissemination of these methods.

The fishing boat (Fig. 18, Mashua) used for small-scale ring net fishing in Gazi beach, Kwale County, has a 10m length and is mainly powered by an outboard motor of 40HP, but it can also set sail and use the wind as an auxiliary propulsion. A crew of the fishing boat informed that it was built at a cost of KES 1 million at Gazi beach by carpenters from Pemba, Zanzibar, with the material timbers brought from these. The boat requires maintenance and repair every six months after the construction. Although the consultant team was unable to visit the North Kenya Bank in Lamu County, longline fishing is conducted on a traditional sailboat-type Mashua. We believe that these locally practiced ring net and long line fishing methods can be promoted by transferring the technologies to other areas.



Figure 18. Large Wooden Fishing Vessel (Mashua) for Ring Net Observed at Gazi beach, Kwale County

Large-sized wooden boats used for ringnet fishing are semi-industrial boats and are included in commercial fisheries, and they need to operate in sea areas farther than 27km (15 nautical miles) of the coast. However, in practice, they often operate in shallow waters of less than 20m closer to shore in competition with artisanal fisheries, as observed in the Gazi beach. Since the net reaches the seabed and dragged, it has been shown that the seabed is damaged and demersal and immature fish are caught (Bett, 2018). For addressing these issues, Small-scale Purse Seine (Ring net) Fishing Management Plan was created in 2015 but has not been approved by the time of First Site Work period. The plan is intended for large migratory fish (tunas, swordfish, etc.) that have long life spans and tend to have a large impact on the resource status due to fishing. Smaller migratory fish (sardines, mackerels, etc.) that have a short life and whose catch unlikely affects the resources condition are not included.

A port with a depth of at least a few meters is required for semi-industrial fishing boats to berth, and an appropriately designed fishing port would need to be built instead of the usual sandy beach landing sites where artisanal fishermen park their boats. At present, KPA is planning to develop seven small-scale fishing ports in five coastal counties, and as mentioned earlier, the first of which has been under construction at Shimoni in Kwale County and expected to be completed in 2025. Refrigeration and ice making facilities are provided in these fishing ports, and a fish auction market is also planned to be established.

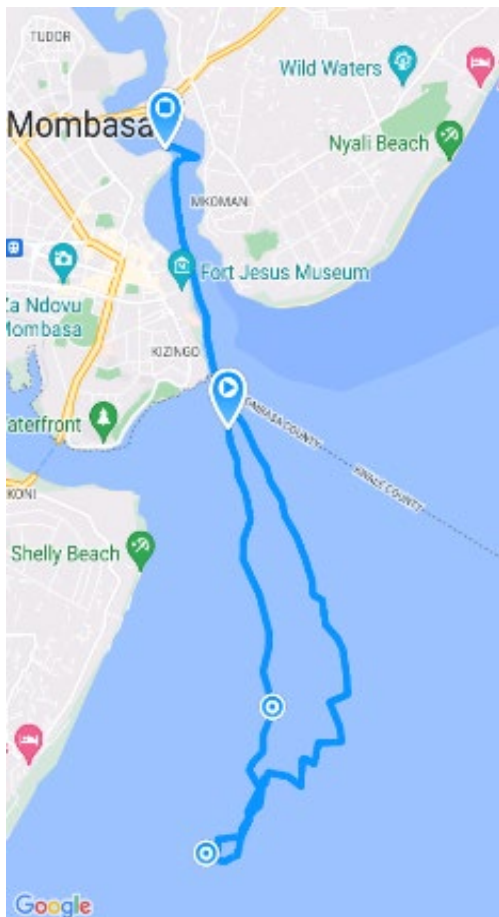


Figure 19. Trail of small-scale fishing boat owned by a Mombasa Old Port BMU member that the consultant boarded with.

However, it is not easy for artisanal fishermen with only small-scale fishing boats to follow the government's policy of fishing in the open sea. Even for the current fishing grounds within the reef, there are many days when their small fish boats cannot go out and fish during the Kusi southeastern monsoon season when the sea conditions are rough. It is even more difficult to fish outside the reef. In addition, a fishing boat license is required to operate a semi-industrial boat for going to the open sea. In BMU of Watamu, Kilifi County, 200 members and 120 fishing vessels were registered, and only four of them had a license to operate their boats of the smallest category. Strictly speaking, more than 95% of them are illegal fishermen who operate fishing boats without license. Taking the basic STCW and Coxswain level III courses required for operating their fishing boats at the Bandari Maritime Academy costs KES135,000 which is out of reach for them with a very low-income level. In the coastal waters where they operate, there is serious concern about the collapse of the resources and they are under regulatory control by county fishery officials, KeFS, KCGS, KWS, etc., and could be arrested at any time. Therefore, they requested supporting the acquisition of these licenses at the time of the interview in this survey.

They know that large fish with high prices can be taken off the coast, and they also know that offshore fishing is recommended by the government due to the lower fishing pressures on the resources there. Therefore, interviews with fishermen indicated that they were fishing off the coast of 10 to 40 miles. But when a consultant went on a small fishing boat to their fishing grounds during the First Site Work period, the fishing boat was actually traveling along the coastline, and the distance from the shore to the fishing grounds remained within two to three miles (Fig. 19).

It is unrealistic for the artisanal fishermen with their small financial resources to purchase semi-industrial fishing vessels that can safely be operated in the open sea. Artisanal fishermen themselves cannot become owners of semi-industrial fishing vessels unless some financial measures such as their BMU provide credits to support funding for them. The government's policy for increasing the number of semi-industrial fishing boats is to engage Public Private Partnership (PPP) arrangement. The idea is to have private enterprises and individuals interested in the promotion of fisheries acquire fishing boats through preferential tax treatment and financial support, and the private sector owners employ BMU members as the crew members to carry out semi-industrial fisheries. If semi-industrial fishing boats will land fish in the developed ports, the people responsible for their sales (brokers) become important players in the marketing of the catch, and will be a potential user of the government support measures of the PPP arrangement mentioned above, as well as realistic candidates to own semi-industrial fishing boats.

The government measures for the promotion of offshore fisheries consist of 1) the improvement of fishing capacity (PPP and financial support, the introduction of ring nets and longline fishing methods, and 2) the development of local fishing ports (seven locations in five coastal counties and strengthening of distribution through refrigeration and ice-making facilities) in order to convert artisanal fisheries to semi-industrial fisheries so that untapped resources outside the reef can be explored (Fig. 20).

In accordance with the policy, the government has granted semi-industrial boats to BMUs of three coastal counties (Lamu, Kilifi, and Kwale counties) (KFIC, 2021). The survey team had an

opportunity to see the vessels provided to Mtwapa BMU of Kilifi County (located at the Mombasa-Kilifi County border) (Fig. 21a & b). Unfortunately, BMU received it had no technical expertise in the operation and fishing of this size of vessel, and could not go fishing even once, leaving it anchored for two years after the granting. The representatives from SDBEF Mombasa Branch proposed to the survey team that this vessel be used as a training material to learn appropriate fishing methods. Since fishing vessels of this size are often seen in Japanese coastal fisheries, it was conceivable to introduce the current situation during the training by connecting Japan through a web link, and to discuss directly between the trainees (KeFS officials assigned to rural areas and county fishery officers) and Japanese fishery cooperative staffs, etc. In fact, there are a number of used Japanese FRP fishing boats observed at Old Town BMU in Mombasa (Fig. 21 c), and it was thought that exchanges of opinions on the operation, use, and maintenance between Kenya and Japan would be a valuable opportunity for the trainees.

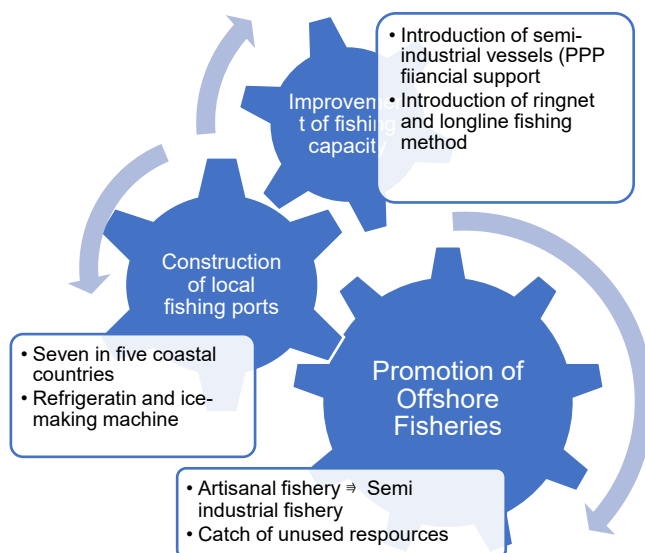


Figure 20. Government's Offshore Fishery Promotion Policy



Figure 21. Semi-industrial vessel (a, b) granted to Mtwapa BMU, Kilifi County and used Japanese-style FRP fishing boat observed at a landing site of Old Town BMU in Mombasa (c)

(9) Promotion of Distant Water Fisheries

The West Indian Ocean is a good fishing ground where 20% of the global tuna are caught, and 20% of it is taken in the Kenyan EEZ (KMFRI, 2018). However, since there was no port on the Kenyan coast where

large industrial fishing vessels of the distant ocean fishery could berth and process the catch, the country could only earn revenue from the issuance of fishing licenses obtained from foreign fishing vessels. The fish processing complex at the Liwatoni Fishing Port in Mombasa, which is currently in progress for the construction and establishment, aims to change this situation. Although the processing facility has not been completed yet, the port already has the capacity to berth large distant ocean fishing vessels (Fig. 22).



Figure 22. Large industrial fishing boats anchoring at piers of Liwatoni Fisheries Processing Complex

There are 48 industrial fishing boats registered in Kenya (many of which are joint ventures with China or South Korea, and only 10 vessels are purely Kenyan owned based on the interview with Kenya Maritime Authority), but less than 10,000 tons of the catch (2016) was actually landed in Kenya.

Fishing vessels operating in the Kenyan EEZ supposed to be required to land at least 30% of their catches to Kenyan fishing ports (FMDA 2016). However, today's large industrial vessels are capable of not only catching fishes but also processing catches on board, so in other words. In many cases, they are often transshipping the processed catches to carrier vessels on the sea, and it is said that the catches are significantly under-reported compared to the actual catch hauled in. Although KeFS has strengthened its Monitoring, Control and Surveillance (MCS) system in collaboration with KCGS, it currently owns only one surveillance vessel (MV Doria) and has insufficient human resources developed. For example, Kenya has contracted with a French company (Collecte Localisation Satellites) for a satellite-based Vessels Monitoring System (VMS), but the monitoring was suspended for eight months in 2021 due to nonpayment of contract fees (Nation, 2021).

The plan for marine product processing facilities at Liwatoni Fishing Port is not limited to increasing the landing from foreign fishing vessels licensed for fishery in Kenyan EEZ by strengthening MCS and control of IUU fisheries. In the future, by increasing the number of Kenyan-registered fishing vessels through

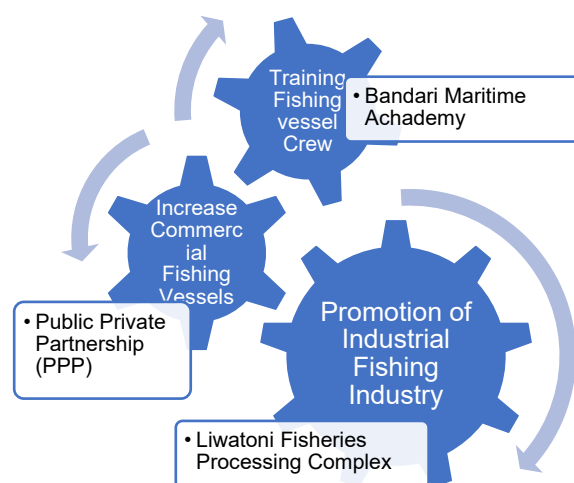


Figure 23. Kenyan Industrial Fisheries Promotion Initiative

engagement of public private partnerships and replacing foreign fishing vessels, the plan aims to promote industrial fisheries by domestic fishing fleets (Fig. 23). As the human resources development necessary to achieve this plan, the training course for fishing boat crews was started by the Bandari Maritime Academy. In reality, the program has only just begun, and the target of graduating 1000 fishing boat crews per year has not been achieved due to the lack of quality instructors and facilities.

The Craft Certificates and Degree curriculums for seafarer training and maritime transportation logistics developed by Kenya Maritime Authority is an internationally accredited program. Kenya, which has the two major ports in East Africa at Mombasa and Lamu as the main maritime hubs for Northern Corridor and LAPSSET Corridor, respectively, has a long-term maritime Blue Economy vision of becoming a major supplier of merchant mariners in Africa, aiming to be like the Philippines, which supplies 25% (460,000) of the world's merchant mariners, along with a view to promote international trade in the East African region. The distant water fisheries development plan also plays a role in this long-term vision of a maritime Blue Economy.

(10) Marine Aquaculture

In order to reduce the fishing pressure in coastal waters where artisanal fisheries are in operation, KeFS and county fisheries department are implementing regulatory controls through BMUs, such as MCS enhancement and IUU fishery crackdown. Another way to reduce the fishing pressure on the same aquatic resource is to provide fishers with new alternative livelihoods. In particular, offering young people in fishing villages employment in industries other than local fishing is an effective way to do this in the long run. The vocational training projects funded by GIZ, a component of the EU-supported Go Blue project, have been successful in providing job placement and reskilling education in the fields of tourism, marine transportation, ship repair, and maritime security, as well as supporting SME start-up, in cooperation with all coastal counties.

The promotion of marine aquaculture is one of the measures which, like these projects, leads to the reduction of fishing pressure from artisanal fisheries by developing an alternative industry and providing associated employment to the young people in the coastal area. Since fishermen are accustomed to handle fish and other marine products, the conversion to aquaculture provides a significant technical advantage to fishermen, allowing them to promote the new industry in the same location (coastal area), and can provide an ideal alternative livelihood source for artisanal fishermen. In fact, aquaculture is a viable alternative industry to fisheries, as approximately 50% of global fisheries production is now produced by aquaculture (FAO, 2022).

Kenya is the fourth largest aquaculture country on the African continent that produces about 20,000 tons a year, almost all of which comes from freshwater fish production (Fig. 24). Marine aquaculture has remained at an infant stage and has not reached the level of commercial exploitation. Since 80% of the production comes from the cultivation of Tilapia, which differs greatly from marine fish in spawning habit and rearing

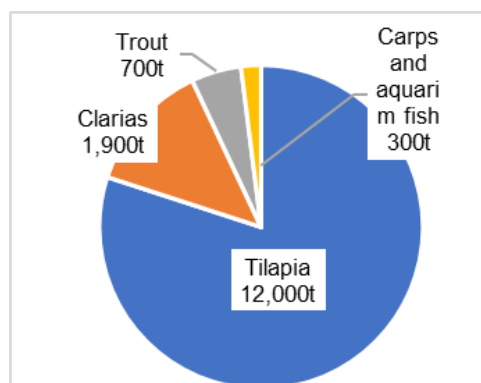


Figure 24. Aquaculture Production in Kenya.
Source: SDBEF 2016

environment, the technological accumulation has not been utilized for promotion of marine fish cultivation. The biggest issue of marine aquaculture promotion is recognized as the lack of seeds to start commercial scale farming, as such the completion of modern hatchery (NAMARET) under KEMFSED project in Shimoni, Kwale County is awaited.

There are milkfish (90%) and mullet (10%) as aquaculture of marine fish which are carried out by local communities using seeds collected from nature (KEMFSED, 2020). Mangrove crab, shrimp and artemia are also experimentally or on small-scale as community operations.

The beginning of the Kenyan milkfish culture dates back to the rearing of fish accidentally entered into the ponds in commercial shrimp aquaculture projects, including the FAO supported project, in Ngomeni, Kilifi County in the 1980s (Mirera, 2019). Shrimp aquaculture ponds were constructed in the mangrove swamps to take advantage of tidal fluctuations to allow the flow of seawater in and out of the ponds, and thus larvae of various aquatic animals including fish are introduced into the shrimp ponds. At that time, the ecological significance of mangroves was not well understood, and mangroves were felled in the global shrimp farming boom to construct many shrimp ponds. The aquaculture of shrimp in Kenya did not develop due to the outbreak of diseases and many shrimp ponds were abandoned. Since the turn of the century, since around 2000, various donors have focused their attention on milkfish farming projects aiming at environmental conservation of coastal wetlands centered on mangrove forests and improvement of livelihoods by cultivating milkfish as a practical demonstration of the Co-Management concept with coastal communities, and small-scale pond cultivation of milkfish by local communities began. Such community-based milkfish farming developed particularly with the World Bank supported Coastal Development Project in 2011-2017, during which the number of communities implementing milkfish farming increased from five in 2007 to 56 in 2015. During the same period, production also increased from almost zero to 3.5 tons/year. However, almost all communities were supported by some donors, and there was little incentive to expand the business in purely market economy terms, excluding benefits from environmental conservation (which were advocated strongly by the donors). As the result, the implementation areas did not expand to the surrounding areas. In addition, since the farming is carried out using natural seeds and seedlings, a large increase in the scale of operation is contradictory from the viewpoint of ecological conservation, which could affect the interest of the donors to wane.

Pond cultivation using mangrove wetlands poses a high risk of large-scale investment because of complexity of land property rights, which is a disincentive for the development of pond-based milkfish farming (Mirera, 2019). The intertidal zone is considered to be part of the ocean, so if mangroves are growing, they are under the control of Kenya Forest Service. Other authorities, including NEMA, the Ministry of Land Physical Planning, and State Department for Blue Economy and Fisheries, also claim authority over the same area. Collisions between coastal communities traditionally using mangrove and marine products and private developers engaged in tourism and housing development are also common.

Considering such environmental and land ownership issues, it is practically difficult to construct large aquaculture ponds in coastal wetlands nowadays. KMFRI aquaculture expert who is supervising the experimental aquaculture of milkfish with a community in Kwale county is currently paying technical attention to the introduction of cage culture systems into the sea waters. The stocking density in pond-based milkfish farming in Kenya is 1.5~3 /m², but cage culture (e.g., in the Philippine) can increase the density to

50-100 /m³, allowing for a significant increase in production outputs. Even after the construction of the NAMARET hatchery in Shimoni is completed, it will take a considerable period of time until the seeding production technology is mastered and the planned numbers of seeds and seedlings are actually produced. It is also meaningful to study and disseminate the grow-out techniques of cultivation using natural seeds in parallel while waiting for the NAMARET to start producing aquaculture seeds. The KMFRI expert said that he was working with the local community on a pilot project not far from the hatchery construction site. Until the time of the survey in the First Site Work Period 2022, they had been using fish cages made with metal and wooden frames, which are commonly used in the inland aquaculture of tilapia, and they have been facing frequent repair and maintenance problems due to damages affected by waves and currents of the sea. So, he was trying to introduce new type of cage frame made of high-density polyethylene (HDPE).

Use of circular HDEP aquaculture cages in milkfish farming and other marine species is popular in Southeast Asia. The adoption of the culture techniques practiced in Southeast Asia, where the cage culture production of fish is high and the economic feasibility is established, would be a shortcut to production expansion in Kenya. It is worthwhile to consider to include a session to introduce such technique in this training project.

In the farming of crustaceans, the survey team obtained an opportunity to observe the culture of mangrove crab carried out by Dabaso Creek Conservation Group (NGO) in Watamu, Kilifi County. The group, originally supported for the establishment by World Bank's Kenya Coastal Development Project (KCDP/WB) in 2011-17, runs an environmental conservation project offering visitors environmental education with fee while going around on a walking trail network built in the wetland of mangrove swamp. The NGO group is well known among travelers as a restaurant serving crab dishes called "Crab Shack". Young crabs of 250g size caught in the mangrove swamp were placed in plastic-made basket trays and fed with chopped small fish to grow to 500g. The farmed crab was only for supplying to the restaurant and is not sold externally. The number of baskets was 26, and each basket is divided in half and kept crab one by one to avoid cannibalism (Fig. 25). In KCDP/WB project, a tourist retreatant in Che Shale in the northern part of the county also were supported for the construction of hatchery of mangrove crab, but it had not produced crab seeds to date.



Figure 25. Cultivation of mangrove crabs by Dabaso Creek Conservation Group
in Watamu region of Kilifi County

- (a) Farming facility for mangrove crabs, (b) Crabs in the culture compartments,
(c) Wooden walkway in the mangrove forest.

Seaweed farming producing an estimated total of 1000 tons/year (raw weight) mainly by producers (communities) in Kwale County (Msuya, 2022) is the largest marine aquaculture sector in terms of wet weight in Kenya. Cultivated species are red algae species of *Eucheuma* ("Spinsum") and *Kappaphycus* ("Cottonii"), which are farmed by monoline method in which ropes planted with seed grass are stretched between short stakes piled in shallow water that ebb out at low tide (Fig. 26). Harvesting is continuously possible at 45-day intervals. Profitability was confirmed by KMFRI in the 1990s, and in 2010 the first commercial aquaculture began in Kibuyuni of Kwale County.



Figure 26. Monoline cultivation of seaweed aquaculture on the beach of Gazi, Kwale County

In African seaweed culture, the scale of production in the neighboring country of Tanzania, mainly in the Zanzibar and Pemba Island region, is by far the largest with 11,000 tons/year in wet weight (2018), which accounts for 92% of the total production in Africa. Kenyan aquaculture was also initiated by transplantation of seedlings from the same region located at the Kenya-Tanzania border area. The produced seaweed is also sold (unit price KES9~30/kg) to Aliba International Company in Zanzibar and C-Weed Corporation (Kenya) Limited whose parent company is Tanzania's largest seaweed purchaser. Seaweed aquaculture has many advantages such as low initial investment cost, low operational cost, simple cultivation technology, good accessibility by female operators, and high climate resilience by carbon dioxide absorption. The cultivated species naturally grow along the Kenyan coast (suggesting environmental suitability), and there is a high possibility of scaling up seaweed cultivation, especially in the southern part. It is a main target sector for Blue Economy in Kenya, but has not yet begun to spread on a full-scale. The low price is a drag on accelerating the diffusion of the farming, and marketing research, including export potential, is needed. In addition, it is generally experienced in Asian countries that mass mortality occurs due to outbreak of diseases (ice-ice disease) and epiphytism (attachment of other algae), and the countermeasures in advance are required.

2.2.3. Activities of Other Donors in Marine Blue Economy

Two main donors that support for the marine fisheries blue economy in Kenya are as follows.

(1) Kenya Marine Fisheries Socio-Economic Development (KEMFSED) Project/WB

KEMFSED Project is a large-scale Blue Economy project implemented with USD 100 million budgeted of the World Bank loan from 2020 to 2025 with the SDBEF as the main counterpart agency. The objective is to improve the management of priority fisheries and mariculture and increase access to complementary livelihood activities in coastal communities. The prioritized fisheries fields are snapper fisheries in North

Kenya Banks, small scale purse seine (ringnet), hand line and small-scale longline fishing, shallow-sea shrimp fishing, octopus and basket fishing in nearshore and bay areas. The project consists of three major components and sub-components⁶:

- 1) Strengthen capacity in governance and management of marine fisheries
 - a. Enhanced governance of marine fisheries and Blue Economy (1. Strengthening fisheries policy and regulations, 2. Preparation of integrated marine special plan, 3. Building fishery management capacity: 4. Improving data quality and use for decision making, 5. control and surveillance, and 6. Training)
 - b. Improved management of nearshore fisheries (1. Strengthening co-management structure such as BMUs and networks, 2. Implementation of Joint Co-management Areas (JCMAs), 3. Conducting social and ecological surveys, and 4. Establishment of bad weather SMS alert system for fishers)
 - c. Infrastructure development for fisheries management at national and county levels (1. Construction of Uvuvi House (one-stop fishery shops) at Nairobi and establishment of national fishery sector hub, 2. Upgrading of county fishery facilities, 3. Establishment of National Mariculture Resources and Training Center (NAMARET), and 4. Upgrading of fisheries infrastructure to reduce post-harvest losses and ensure compliance to regulation).
- 2) Coastal community empowerment and livelihood improvement:
 - a. Provision of three types of small-scale grants (1. Livelihoods productive grant (98 wards, 20,000 households), 2. Social welfare grants to improve social facilities, 3. Environmental and natural capital grants to promote environmental management projects)
 - b. County government support for implementation of the small grants in Activity a
 - c. Strategic partnerships with four private companies engaged in aquaculture or contract farming schemes to provide technical assistance to smallholder producers to improve their access to markets
- 3) Project Management: The national project coordination unit (NPCU) finances and supports project management at the national and county levels to ensure effective and timely execution of project activities. A satellite NCPU office is established in Mombasa

(2) Go Blue Project / EU

Go Blue project is a partnership between the EU and the Government of Kenya to advance the Blue Economy Agenda through coastal development with an overall objective to unlock the potential of sea-land opportunities in coastal urban centers for sustained, inclusive and sustainable economic growth with employment impact, while conserving and sustainably using the coastal and marine environment as well as promoting effective and integrated maritime governance.

Six counties, including five coastal counties (Lamu, Tana River, Kilifi, Mombasa, and Kwale) and Taita-Taveta county, are included and it is implemented with the total budget of EUR14,750,000 from 2021 to

⁶ Source: Project brochure: <https://kemfsed.org/wp-content/uploads/2022/12/KEMFSED-Brochure-Dec9.pdf>

2024. Go Blue project consists of sub-projects implemented by donor agencies (GIZ-Germany, ACIS-Italia, Camoes-Portugal, Expertise France) in the EU member countries and UN agencies (UN Habitat and UN Environment). Jumuiya ya Kaunti za Pwani (JKP), a common economic development-block for the six counties, coordinates the projects as a common stakeholder. Go Blue project consists of three main components.

- 1) Employment and entrepreneurship support: Promoting startups and job creation with a particular focus on young people and women to accelerate sustainable and inclusive blue economy growth in coastal urban areas
 - a. Skills and value chain development: Providing entrepreneurs and employment opportunities in fisheries and aquaculture related to the Blue Economy
 - b. Fisheries and agriculture: Strengthening Joint Environmental Management (Co-management), Capacity building for coastal farmers (cassava value chain) and capacity building for JKP
 - c. Tourism and cultural heritage: Promoting inclusive employment for tourism and cultural heritage conservation activities in JKP coastal areas
- 2) Environmental and spatial planning: Mainstreaming marine environmental conservation in coastal urban policy planning and implementation, leading to sustainable, inclusive and sustainable economic growth, coastal tourism development, and climate change mitigation
- 3) Maritime safety and security: Formulation of maritime safety policies, strengthening the capabilities of KCGS and other maritime safety-related organizations, developing maritime safety laws, and strengthening collaboration with neighboring countries to strengthen regional maritime safety.

2.3. Questionnaire Survey on Training for Government Officials

This section reports on the work related to 'Outcome 2: Training needs for fisheries administration staff are organized'. A training needs assessment was conducted by means of a questionnaire survey using Google Forms to collect and analyze information on training cases previously conducted for fisheries sector staff. Based on the results of the survey, training needs and training content are discussed.

The questionnaire survey asked government officials working in the marine fisheries sector (counterparts officials in MMBEF, SDBEF, and KeFS, as well as fisheries technicians from coastal counties) about the content of training provided to government officials, the training needs of government officials and the content of training provided by government officials as lecturers, and received responses from 79 respondents. The following are the results for each question.

(1) Training Participation

Regarding the age composition of respondents, more than half of the respondents were in their 20s, suggesting that younger officials in need of training were more likely to respond to this survey (Fig. 27). More than half of the total respondents were male, but looking at the gender composition by age, the proportion of females was increasing as they get younger, and more than half of those in their 20s were composed of females.

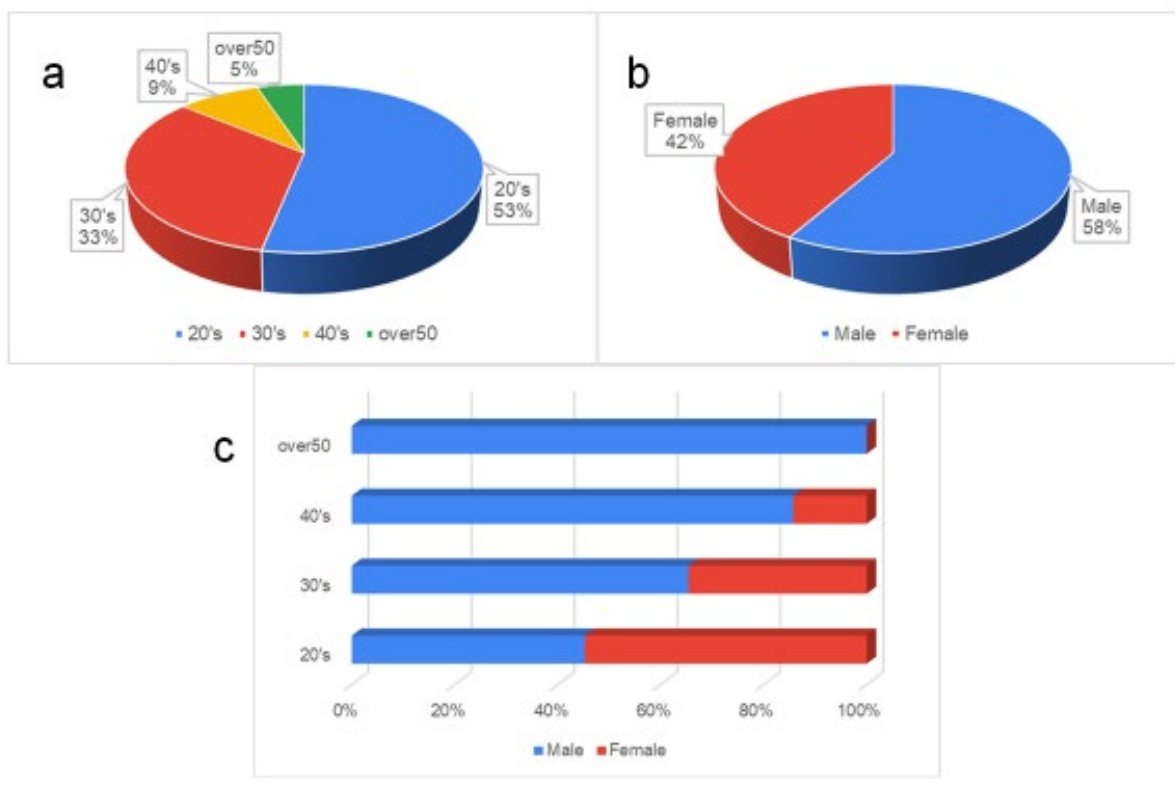


Figure 27. Age and Gender Composition of Respondents
(a. Age Composition, b. Gender Composition, c. Gender Composition by Age)

Forty-nine percents (49%) of the total respondents have never participated in any training. Looking at training participation by age group, nearly 60% of those in their 20s have never participated in training, and more than 40% of those in their 30s have never participated in training (Fig. 28).

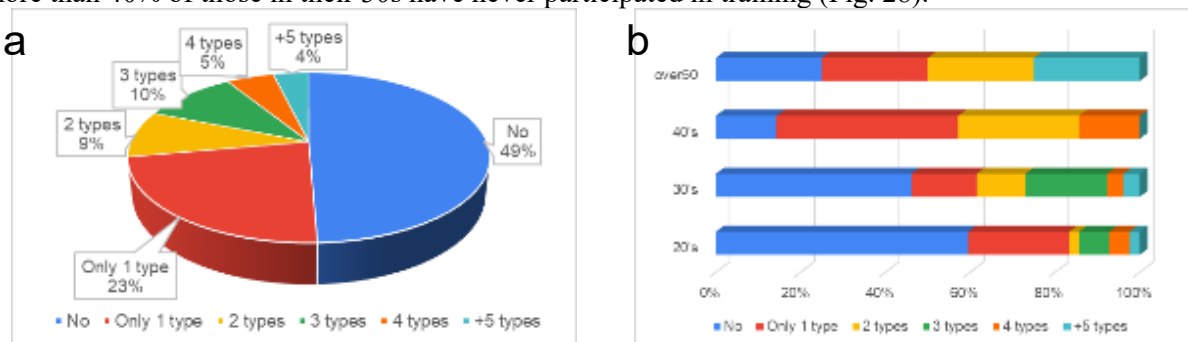
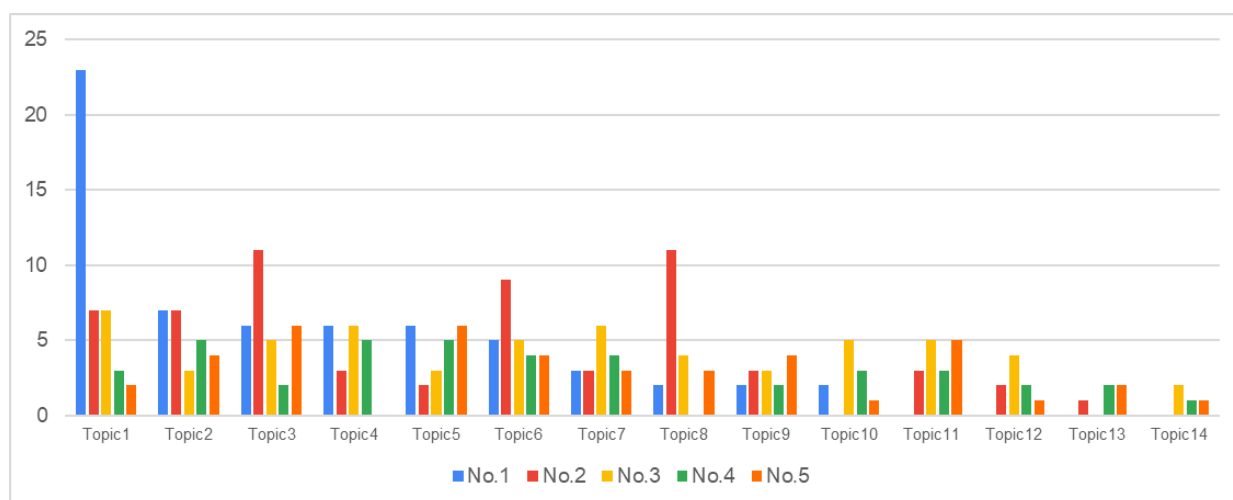


Figure 28. Respondents' Training Experience (a) and Training Experience by Age (b)

(2) Training needs

When asked to rank the themes they want to take from among the 14 training themes that can be considered in the field of the marine fisheries' Blue Economy, the training theme related to "Fisheries resources management & protection" ranked first. The second most popular training theme was "IUU and marine safety", "Offshore fisheries development and technology", and "Marine aquaculture". The training themes with higher average needs were "Fisheries governance", "Post-harvest management and technology" and "Marine Product Processing, product hygiene & safety" (Fig. 29).



Topic1: Fisheries resources management & protection
 Topic2: Fisheries governance
 Topic3: IUU and maritime safety
 Topic4: Post-harvest management and technology
 Topic5: Climate change and resilience
 Topic6: Coastal fisheries development and technology
 Topic7: Marine product processing, product hygiene & safety
 Topic8: Marine aquaculture

Topic9: Marine fisheries and aquaculture extension
 Topic10: Offshore fisheries development and technology
 Topic11: Marine fisheries and aquaculture research
 Topic12: Infrastructure development for marine fisheries & aquaculture
 Topic13: Finance and insurance for marine fisheries activities
 Topic14: Supply of fisheries and aquaculture materials, equipment and tools

Figure 29. Distribution of respondent frequencies by training theme

As shown in Fig. 30a regarding the question on the preferred venue for training, 49% of respondents answered "in Kenya", 32% answered "overseas", and 19% answered "both (in Kenya and overseas)". As shown in Fig. 30b regarding the types of training, 38% of respondents answered "face-to-face lectures", 3% answered "practice mainly", 53% of respondents answered "lectures and practice", and 6% answered "web-based lecture". It can be interpreted that type of training easier to accept is implemented in a mixed form of face-to-face lectures and practical training sessions.

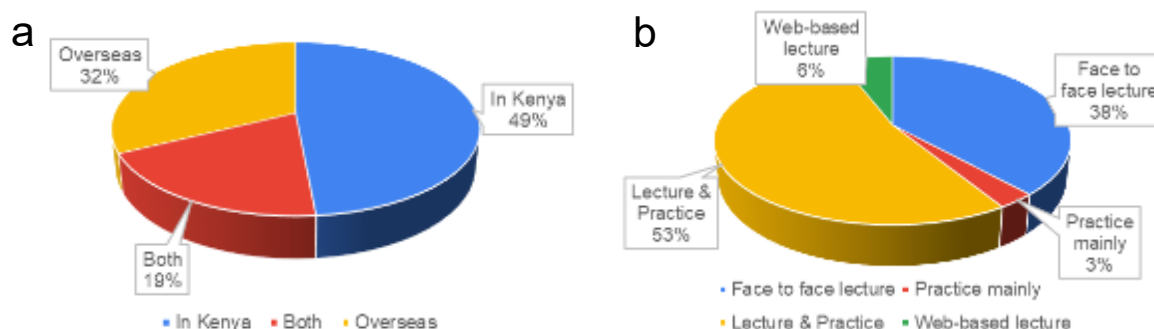


Figure 30. Number of respondents to the desired training site (a) and the desired training form (b)

1) Training needs of central level staff

Blue Economy is a concept in which not only biological resources such as flora and fauna but also inanimate resources such as marine minerals and fossil fuels are targeted for development. Therefore, it includes a wide range of industrial sectors such as marine transportation, harbors, tourism, marine mineral resources and marine renewable energy. Furthermore, in order to aim for a sustainable and equitable distribution, various social fields such as environmental, labor, health and welfare are involved. For this

reason, the administrative agencies concerned are truly diverse, and the definition of Blue Economy differs depending on the implementation agency, and the meaning of the development project differs. For example, Go Blue projects and KEMFSED project, which implement the two large-scale blue economy projects in Kenya, differ in nuances from each other in their respective project objectives as follows:

KEMFSED/WB Project objectives: To improve management of priority fisheries and mariculture and increase access to complementary livelihood activities in coastal communities (source: Project appraisal document⁷)

Go Blue/EU Project objectives: The focus is on coastal urban centers for inclusive, integrated, participatory, and sustainable economic growth, including conserving the coastal marine environment and promoting effective and integrated maritime governance (source: Go Blue brochure⁸)

The former tends to focus on the direct outcomes of economic development such as development and livelihoods, while the latter focuses on the distribution of economic outcomes such as inclusiveness and sustainability. The World Bank's project is a loan project that is premised on repayment within a certain period, while the EU project is a grant aid that does not have such a premise. It is thought that the fundamental difference in project form is reflected in the difference in the direction each project is aiming for.

Also, due to the difference in scope and goals, the implementation policies of the two projects are also different. While KEMFSED mainly carries out projects through central government agencies. On the other hand, in Go Blue project, the coastal economic co-operation organization (Jumuiya ya Kaunti za Kwani: JKP) established by the local government of the six coastal counties is carrying out the overall coordination of the project and promoting the project.

Blue Economy is often used as policy-making and investment objectives, but does not yet have a widely accepted definition (WWF⁹). The objectives of the Blue Economy projects, which industrial sectors to include, and who to target, vary depending on the natural and social-economic environment and ethnic and cultural backgrounds of the project proponents. And because such backgrounds vary depending on the country and its history, it can be said that the diversity of definitions and goals is what characterizes the Blue Economy development.

Kenya, therefore, should have its own Blue Economy, and its definitions and objectives should vary with changes in the environment. For example, the Blue Economy was first mentioned as the eighth economic pillar of the 3rd Medium-Term Development Plan (2017-22) of Kenya Vision 2030, which states that "(Blue Economy) encompasses a range of productive sectors, including fisheries, aquaculture, tourism, transport, shipbuilding, energy, bioprospecting and underwater mining and related activities". The fisheries officials of SDBEF, KeFS, and coastal counties targeted by this training project are working as public officials in a portion of these broad Blue Economy sectors, and the scope and objectives of their Blue Economy should be different for each individual. Furthermore, if they move on in the future, they will again be confronted with a different issue of Blue Economy depending on the new environments. What is most important for them is to have their own view of the Blue Economy from the viewpoint of their positions at the time and

⁷ Source: Project Appraisal Document for KEMFSED project, Report No. PAD3024

⁸ Source: Go Blue Brochures, <https://www.goblue.co.ke/about-us>

⁹ http://d2ouvy59p0dg6k.cloudfront.net/downloads/15_1471_blue_economy_6_pages_final.pdf

to have the ability to make decisions on the issues they face. If such diversity and transitionality in scope is an inherent characteristic of the Blue Economy, the project should not try to teach them about a particular Blue Economy (e.g., the blue economy of Japan, UN, World Bank, or EU) in this training project, but rather, it should expose them to the reality of the Kenya Blue Economy as broad a scope as possible, think of themselves, and develop their own blue economy.

Therefore, this project would like to make the trainees visit to the sites of external organizations in a wide range of related fields as possible, listen to the current status of Blue Economy activities from the standpoint of each organization. At the same time, the project would like to consider providing as many training environments as possible that makes them to discuss with the target fishermen and other relevant parties in the training programs. Furthermore, by letting the trainees discuss with each other so that they can foster their own view of the Kenyan Blue Economy, it is expected that it will lead to the expansion of their basic skills as government officials.

2) Training needs of local staff

KeFS staff assigned to coastal areas and fisheries officers in counties are in a position to implement fisheries and aquaculture promotion measures, and there is a strong need for training on specific technical issues. For example, semi-industrial fishing vessels provided to BMU in Mtwapa are anchored in a port for two years without ever going out to fishing and only periodically started the engine to confirm its functionality. The main reason for no use was said that fishing gear was not provided together. However, the real reason is that the BMU members who are fishing for demersal fish on reefs and rocks in nearshore waters are not familiar with fishing methods for large migratory fish (tuna and swordfish) in offshore waters, so it seems that they are not technically capable of getting benefits from the opportunity given by the government. If the fisheries officers who were the typical target officers for this training project had knowledge and experience in such appropriate fishing methods (ring net and longline fishing), they should have been able to provide guidance and support, and the situation where the fishing boats were anchored for two years would not have continued.

Similarly, for milkfish and mangrove crab aquaculture, which is at an early stage of development in Kenya, it would be possible to provide practical responses and supports to the target communities if the public officers whom this training program works for had knowledge and experience of technologically advanced aquaculture methods in Southeast Asia. It would be very important to respond to these needs for the trainees assigned at the local sites on the ground in this training project. Although a lot of information can be obtained through books and the internet, opportunities to actually see the field and talk directly with the people involved are very limited. In this training program, it is considered highly worthwhile to first introduce the situation in Southeast Asia, where the same technology is used but where the current challenges in Kenya have been overcome and the situation is one step more advanced, through online lectures, and to promote dialogue between the trainees and local experts of Southeast countries.

(3) Training instructor resources

In the questionnaire for the public officials in the C/P institutions, there is the question which asked whether the respondents had experience in providing training as instructors. As shown in Fig.31a, there are

38% of respondents who had lecturer experience. The trainees for such experience were mainly fishermen and employees of private companies, accounting for 69% of the total (Fig. 31b). It is hoped that these government officials will become leaders to play a role in educating the newly recruited trainees in this training program.

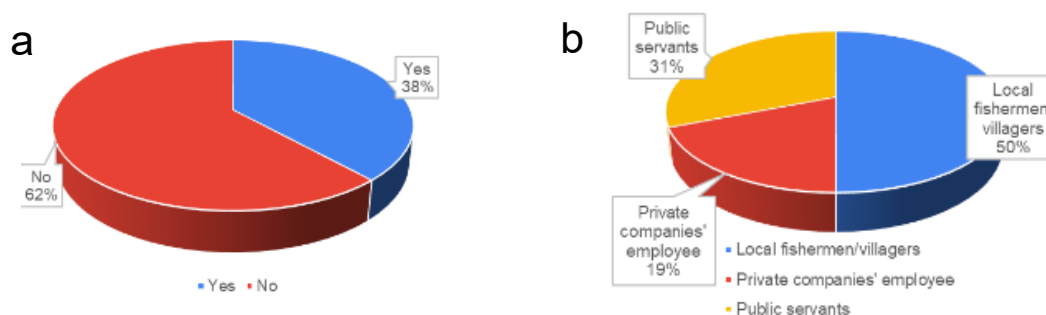


Figure 31. Experience of Training Instructor (a) and Subjects of Training (b)

The personnel in charge of related organizations visited during the Site Work period were well-versed in fisheries-related activities in each organization, and are training resources with sufficient knowledge and practical experience as lecturers for the project. All of those respondents with training experiences positively answered the questions about their cooperation in the project. Even if the high-ranking respondents who would be busy and unable to avail for the actual training period, the project believes that he/she can appoint a substitute person from the same institution.

2.4. Formulation of Training Program

This section discusses the work related to Output 3: 'Training program is developed by the project', based on an understanding of the current status of the marine fisheries industry, the issues of the related organization, and the needs of fisheries sector staff as informed in the previous sections. This section also explains the setting up of a working group (W/G) as the main mechanism to implement the actual training programs. The project positioned the W/G meeting as a place where Training of Trainers (TOT) activities were implemented in this project, and the actual training programs were developed through discussions in the W/G meetings on the prioritization of training topics, timing and logistics of training implementation, etc. The details for the training program development were shown below.

2.4.1. Development of Training Implementation Policy

Characteristics of Trainees

The target trainees for this training were newly recruited officials from central and local government fisheries administrations (specifically KeFS, SDBEF and the five coastal county fisheries departments) who have been hired to implement the new Kenya national policy for the Promotion of the Blue Economy. They are those who had approximately three years or less of in-service activity at the start of this project, in late 2022. They had been selected according to the national (or local) civil service recruitment system and have a high level of intellectual ability with at least a bachelor's degree. On the other hand, they have academic backgrounds in a variety of fields across the humanities and sciences, and not necessarily in marine, biological or fisheries sciences. Their previous work experience covers a wide range of fields. They are

expected to be general administrative officers and not necessary to be officers working in the technical field of fisheries. Typical previous work experience includes bankers and teachers. Their current position is most likely their first assignment as fisheries administrators, and the scope and duration of their work experience in actual fisheries administration is fairly limited.

Trainees affiliated to local government are assigned to several fishing village organizations (BMUs) within the county as their area of responsibility, and most of those who belong to KeFS are also assigned to the five coastal counties. While SDBEF staff, who are few in number, are posted to the Mombasa branch, the county and KeFS officers, who make up the majority of the trainees, work directly with fisherfolks in the fisheries frontlines. In other words, the trainees in this project have a certain amount of previous work experience and are characterized by high learning ability but limited experience in the fisheries sector, and are working hard in their daily activities while dealing directly with fishermen and other fisheries related personnel at the fisheries sites.

Kenya Fisheries Education Situation and Training Needs of the Trainees

The lack of practical training and capacity-building opportunities in the education system for frontline workers in the fisheries sector was noted in the recommendations for a policy framework for aquaculture education in Kenya (KMFRI, 2021). During the first Site Work period, it was confirmed that this characteristic of lack of practical experience in the field of fisheries education system is not limited to aquaculture, but can be said to be true for the fishery fields in general. In particular, for newly employed staff such as the trainees of this project mentioned above, this is the cause of the most difficulties in their daily activities, and the project consultants strongly felt the need to introduce as many actual fisheries sites to the trainees as possible during this training course.

However, many trainees do not have sufficient basic knowledge in the fisheries sector to fully understand what they would see at the field if they were suddenly brought to various fields of fisheries activity sites. Therefore, in order to understand the background of the field fisheries activities being carried out in each of the visited sites, Kenyan experts in the respective fields were either accompanied to the sites for explanations or to give general lectures in Mombasa on the basics of the fisheries technologies to be seen and heard in the visited sites. For example, the training program could be structured to include a lecture on the current state of Kenya's fisheries resources and fisheries technology before going to a coastal fisheries site to observe fishing activities of a BMU. Most of the lectures on fisheries technical specializations were given by KMFRI experts.

Blue Economy Concepts Suitable for Training Target Group and Its Optimal Learning Methods

This project is not simply for running a training program for fisheries development, but for 'Blue Economy' development. As mentioned above, the blue economy is a new development concept that does not have a uniform definition, but rather is characterized by a diversity of definitions depending on the actors using it and the resources targeted for use. The blue economy covers all available resources under water and their sustainable management, and thus is extremely diverse in terms of the sectors it covers as well as the range of government agencies with administrative jurisdiction over each. For Kenya's fisheries Blue Economy, SDBEF and KeFS are responsible for its administrative enforcement in the central

government. Similarly, a variety of relevant administrative bodies are responsible for resource management and operations in areas such as maritime affairs, ports, shipbuilding, tourism, energy, marine biological resources, marine mineral resources, coast guard and maritime education. Furthermore, each coastal county has a similarly different Blue Economy development policy and implementation system. In other words, each central and local government institution has a different view of the blue economy and different ways of dealing with it.

With such a diversity of views on blue economy among the institutions targeted for training by this project, it is very difficult for the project to decide what training activities and how to implement them effectively to lead to the development of the 'Blue Economy' capacities of the target trainees, who have just started working as frontline officers at their place of assignment. After careful consideration, it was decided that the project would not use a unilateral training method whereby a fixed 'blue economy' is taught to the trainees, but rather provide them with opportunities to experience the reality of the blue economy at the frontline of Kenya's marine fisheries, and encourage them to form and update their own unique view of the blue economy.

This interactive training method was expected to be more difficult to implement effectively than the unilateral training method of school lessons, where the students are taught an answer to a question, because it requires more ability on the part of the trainees to think thoughtfully about the issues hidden under the apparent question. However, considering the characteristics of the trainees in this project, who had a certain level of working experience and a high intelligence standard, but very limited practical experience in the fishery field, as mentioned above, this training method was considered more suitable.

Prior to the start of the project, the consultants had considered having an online lecture conducted by a person who is regarded as an authority on the blue economy in Japan, and had actually consulted such a university professor in advance. They were also considering asking Kenyan blue economy experts to give lectures on different fields and to conduct a quiz to measure their understanding of the lecture content. However, the concept of blue economy is specific to each of the social, economic and natural environments in which it is formed, and unlike learning about theorems in natural science, there is no single answer. Rather, it is characterized by a myriad of answers reflecting the diversity of the people responsible for its activities in different environments. Such training programs, which had been considered before the project started, were dropped from implementation options during the course of conducting and compiling the first site survey operations.

Incorporation of Online Lectures on Philippine Fisheries Technology into Training Program

On the other hand, in the course of considering such interactive training implementation methods, online lectures on 'Philippine Fisheries Technology', which had not been considered before the project, were examined as an alternative to the online training to Japanese blue economy experts that had been initially considered.

Southeast Asia is a leading fisheries region, providing nearly a quarter of the world's fish production. The production of capture fisheries, especially small-scale coastal fisheries, has reached a plateau due to overfishing problems, and aquaculture production is taking on greater importance in the region than fisheries production. For many sub-Saharan African countries including Kenya where the overfishing of

coastal fisheries has become a problem, and where catch regulations and IUU fishing problems have plagued the industry, while the development of marine aquaculture has barely begun, Southeast Asia is a step or two ahead in all aspects of the fishing industry and has much to learn from its history. Furthermore, the socio-economic environments of Southeast Asia and African countries have relatively more similarities than those of Japan and many other developed countries, with the advantage that barriers to technology transfer are relatively low.

During the first Site Work period, when the consultants observed the fisheries situation in the Kenyan coastal areas, they realized the potential of the Philippine fisheries and aquaculture technologies with which they were involved to be effective in solving Kenya's current problems and promoting development. Behind the technological development of the Philippines was a history of overcoming the problems of overfishing and lack of aquaculture seeds and feeds in coastal areas, which Kenya is currently suffering from. In other words, the technologies currently prevailing in Southeast Asia are not only economically productive, but also have the inherent potential to solve various pressing issues facing Kenya today, where the socio-economic environment is relatively similar.

Therefore, it was decided to examine the feasibility of online lectures by Filipino experts on Philippine fisheries technology and its development process as an alternative to the online lecture program of a Japanese blue economy authority. For this purpose, prior to the second round of field work, a consultant visited the Eastern Visayas region of the Philippines, where he had previous work experience, to check the state of the latest fisheries technology and to examine the feasibility of implementing online lectures by Filipino experts. As the feasibility of implementation was unknown at this point, the costs of the trip were borne by the company.

On the Philippine side, the Eastern Visayas Region office of the Bureau of Fisheries and Aquatic Resources (BFAR-8), the national fisheries administrative authority, and the regional branch of the National Fisheries Research and Development Institute (NFRDI), the national fisheries research institute, were very supportive and recommended local technical experts and private sector technicians as potential lecturers. The consultant met with these potential lecturers and asked them to present the latest technology as well as the history of technological development.

The visit to the Philippines prior to this second field operation confirmed that lectures on the following four areas of fisheries activities in the region would be potentially effective in resolving current fisheries issues in Kenya and that there were appropriate lecturers willing to cooperate: 1) offshore small-scale fishing, 2) milkfish aquaculture, 3) mangrove crab farming, and 4) seaweed farming. These were summarized in a presentation (Appendix 2), including a video filmed in the field, and it was decided to propose to the Kenyan side during the second site work period that an online lecture by a lecturer from the Philippines be conducted during the First In-Country Training course.

Following the considerations and studies on the formulation of the training program as described so far, the project developed a basic program structure for the First In-Country Training program, which should consist of the following three parts.

1. Blue Economy lectures: lecturers from the national branch offices of the Blue Economy related institutions in Mombasa will be invited to give lectures on the concept and actual activities of the blue economy from the perspective of their respective organizations.

2. Fisheries site visits: as many Blue Economy activity sites as possible will be visited to provide the trainees with opportunities to see and hear the actual situation on the ground and to exchange views with those implementing the activities. In addition, lectures by Kenyan experts on the relevant fisheries technology and background of the activities will be provided.
3. Online lectures on Philippine fisheries: online lectures on the Philippine fisheries sector that may contribute to solving Kenya's fisheries blue economy development challenges.

2.4.2. Establishment of Implementation Structure

During the first Site Work period, the local situation was assessed and a training policy and basic program concept were formulated. Subsequently, during the second Site Work period (29 October - 28 December 2023), the implementation structure of the training program was established and the program details were developed as described in this section.

Launching of Working Group

The Working Group (W/G) for the project included representatives from the Mombasa branch of SDBEF and KeFS, the heads of five coastal county fisheries offices, KMFRI and KFIC. In other words, it is made up of the people with substantive responsibility for the implementation of fisheries administration in coastal areas, both central and local governments, who are familiar with field practice and make critical decisions on a daily basis. The training participants are their newly recruited staff. Furthermore, they are not only familiar with their training needs, but are also familiar with national and local training resources with which they have personal contacts. Naturally, no one was better qualified than them to select the specific training program, and the details of the program were decided through consultations with the W/G.

As already mentioned, the project's training policy was to make the training interactive and participatory, and the specific training program was also formulated through discussions at the W/G meeting, with a view to making the training operation as interactive and participatory as possible.

The training concept prepared before the project started envisaged a cascading two-stage training system consisting of in-country training for new civil servants and TOT (training of trainers). This training system is suitable for learning natural scientific theorems and technical systems that are not subject to contestation, and is an efficient training system that develops a small number of core personnel from whom a large number of final trainees are discharged. However, as has been explained, the Blue Economy concept is characterized by a great diversity over the resources targeted and among the people involved in the management of those resources, and thus consequently by the existence of a myriad of answers depending on the position rather than one answer. Therefore, it was considered that the quantitative efficiency of the cascade training system would not be exploited.

Taking into account the qualifications of the trainees, the state of domestic resources and the characteristics of the Blue Economy concept, the project decided to adopt a policy whereby the training implementation process itself provides the trainees with opportunities to think and improves their Blue Economy thinking capacity through interactive exchanges. The W/G meetings were regarded as part of the training system of the project and equivalent to TOT, and the same policy of emphasis on interactive and reciprocal interaction was adopted in their operation.

The W/G meetings run under this policy provided a forum for the exchange of views between the project side and the Kenyan C/P agencies, and consequently played an important role in the implementation of the project. As will be discussed below, they were held not only before and after the In-Country Training courses but also during the period when the Japanese consultants were not in Kenya, giving them a particularly important position and contributing significantly to the qualitative improvement of the project. A total of 14 W/G meetings were held during the project period (Table 8).

Table 8. Working Group Meetings implemented in this Project

W/G	Date	Venue*	Main Agenda
0 th	21 Feb. 2023	Malindi	Preparatory meeting, held in Malindi with five coastal county fisheries departments invited in addition to SDBEF and KeFS.
1 st	2 March 2023	KFIC	Development of In-Country training outline; determination of W/G meeting members (representatives from SDBEF, KeFS, five coastal county fisheries departments, as well as KMFRI and KFIC). Training targets were set to be newly recruited staff of these institutions.
2 nd	17 March 2023	Kikambala, Kilifi	Formulation of the First In-Country Training programs. Approval of online lectures from the Philippines as programs.
3 rd	23 June 2023	KFIC	Held immediately after the implementation of the 1 st In-Country Training. Evaluation of training contents, proposal of improvement measures, and prioritization of the Philippines technology training components.
4 th	4~5 Sept. 2023	KFIC	Held after the return from the 1 st Third Country Training. Report on the training contents, evaluation, and discussion on the measures to spread the results of the training.
5 th	28~29 Sept. 2023	KFIC	Formulation of the 2 nd In-Country Training program. Four Filipino technicians scheduled to travel to Kenya participated in the meeting online.
6 th	6 Nov. 2023	KFIC	Final confirmation for training preparation. Briefing and discussion of the construction plan by the Filipino technicians who were already in Kenya.
7 th	23 Nov. 2023	KFIC & Malindi	Held in Malindi immediately after the 2 nd In-Country Training for program evaluation. Inspection of Banca boat, discussion on the use and deployment of Philippine transferred technology. Nomination of participants for 2 nd Third-Country Training.
8 th	30 Jan. 2024	KFIC	Explanation and discussion of the 2024 Plan, discussion on the operation of technology introduced from the Philippines, recommendation of participants for short-term training in Japan (Knowledge Co-Creation Program) in 2024.
9 th	26~27 Feb. 2024	KFIC	Recommendation of participants for the 2 nd Third Country Training (Zanzibar), progress of banca fishing boat activities, status of seed housing in HDPE fish cages
10 th	19 Apr. 2024	KFIC	2 nd Third Country Training outline finalized; preparation for 3 rd In-Country Training; support for activity plan using HDPE fish cage aquaculture in Lamu County; progress in Banca Boat activities.
11 th	29 Apr. 2024	KFIC	Report on the implementation of the 2 nd Third Country Training, status of progress in HDPE fish cage seed stocking, progress in preparing for the 3 rd In-Country Training, recommendation of applicants for short-term training in Japan (Knowledge Co-Creation Program) in 2024.
12 th	23 May 2024	KFIC	Evaluation of the 3 rd In-Country Training, output of the In-Country Training, status of progress in Banca Boat activity and HDPE fish cage, outline of the 4 th In-Country Training, and progress of applicants' nomination for short-term training in Japan (Knowledge Co-Creation Program) in 2024.
13 th	21 June 2024	KFIC	Progress on preparations for the 4 th In-Country Training, progress on Banca Boat and HDPE fish cage activities, confirmation on how to prepare In-Country Training output (Video book), progress on applicants for short-term training in Japan
14 th	5 July 2024	KFIC	Training evaluation for the 4 th In-Country training, preparation for the wrap-up seminar and checking the registration status of Banca Boat.

* Venue: KFIC in Mombasa – Conference room of KFIC. Kikambala & Malindi in Kilifi County: Conference room of private hotels

Project Implementation Structure

At the start of the first field operations of the project, it was envisioned that the venue for In-Country Training would be in the capital city of Nairobi, and that the implementing agencies on the Kenyan side would be the SDBEF and KeFS headquarters. However, in order to implement the strategy of providing as many opportunities as possible for field visits where trainees can get a real picture of the actual fisheries situation, the training site should be centered in Mombasa and further spread out to the neighboring coastal counties. The cooperation of the coastal county governments is also essential. If the training is to be Nairobi-centered, it will be impracticable for the training to focus on fisheries site visits.

In the early stages of the second field operation, which aimed to develop a training program, initial discussions were held with KeFS and the Mombasa branch offices of SDBEF to reach agreement on the implementation concept of the first in-country training comprising the three main components (blue economy lectures, fisheries field visits and Philippine online lectures) as presented in Section 2.4.1. An expanded meeting including the coastal county fisheries department was held in Malindi, Kilifi County, near the centre of the five coastal counties, to discuss the institutional structure for implementing this training project. The meeting strongly requested that the local country government fisheries departments in the five coastal counties be included in the implementation structure, and following approval by the central government (SDBEF and KeFS), a working group (W/G) consisting of the Mombasa branch offices of SDBEF and KeFS and the five coastal county fisheries departments was set up, and an implementation structure for this project was established with the W/G as the central organization for the project implementing (Fig. 32).

The change in the implementation structure of the project from a central government agency (KeFS and SDBEF)-led implementation in the capital city of Nairobi to a W/G (including the coastal county fisheries departments)-led implementation in Mombasa and the coastal counties, shifted the basic nature of the training to a field-oriented and site visit-based approach, although it also included a conceptual lecture on blue economy policy.

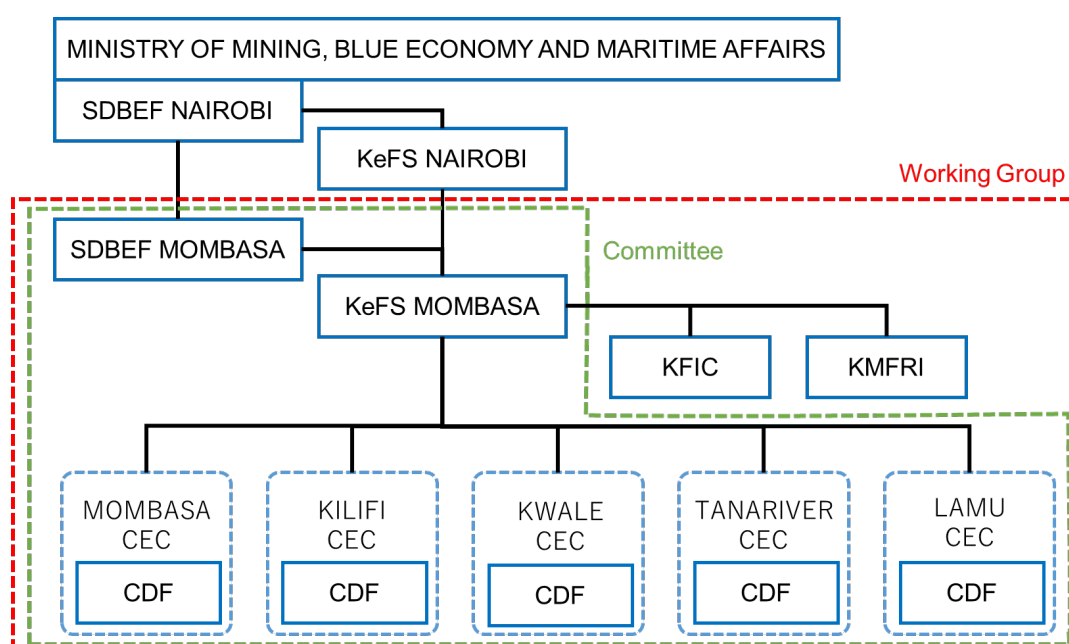


Figure 32. Implementation Structure of the Project

KeFS officials and coastal county fisheries department officials deployed to various sites in the fisheries sector are in a position to promote fisheries and aquaculture promotion measures on the ground and have a high need for training in solving specific technical problems. While their work ranges from coastal resource management, IUU fishing regulations, modernization of fishing vessels and landing facilities, seaweed aquaculture promotion, implementation of aquaculture pilot projects, fish processing, support for setting up and running women's cooperatives, etc., they are in need of specific technologies that contribute to improving the livelihoods of the fisherfolk they actually meet on a daily basis and in improving the natural and socio-economic environment that foster those beneficial technologies. They are looking for concrete ways of government intervention in the daily work. Their needs are very different from those of central government officials who are responsible for policy formulation and evaluation and whose main practice is to analyze the current situation and conduct studies on the impact of policy introduction.

When thinking about the introduction of the new development approach of the Blue Economy into the training program, it is obvious that both a comprehensive and conceptual understanding and an understanding of individual specific technologies are necessary, but the proportion of importance of this understanding differs greatly between staff assigned to central headquarters and those assigned to the coastal branch offices of SDBEF/KeFS and local government staff. Looking back at the end of the project, it can be said that the incorporation of many field visit programs and topics on the introduction of Filipino technology into the training program, in line with the interactive and participatory training implementation policy tried by the project was only possible with the participation of the fisheries departments of the five coastal counties in the W/G structure.

2.4.3. Development of Training Programs and Selection of Implementation Methods

As explained in the previous section, after establishing a W/G-centered implementation structure at the beginning of the second Site Work period in line with the implementation of the training program formulation policy, which is encapsulated in a three-part basic structure including field visits, the specific lecture topics and site visit selection were finalized during the W/G meetings held before the First In-Country Training implementation.

As for the Third Country Training, which is another form of training in this project, the Kenyan side did not have sufficient information, especially on the logistic aspect, so the project side developed a tentative training program in line with the objectives of this training (information sharing and human resource exchange) and confirmed the details through discussions at the W/G meetings.

(1) Basic Structure of In-Country Training Program

The point made about the importance of field site visits does not at all negate the importance of a lecture-based training program on Blue Economy. Ensuring that trainees have a correct understanding of the new development concept of Blue Economy is a central issue of this training project. Therefore, the actual training program was designed to provide a good balance between lectures and field visit programs, with the first three days of the 10-day training period being lecture-based training in Mombasa, and the remaining seven days being spent travelling one after another to various fisheries activity sites in the neighboring counties to see the actual Blue Economy activities and exchange opinions with the implementers. This basic

training program structure (Table 9) was maintained throughout the four In-Country Trainings.

Table 9. Basic Program Structure of In-Country Training

Part	Program Component	Duration	Main venue	Lecturers and field trainers
1 st Part	Lectures on Blue Economy (+ facility observation)	3 days	Mombasa	National experts from the visiting national offices
2 nd Part	Site visit of fisheries and aquaculture practice implementation	7 days	Kilifi, Kwale, and Mombasa counties	Private and government experts from field sites visited

(2) Programs of In-Country Training (The First Training)

As mentioned above, the first part of the lecture-based training program on Blue Economy invited lecturers from the national branch institutions based at Mombasa that are engaged in Blue Economy-related activities to explain their views on Blue Economy, their specific activities, history and background from the perspective of respective institution. In the case of the First In-Country Training, seven partner institutions (SDBEF, KeFS, Kenya Maritime Authority (KMA), Kenya Fisheries Corporation (KFIC), Bandari Maritime Academy (BMA), Kenya Coast Guard Service (KCGS), Kenya Marine Fisheries Research Institute (KMFRI) and Kenya Wildlife Service (KWS)), were invited and gave lectures. Table 10 shows the program of the First In-Country Training.

Table 10. Program of the First In-Country Training

Day	Institution	Training title	Day	Institution	Training title
1 st day	SDBEF	Overview of the blue economy in Kenya	4 th day	KMFRI	Marine aquaculture development in Kenya
	KMA	Ocean governance and marine management		KMFRI	Marine fin fish hatchery -NAMARET
	BMA	Seafarers training	5 th day	KMFRI	Finfish farming systems and cultured systems (rabbit fish)
2 nd day	KFIC	Exploitation of distant fisheries resources & HACCP fish processing Plant		KeFS	
				KMFRI/CGK	Seaweed farming in Kenya
				KMFRI/CGK	Small scale fishing techniques and processing
3 rd day	KCGS	Role of KCGS in securing maritime security for a sustainable blue economy.	6 th day	Mlango wa Papa	Offshore fishing by Community based Organization
	KeFS	Fisheries management and development measures		SDBEF/CGK	Semi-industrial fisheries development, cold stores, FADs
				KMFRI/CGK	Finfish farming in coastal ponds in Kilifi
3 rd day	KMFRI	Status of Fisheries resources and lost opportunities in Kenya	7 th day	Crab Alive Ltd.	Mangrove crab farming in Kenya
	KMFRI	Fisheries and aquaculture climate change		KMFRI/CGK	Semi-industrial fishing boats in Kenya
	KMFRI	Improving fishing gear technology and FADs	8 th day		
	KWS	Marine protected areas and tourism		Sea Harvest	Fish Processing and Marketing

For those programs for which the evaluation from the trainees was particularly poor, various improvements were made for the next training. Most of the training programs were conducted by the same lecturers on the same topics from the second course onwards. The left-hand side of the table shows the titles of the classroom-based training program in Mombasa for the first three days, and the right-hand side shows the titles of the field visit program from the fourth day onwards. However, the online lectures from the Philippines conducted during the last two days are not included (see below).

(3) Basic Structure of Third Country Training

The second training program of this project, the Third Country Training Program, was conducted with the aim of promoting continuous information sharing and human resource exchange by visiting the neighboring countries and observing the implementation on-going situation of the Blue Economy development. Potential sites and countries for the study visits included fish processing (tuna canning) and fishing port operations in the Seychelles, activities to improve small-scale fishing and coastal community livelihoods in Tanzania or Mauritius, and their national Blue Economy policies on sustainable resource use and fisheries promotion. At these destinations, the participants observed activities on the field and exchanged views with relevant government and private sector stakeholders, with the aim of making the training content beneficial for both the Kenyan side as well as the host country side.

The training program was planned to be implemented several times a year, with each training course lasting one week. After each visit, a reporting session was held at the W/G meeting to share the results and provide feedback. About five participants were selected from W/G members for each training, and the Third Country Training was positioned as part of the TOT training.

It should be noted that during the Second In-Country Training, demonstrations of Philippine technologies (Banca fishing boats and HDPE fish cage) were added as field activities upon the strong proactive request of the Kenyan side that bring the training content from the conceptual level down to the tangible level, and Philippine technicians were invited to conduct the training. Due to budgetary and implementation schedule constraints, this resulted in a change from the originally planned three countries to visit to two countries, Seychelles and Tanzania (Zanzibar) to visit.

2.5. Implementation of In-Country Training Programs

Within the scope of work related to ‘Output 4: Training Program is implemented’, this section (2.5) describes the Implementation of In-Country Training. The implementation of Third Country Training is explained in the next Section 2.6.

‘Overview, Evaluation and Improvement of In-Country Training Program’ is presented in the first sub-section (2.5.1), and then, a separate sub-section (2.5.2) is provided to elaborate on ‘Implementation of Training on Introduction of Philippine Fisheries Technologies’.

In-Country Training was conducted over a total of four courses for different cohorts of trainees as packaged trainings in which trainees not only participated in the lecture and site visit programs, but also evaluated the contents of the training programs attended. Each training course was evaluated in stages by participants, projects and W/G, and a mechanism was set up to reflect feedback from the previous training course to allow for gradual modification and improvement of the training program.

2.5.1. Overview, Evaluation and Improvement of In-Country Training Program

The First In-Country Training followed the training program (Table 10) developed during the Second Site Work period (14 February- 6 April 2023) and was conducted during the Third Site Work period (3 May - 27 June 2023) after a preparation period of approximately two months. Subsequent In-Country Trainings were also conducted in essentially the same way as the procedure described below, and took place a total of four times throughout the project at the times indicated in Table 11.

The basic program structure of the In-Country Training, as shown in Tables 9 and 10 above, was

comprised of a first part consisting of lectures given by officials invited from the Blue Economy-related national institution offices located in Mombasa, and a second part consisting of site visits to 11 to 13 field visit sites where Blue Economy activities were on-going. However, during the first training course, online lectures on the situation of Philippine fisheries by a Philippine national expert were conducted as a special program. In addition, during the Second In-Country Training Course, special programs of site visits were incorporated, including demonstrations by Filipino technicians using an actual pre-built Banca fishing vessel and a HDPE fish cage.

Table 11. Outline of In-Country Training Courses Conducted during the Project Period

Course	Period	First Part	Second Part	Third Part
First	6~12 June 2023*	Blue Economy lectures by national institutions based in Mombasa	Blue Economy site visits	Online lectures on Philippine fisheries
Second	13~22 Nov. 2023	Blue Economy Lectures by National Institutions based in Mombasa	Blue Economy site visits	Site visits to Philippine Fisheries Technology
Third	13~22 May 2024	Blue Economy Lectures by National Institutions based in Mombasa	Blue Economy site visits	
Fourth	24 June~3 July 2024	Blue Economy Lectures by National Institutions based in Mombasa	Blue Economy site visits	

* Only the first course was a weekend training. The actual training period remained constant at 10 days throughout the four courses.

Procedures for Implementing In-Country Training Program

The program prepared after reviewing the contents of each training course was finalized after discussing it at the W/G meeting held prior to the implementation of the training and making amendments if necessary. Subsequently, requests for cooperation to the training courses were issued in the name of the KeFS Mombasa Office Director to the relevant national and local government offices to which the training lecturers and field visit program instructors belonged, and then, the Project Focal Person (F/P) directly contacted the lecturers and field personnel nominated by the representatives of the respective institutions to confirm participation.

Number of Programs and Cooperating Institutions in In-Country Training

Table 12 lists the names of the institutions that agreed to assign instructors for the lecture or field visit programs and the number of training programs that each institution was responsible for. The total number of Kenyan national institutions, private companies, fisheries associations, fishermen associations, BMUs and CBOs that assisted in the implementation of this training was 26. It was largely due to the contribution of Project F/P that such a large number of national institutions were cooperating. Three of these institutions assigned personnel for this training program, either online or in person, were based in the Philippines. The number of training programs conducted by these partner institutions in one training course ranged from 42 to 47. It can be seen that KMFRI provided significant cooperation in the implementation of lecture programs and the County Government Fisheries Department and KMFRI in the field visit programs.

As 10 trainees and a videographer for documentation, among others, visited fisheries activities in three coastal counties, it was necessary to borrow a microbus for the duration of the training to travel the long

distance. Fortunately, the provision of a microbus by KeFS, donated by the on-going World Bank's KEMFSED project, ensured the efficiency and safety of the trainees' mobility and enabled the project to complete the four training courses with transport without any accidents. This was also helpful in terms of costs, as only the daily allowance for the driver and the actual cost of fuel were paid.

Table 12. Number of Cooperating Institutions for the In-Country Training

Training course	First Training		Second Training		Third Training		Fourth Training	
Training period	12~22 June 2023		13~22 Nov. 2023		13~22 May 2024		24 June ~3 July 2024	
Training Type	Blue Economy Lecture	Site Visit	Blue Economy Lecture	Site Visit	Blue Economy Lecture	Site Visit	Blue Economy Lecture	Site Visit
SDBEF	1	1	1	1	1	1	1	1
KeFS	1	1	1	1	1	1	1	1
KMFRI	5	7	4	7	3	5	4	5
KFIC	1	1	1	1	1	1	1	1
KMA	1						1	
BMA	1	1	1	1	1	1	1	1
KWS	1	1	1	1	1		1	1
KCGS	1		1		1		1	
Crabs Alive		1		1		1		1
Kilifi CG		4		4		4		4
Shella BMU		1		1		1		1
Pwani SeaBoat Repair		1		1		1		1
Kibokoni Farm		1		1		1		1
Mtwapa BMU		1		1		1		1
Mlango wa Paps				1		1		1
Sea Harvest Co.		1		1				1
Mombasa CG				1		1		1
Gazi Women Group		1		1		1		1
Kwale CG		4		6		6		6
SolColDry				1		1		1
Kjiweni Fish. Group		1		1		1		1
Kibuyuni BMU		1		1		1		1
Huwaen Inc.				1		1		1
Philippine BFAR	1							
Philippine boat building company				1				
INCA Philippine Inc				1				
Sub Total	13	29	10	37	9	31	11	33
Total training number	42		47		46		44	

Number of Trainees over the Four In-Country Courses

Invitations for trainees to participate in this In-Country Training programs were issued in the name of the KeFS Mombasa Office Manager to SDBEF, KeFS, KMFRI and the five coastal counties, together with a training brief (General Information) and the program. Participants were active civil servants with an educational background of at least a completed bachelor's degree and up to the maximum of three years' work experience at their current place of work. The number of trainees for each course was set at 10, mainly due to the implementation capacity, with one trainee each in the five coastal counties, two each in SDBEF

and KeFS, and the remaining one in KMFRI. However, for the second and third training courses, a special exception was approved by the W/G to allow the participation of three trainees from SDBEF under the condition that the two daily accommodation allowances during the training period be divided among the three trainees. The total number of participants in these courses was therefore 11. The total numbers of trainees who participated in the four training courses and their respective institutional affiliations are shown in Table 13, with a total of 42 new trainees from central and regional fisheries-related institutions having completed the training.

Table 13. Total number of trainees participated in In-Country Training and their institutional affiliations

Institutions	SDBEF	KeFS	KMFRI	CGKw*	CGM*	CGKI*	CGT*	CGL*	Total
First Training	1	4		1	1	1	1	1	10
Second Training	3	2	1	1	1	1	1	1	11
Third Training	3	2	1	1	1	1	1	1	11
Fourth Training	2	2	1	1	1	1	1	1	10
Total	9	10	3	4	4	4	4	4	42

* CGKw: County Fisheries of Kwale, CGM: County Fisheries of Mombasa, CGKI: Country Fisheries of Kilifi, CGT: County Fisheries of Tana-River, CGL: County Fisheries of Lamu

Evaluation and Improvement of Training Program

The project conducted a total of four In-Country Training courses with basically the same contents, and sought to improve the quality of each training courses through a PDCA cycle: a) evaluation after each training program, b) propositions for improvement of the program and implementation methods, c) formulation of a next training program, d) implementation of the next training program. The following two methods were used to evaluate the training results: a) evaluation by individual trainees; b) evaluation by the trainees as a cohort trainee.

a) Individual trainee evaluations and analysis of the results

Trainees completed an evaluation questionnaire (using Google Form) provided by the project team at the end of each training program, the results of which were compiled by the project team. The questionnaire consisted of a form that asked for a multiple-choice response to the following 10 items. These are: overall evaluation, appropriateness of theme, appropriateness of content scope, relevance to own activities, appropriateness of training time, time allocation to the components, lecturer's way of proceeding, lecturer's expertise, response to questions and willingness to recommend to others. The analysis was conducted by quantifying each response by coding it on a five-point scale from most favorable to most negative, and then compiling and analyzing the coded data on MS Excel spreadsheet. The results were also calculated and visualized graphically in order from the top to the bottom by calculating the total evaluation score for all training programs. Fig. 33 shows the results of the First In-Country Training Program. The similar graphs showing the results from the second and subsequent training courses are shown in Appendix 3. The total evaluation points for all training programs were also calculated and compared with the previous training results.

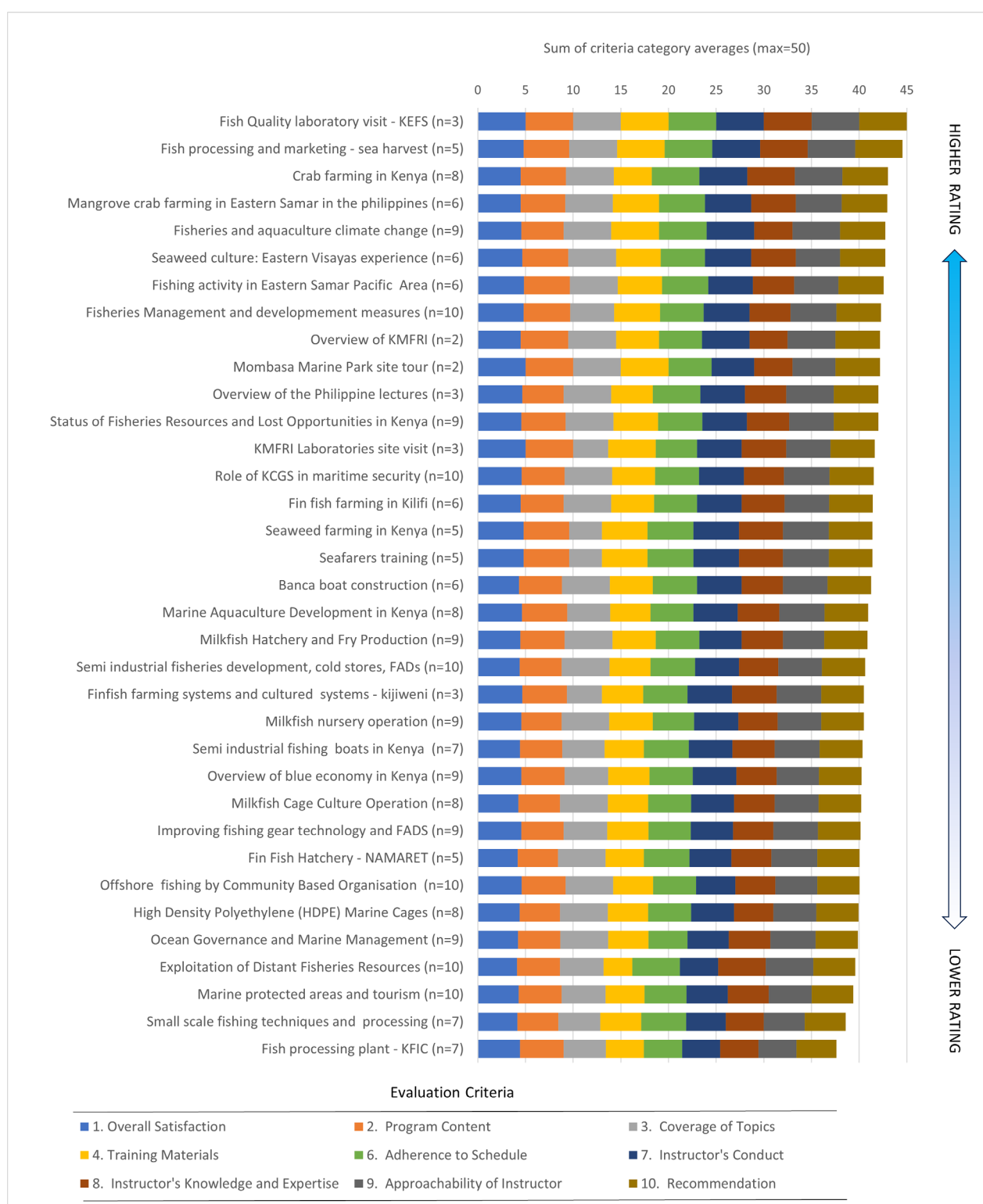


Figure 33. Graph showing the evaluation of training programs conducted in the First In-Country Training

In each evaluation, the top and bottom five programs were discussed and the reasons that led to their evaluation were discussed. The instructors were then informed of suggestions for improvement, particularly with regard to the lowest-ranked themes. The aim was to improve the quality of training contents in the next and subsequent training courses.

b) Evaluation of the training program and training management method for the trainee cohort

On the last day of the training, as a self-study activity for all trainees, a discussion was held on the training programs they had attended and on the training implementation of the project team, during which a unified evaluation of the whole trainee cohort was compiled and suggestions for improvement in the future training implementation were drawn. A summary of these discussions was compiled in the form of a presentation and presented by a representative selected from among the trainees at the W/G meeting held the day after the end of the training.

Table 14. Improvements Incorporated in the Second In-Country Training Course based on Review of the First In-Country Course

	Training title	Contents revised
1	Blue Economy in Kenya	The time used for presenting specific examples are not enough. Needs to simplify the general discussion of relevant laws and policies and spend more time on the actual government measures to promote fisheries and aquaculture.
2	Maritime Administration and Management	Lectures by KeFS and KMA overlapped on this topic. It will remain in the program, but shall be included in the KeFS' lecture on "Fisheries Management and Development" instead of being taught by KMA (Kenya Maritime Authority), which took charge of this topic last time, to eliminate duplication of content.
3	Roles of KPA and KMA in the blue economy	It was observed that the unique view of the blue economy from the standpoint of each institution was not fully explained. Reduce time allocations to 30 minutes each by eliminating duplication of content in both lectures.
4	Exploitation of Distant Water Fisheries Resources, Process Flow Description (HACCP) KFIC	The title of the lecture was 'Exploitation of distant fisheries resources & HACCP fish processing plant, but the tour of the KFIC facilities that followed the lecture was not included in the scope of the lecture content and did not provide a sufficient understanding, particularly with regard to the processing facilities. The next KFIC lecture should focus on seafood processing and omit the offshore fisheries portion, to match the content of the factory visit after the lecture. Offshore fisheries will be covered in the programs of "Access to Fisheries Resources and MCS" by KeFS.
5	Marine Protected Areas and Marine Tourism	As the content of the lecture is not sufficiently related to the marine park visit that will follow, the title and content should be changed, the title and content to "Overview of Marine Protected Areas and Tourism" and adapt the content to the site visit after the lecture. The site visit will be conducted at low tide so that the trainees can see the condition of the coral reefs.
6	Improved Fishing Gears and FADs	As the description of the technology remained narrow in meaning and little reference to the sustainability of fishing technology in the context of the blue economy. Explain not only technological improvements, but also their relevance to the "sustainability" of the fishery.
7	Offshore Fishing Technologies and Gears	Much time was spent on the longline fishery, with little explanation of other fishing methods. Explain not only longline methods but also other fishing methods used for offshore fishing and allow trainees to see the actual fishing gears.
8	Training on Weekend	There were complaints, especially from trainees coming from further afield, about the missing training weekends. This is not a content issue, but a logistical challenge. Rather than a waste of time, the dissatisfaction stemmed from the unfairness of the financial burden on trainees from further afield, as they were not paid for their stay during the weekend breaks. In the First Training, there was a break on weekends during the training period, but the next training will be continued. However, the number of programs during the weekend will be reduced to allow time for trainees to rest.
9	New Site Visits	Based on feedback from training participants that there were not enough field visit themes, the following new sites in Kwale County to visit were added; • Large-Scale Sardine Dagaa Processing Plant (Chinese company, Huawen) in Shimoni • SolCoolDry project in Mwazaro (a Go Blue project of EU): A research project on drying and value-addition for fish and other products using solar power.
10	Trainee selection criteria	It was found that some trainees were not newly recruited staff. Although the objectives were clearly stated in the training G/I, the trainee qualifications (the criteria by which each participating institution selects its trainees) were not clearly stated, and the following criteria regarding trainees were clarified, the following trainee composition and selection criteria for trainees should be clarified. • Composition of trainees: One trainee from each of the 5 coastal counties, two from KeFS, two from SDBEF, one from KMFRI, a total of ten (actually 11 trainees participated due to circumstances described below). KMFRI will send a trainee to the training first time. • Trainee selection criteria: 1) Bachelor's degree holders in a fisheries-related field, 2) assigned to a fisheries-related department, 3) not participated before in this training program, and 4) employed within the past 5 years. The above were listed in the G/I as the eligibility criteria in the invitation letter to the Second In-Country Training.

The W/G reviewed the implementation of the training and its evaluation through presentations by the trainees' representatives, and discussed specific ways to improve the training programs, especially for those programs that were not rated highly by the trainees, as well as ways to improve the overall program operation. The results were recorded in the W/G minutes and used as reference material for reflecting them in the preparation of the next In-Country training program.

For example, a total of three W/G meetings were held between the First and Second In-Country Training courses, which resulted in the specific improvements shown in Table 14 being included in the second training.

Improvement of Training Programs

Preparation of the next training program was carried out by the local project team (Project F/P and locally employed P/A) as and when possible after each training course. Discussions on improving the training content with the lecturers and field visit leaders were the main focus, and although it was necessary to change the program content and sequence from time to time to suit the convenience of the lecturers and field visit hosts, however, the structure of the basic training program remained consistent. As the training programs were repeated, the advance preparation gradually improved, and by the time the Japanese experts arrived in Kenya, the substantive training program had almost been determined.

After the training content was prepared, a G/I for the training and requests for cooperation for invited lecturers and site visit sites were issued from KeFS approximately two weeks before the start of the training, and requests for selection of trainees were sent to the participating institutions at the same time. A working group meeting was held about one week prior to the start of the training to report on the progress of the training preparations and to finalize the training program.

Most of the in-country trainings required sudden schedule changes due to the availability of lecturers, visiting site instructors, etc. However, the project field teams (F/P and T/A) were able to respond quickly and coordinate with the participants and affected lecturers, enabling the training to be completed successfully within the originally planned period.

For example, in the Second In-Country Training course, the training schedule had to be changed at short notice due to the following reasons: 1) exceptionally high rainfall in the training area along the Kenyan coast during the training period, which hampered the movement of trainees and field instructors; 2) the first day of training was declared a national holiday this year as a tree planting day; 3) a World Fishing Day meeting was organized during the training period, to which the participants of the project team and trainees were invited; 4) a private fish processing company in the site visit program refused to accept trainees during the busy fishing season. In the case of this training, most of the changes, such as weather conditions, were found after the start of the training and three among the 32 training programs could not be implemented. However, flexible measures, such as holding the opening ceremony on the second day, were efficiently taken by and between the project training management team and the trainees and lecturers, and other training programs could be implemented by changing the timing of the training. Table 15 shows the actual schedule of the second in-country training program.

Table 15. Programs of the Second In-Country Training

Day	Institution	Training title
1 st day	SDBEF	Overview of Blue economy
	KMA	Ocean governance and marine management
	BMA	Seafarer training and BMA facility tour
2 nd day	Project	Opening Ceremony
	KeFS	Vessel monitoring system (VMS)
	KCGS	Role of KCGS in securing maritime safety for sustainable blue economy
	KFIC	Fish processing and visit to KFIC processing plant
	SDBEF	Fisheries management and development measures Fisheries resources access & MCS
	KeFS	Fish quality laboratory
3 rd day	KMFRI	Status of fisheries resources and lost opportunity in Kenya
	KMFRI	Fisheries and aquaculture climate change
	KWS	Overview of marine protected areas and tourism
	KMFRI	Improving fishing gears and FADs
	KMFRI	KMFRI laboratories

Day	Institution	Training title
4 th day	CrabAlive Ltd.	Mangrove crab farming in Kenya
	BFAR	Construction of Philippine Banca boat with operation demonstration and fiberglass boat construction
5 th day	KMFRI /CGK	Finfish farming in coastal ponds in Kilifi
	SDBEF /CGK	Semi-industrial fisheries development, cold storage and FADs
	SDBEF	Observation of FADs
6 th day	Mlango wa Papa	Offshore fishing techniques and gears
7 th day	KMFRI /CGK	Seaweed farming in Kenya Visiting seaweed farming site
8 th day	INCA /KMFRI	Circular HDPE finfish farming system (field visit)
	KMFRI	Visiting NAMARET hatchery
	KMFRI	Finfish farming in Kenya (lecture)
	INCA	Overview of circular HDPE marine fish cages (lecture)
9 th day	KIRFI	SolCoolDry Go Blue project
	Project	Participating in World Fisheries Day Celebrations
	Huawen	Sardine processing and marketing (Chinese company)
10 th day	KMFRI	Small scale fishing techniques and processing

For the Third In-Country Training course, information was received just before the training was conducted that the host site (Crab Alive Ltd) of ‘Mangrove Crab Farming in Kenya’, only had the first day of the training available. As a result, the training started with a site visit to the aquaculture site, which was the furthest away from Mombasa, and the opening ceremony was held on the second day, which was an irregular schedule similar to the second training course. Table 16 shows the program for the Third In-Country Training.

It should be noted that the mangrove crab farm has successfully produced the long-awaited juvenile crabs after the previous training visit at the First Training course, making it the first successful artificial hatching of animal seedlings in Kenya. Due to this unusual schedule, it was possible to provide the trainees with the opportunity to see the historical juvenile crabs and receive a direct explanation from the operator (Fig. 34).

In the Third and Fourth In-Country Training course (Table 17), the Kenyan collaborators in the productions of Banca boat and HDPE fish cage manufactured during the Second In-Country Training period took the lead in demonstrating how to use them and explaining the respective technologies. Details of the training on these introduced Philippine fisheries technologies are explained later in Section 2.4.2, ‘Implementation of Training on the Introduction of Philippine Fisheries Technologies’.

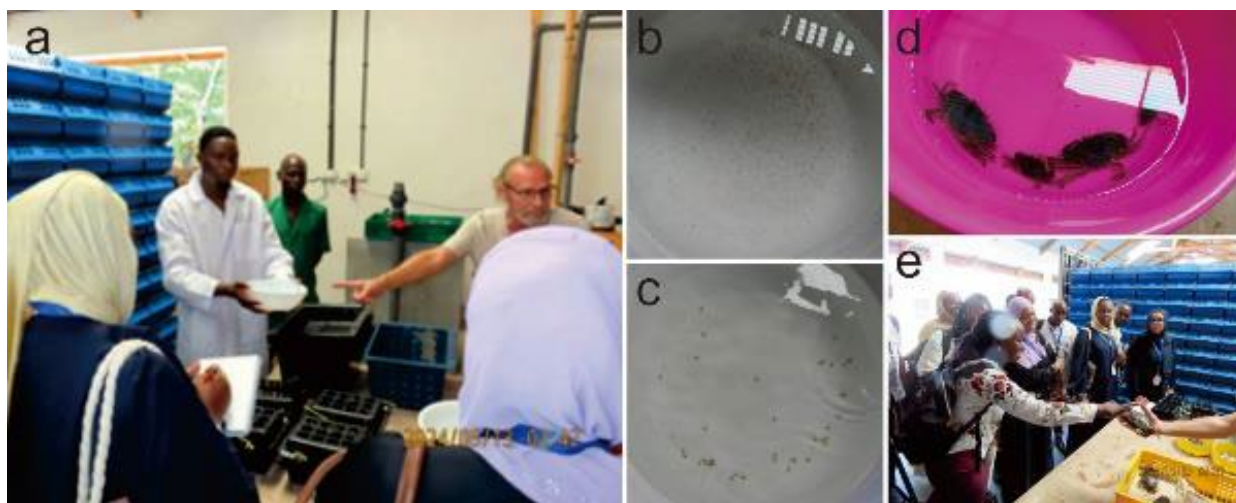


Figure 34. Visit to Crabs Alive Ltd. (Private company) in the Second In-Country course

a: the owner (Mr. Justin) showing the first artificially produced crablets in Kenya, b: crab larvae (Zoea stage) seen on the bottom of basin, c: the last floating stage larvae (Megalopa stage), d: Crablets grown to a size possible to sell as farming seeds, e: trainees touching a softshell crab (just after moulting, a gourmet foodstuff that can be cooked and eaten whole) that are produced at Crab Alive Ltd.

Table 16. Program of the Third In-Country Training

Day	Institution	Training title	Day	Institution	Training title
1 st day	CrabAlive Ltd.	Mangrove crab farming in Kenya	4 th day	SDBEF	Overview of Blue Economy in Kenya
	BMA	Seafarers training and BMA facility tour		KMA	Ocean governance and marine management
2 nd day	KFIC	Fisheries processing and KFIC facility tour		KMFRI	Fishing techniques in Kenya – gear, FADs, and vessels
	KCGS	Role of KCGS in securing maritime safety for sustainable blue economy		Japanese consultant	Small scale fishermen's Blue Economy alternative on the Kenyan coast
	KeFS	Fisheries management and development measures Fisheries resource access & MCS		Pwani Sea Boat Repair	Small scale offshore fishing vessels: Harnessing innovation: construction of FRP banca boat
	KeFS	Fish quality laboratory		Self-Study	Discussion on benefits of Banca boat and adoption
	KeFS	Vessel management system (VMS)	5 th day	CGK	Finfish farming in coastal pond at Kibokoni, Kilifi
3 rd day	KMFRI	Status of fisheries resources and lost opportunities	6 th day	Mlango wa Papa/KMFRI	Offshore fishing techniques and gears
	KMFRI	Fisheries and aquaculture climate change	7 th day	KMFRI /CGK	Seaweed farming in Kenya Visiting seaweed farm site
	KMFRI	KMFRI laboratories	8 th day	KMFRI	Marine aquaculture development in Kenya (lecture)
	KWS	Overview of marine protected areas and tourism		Japanese consultant	Harnessing innovation; HDPE mariculture cage integration in communities (lecture)
9 th day				KMFRI	NAMARET hatchery (visit)
				KMFRI	HDPE marine fish cage (visit)
				Japanese consultant	Practical session on HDPE cage fabrication
			10 th day	Huawen	Sardine processing and marketing (Chinese company)
				KIRDI	SolCoolDry Go Blue project
				KMFRI /CGK	Small scale fishing techniques and processing
				Sea Harvest	Fish processing and marketing

Table 17. Programs of Fourth In-Country Training

Day	Institution	Training title
1 st day	SDBEF	Overview of Blue Economy in Kenya
	KMA	Maritime governance and administration
	BMA	Seafarers training and BMA facility
2 nd day	KCGS	Role of KCGS securing maritime security for sustainable Blue Economy
	KFIC	Fish processing and visit to KFIC fish processing plant
	KeFS	Fisheries management and development measures
	KeFS	Fisheries resources access and MCS
	KeFS	Vessel monitoring system (VMS)
	KeFS	Fish quality laboratory
3 rd day	KMFRI	Status of fisheries resources and lost opportunities
	KMFRI	Fisheries and aquaculture climate change
	KMFRI	Fisheries technology: gears, FADs and fishing vessels
	KMFRI	KMFRI laboratories
	KWS	Overview of marine protected areas and visit to Mombasa marine park
4 th day	CrabAliveLtd.	Mangrove crab farming in Kenya
	Project	Small scale fishermen's Blue Economy alternative in Kenya cost
	Pwani Sea Boat Rep.	Small scale offshore fishing vessels Harnessing innovation: construction of FRP Banca boat
5 th day	KMFRI/CGK	Finfish farming in coastal ponds in Kilifi
	SDBEF/CGK	Semi-industrial fisheries dev., cold storage and FADs
	SDBEF	Observation of FADs
6 th day	Mlango wa Papa/KMFRI	Offshore fishing techniques and gears
7 th day	KMFRI/CGK	Seaweed farming in Kenya
8 th day	KMFRI	Fish farming in Kenya (lecture)
	Project	HDPE fish cage (lecture)
	KMFRI	Visit to NAMARET hatchery
	KMFRI	Circular HDPE fish cage (visit)
9 th day	Huawen	Sardine processing and marketing
	KIRDI	SolCoolDry Go Blue project
	KMFRI/CGK	Small scale fishing techniques and processing
10 th day	Sea Harvest.	Fish processing and marketing

Results of the Continual PDCA Cycle for Improvement of Training Programs

After each in-country training course, the results of the evaluation of each training program by evaluation indicators and the overall evaluation by the trainees have been presented. Although the difference in results between the first and the following training session was slight and no statistically significant difference was found, when looking at the trend of evaluations over the four sessions, it was clear that the evaluation of the training improved with each session, and a statistically significant difference between the first and the last training course was found at the 95% confidence limit (Fig. 35 left). Similarly, although there were some evaluation items for which no clear differences were seen, when the results for all four training courses are shown collectively, there was a trend towards higher evaluations as the training was repeated for all indicators (Fig. 35 right). Although, strictly speaking, the validity of comparing the results of the four evaluations remains questionable, as the trainee cohort in each course was different, it could be concluded that the method adopted by the project aiming to improve the training content through the PDCA cycle has achieved a certain level of success when looking at these results as a whole.

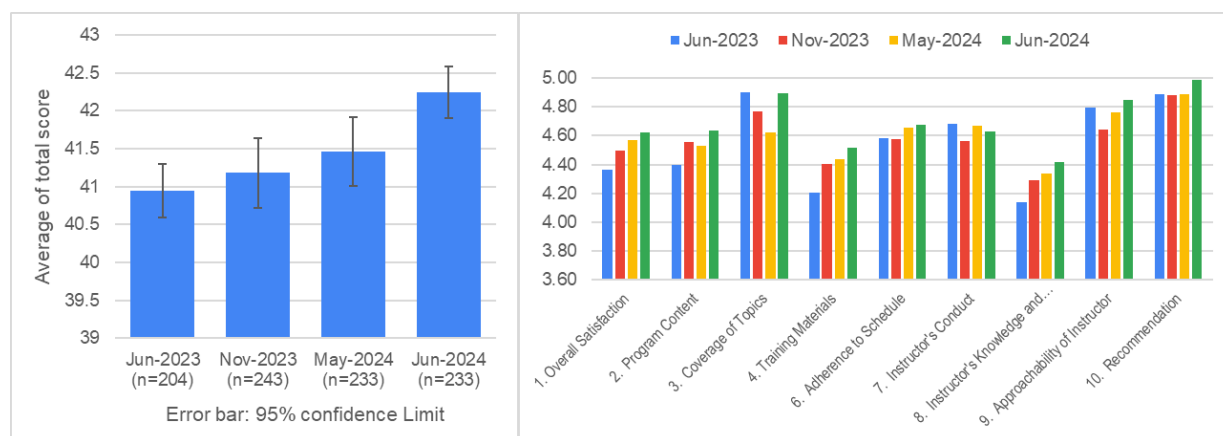


Figure 35. Overall evaluation of the in-country training courses held a total of four times (right) and changes in the evaluation results for each evaluation indicator.

2.5.2. Implementation of Training Programs on Philippines Fisheries Technology

One of the programs of the In-Country Training conducted in the project was the introduction of fisheries technology from the Philippines. The training was not merely a classroom-style online training based on theory, but also included demonstrations of the core technologies (small-scale fishing boat and aquaculture fish cage) using actual products after inviting Filipino technicians to Kenya and actually manufacturing them. This initiative was the most significant feature of the In-Country Training.

This section outlines the process that led to the introduction of this Philippine technology, followed by a specific account of how the training was implemented. It also discusses what impact the training has had, based on the evaluations by participants and stakeholders on the Kenyan side and the observed reactions of the stakeholders, and the significance of introducing Southeast Asian fisheries technology as in-country training.

Online Lectures on Philippine Fisheries Technologies

As described in Section ‘2.3.1: Incorporation of Online Lectures on Philippine Fisheries Technology into the Training Program’ in the Second Site Work period for formulating the First In-Country Training Program, a presentation using videos and other materials taken in advance was given on the fisheries situation in the Eastern Visayas region of the Philippines in a W/G meeting of this project, implying that the technology used there could lead to solutions to the current problems in the Kenyan marine fisheries industry. At the same time, it was strongly urged that the project not merely stop at presentation of online lectures on the current state of fisheries in the Philippines, but aim to introduce specific technologies to Kenya.

Therefore, prior to the Third Site Work period, the main activity of which was the implementation of the First In-Country Training, one of the Japanese consultants visited the Eastern Visayas region of the Philippines again and discussed specific details of the online lectures on the fisheries situation in the Philippines with the BFAR and NFRDI offices in the region. They also discussed practical ways to incorporate some of the core technologies that are shown in the online lectures in the later In-Country Training.

Specifically, lecturers were selected to conduct online training, the necessary internet connection arrangements were discussed and face-to-face interviews with Filipino lecturers were conducted. In some technical fields, private sector technicians were sought based on the Japanese consultant’s past experience of working in the Philippines, and cooperation was requested and agreed upon.

On the Philippine side, extremely active preparations were made for the success of the online lecture presentations and two rehearsal sessions were conducted. As a result of this careful preparation, the online lectures were conducted well during the last two days of the First In-Country Training (12-22 June 2023) with the content shown in Table 18. The online lectures were held in the main conference room of KMFRI borrowed free of charge and connected via excellent videoconferencing facility and a good internet connection. The soft files for presentation used in the online lectures shown in the table below are attached as Appendix 4.

Table 18. Online Lectures on the Philippine Fisheries Situation Presented in the First In-Country Training

Time and Date	Responsible organization	Lecture topics
21 st June 2023 9:00~9:15	BFAR-8	Philippine and Eastern Visayas Fisheries
9:25~9:55	BFAR-8	Milkfish hatchery operation and fry production
9:55~10:35	Mataro Aqua Farm (Private farm)	Milkfish nursery operation in ponds
10:35~11:15	INCA Ltd.	High density polyethylene marine cages in the Philippines
11:15~12:00	Mataro Aqua Farm (Private farm)	Milkfish cage culture operation
22 nd June 2023 10:10~10:15	BFAR-8	Seaweed culture: the Eastern Visayas Experience
10:00~10:50	NFRDI	Mangrove crab farming
10:50~11:20	BFAR-8	Small-scale fishing activities in Eastern Visayas
11:20~12:00	BFAR-8	Wooden boat construction
12:00~12:10	BFAR-8	Message from BFAR-8

In response to a strong request from the Kenyan side, the consultant proposed six training programs on specific technologies supporting the development of the Philippine fisheries sector as explained in the online lectures, which could be considered for practical training and facility construction in Kenya (Table 19). These programs were formally proposed at the W/G meeting in Kenya and the cooperation of the facility fabrication technicians and lecturers from the Philippines had already been confirmed for the implementation of each program. The presentation materials used for the explanations are in Appendix 5.

Table 19. Philippine Fisheries Technologies that are considered for Training Programs

No.	Training title	Overview
A-1	Construction and installation of high-density polyethylene (HDPE) aquaculture floating cage	Milkfish and rabbitfish are being cultured on a trial basis in tilapia cages in Kenyan sea, but the poor strength of the floating cages is becoming a problem due to the effects of ocean waves and currents. Thus, a cage made of high-strength material of HDPE pipes will be constructed and installed.
A-2	Mangrove crab seedling business by capturing natural larvae and nursery rearing of the larvae	The price and demand for mangrove crabs are high in all coastal counties, but the shortage of seedlings for farming or fattening is a bottleneck for the extension. Introduce an appropriate use of natural crab larvae and the nursery culture system for supply of the seedlings.
A-3	Longline seaweed farming	The off-bottom cultivation method in Kenya, which is practiced in the intertidal zone, has large diurnal variations in the farming environment and is easily exposed to diseases. A Philippine-style longline system will be introduced off the coast where the cultural environment is stable.
A-4	Fishpond construction for finfish nursery	Practice the construction of coastal wetland aquaculture ponds that utilize tide fluctuation to manage seawater in/out-flows suitable for the production of A1 and A2 aquaculture seedlings.
B-1	Improvement of small fishing vessels to enable offshore fishing	There are surplus fishing resources off the coast of Kenya, but artisanal fishermen cannot reach the offshore fishing grounds due to the poor navigational capacity of their fishing vessels. Build a Philippine banca-type fishing boat that is affordable and enables them to reach the fishing grounds.
B-2	Appropriate offshore fishing methods for small-scale fishers with FAD (fish aggregating device)	In order to develop a fishing method suitable for artisanal fishermen who have become able to operate offshore due to improved navigation capabilities of their fishing boats, trial fishing with improved line fishing methods is conducted with the introduction of the Philippines-type low-cost FAD.

However, these fisheries technologies were proposed based on the results of a survey of the current situation of fisheries along the Kenyan coast, which lasted only about a month, and based on past experience of Japanese experts and two recent short-term field surveys in the Philippines. Therefore, a thorough review from the Kenyan side is essential to determine whether they are truly compatible with the current issues on the Kenyan side.

The project pursues a strategy of improving the capacity of the trainees to perceive the blue economy through a training implementation process based on a participatory and interactive exchange of views. In line with this strategy, the project decided not to introduce these fisheries technologies unilaterally into the training program, but to propose them to the Kenyan side and leave the final decision to the Kenyan side.

Specifically, at the W/G meeting prior to the implementation of the First In-Country Training, a Japanese consultant explained to the Kenyan members the outlines of the proposed technologies using video footage taken in the Philippines and their training implementation methods described in the table above. The same presentation was also made to the trainees, who were then given a detailed technical explanation of the relevant technologies in on-line lectures by Filipino experts during the training program. This helped the trainees and W/G members on the Kenyan side to deepen their understanding of the proposals.

The trainees were asked to consider and prioritized the extent to which the six technologies could contribute to solving Kenya's current challenges during a plenary session on the last day. The results of prioritization are shown in Table 20.

Table 20. Trainees' Prioritization of Philippine Technologies for incorporation into the training program

Priority	Technology for transfer to Kenya	Priority	Technology for transfer to Kenya
No. 1	Construction of HDPE marine cage	No. 4	Longline seaweed farming method
No. 2	Offshore fishing method with FADs	No. 5	Nursery operation for mangrove crab
No. 3	Construction of Banca-boat	No. 6	Sluice gate construction

At the W/G meeting held the day after the end of the First In-Country Training, the trainee representatives presented the results of their priorities and also explained the reasons. Based on the presentations, the final priorities on the Kenyan side were decided after discussions at the W/G meeting. As a result of the discussions between the trainees and the W/G members, out of the six technologies proposed, the construction of the sluice gate for the aquaculture pond was eliminated on the grounds that there was no need to invite Filipino engineers and the Kenyans themselves would be able to construct it adequately. The final priorities for the remaining five technologies for introduction into Kenyan through these training programs were determined as shown in Table 21.

Table 21. Final Prioritization of Philippines Technologies to Introduce to Kenya through the Training Program decided by the Working Group

Priority	Technology for transfer to Kenya	Priority	Technology for transfer to Kenya
No. 1	Construction of HDPE marine cage	No. 4	Nursery operation for mangrove crab
No. 2	Construction of Banca-boat	No. 5	Longline seaweed farming method
No. 3	Offshore fishing method with FADs		

Discussions in the W/G on prioritization for the introduction of Filipino technologies were very active, and the exchange of views on the priority of seaweed farming was particularly noteworthy. Longline seaweed farming was highly favored as the most needed technology in Kenya when it was proposed to the W/G meeting held prior to the First In-Country Training implementation. Current seaweed farming in Kenya uses a method whereby short stakes are erected on shallow intertidal beaches and seaweed seedlings are cultured on ropes stretched between the stakes (Fig. 36). However, this method results in large diurnal temperature fluctuations, high temperatures at low tides as they are exposed to air and low temperatures at high tides as they submerge to the seabed, which makes the seaweed susceptible to a disease called ice-ice disease. This disease reduces the efficiency of healthy seedling reproduction and is a major obstacle to expanding the culture area. The same problem was experienced in the Philippines around 2000, where a switch was made to a longline aquaculture method (Fig. 37), where seaweed seedlings are suspended from ropes set slightly offshore on the surface of the seawater, in order to keep the seaweed in the sea at a constant temperature. This method, which minimizes the effects of temperature variation and promotes healthy seaweed growth, is now mainstream in the Philippines and has been shown to be economically sustainable. Therefore, the longline aquaculture method was considered to be effective also in Kenya.



Figure 36. Stake seaweed farming in the intertidal zone in Kenya.



Figure 37. Longline seaweed farming offshore water in the Philippines

However, one of the female trainees who attended the online lecture pointed out that a working boat is needed to conduct the offshore longline method, which would prevent the women who currently make up almost 100% of Kenyan seaweed farming from participating. Therefore, longline aquaculture was given a lower priority and was ranked fourth by the trainees' meeting. The results and reasons for this were presented at the W/G meeting held the day after the end of the First In-Country Training, which ultimately resulted in the lowest priority at the W/G meeting. The female trainees, although fully aware of the technical advantages, gave more weight to the gender perspective and, as a result, decided not to prioritize the introduction of longline aquaculture. This opinion was supported by the W/G members. It can be said that a comprehensive decision was made, taking into account not only technological and economic sustainability, but also social sustainability. This process is a manifestation of the aim of the training, which is to contribute to the fostering of blue economy thinking skills through interactive engagement between lecturers and students. The decision to incorporate a social perspective is expected to contribute to the sustainable development of seaweed farming in Kenya in the future.

Discussion of priorities for milkfish and mangrove crab farming was also very interesting from the perspective of blue economy development in Kenya. There were questions raised from a blue economy perspective about the technologies proposed by Japanese experts on mangrove crab seedling production and milkfish aquaculture as being suitable for Kenya's current fisheries challenges. Indeed, fish and crustacean aquaculture generally requires expensive and often high animal protein content feed, and there is a social equity issue of limited benefit effects for small-scale fishermen with low capital capacity. It can also be seen as problematic from the perspective of environmental sustainability, as it requires more fishmeal than the produced fish weight by aquaculture. Therefore, seaweed and shellfish farming, which do not require feed, is considered a more sustainable aquaculture development in line with the blue economy development. No-feed aquaculture for shells and seaweed have been chosen for so called Blue-Growth development by JICA.

Furthermore, in Kenya, there are still no marine aquaculture animal species for which seed production has been successful, and small wild animals are used to replace farmed seedlings, so crab farming is not environmentally sustainable in this aspect either. In tropical regions, crab farming is often carried out in breeding ponds created by cutting through mangrove forests, which is also undesirable from an environmental sustainability perspective. In addition, feed for marine aquaculture is not commercially available in Kenya and is generally cultured animals are fed with wild juveniles, small fish and crustaceans caught in the mangrove swamps. Thus, current marine fish and crustacean aquaculture in Kenya remains at a fairly low blue economy standard in terms of social and environmental sustainability. Under these circumstances, it is not surprising that some consider it inappropriate for fish and crustacean aquaculture development to be implemented in this Blue Economy training.

However, the fact that Kenya's blue economy standard (i.e., overall sustainability from economic, social and environmental perspective) for marine fish and crustacean farming is extremely low suggests that there is significant room for improvement. For example, if the current score is minus 100 points and there is a proposed intervention that would reduce it to minus 50 points, this would be a net positive development of 50 points. If the various non-blue economy aspects mentioned above could be recognized realistically and the potential for improvement through introduced technology from the Philippines could be demonstrated in the training programs, this would contribute to improving the trainees' competence in blue economy considerations. The technology introduced from the Philippines may not achieve ideal blue economy aquaculture, but it will provide an opportunity to differentiate from the current very low blue economy status and to look at further shortfalls to be improved. It is the aim of this project to provide trainees with a way of thinking that focuses on the process rather than the apparent outcome of the training.

For example, at a site where a private company engaged in mangrove crab aquaculture, which was visited each time during this training, a Filipino specialist on the same species of hatchery technology was employed for more than a year, and by the Third In-Country training, the first artificial seedling production of hatchery fry in the country had been successfully achieved. The training cohorts witnessed technological developments each time, and in the last round, they were able to confirm the distribution of seedling crablets to the neighboring fishermen's cooperatives to start intermediate crab rearing projects. The farm is also involved in an awareness-raising project where tilapia fish are raised and fed to crabs instead of wild small mangrove fishes and crustaceans, and also mangrove plantations are carried out to purify the effluents from

the crab rearing tanks. In another example, the fish and shrimp ponds in Kibokoni, Kilifi County, which are visited every time during these training courses, were originally constructed on the coast where there were mangrove swamps, but now when the trainees visit for training, mangrove seedlings are purchased as part of the training rewards and planted by the trainees. It is highly likely that this type of training will help to foster the trainees' view of the blue economy as what they see and hear during these training sessions are good examples of increasing blue economy standard.

The fact that the introduction of HDPE fish cage construction technology based on milkfish aquaculture in the Philippines was ranked as priority number one and mangrove crab aquaculture as priority number four in the trainees and W/G members' independent evaluation is fully understandable if one knows the current situation of aquaculture actually conducted on the Kenyan coast. The discussions among the trainees and W/G members of this project confirmed that they were not bound by rigid preconceptions that because it is blue economy development, support should be provided for the development of seaweed and shellfish, etc., which have a low environmental impact, but that they were observing the current situation of fish and crustacean farming in Kenya from an objective standpoint. It was believed that the project's training policy, which is interactive and emphasizes the training process, is appropriate.

Construction of Banca Boat and HDPE Aquaculture Cage as Training Programs.

As mentioned above, during the Third Site Work period, the priorities of six advanced Philippine fisheries technologies were confirmed by the training participants and W/G members from the Kenyan side. This confirmation was in response to a strong request from the Kenyan side to introduce the technologies not only theoretically through lectures, but also through actual training programs. In order to actually realize such training, facilities and equipment to support the priority technologies are required, but of course these do not exist in Kenya, so Filipino technicians need to be invited to Kenya and manufactured before the training on relevant technology.

The project was envisaged to implement training programs, and in terms of the budget, although there were expenses for meetings for the implementation of lectures, the initial estimates did not include expenses for inviting technicians from abroad or purchasing materials for the production of large-scale facilities and equipment. Therefore, the project proposed to change the original plan to visit three countries for Third-Country Training program to only two, and to implement a training program on the introduction of Philippine technology, which was strongly requested by the Kenyan side, without significantly changing the overall costs, and this was approved by JICA. The training program for the introduction of Philippine technology, which was made possible by this change in the budget item without changing the overall total, was limited to accommodate the top two technologies in Kenya's order of priority, specifically 1) High-Density Polyethylene (HDPE) aquaculture cage and 2) small-scale fishing vessel construction for offshore fishing (Banca Boat). It should be noted that the fish aggregate device (FAD) was ranked second in the trainees' evaluation, but was replaced by the Banca boat in the final evaluation by the W/G. This change is a result of policy-level considerations to avoid duplication, as the FAD introduction is being implemented under the 'Strengthening Livelihoods, Food Security and Maritime Security through Improving the Resilience of Reef-based Fishing Communities in Indian Ocean African Countries' funded by the Japanese Government and implemented by the FAO. This is a result of additional policy-level considerations by the

W/G to avoid duplication.

Implementation of Training Programs for the Introduction of Philippine Fisheries Technology

The training programs on the two selected Philippine fisheries technologies were conducted as training topics listed in Table 22 during the Second In-Country Training (13-22 November 2023).

Table 22. Training Programs on the Selected Philippine Fisheries Technology

Date and time	Lecturers	Training topics
16 Nov. 2023 13:45~16:15	Dan De San Miguel (BFAR-8) Ronnell Macabocsit (a Private boatbuilder)	Construction of Banca fishing boat
22 Nov. 2023 10:10~12:00	Don Reorizo (INCA Philippines Inc.) Crisanto Saavedra (INCA Philippines Inc.)	Construction of HDPE marine fish cage
10:00~10:50	Don Reorizo (INCA Philippines Inc.)	HDPE marine fish cage (lecture)

These trainings were conducted using replicated training equipment in Kenya, a small-scale fishing vessel actually fishing in the offshore fishing grounds of the Philippines and the most widespread HDPE aquaculture fish cage in the Philippines. The fishing boat and fish cage were built by a team of two Filipino technicians each in cooperation with the Kenyan technicians, one in charge of training and the other of production, who travelled to Kenya about a month ago. The Japanese consultant made a third trip to the Philippines to sign a contract for their activities in Kenya and to provide travel support for one of the Filipino technicians who had never travelled abroad.

The HDPE fish cage was built at NAMARET, KMFRI branch office in Shimoni, Kwale County, by a team formed by KMFRI comprising local fishermen, NAMARET staff and Mombasa HQ personnel in collaboration with two specialists from INCA Philippines Ltd. The banca fishing boat was built at Shella Beach, Malindi, Kilifi District, in collaboration with a local shipbuilding company (Pwani Sea Boat Repair) that builds fishing boats and other small craft in the area and two Filipino specialists. It should be noted that the private company's appointment as the substantive C/P agency for this training program was pre-approved at a W/G meeting, which included the SDBEF and KeFS Mombasa office directors, as well as a representative of the Kilifi Fisheries Department.

All necessary equipment and materials were procured locally, with the exception of the propeller and rudder, which were brought from the Philippines. The preparation started two months before the Japanese experts' travel by the Project Assistant (P/A). After the arrival of the Japanese experts, the equipment was purchased mainly in Mombasa and transported to the respective construction sites.

Procurement of Materials and Equipment for the Production of Philippine Fisheries Technology (Banca Boats and HDPE Cage).

The procurement of materials and equipment required for the local construction of the facility was carried out in the following steps. First, a detailed list of materials and equipment required for the facility (Bill of Quantity: BOQ) was created based on the basic specifications specified by the project side and finalized through discussions with Filipino specialists. Based on this list, the P/A confirmed where materials and equipment would be obtained and confirmed that almost all materials could be procured within Kenya. Based on this, quotations based on local purchases were started to be obtained in August 2023,

approximately three months before the training implementation.

Among the fish cage construction processes, the fabrication of concrete anchor blocks, which require time for concrete curing, was carried out and completed under the supervision of the P/A from early to mid-October, before the Filipino specialists arrived in Kenya. Other materials and equipment were procured by mid-October, purchased upon arrival in Kenya by Japanese experts, and transported to the construction site. A detailed list of suppliers and prices of all equipment and materials was prepared to enable other institutions to re-build fishing boats and fish cages in Kenya, and was presented by the project team at the 7th W/G meeting (23 November 2023) held after the 2nd In-Country Training (Appendix 6).

Of the fishing boat building materials, rudders and propellers were purchased in the Philippines and brought in, as they were not available in Kenya. In addition, the shipbuilding engineer's personal tools that he was comfortable with (chisels, hacksaw, axe, etc.) were brought from the Philippines as his checked in baggage. As for the fish cage materials, there was nothing that could not be procured locally, but as for the diving equipment (BCD, wetsuits, fins, masks, etc.), personal possessions were brought in as checked-in baggage.

Construction of small Philippine-type small-scale fishing boats (Banca boats).

This section describes the construction of small Philippine-type fishing boat (Banca boat) that the project has decided to introduce through a training program. The technical details of the construction process are described in the Manual on Banca Boat Construction in Kenya (Appendix 7).

1) Principal Specification

There is reportedly a surplus of large fish stocks off the Kenyan coast that migrate through the Indian Ocean, but many small-scale fishermen are unable to catch them due to the limited navigational capacity of their fishing vessels. In a similar environment, fishermen in coastal villages on the Pacific side of the Philippine Islands use small fishing vessels called Banca boat locally with slender, streamlined hulls and double outriggers, which are fast and resistant to rolling, to catch large tuna species. Therefore, the specification was set to precisely reproduce a Banca fishing boat of a 26-foot length with a 13-hp small inboard engine (Fig. 38) that is actually used for offshore large migratory fishing in the Guiuan region of Eastern Samar, where the Japanese experts have past working experience.

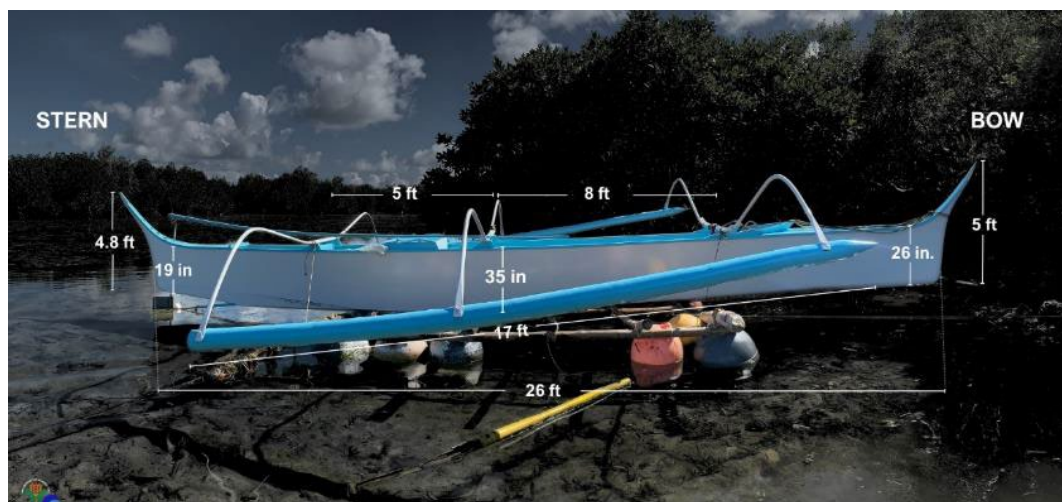


Figure 38. A fishing boat of the same model used in Guiuan, Eastern Samar, as a Banca boat built in Kenya

The vessel is extremely slim, with a width of 84 cm at its widest point. The engine is a small general-purpose engine used to power agricultural and other equipment and is located in the central part of the vessel. The centre of the hull bottom is made of solid single timber, while the outer panels of the side sections are made of marine plywood and are lightweight. Outriggers are made of bamboo with a diameter of about 10 cm, but PVC pipes of about the same thickness are sometimes used as an alternative. Three outriggers are attached to the hull with a curved piece of 1-inch galvanized steel pipe. This mounting component was originally made by bending bamboo while it was heated, but steel pipes are still widely used locally.

2) Selection of Boat Building Specialists

The selection of Boat Builders was done through interviews with nominees of the heads of the Guiuan Branch of BFAR Office 8 and NFRDI regional office accompanied by officials from the same offices. First, a prominent Banca boat carpenter in the region was interviewed and approached about being sent to Kenya, but he declined on the grounds of his advanced age. The consultant then met his apprentice, a local boat builder who was constructing fishing boats as small-scale business at his home while practicing fishing large tunas offshore, and with his and his family's approval, nominated him as the Boat Builder to be dispatched to Kenya. In addition, the Provincial Fisheries Officer (PFO) of BFAR-8, who provided the online lecture on construction of Philippine type small fishing boat and offshore small-scale fishing during the First In-Country Training and had jurisdiction over the Boat Builder's residential area, was appointed as Boat Instructor. His role is to assist Boat Builder in construction of Banca boat and to provide training effectively on boatbuilding for Kenyan beneficiaries. The duration of the dispatched Boat Builder was set at 37 days, which was required for the shipbuilding process, while the Boat Instructor departed two weeks later (using the same flight as the next fish cage specialists) and was dispatched for 25 days.

3) Arrangement for Construction of Banca Boat

The construction of Banca boat took place at Shella beach in Malindi, Kilifi County (Fig. 39). This beach is the location of the Malindi Fisheries Branch office of Kilifi County and is home to several small businesses engaged in boat building for wooden and Fiber Reinforced Plastic (FRP) vessels.



Figure 39. Location of Banca boat building site: Shella beach, Malindi, Kilifi County

There are few landing sites along the Kenyan coast where small-scale fishing vessel construction takes place at a commercial level, and Shella beach at Malindi, where the Government Fisheries Agency is also located, is naturally considered as a suitable site for the construction of Banca boat for the project. Therefore, when the local construction of Banca boat was adopted at the 3rd W/G meeting, the Deputy Director of the Kilifi County Fisheries Department was selected to head the subcommittee in charge of the boat building project. At the same time, Pwani Sea Boat Repair, a leading boatbuilder at Shella beach, was appointed as the collaborator for Banca boat building activities.

The capital capacity of BMUs alone is generally not sufficient to build fishing vessels with high navigational capacity, and the Government has recognized the importance of Public Private Partnership (PPP) initiatives for supporting small-scale fishermen to enter the offshore fishing industry. The selection of Shella beach as the site for the construction of the Banca boat in this project and the decision to have a private operator as the technical host organization is in line with the government policy.

Small-scale fishing boats with a slender hull and double outriggers, like the Philippine Banca boat, are also found in Kenya and are called Ngalawa (Fig. 40). Both are believed to derive from the island countries in Southeast Asia, and spread to a wide range of regions in the Pacific and Indian Oceans along with the migration of the Austronesian language people. While the Ngalawa boat retains its original form with a hull dugout from a log and double outrigger with a sail, the Banca boat is an advanced type with a marine plywood hull and a small inboard engine, which is lighter and has superior driving power. Therefore, Kenyan fisheries professionals can concretely imagine the navigational capabilities of the Banca boat when explained conceptually. The representative of Pwani Sea Boat Repair, a company specializing in the construction of FRP fishing boats, was interested in the project from the beginning, and had expressed a positive willingness to cooperate in the Banca boat construction, for example by offering accommodation for Filipino technicians at his home free of charge. The company has no FRP ship design engineer, and currently takes a traditional wooden ship mold and copies the hull form to replicate and sell FRP ships.

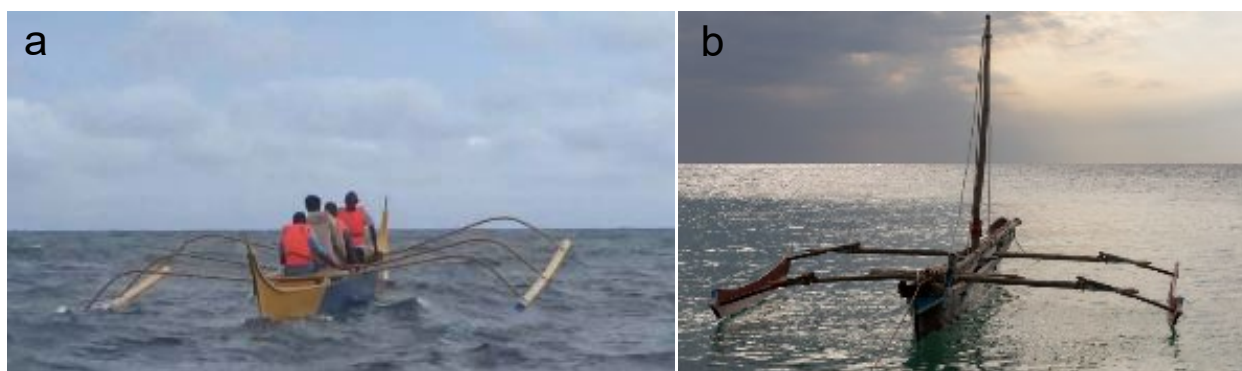


Figure 40. Banca Fishing boat (a) and Ngalawa fishing boat (b)

Source for the right photo: <https://en.wikipedia.org/wiki/Ngalawa>

Based on these backgrounds, Pwani Sea Boat Repair was appointed as a cooperative partner for this project, and an agreement was signed on the terms and conditions of boat building activities, which was also witnessed by the persons in charge at the branch office of County Fisheries Department, and a representative of the BMU (Beach Management Unit). The boat building activities took place next to the

company's store (Fig. 41) with free electricity supply for the woodworking by power tools. In addition, the project side purchased blue tarps, and Pwani Sea Boat Repair used its own materials for tent poles to secure a safe work area by putting up a tent curtain to protect a large area from rainfall during the work. The boat building work was supervised by Pwani Sea Boat Repair which hired at the project's expense selected four staffs, a highly skilled carpenter, an assistant, a night watchman, and a videographer for documentation purposes.



Figure 41. Boat Building Works: Keel being hollowed out by hatchet (a), Ribs being assembled (b).

4) Building Wooden Banca Boat: Environmental Sustainability and Necessary Craftsmanship

Materials and necessary power tools were purchased primarily in Mombasa and brought to the construction site at Malindi. While the hull of the Banca boat is made of water-resistant marine plywood, the keel retains the vestiges of the Ngalawa boat and is made of a single piece of natural solid wood. The newly constructed 26-foot-long fishing boat requires a plank measuring 8 m long by 72 cm wide by 5 cm thick, which requires the felling of a large tree more than one meter in diameter. The project attempted to obtain the lumber from Lamu Island in Lamu County, where wooden boats are still being built, but this size (especially one meeting the required length) was not available.

Red Lauan (*Shorea negrosensis*) is used in the locality of Filipino Boat Builder (Samar Island). This tree, which can reach 50 m in height and 2 m in diameter, grows straight like a cedar, making it possible to cut out long lumber. As furniture or building material, it is said to be susceptible to insects and does not preserve well, but as ship material, it has the advantage of being soft wood and easy to process. In the end, it was decided to use the mango tree as an alternative, which is similarly easy to process and is used as a dugout wood for Ngalawa boats in Kenya. The tree reaches a height of 30 m and a trunk thickness of more than 3 m, but branches at a low position to form a large canopy. Therefore, although the tree met the width requirement, the required 8-meter length of timber could not be found. After consulting with a Filipino Boat Builder, it was eventually decided to have half-length lumbers to be joined together lengthwise. Because of the time required to obtain and join the lumber, the boat building process was delayed by about one week from the original schedule.

It may be possible to find a red lauan-like timber in Kenya from the lessons learned this time, but whatever the tree species, it is not appropriate from an environmental sustainability perspective to cut down a large tree of the required size. It would be difficult to build a large number of the wooden Banca boats constructed as this time within Kenya. In fact, the Philippines is in the same situation, with the national fisheries authority (i.e., BFAR) already discouraging the construction of wooden Banca boats and

recommending the adoption of FRP fishing boats of the same design or hybrid boats that use marine plywood for the hull planking and FRP material for the keel.

Furthermore, it is impossible for the Kenyan carpenter to master the boat building skills of Filipino Boat Builder in this one boat building process, as artisanal skills of master craftsman are extensively used in the construction of wooden boats. In the first place, the Filipino Boat Builder builds fishing boats without using any drawings at all, so the construction of Banca boats is not suitable for boat building training in the form of a workshop. Like the master craftsmen of traditional facilities, the details of all the processes necessary for construction are all in his brain, and he builds based on his experience. Due to the nature of the required skills, it takes several years to master the artisanal techniques through an apprenticeship learning process in which several vessels are built together. In conclusion, it would be extremely difficult for the Kenyans alone who worked together with the Filipino Boat Builder to duplicate the fishing boat with the same level of finishing as the Banca boat the project has just built.

5) Training on Banca Boat Operation and Trial Fishing

Although the boat building process was delayed due to the time required to procure and joint the pieces of lumber for keel, the construction team at Malindi was able to make up for the delay by working many overtime hours toward the end of construction. Due in part to the personality of the friendly Filipino specialist, overtime work was initiated voluntarily between the two parties, and a good relationship was maintained with Pwani Sea Boat Repair. Nevertheless, the boat was completed only two days before Filipino boat building specialists' leaving Malindi to return to the Philippines, and the scheduled two days of boat operation and trial fishing training had to be shortened to one day.

Two Filipino specialists trained on boat operation for a total of six Kenyan fishermen: two from Mkunguni beach in Kwale County and one from Wesa beach in Kilifi County (these three were nominated by Fisheries Departments of the respective counties as they are fishing currently with Ngalawa boats), and three fishermen from the local Malindi fishing community who were nominated by Pwani Sea Boat Repair. The boat-operation training session took place on 23rd November 2023 near Shella beach, once in the morning and once in the afternoon. Attendees of the W/G meeting held on the same day took advantage of their lunch hour to observe the Banca boat built at Shella Beach and heard on evaluations of the boats from the fishermen who participated to the boat-operation training. The fishermen reported that the boat was easy to maneuver, and the speed was high because the Banca boat cuts through the waves unlike the ordinary FRP fishing boats with a flat bottom which ride on them.

Furthermore, after the Filipino technicians and Japanese consultant left the country, trial fishing was conducted for one week (until the end of November) by three Malindi crew members who participated in the boat operation training. The terms regarding the implementation of trial fishing were agreed with Pwani Sea Boat Repair, the company that is expected to manage substantially the Banca boat until a government office takes over.

The trial fishing consisted of three trips to fishing grounds at different distances, and the results are shown in Table 23. It was in the offshore fishing season of Kaskazi when sea conditions are calm, and on the third outing they were able to spend two days fishing offshore at Kingspot (located 63 km northeast of Malindi). Unfortunately, the catch was small due to the bright moonlight night.

Table 23. Results of Trial Fishing with the newly built Banca boat

Date	2023/11/25	2023/11/27	2023/11/28~29
Catch	Baracuda (1pc): 5.2kg Kingfish (1pc): 5.3kg	Changu* (1pc): 1.5kg Some low value fish	Baracuda (2pcs): 4kg Kingfish (1pc): 6kg
Fishing Ground	Shale of Che Shale	Near Malindi marine park	Kingspot (63km NW from Malindi), -02°46'14.63", 040°29'08.00"
Fuel used	6L	1.5L	20L
Duration	7hrs (7am to 2pm)	6hrs (7am to 1pm)	24hrs (1:30pm~Next day0:30pm) night fishing
Crew	2 persons	3persons	3persons
Fishing Method	Trolling	Handline	Handline & trolling

* Changu fish: *Lethrinus rubrioperculatus*

The completed Banca boat (Fig. 42) proved to be fast and fuel efficient. For example, to sail to Kingspot, an offshore fishing area, a commonly used small FRP boat with a Yamaha 15 hp outboard engine (Fig. 43) required at least 40 liters of petrol and two-stroke oil, while the banca boat required only 20 liters of petrol and less time for the round trip. For the fishermen, the difference in fuel consumption was substantial. However, as the fuel consumption of the FRP boat with outboard motor is based on the experience of fishermen who know the fishing grounds well, it was decided to verify the fuel consumption of the FRP boat with outboard motor later, as explained below, using a more objective comparison method where both types of fishing boats were used to fish along the same route.



Figure 42. Banca boat constructed by the project
(Small wooden boat with 13hp inboard engine)



Figure 43. Small FRP boat commonly used for
fishing with 15hp outboard engine

A comparative trial of both types of small fishing vessels was conducted from 17-19 February 2024, from Mayungu beach, which is located approximately 9 km south of Malindi and is the largest landing site in Kilifi County. The selection of participating fishermen and negotiation of terms and conditions were carried out with the assistance of a Kilifi County fisheries extension officer, who is responsible for the area. The trials were conducted under the supervision of the project local team (Project F/P and T/A). The consultant was not in Kenya at the time of the trial and advised on planning and supervised the activity from Japan.

Both types of vessels simultaneously set out from Mayungu beach to the same offshore fishing grounds and fuel consumption was compared. The trips were repeated three times to three different fishing grounds (Fig. 44) and the average fuel consumption of each fishing vessel was statistically compared.

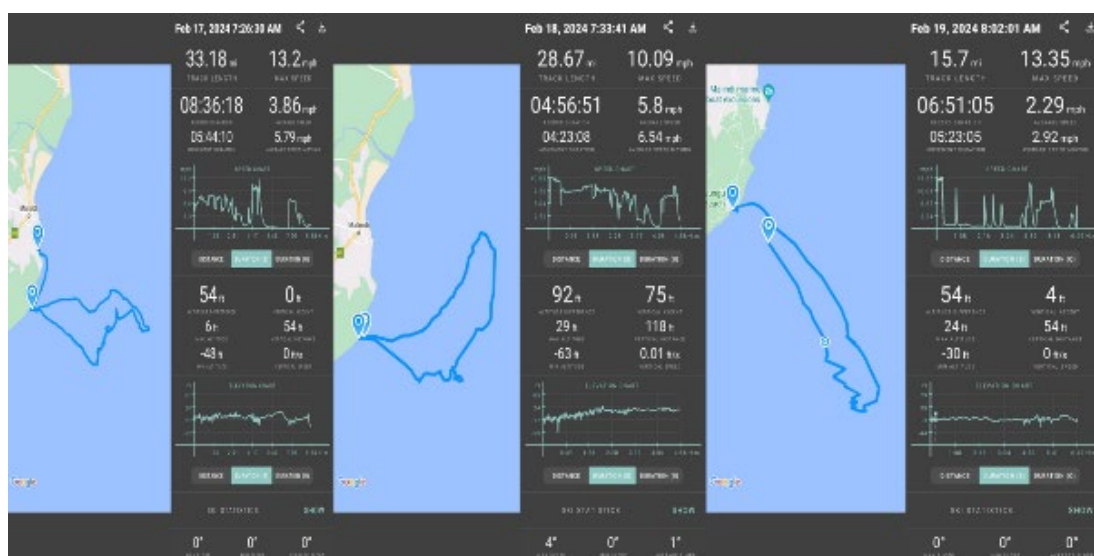
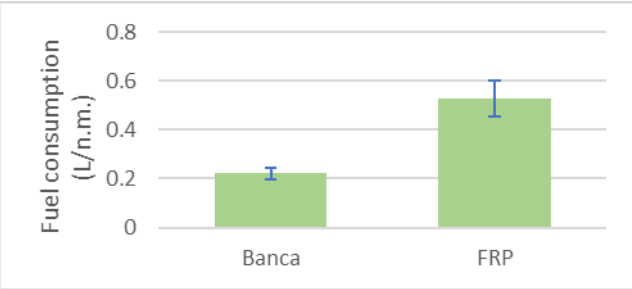


Figure 44. Trails of fishing vessels participating in the fuel efficiency comparison trials that departed from Mayungu beach (three times)

The results clearly confirmed that the Banca boat had less than half the fuel consumption of the FRP outboard motor boat (Table 24). These results were reported at the 8th W/G meeting on 30 January 2024, where it was recommended that similar operational demonstrations be carried out at other regional landing sites.

Table 24. Results of Fuel Consumption Trail between Banca boat and FRP outboard fishing boat

Type of Fishing Vessel	Banca Boat with Inboard Engine (13HP)			FRP Boat with Outboard Engine (15HP)		
Trial	First	Second	Third	First	Second	Third
Date of trial	17 th Feb.	18 th Feb.	19 th Feb.	17 th Feb.	18 th Feb.	19 th Feb.
Distance in nautical mile	25.11	25.23	15.21	25.11	25.23	15.21
Fuel used in litters	6.5 L	7 L	3.5 L	16 L	17 L	8 L
Crew (person)	2	3	2	3	3	2
Fuel consumption rate (L/naut. mile)	0.225	0.239	0.200	0.554	0.580	0.457
Average	0.224 L/nautical mile			0.530 L/nautical mile		
95% confidence limit	0.0223 L/nautical mile			0.0733 L/nautical mile		
Figure comparing the result (error bars indicate 95% confidence limits)						

It has been pointed out that the low navigational capacity of fishing vessels used by small-scale fishermen in Kenya prevents them from reaching the offshore fishing grounds of large migratory pelagic fish species (tuna and like fishes), which are considered to be in abundant supply, while the large number of fishermen crowded in coastal areas has led to depletion of nearshore stocks, particularly of demersal fish species. The Kenyan government is therefore trying to modernize its fishing fleet by providing small FRP vessels with outboard motors to BMUs across the country. The Banca boats will allow fishermen to travel to and from

fishing grounds more quickly and cheaply, which is expected to ensure an increase in the actual number of fishing trips by fishermen.

6) FRP Conversion of Banca Boats

Banca boats proved to be not only lightweight and small enough to actually navigate to offshore fishing grounds in Kenya waters, but also more fuel efficient and faster than the small FRP outboard motor boats prevalently used in Kenya. In particular, the ability to reach the same fishing grounds faster using less than half the fuel had a significant impact. For this reason, Pwani Sea Boat Repair, which cooperated to build the Banca fishing boat, received many enquiries about building the similar fishing boat. However, as mentioned earlier, replicating wooden Banca boat in Kenya is not environmentally sustainable as solid large trees are required for the keel part, and difficult to construct because of extremely high level of artisanal woodworking techniques.

That is, the first step is to copy the hull shape using the high-quality wooden boat as a model, and then to replicate it as an FRP fishing boat from the mold. One of the reasons for accepting Pwani Sea Boat Repair, a private company, as a collaborator for the construction of the fishing boat was that its main business is the construction of FRP vessels and it was equipped with the technology to convert the wooden banca vessel to FRP.

On the other hand, it is easy to assume that Pwani Sea Boat Repair had this policy in mind from the outset and saw a business opportunity in it. While it would be very difficult to produce a Banca boat that has never been seen in Kenya as an FRP fishing boat at once, it is technically easy and safe to make a wooden boat stepwise, use it as a model, take its formwork and copy its hull shape. Furthermore, the wooden ship construction steps provide the advantage of a deep understanding of the ship's structure and characteristics, and the knowledge gained in the process is useful in the construction of FRP vessels. It was considered a necessary step, even if it was a long way off, especially when converting wooden vessels, which were built by sophisticated craftsmanship without the use of drawings, to FRP.

In fact, at the end of the Second In-Country Training, in which Filipino specialists built a Banca boat, Pwani Sea Boat Repair had just delivered a common type of FRP fishing boats to the World Bank-supported KEMSFED project and was expecting payment from the project, so they were planning to build an FRP mold in the next month after the training ended. In reality, however, the funds were not available until April 2024, but anyway they were able to take a mold and build the FRP hulls of the Banca boat (Fig. 45).



Figure 45. FRP fabric being stretched over a wooden banca boat to make a FRP mold (a);
FRP banca hull taken out (b).

It became clear that the Kenyan side responded favorably for the extension of Banca boat in Kenya with concrete signs of starting production of FRP Banca boats. The project decided to support their initiation for construction of FRP Banca boat construction, and used the first three days of the travel time for Third In-Country Training to make the fourth visit to the Philippines to gather information on the conversion of Banca boat to FRP and to observe the manufacturing process of rudders and propellers, which cannot be produced in Kenya.

As FRP material has a specific gravity greater than 1.0 and sinks underwater when the vessel is filled with seawater, it is necessary to provide sealed void sections at the front and rear sides of the FRP boat to maintain buoyancy. Their specific location and size were video-recorded. It was also recommended that PVC pipe be used as a skeleton-forming material to maintain the shape of the FRP boat. These technical precautions were communicated to Pwani Sea Boat Repair using photographs and videos after the arrival in Kenya (Fig. 46).

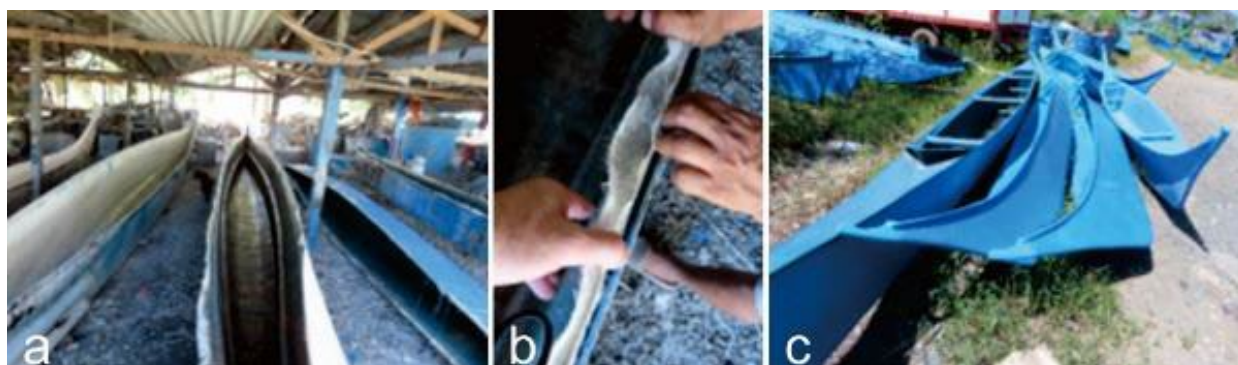


Figure 46. BFAR Region-8 FRP ship fabrication plant
Banca boat mold fabricated (a), showing the outer mold and inner product peeling off (b),
small FRP Banca boat (no engine, paddle boat) fabricated (c)

On the second day of the stopover in the Philippines, the Japanese consultant visited a workshop specializing in the manufacture of Banca fishing boat parts (located in Catbalogan, Samar), which has one of the best reputations for technical skills in the region, to observe the production processes of stainless-steel propellers and rudders. The shop had a front width of about 5 m and was a small-scale cottage factory run by five specialized skilled employees (Fig. 47). The skilled workers explained how propellers and rudders were made from a single stainless-steel plate and a rod, which were recorded in photographs and videos. Finally, the propellers and rudders for the four new FRP boats in the process of construction in Kenya were purchased to take to Kenya. The intermediate products from the cut-out metal sheet to the finished product along the manufacturing processes were also obtained.



Figure 47. Specialist cottage industry shop in stainless steel fabrication of propellers, rudders, etc. for Banca boats in the Philippines (Catbalogan, Samar Province)

After entering Kenya, the owner of Pwani Sea Boat Repair accompanied by the Japanese consultant with the intermediate parts along with the videos and photographs visited a steel workshop in Malindi, where the owner had been commissioning his boat parts, to explain the manufacturing procedure. The workshop owner/engineer assured that the machinery he owns in the workshop was sufficient for the manufacturing of the propellers and rudders. Although it will not be ready in time for the production of the four FRP Banca boats by the Pwani Sea Boat Repair, the owner is considering to ask the workshop to become able to produce the propellers and rudders if orders of FRP Banca boat increase in the future. It should be noted that the Regional Director of the NFRDI at Guiuan in the Philippines, who accompanied the trip to Catbalogan visited the same factory later again to produce videos on the manufacturing processes for the propeller and rudder, and handed them over to the project (Appendix 8).

During the Third In-Country Training, it was possible to conduct the training using an FRP banca vessel being built in Kenya and a wooden banca vessel built by Filipino specialists (Fig. 48).



Figure 48. FRP banca boat shown during Third In-Country Training

(a) FRP hulls stored in the boat yard, (b)&(c) FRP hulls being explained by Kenyan fabricator of Pwani Sea Boat Repair, (d) Wooden Banca boat built by Filipino Boat builders during the 2nd In-Country Training

This training project does not have a budget to support initiatives on the dissemination of the introduced technologies on the Kenyan side and was not included in the scope of the project, so full-scale support could not be provided. Therefore, activities contributing to the dissemination of this introduced technology in Kenya were initiated on a voluntary basis by the Kenyan counterpart institutions including private partners. In particular, the construction and sale of FRP banca fishing boat was solely self-financed by the private sector, which suggests the economic sustainability of the practicality of Banca boats from a private

sector perspective. It is hoped that the Banca boat extension activity will be scaled up through private initiatives and government supports after this project's completion.

Construction of a Philippine-type HDPE Fish Cage

1) Determination of HDPE Fish Cage Specification and Selection of Philippine Specialists

JICA's "Typhoon Yolanda Disaster Recovery and Rehabilitation Project" was implemented to support the recovery of the coastal areas of Leyte Bay in the Eastern Visayas region of the Philippines after the super typhoon hit the region in October 2013. Under the Quick Impact Project (QIP), a project scheme to restore fisheries livelihoods, HDPE circular fish cages were introduced, and now, 10 years after the disaster, the number of fish cages has tripled from the pre-disaster level (from approximately 100 to 300), making them the basic cage specifications in the region. In this project, the same type of fish cage, which has proven its durability, functionality, and economic efficiency through this development, was introduced. The basic specification is a single-collar HDPE fish cage frame with a polyethylene knotted cage net suspended from it and moored by a grid mooring system (Fig. 49).



Figure 49. HDPE fish cages used in Basey, Samar Province in the Philippines

For the selection of fish cage construction specialists to be dispatched to Kenya, negotiations were made with INCA Philippine Inc. which is one of the largest suppliers of HDPE cage in the Philippines, based on the experience of the Japanese expert in the above-mentioned project in the Philippines. The company recommended Mr. Willam Reorizo as an engineer and Mr. Crisanto Saavedra as a fish cage construction technician, and agreed to dispatch them for a period of 24 days.

2) Procurements of Materials for HDPE fish cage

Procurement of the materials and equipment required for the HDPE fish cage facility proceeded in the same way as for the production of Banca boat. First, (i) a detailed Bill of Quantity (BOQ) was prepared, (ii) the availability of producing materials and equipment in Kenya was confirmed, and (iii) quotations for purchase were started to be obtained in August 2024, approximately three months before the training was conducted, (vi) the actual procurements started after the Japanese consultant arrived in Kenya for most of the materials and equipment, and transported them to the construction site.

Of the HDPE fish cage construction process, the fabrication of anchor blocks, which takes time especially

for curing concrete, was carried out and completed under the supervision of the Project Assistant (P/A) at the construction site from early to mid-October 2024, before the Filipino engineers travelled to Kenya.

3) Construction site for HDPE Fish Cage

The W/G Subcommittee on the fabrication and installation of HDPE fish cage headed by the representative member for KMFRI designated Kijiweni, Shimoni, in Kwale county where he had been leading a cage culture pilot project as the site for the construction and installation of the HDPE cages (Fig. 50). Rabbit fish had been cultivated at this site using wooden cage since 2022, suggesting that the marine environment is suitable for cage farming. Because fast current runs always back and forth along the Shimoni Channel between Shimoni and Wasini Island, fish in the cage are always exposed to fresh seawater to maintain a good rearing environment for the growth of fish. In addition, the fact that there were fishermen who have been managing aquaculture cages was also an advantage of using this site as a cage construction site for this project. In addition, the construction of the National Mariculture Research and Training (NAMARET) center by World Bank's KEMFSED Project, which is set forth to become a future center of marine aquaculture research and development in the country, was another advantage for designating this site for the fish cage construction. The facility includes Kenya's first modern, full-scale marine aquaculture hatchery. Overall, it was seen as reasonable that the designation of Shimoni as the site for the construction of the cage.



Figure 50. Shimoni, Kwale county, the site for construction and installation of HDPE fish

4) Arrangement for Construction and Installation for HDPE Fish Cage

In order to acquire the skills of Filipino technicians to construct and install the HDPE cage, KMFRI dispatched a team consisting of two researchers, two licensed divers, and one coxswain from the headquarters in Mombasa for the whole duration of the construction and installation activity, using its own budget. On the advice of the representative member for KMFRI at W/G, who knows the local community well, the project hired one leader and two work collaborators from each of three neighboring BMUs (nine people in total). Thus, a structure for implementing the construction and installation of HDPE cage at Shimoni consisted of the Kenyan team of researchers, technicians, and community work collaborators, and the Philippine team of an engineer and a technician. This implementation structure allowed to establish a near-ideal technical cooperation structure that made possible for technology transfer at two levels, from

understanding of concepts to imparting of working techniques.

Unlike boat building techniques for Banca boat, the construction process of fish cage does not require highly artisanal skills that take time to master. The fabrication process is completed through the following steps: 1) fabrication of concrete anchor blocks, 2) fabrication (sewing) of the fish cage nets, 3) butt-fusion welding of HDPE pipes, 4) construction of a raft for installation of cage, 5) fabrication of grid mooring rope frame, 6) dropping of anchor blocks, 7) installation of grid mooring rope frame, 8) installation of cage frame and cage net. Fishermen who are accustomed to handling nets and ropes will be more or less familiar with these processes, except for the butt-fusion welding of the HDPE pipes. The cage construction and installation process are well suited for conveying the technology in a training format with a work team of about 10 people, as was the case here.

The nature of the technology and the ideal conditions of hosting the project meshed well, and despite the short construction period of less than three weeks (excluding the period of constructing concrete anchor blocks which was done without field supervision by Filipino specialists), the technology for the construction and installation of the fish cage was transferred to the Kenyan side more effectively than anticipated. The Kenyan beneficiary team alone is confident that the fish cage system can be rehabilitated, developed, and expanded in the future. Fig. 51 shows the fish cage fabrication and installation activities that took place.



Figure 51. Construction and installation of HDPE fish cage at Shimoni, Kwale County
Sewing of fish cage net (a), Butt-fusion welding of HDPE pipes (b), Dropping of concrete anchor blocks (c),
and Installation of fish cage in the grid mooring system (d)

5) Features and advantages of the introduced fish cage

The Philippine-type aquaculture fish cage system introduced in the Second In-Country Training period includes the following innovations that significantly reduce the production cost. Any of these technologies would not be included in a model ordered from a commercial fish cage manufacturer in Kenya, but they have been in use in the Philippines for a long time and have proven their durability and practicality. These technologies are breakthroughs for Kenya, especially in marine aquaculture and were covered by some

media in Kenya arranged by KMFRI¹⁰.

- Self-made circular HDPE cage frame: The use of HDPE pipes as a material for fish cage frames is common, and has been already in use in Kenya for tilapia aquaculture in inland lakes. However, since the frames are usually ordered as commercial products from specialized suppliers, this is the first time that fishermen have connected the HDPE pipes to make a circular cage frame locally (Fig. 51 b). This will significantly reduce construction costs and at the same time allow them to repair and maintain the HDPE frame.
- Grid mooring system for anchoring cage structure: In the case of direct mooring (Fig. 52 a), the force dragging the floating structure from the anchor is directly applied to the fish cage frame, so the action of waves and currents on the sea surface repeatedly exerts force on the frame, which is likely to cause more damage to it. For example, at a high tide in areas with strong tidal currents, the cage frame is pulled under the sea and becomes subjected to a strong stress to the extent that the cage frame is deformed. In the Grid Mooring system (Fig. 52 b), a rope grid is suspended from large 200L floaters, and the rope grid is not pulled in and stays at the same water level. Since the drag force from the anchor is not directly applied to the fish cage frame, there is less load on the fish cage frame and less damage.

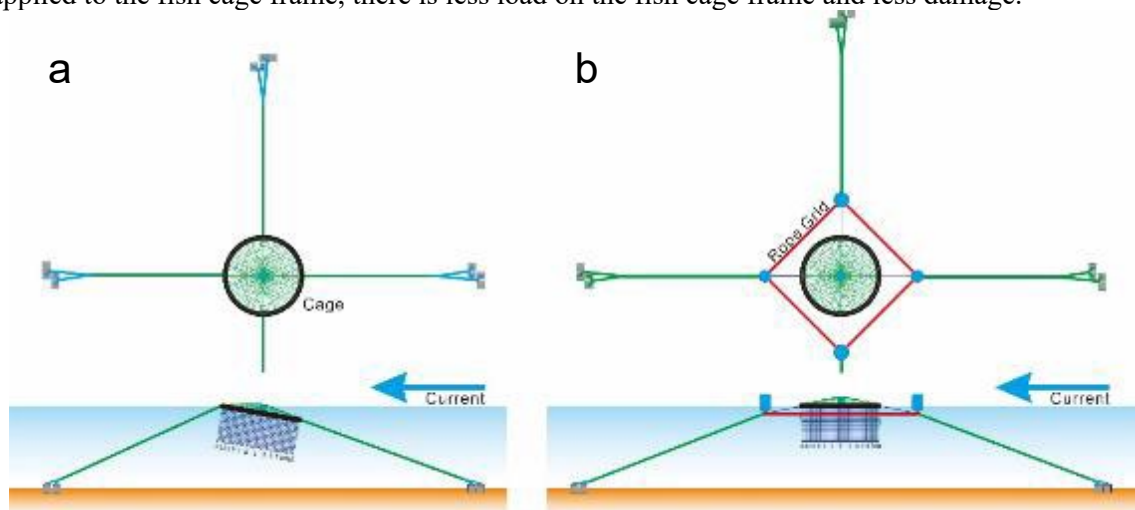


Figure 52. Direct mooring system (a) and indirect mooring (b) system using Grid Mooring (rope frame)

- Use of waste tire beads and used drums: The tire bead part cut out from waste tires is used for the handle of the concrete blocks where the anchor rope is tied (Fig. 53 a) and for the rope connection ring of the Grid Mooring rope frame (Fig. 53 b). In addition, used polyethylene drums enclosed in baskets made of 16mm diameter rope are used as the main float for Grid Mooring system (Fig. 53 c). The tire beads and used polyethylene drums are available in Kenya at a fraction of the price of genuine materials from fish cage manufacturers.

¹⁰ Some media coverage on the HDPE cage technologies by this Project includes the following.
STAR, 2023. <https://www.the-star.co.ke/counties/coast/2023-11-27-kmfri-unveils-first-plastic-fish-cage-project-in-kwale/>
KTN News, 2023 <https://www.youtube.com/watch?v=0yHQadUIMV8&t=23s>
Citizen TV, 2023 <https://www.youtube.com/watch?v=yx4AEJE7r4s>



Figure 53. Concrete anchor block using tire beads for rope attachment handle (a), grid mooring rope frame using tire beads for rope connection ring (b), large 200L float using used PE drum (c)

- Single-collar HDPE pipe frame model: A typical HDPE fish cage (Fig. 54 a) has a cage frame made of multiple collar HDPE pipe rings and a handrail, but the fish cage frame made in this project has a single collar pipe ring (Fig. 54 b) without a handrail. It is a low-cost model in which use of extremely expensive HDPE pipes is reduced to the minimum amount essential for fish rearing. The multiple collar HDPE pipe rings and handrail make the cage operator easy to work at the sea but do not contribute in principle for the growth of fish.

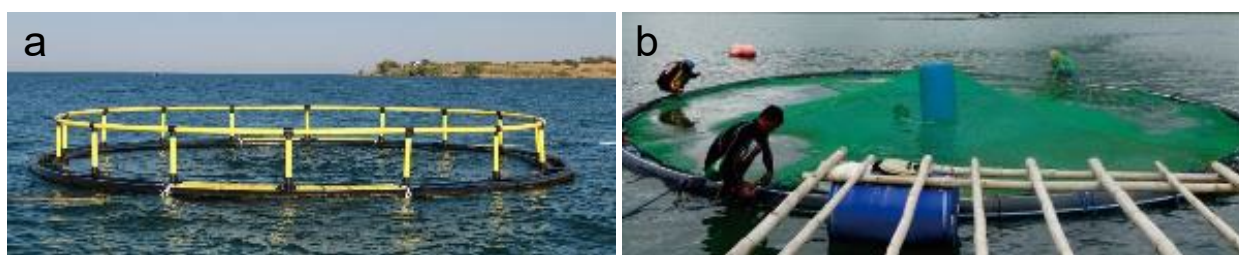


Figure 54. A common HDPE fish cage model with a handrail on a double collar frame (a).
Single-collar model without handrail (b)

6) Utilization plan for constructed HDPE fish cage

The fish cage produced this time is a low-cost and practical model as explained above, but it is not expected to contribute significantly to the spread of marine fish farming immediately. In Kenya, no single species of marine finfish has been established for hatchery seedling production, so the only way to do cage fish farming is to capture natural seedlings and stock them in a fish cage (sometimes called as "fattening"). Construction of a hatchery is underway at NAMARET at Shimoni and partial operation has just started without production of rotifer and other micro-feed organisms yet, and is expected to take substantial time to become fully operational. Even if the facility is fully functional and seedlings are successfully produced for priority fish species, it may take many years more, before the technology is transferred to the private sector and local commercial seed producers begin seed production, and make aquaculture seedlings available to the cage culture operators and entrepreneurs interested in commercial cage culture operations.

Similarly, feed for marine fish farming is not available from commercial suppliers. Currently, KMFRI is manufacturing the mariculture feeds on a trial basis and using them in various pilot projects. The pilot cage culture of rabbit fish at Kijiweni, where this project installed a cage system, has also been using feeds made by KMFRI.

Therefore, in light of the current developmental stage of Kenyan marine aquaculture, it is appropriate that the fish cage constructed in this project be used mainly for the development of technology on the seedling and feed productions, which KMFRI is responsible for. Specifically, they may be used for raising broodfish for seedling production or for test rearing of fish for evaluation of marine fish feed.

The researcher in charge of aquaculture development at KMFRI who is also the head of subcommittee of W/G on the construction of HDPE cage, is working on a plan to expand the one-unit cage system that has been built in this project into a three-unit cage system to contribute to these objectives. KMFRI already owns 10-meter diameter HDPE cages purchased by another project. Since this plan was informed to the project prior to the construction of the facility, the number of mooring ropes was increased in advance in anticipation of the expansion. The manual for HDPE cage production and installation prepared by the Filipino fish cage engineer in this project (Appendix 9) includes an appendix showing the procedure for expanding the current one-unit system to a three-unit system (Fig. 55).

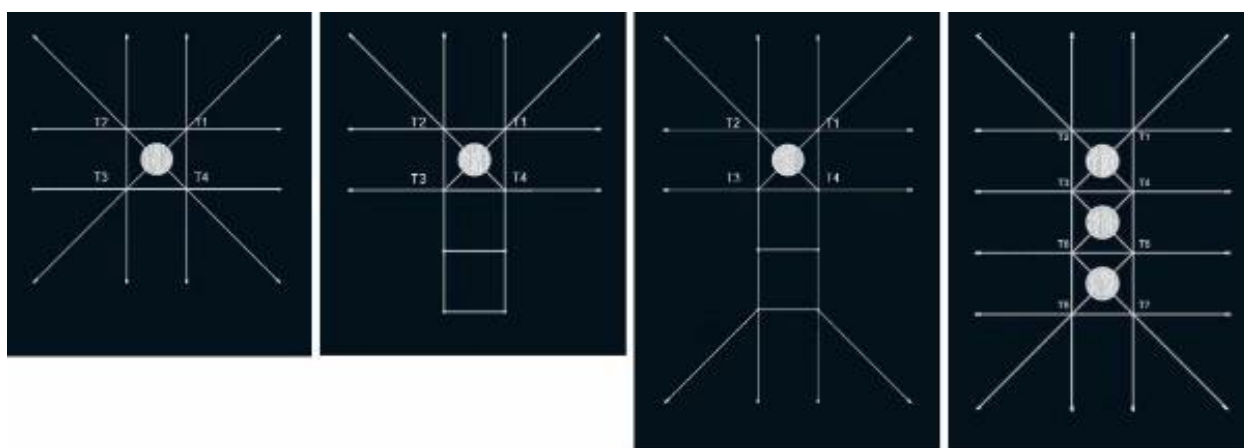


Figure 55. Expansion procedure from the one-unit grid mooring system fabricated and installed in this project to a three-unit system (Source: manual by INCA Philippine Inc.in this project).

KMFRI's future cage culture trials will likely be conducted by the local community who are responsible for the daily operations of fish rearing work as they have been doing so in the past in the pilot projects at Kijiweni. The accumulated experience in raising fish will enable the fishermen's community to own the cage farming facility and implement the project by themselves. However, for the time being, captured natural seedlings must be used for the cage fish farming because the current status of seed production is not advanced as described above. Therefore, the scale of farming operation is limited to a fairly small scale. The 10m-diameter fish cage (volume of rearing water in the cage: approx. 400m³) is capable of harvesting 7,000 to 20,000 fish, depending on the species and farming intensity level, which is too large considering the financial capacity of the fishermen's community as well as the impact of taking wild seedlings from natural resources.

In addition, the 225 mm diameter HDPE pipe used for the 10 m diameter cage is not readily available in rural areas, and the rental fee for butt-fusion welding machinery is very high. This makes it difficult for average fishermen community to bear the initial investment cost in building the facility. Therefore, a small HDPE fish cage frame (5 m in diameter) was made using 50 mm diameter HDPE pipe, which is readily available even in rural areas, and a socket fusion machine also available at general hardware stores (Fig.

56). The leftover netting and rope materials from the 10-m diameter fish cage construction were almost enough for one small 5m-diameter fish cage. Since the construction and installation is possible with the cooperation of KMFRI and local fishermen who participated in the training in this project at Shimoni, the drawings for 5-m cage system are shown in the manual for HDPE cage construction and installation (Appendix 9). In a 5-m diameter fish cage (rearing volume: 50 m³), it is possible to rear about 1,000 to 2,500 fish. If small-scale rearing using natural seedlings can be promoted at the level of fishing communities and the development of seedling production at NAMARET can proceed in parallel, it will help raise the level of aquaculture technology in the country as a whole.



Figure 56. Construction of a small fish cage frame (5m diameter) made with 50mm HDPE pipe using a socket fusion

The HDPE fish cage was shown to be overwhelmingly more wave resistant and robust than conventional wooden-framed square fish cages. The trainees clearly recognized the difference in wave resistance by comparing it with the same HDPE pipe assembled into a square fish tank that was installed next to the circular cage constructed by the project by chance. Therefore, KMFRI and the local fishermen who assisted in the production of the fish cages are now in the process of applying to the World Bank's KEMFSED project for a pilot aquaculture project involving the expansion of the facility by replicating the fish cage facilities installed during this training.

2.6. Implementation of Third-Country Training Programs

This activity, related to Outcome 5 “Mutual learning (knowledge sharing) with neighboring African countries is achieved through third-country training” involved the implementation of third-country training in neighboring countries. The case studies included blue economy policies, fish processing (canned tuna) and port management in Seychelles, as well as small-scale fisheries and livelihood improvement in coastal communities in Tanzania. The training was designed to meet the identified training needs and was conducted as part of a Training of Trainers (TOT) initiative. Reporting sessions were held after each training session to promote continuous information sharing and personnel exchange. Details are as follows.

2.6.1. 1st Third-Country Training (August 2023: 4th On-Site Work)

(1) Preparation

Coordination with the Seychelles side regarding the selection process for Kenyan participants was primarily conducted via email from Japan.

Coordination with the Seychelles Side

Preparation for the 1st Third-Country Training (Seychelles) began with a virtual meeting held on 6 March 2023, at the JICA Kenya Office with the Seychelles Fishing Authority (SFA). Following this, information regarding fish skin processing techniques and tuna quality assessment, of interest to the Seychelles side, was collected from both Japan and Kenya while formulating and coordinating the on-site visit and training program via email communication.

Initially, the program included a session for exchanging opinions with staff from the Blue Economy Department of the Ministry of Fisheries Blue Economy on the morning of the first day. However, one week prior, this was changed to a discussion with SFA staff instead, as staff from the Blue Economy Department had to attend an emergency Cabinet-related meeting.

Selection Procedures for Kenyan Participants and Preparation of Presentation Materials

The candidate participants were determined during the W/G meeting on June 23, 2023. Following consultations and reports to the central government, the official selection of participants was made by the Principal Secretary (PS) of SDBEF on August 22. After the W/G meeting, there was a discussion regarding replacing the fisheries technician from Tana River County with the head of the SDBEF Mombasa branch among the candidate participants (SDBEF, KMFRI, KFIC, KeFS, Kilifi County, and Tana River County). However, it was decided that only one representative from each organization should participate rather than two from the same organization, leading to the final selection of the original members.

The presentation materials prepared by the Kenyan side for this third-country training included individual presentations from each participant and a video interview with fish skin processing businesses in the Kisumu region. These presentation materials (Appendix 10) were finalized during a briefing meeting held on August 25, 2023, with participant members and the head of the SDBEF Mombasa branch.

(2) Implementation

The first third-country training was conducted from August 28 to September 2, 2023, targeting six participants (see the table below). Out of the six days, two days were allocated for travel, leaving four effective training days.

Table 25. The first third country training program (Seychelles)

Date	Time	Contents
August 28 th , 2023	8:20AM	Departing from Mombasa Airport (KQ601)
	9:20AM	Arrival at Nairobi Airport
	12:30AM	Departing from Nairobi Airport (KQ250)
	5:45PM	Arrival at Mahe Airport
August 29 th , 2023	9:00AM – 12:00AM	Exchange of opinions with the Seychelles Fisheries Authority (SFA), SFA processing Lab visit
	PM	Courtesy call to the Embassy of Japan in Seychelles
August 30 th , 2023	9:00AM – 12:00AM	Exchange of opinions with SFA Observation of Sample acceptance (SFA Lab) Victoria fishing port visit
	1:00PM –	Providence Fishing Port visit BAQF visit Processing company (Ocean Basket) visit

Date	Time	Contents
August 31 st , 2023	10:00AM	University of Seychelles (BERI)
	1:00PM	Exchange of opinions with fishermen
September 1 st , 2023	9:00AM	Processing company (OCEANA) visit
	1:45PM	Wrap-up meeting
	3:00PM	Move to the airport
	5:35PM	Departing from Mahe Airport (KQ251)
	7:45PM	Arrival at Nairobi Airport
September 2 nd , 2023	9:00AM	Departing from Nairobi Airport (KQ614)
	10:00AM	Arrival at Mombasa Airport

Exchange of opinions with SFA

The Seychelles Fishing Authority (SFA) was incorporated by the SFA Act on August 31, 1984. It had existed physically since September 1983 when the Seychelles Industrial Fishing Authority (SIFA) was established. The organization was founded at a time when tuna fishing, especially by foreign vessels, was rapidly developing and aimed to protect the resource base for sustainable development. Initially, the SFA had a research and development role in the fisheries sector and a commercial development role for the Fishing Developing Company (FIDECO). Although the SFA has grown over the years and brought many changes to the fisheries sector, from technology to policy, it still has a mandate for fisheries management. The functions of SFA are classified as follows. 1) Research: Obtain data on species abundance using underwater cameras. These studies aim to improve the planning and implementation of fisheries management, the sustainability of fisheries resources, a better understanding of the relationship between the environment and fisheries resources, and the promotion of diversity in fishing activities. 2) Fisheries resource management: Develop and implement sustainable fisheries management plans to ensure that fisheries support is used in accordance with the principles of ecologically sustainable development and that impacts on bycatch are minimized. 3) Fishery statistics: Fishery Information Management System (FIMS) has been established and maintained. Statistical bulletins and technical reports are being created and real-time data at landing sites are being obtained. 4) Monitoring, Control and Surveillance (MCS): Efforts are being made to utilize Vessel Monitoring System (VMS) and Electronic Monitoring System (EMS), and to digitize licenses and fishing certificates. 5) Aquaculture: Promote the investment and sustainable growth of aquaculture, maximize the socio-economic benefits of aquaculture to society, and develop appropriate aquaculture technologies through research and development. 6) Quality assurance of catches: SFA has Quality Inspection Laboratory with a wet lab and a dry lab for sample analysis.

SFA Processing Lab

It provides a place for small business entrepreneurs to support the development and marketing of new seafood processing products. There is a successful example of fish burger as a new value-added product. The laboratory is equipped with the basic processing equipment necessary for seafood processing, including -40 degree C refrigerators, sausage making equipment, vacuum packaging machines for individual packaging with carbon dioxide filling.

As a laboratory, it conducts research on fish skin processing and seaweed processing, holds events to popularize fish eating among children, and develops sales channels for processed sea urchin.

Additionally, the FISHBITES application has been developed by SFA to encourage local production and

consumption of seafood and to promote interest in local fisheries. The Tourism Authority will also work together with SFA to provide safe seafood recipes and market information useful for sourcing raw materials through publicly available data, not only for tourists staying in hotels but also for tourists staying in self-catering apartments and local residents.

SFA Quality Inspection Laboratory

SFA Quality Inspection Laboratory has a wet lab and a dry lab, where collected samples are analyzed. Every week, samples are collected directly from fishing boats to obtain biological information such as fish length and weight. Information on fishing locations will also be obtained through VMS. These data are also submitted annually to the Indian Ocean Tuna Commission (IOTC).

Visit to fish processing company

There are five fish processing companies in Seychelles. Four of these companies (Oceana Fisheries, Ocean Basket, Sea Harvest and RM Seafood) handle fresh fish and frozen processed products, and one company (Indian Ocean Tuna Limited) produces canned products. In this program, we visited two companies: Ocean Basket and Oceana Fisheries. Since it was the monsoon season, the amount of fish landed was low, so we were unable to observe the active process, but it was an opportunity for meaningful discussions with those involved.

1) Ocean Basket

Founded 15 years ago, the landing site and processing plant is located in Providence, with a 3000-ton refrigerated warehouse in Victoria. Yellowfin tuna landed with its gills and internal organs removed is processed to cut head and tail off, and kept cool for exportation. In Seychelles, there is no dry ice, so frozen gel packs are used as cooling agents. At the time of the visit, yellowfin tuna was not being processed, but Swordfish caught by longline fishing and frozen was being thawed and processed into fillets and vacuum packaging.

2) Oceana Fisheries

This is one of the largest fish processing facilities targeting groupers, snappers, large migratory pelagic fishes, crabs and lobsters. The main species include both demersal and pelagic. The main market for export includes USA, China, Australia, EU and also Israel.

For the tuna species, they have two machines within the facility for testing histamine. In terms of eco-labelling, currently, the company has obtained no international certification for their products, but it has established a traceability system (HACCP system). A U.S. FDA inspection was conducted a few weeks ago. On waste management, they process the fish waste to pet food which is in cubes sold at 18 rupees for 50kg, i.e., 1.3-1.4 USD.

The main challenges encountered include rapid rise in number of local operators, accessibility to raw materials, high freight costs and high electricity costs.

Fishing Port Management

Fishing Port Management Division in SFA aims to: 1) develop modern fishing ports and quays to support the growth of the fisheries sector, 2) ensure the optimal use of fishing ports for ensuring there is revenue generation through the fishing port activities, 3) improve port services for the fisheries sector by adopting new technologies, 4) ensure a sufficient supply of ice to fishermen.

1) Victoria Fishing Port

Victoria artisanal fishing port has an overall length of quay is 350 meters and has an ice plant with production capacity of 5 tons per day, and a fresh water and fuel depot. The landing shed is well maintained in terms of hygiene and sanitation. In terms of waste management, they have a waste oil collection center and bins for garbage disposal in designated areas within the port.

2) Providence Fishing Port

Providence semi-industrial fishing port is the largest fishing port on Mahe after Victoria. The quay length which serviced over 50 fishing boats on average weekly for loading and unloading, refueling and berthing. Other facilities include storage units, 3 ice plants with a production capacity of 5 tons per day, a blast freezer and a cold room that are currently non-functional, a fresh water and fuel depot.

BAQF visit (Aquaculture facility)

We toured Broodstock Acclimation and Quarantine Facility (BAQF), aquaculture center at Providence Fishing Port. Water for the aquaculture facility is taken from an inlet point at mid-water level, about 50 meters offshore, using a pipe with slits with its end anchored to the bottom. The water intake pump runs for 4 minutes and stops for 2 minutes, and every six months the intake pipe is brought ashore and cleaned to remove any oysters, barnacles, etc. that have stuck to the pipe. Several types of broodstock fish (grouper and snapper) are managed in the holding tanks, and research and seed production are carried out there. They are also conducting breeding experiments on ornamental fish. Water quality tests at the farm were conducted monthly during the first two years of establishment, but are now conducted quarterly. Fish cages for aquaculture have been set up offshore, and the Kenyan participants hope that they will be able to utilize Seychelles' experience and knowledge in the future by introducing Philippine technology and by managing the HDPE fish cages. In addition, the participants from KMFRI brought a pipe with a slit for water intake to Kenya to try to use it as a water intake pipe for NAMARET.

Exchange of opinion with Seychelles fishermen

An exchange of opinions with Seychelles fishermen (fishing vessel owners) took place in the SFA conference room. The fishermen who gathered were representatives of fishermen's associations, and the Kenyan side gave a presentation on an overview of fisheries in Kenya and fisheries co-management.

Seychelles fishermen asked questions about women's involvement in fishing in Kenya, and the Kenyan participants explained that most women are involved in the value chain in the seafood processing industry, and about women's participation in octopus fishing in Kenya. It was also explained that in Kenya, participation in Beach Management Unit (BMU) is encouraged and local fisheries stakeholders are

organized.

On the other hand, in Seychelles, although there is no BMU, there are fishermen's cooperatives that are organizationally weak. A quota system has been implemented to reduce the amount of fish caught, such as sea cucumbers. In addition, a co-management plan has been implemented that prohibits the fishing of fish less than 32 cm in length and establishes a closed season for sea cucumber fishing from July to September each year. Trawling and bottom longlining are considered illegal fishing, while monofilament gillnets are allowed for shark fishing. Fishermen benefit from government subsidies for ice and fuel, but the workforce is aging and there are few young people interested in fishing. Most of them choose activities other than fishing, such as operating boats in the tourism industry.

University of Seychelles (Blue Economy Research Institute: BERI)

The Blue Economy Research Institute at the University of Seychelles was established in 2009 and conducts research in environmental science. Programs such as ocean acidification monitoring and seaweed and blue carbon mapping are currently underway. It provides supports in field data sampling procedures, policy and strategy development, and decision making. In addition, they have launched a free online blue economy course and are implementing a blue leadership program in collaboration with the Western Indian Ocean Marine Science (WIOMSA). The agency's challenges include data management, knowledge sharing, capacity building, collaboration, and science policy transformation.

The Marine Aquaculture Conference hosted by KMFRI/IRD is scheduled to be held from October 23rd to 25th, 2023. BERI, upon invitation from the KMFRI participant member will virtually participate in the Conference from Seychelles.

(3) Reporting the results

One of the participants reported on the results of the first third country training using presentation materials (Appendix 10). The following was discussed.

- Presentation in CECM (County Chief Executive Council Members)

It was suggested that a presentation on the Seychelles study tour report should be made during the County Chief Executive Council Members (CECM) Caucus meeting. The agenda for the CECM Caucus meeting should include this presentation.

- Improving Fisheries Quality

Seychelles has high-quality standards in the fisheries sector, enabling them to supply fish to the European Union market. The need to establish at least one model fish landing site in Kenya that meets the European market's standards was recognized. Public Private Partnerships (PPPs) were mentioned as a potential approach to improving Kenya's fisheries sector.

- Desire to adopt the BAQF mariculture inlet design by NAMARET

A participant proposed the use of the inlet design observed at BAGF in Seychelles, which involves a High-Density Polyethylene (HDPE) pipe with slits on the side to filter water and prevent biofouling matters like barnacles. This Seychelles' design was considered superior to the one planned for NAMARET (National Mariculture Research and Training Center) and it will be considered.

2.6.2. The Second Third Country Training (April 2024: 4th On-Site Work)

(1) Preparation

Coordination with the Zanzibar side and the participant selection process on the Kenyan side were primarily managed through email communications from Japan. Through these exchanges, the program was adjusted in collaboration with the Zanzibar side.

Coordination with Zanzibar side

Preparations for the 2nd Third Country Training (Zanzibar) began around February 2024. The formulation and coordination of the site visits and training program to be conducted locally were progressed. Emphasis was placed on providing opportunities for discussions between relevant staff on each theme, ensuring that both parties could exchange opinions to the fullest extent possible. Additionally, a program was designed to include opportunities for directly observing activities on-site, allowing for more practical learning experiences.

Selection Process of Participants from Kenya and Preparation of Presentation Materials

The candidates for participation were decided during the W/G meeting held on November 23, 2023. After a proposal and reporting by the W/G to the central government, the final selection of participants by the Principal Secretary (PS) of SDBEF was completed on March 28, 2024. Among the candidate participants (from SDBEF, KeFS Nairobi, KeFS Kwale Branch, Mombasa County, Kwale County, and Lamu County), the participant from Lamu County was unable to adjust their schedule and proposed a substitute. However, since this request was made just before the business day preceding the event, it was not possible to coordinate within the W/G or modify flight arrangements in time. As a result, the number of participants was reduced for the second third-country training.

The presentation materials prepared by the Kenyan side for this training (Appendix 11) were reviewed and confirmed during the W/G meeting.

(2) Implementation

The second third-country training was conducted for five participants from April 21 to April 27, 2024 (Table 26). Out of the seven days, two days were allocated for travel, resulting in a net training duration of five days.

Table 26. The 2nd Third Country Training Program (Zanzibar)

Date	Time	Contents
April 21 st , 2024	12:35	Departing from Mombasa Airport (KQ301)
	13:35	Arrival at Nairobi Airport
	18:35	Departing from Nairobi Airport (KQ494)
	19:50	Arrival at Zanzibar Airport
April 22 nd , 2024	9:00 – 12:00	Explanation and exchange of views on current blue economy policies and marine protected areas in Zanzibar and Kenya
	11:00 – 12:00	Explanation and exchange of views with Director of Fisheries and Aquaculture Development (DFAD) on policy content (e.g. loans to fishermen, co-management, seaweed farming)
	14:00 – 15:00	Explanation and exchange of views with the Director of the Department of Marine Conservation (DMC) on the management policy content of marine protected areas

Date	Time	Contents
April 23 rd , 2024	10:00 – 12:00	Explanation by the Director and staff of the Zanzibar Fisheries Research Institute (ZAFIRI) on its research and role, and exchange of views on possible joint research with Kenya
	13:00 – 15:00	Explanation and exchange of views on the role and technical content of the facility by staff of the Zanzibar Marine Hatchery Limited (ZMHL).
April 24 th , 2024	9:30 – 11:00	Presentation on the history and system of the market by the DFAD staff at Malindi fish market
	11:00 – 12:00	Explanation and exchange of views by staff of the Zanzibar Fisheries Corporation (ZAFICO) on the nature of the project and current issues
	13:00 – 15:00	Explanation and exchange of views on the role and projects (e.g. construction of processing facilities on Pemba Island) by the Director of the Zanzibar Seaweed Corporation (ZASCO) and visit the warehouse ready for shipping
	15:00 – 17:00	On-site visit of ZAFICO's business case study (cold chain improvement)
April 25 th , 2024	10:00 – 12:00	Explanation and discussions with staff of the Institute of Marine Sciences (IMS), University of Dar es Salaam on research topics such as seaweed farming, marine remote sensing, marine environment, socio-economic, etc.
	13:00 – 15:00	Policy explanation and discussion with staff by the Director General of Deep-Sea Fishing Authority (DSFA)
	16:00 – 17:00	Wrap-up meeting: Kenyan side reports to the MBEF on the content of this visit and discussions, and exchange of views on common issues and possibilities for specific future cooperation. (application of licensed fishing methods and village-level co-management practices in marine protected areas, supply of raw materials from Kenya for seaweed processing and export, training of seafarers in Kenya).
April 26 th , 2024	13:30 – 14:00	Visit market in Stone town etc.
April 27 th , 2024	10:10	Departing from Zanzibar Airport (KQ491)
	11:30	Arrival at Nairobi Airport
	13:00	Departing from Nairobi Airport (KQ606)
	14:00	Arrival at Mombasa Airport

Exchange of opinions with MBEF

In the presence of Dr Hamad (PS), relevant officials and Zanzibar's Blue Economy situation were briefed on the Blue Economy situation in Zanzibar, and an exchange of views on the Blue Economy took place, which also included an introduction to Kenya.

In Zanzibar, the Blue Economy is defined based on its current situation and context and is defined as 'The sustainable use and conservation of aquatic resources in both marine and freshwater environments'. It does not rely on a definition that focuses solely on marine fisheries resources but emphasizes the optimization of resources from domestic fisheries resources (marine and inland water).

The Ministry has high priorities with regard to the following five areas related to the blue economy. (i) fisheries and aquaculture; (ii) sustainable tourism; (iii) energy (oil, gas and offshore R.E development); (iv) marine trade and infrastructure; and (v) blue economy governance (MSP, maritime safety and security, blue diplomacy and blue finance). In terms of policy and legal frameworks, relevant policies are also in place, such as the Blue Economy Policy 2022, the Blue Economy Strategy 2022, the Intervention plan for Strategic Sectors 2021, and implementation of IMF Covid-19 recovery fund.

Department of Fisheries and Aquaculture Development (DFAD)

The Director explained the role and activities of DFAD and exchanged views with Kenyan participants at the Zanzibar BEFM meeting room.

The Zanzibar Government supports fishermen by providing them with well-equipped fishing vessels (fish finder, fishing gear, GPS and safety equipment). This assistance is provided through an interest-free loan scheme.

Fisheries co-management in Zanzibar is implemented through the Shehia Fisheries Commission, appointed by the regional commissioner. They can operate without by-laws but are guided by the Fisheries Act. The smallest unit of fisheries management is the Shehia Fishermen Committee, comprising 12 members. Main functions include ensuring compliance with fisheries regulations and data collection. The main Fisheries Act managing fisheries in the country supports their functions since Shehia's do not have customized by-laws. Its members are elected from the fisher clusters and appointed by the Regional Commissioner.

Recreational fisheries is an important aspect of tourism comprising sport fishing and snorkeling. Other recreational products include kite surfing, kayaking, ski diving, water horse riding, and motorbike riding at the beach.

Zanzibar is the largest seaweed producer in Africa and the 10th largest in the world (2022)¹¹. 80% of seaweed farming takes place on Pemba Island and 20% on Unguja Island. Most of the seaweed is exported as dried products, but value addition is underway, including the development of a seaweed processing plant on Pemba Island and joint research with a British university to produce organic fertilizers using seaweed. To expand seaweed farming, the government is providing boats to access the farms, training on maritime safety and value-adding (processing) techniques, which is a major boost for women to start seaweed farming.

Department of Marine Conservation (DMC)

The Director explained the role and activities of the DMC and exchanged views with Kenyan participants.

Seventy-five percents (75%) of Zanzibar's territorial waters are under marine conservation areas where fishing activities are allowed through gear selectivity with a few areas identified as no-take zones and no armed forces are involved. The Department of Conservation in Zanzibar through legislation collects entry fees whereby 25% of this goes to the National Government, 75% to the Department. The 75% is further shared between the department and the community in a ratio of 7:3 respectively.

Zanzibar Fisheries Research Institute (ZAFIRI)

The Director and other researchers explained to the Kenyan side what they are doing at ZAFIRI and exchanged views.

Zanzibar Fisheries Research Institute was established under Statutory Notification No. 32 on 19 April 2019 to conduct research studies to address issues related to fisheries and natural resources and to develop and certify quality control guidelines to meet the standards required for the export of seafood products. ZAFIRI is responsible for marine spatial planning and plays a key role as a data hub for all activities carried out in other marine-related research. It has an MOU with the Tanzania Fisheries Research Institute (TAFIRI) on marine waters. It is open to collaboration with Kenya, particularly on marine spatial planning.

¹¹ <https://www.globalnote.jp/post-7004.html>

Zanzibar Marine Hatchery Limited (ZMHL)

ZMHL representatives gave a detailed explanation of the role of the facility and each section as they toured the facility, followed by a question-and-answer session.

ZMHL is a seed production facility comprising three main sections (sea cucumber, seaweed and marine tilapia). The company aims to export sea cucumbers to Asian countries and is involved in sea cucumber seed production as well as processing. The facility was established through a PPP agreement between a private investor and ZAFIRI, which owns 49% of the shares in the seed production facility and has thus far provided seed to aquaculturists free of charge. It is currently also researching milkfish seedstock production and last year purchased milkfish from Indonesia for parent fish breeding.

The participants recognized that it is important to hasten the establishment of seed production facilities in Kenya and to make sea cucumber one of the seed production varieties. It was also important for Kenya to adopt a similar public-private partnership type of investment for the efficiency and effectiveness of the facilities.

Malindi Fish Market

The committee heard explanations of operations and challenges from the Fisheries and Aquaculture Department, which oversees the Malindi fish market in an integrated manner, as well as from the members of the committee.

The Malindi fish market was constructed with Japanese grant aid. It is divided into various sections- office area, restaurant area, landing area, auction area, ice making area, retail area and refrigerated area - and is supervised by a committee comprising key stakeholders of the market, including the Ministry of Fisheries, local authorities, auctioneers, traders, fishermen, women and youth. Ice machines, in particular, are privately introduced and managed.

Participants expressed the view that in Kenya, it would be recommended that the facilities be managed by the private sector and monitored by a similar committee.

Zanzibar Fisheries Corporation (ZAFICO)

In a meeting room at the Malindi fish market, a representative explained ZAFICO's activities.

The company was established in 2017 and operates in the offshore fishing, fish processing and mariculture activities. The company comprises the following shareholders. (i) Zanzibar Social Security Fund, (ii) Zanzibar State Trade Cooperation, (iii) Zanzibar Port Corporation and (iv) Zanzibar Insurance Corporation. They are also engaged in fishing activities but face the following challenges. (i) lack of technical expertise on deep-sea fishing; (ii) high operating costs; and (iii) lack of equipment to identify key fishing grounds based on currents and algae. There are currently plans to develop a market information system where fishers will be uploading the catch, and buyers will be making an order through the system.

From the discussions, the Kenyan participants had the following recommendations:

- To increase effectiveness and efficiency and avoid over-reliance on public finances, KFIC and other fisheries-related business organizations should be owned and managed through shareholdings.
- The Government of Kenya, through ZAFICO, could work with the Revolutionary Government of Zanzibar to engage Kenyan fishing vessel crews trained at BMA on Zanzibar fishing vessels.

- The Kenyan Government should consider the same idea (development of a seafood information system) to improve access to markets for seafood products.

Zanzibar Seaweed Corporation (ZASCO)

The directors explained ZASCO's business and the challenges it faces.

The company was established in 2022 under the Companies Act No 15 of 2013. It is managed by a Board of Directors. ZASCO's shareholders, like ZAFICO, are (i) Zanzibar Social Security Fund, (ii) Zanzibar State Trade Corporation, (iii) Zanzibar Port Corporation, and (iv) Zanzibar Insurance Corporation. A seaweed processing plant is currently under construction on Pemba Island in cooperation with a private UK company.

The Kenyan side, after being briefed on the seaweed export strategy and other objectives of ZASCO, is of the opinion that in order to inject more capital into the seaweed farming industry, the Kenyan Government should establish a business-oriented Algae Farming Corporation and allow existing corporations to hold shares in the company. This would provide seaweed farmers with additional funds to increase production and develop critical infrastructure such as seaweed processing facilities for value addition. The establishment of such a seaweed company would also improve seaweed market access for local fishermen and farmers, the report also points out.

Institute of Marine Science, University of Dar es Salaam (IMS)

A total of 10 lecturers at IMS, led by the Dean of the Faculty, attended the meeting and were briefed on the research and other activities being carried out at the University.

Marine resources support the socio-economic aspects of the majority of communities living in coastal areas. It is essential that the socio-economic aspects are taken into account in any research operations or projects. The Revolutionary Government of Zanzibar, through the Blue Economy Fisheries Ministry, has a program to support offshore seaweed farming on seaweed farms (80% female). This support includes the provision of FRP vessels to enable access to seaweed farms and training on various knowledge and techniques important for seaweed farming. IMS tries to communicate research findings to as many stakeholders as possible. The collection of seaweed (*Ulva* species) washed up on the beach has recently been seen on the coast of Zanzibar. *Ulva* is collected, dried, packaged and exported to Vietnam for use as livestock feed. Currently, *Ulva* is collected on the beach after being washed up on there. However, some unscrupulous traders hire fishermen to collect it from the sea. This is ecologically inappropriate and should definitely be stopped.

The views of the Kenyan participants are as follows. Kenya should explore ways to collect *Ulva* seaweed washed up on the coast. The Government should approach the Vietnamese Government and other Asian markets to explore the possibility of exporting *Ulva* seaweed. As in Zanzibar, 80% of those involved in seaweed farming in Kenya are women. The Government and other stakeholders should consider supporting women and their families to increase seaweed production by providing inputs, developing infrastructure and providing training.

Deep Sea Fishing Authority (DSFA)

The Director General of the DSFA and relevant staff gathered and were briefed by the DG on the role of the DSFA.

The Authority is a semi-autonomous body funded by the government of the United Republic of Tanzania with its headquarters in Zanzibar. The authority is mandated to formulate, implement, and monitor the implementation of national policies and strategies in the EEZ, and develop & manage fisheries activities in the EEZ, among other functions. The Authority charges a license fee of USD 6,000/3 months for purse seiners, which account for 45% of the total catch and earns USD 70,000/year for Tanzania. Long-liners pay a license fee of USD 3,000/3 months. The Authority unsuccessfully tried to impose compulsory landing of all fish caught in Tanzania EEZ. The measure caused the foreign fishing vessels to leave Tanzania waters and the authority had to withdraw the measure. The authority is piloting electronic monitoring using cameras to monitor fishing operations on board three national fishing fleets, which are fitted with cameras. A detailed strategy for collecting data on the catch of tuna and tuna-like fish has been established, with data being collected through observers on board the incoming fishing vessels. The majority of pelagic fishing nations (DWFN) land fish caught in the Western Indian Ocean in the Seychelles. This is because the Seychelles has extensive infrastructure in place to support the landing of fish, and services such as fuel bunkering are provided.

The views of the Kenyan participants were as follows. The transfer of EEZ fisheries management in Tanzania from the Ministry to a semi-independent agency ensured smooth resource management and increased revenues from EEZ resources. Kenya faces similar challenges to Tanzania and should consider establishing a fishing port with critical cold chain infrastructure through PPP arrangements. Such an investment would raise Kenya's competitiveness to compete with Seychelles, which has an advantageous position in the African East Coast and Western Indian Ocean waters. The Kenya Fisheries Authority should consider learning best practices from the DSFA and establishing a specialized bureau within the administrative structure to better manage EEZ resources and increase revenue from the EEZ space. Kenya has a similar pelagic fisheries development strategy to Tanzania and should explore how modern and novel technologies such as artificial intelligence can be incorporated into data collection methods currently deployed in other jurisdictional waters.

Wrap up meeting

Finally, a summary was made with the Deputy Permanent Secretary of the MBEF and relevant officials. The following exchange of views took place.

Seventy-five percents (75%) of Zanzibar's marine coastal waters are under conservation and few areas are under a no-take zone management regime. The Malindi fish market and fish landing facility is a complex infrastructure built with Japanese grant aid. It includes a fish landing area, an auction area, a retail area and an ice-making area. Important parts of the market, such as ice-making facilities and toilets, are managed by the private sector.

Only certain fishing gear is permitted in marine protected areas. A similar approach is followed in Kenya, except for the punitive enforcement methods used in Kenya. The effectiveness of Zanzibar's non-punitive enforcement methods should be assessed to find out how best to incorporate them into Kenya's enforcement

methods; SDBEF and county governments should involve interested private contractors to manage all existing beach infrastructure and facilities.

Seaweed farming in Zanzibar is advanced (it has been going on for over 30 years) and the Zanzibar Revolutionary Government, through ZASCO, is building a seaweed processing plant with a processing capacity of 30,000 tones. Current seaweed production in Zanzibar is 12,000 tones, so at full capacity there would be a shortage of 18,000 tons of raw material. A huge seaweed market will emerge in Zanzibar and there is a huge business opportunity for Kenyan seaweed farmers to supply seaweed. To prepare seaweed farmers for this opportunity, they need to organize their farmers into cooperatives.

ZAFICO is financially independent and operates through shareholdings; the lack of technical expertise in EEZ fisheries is one of the challenges faced by the corporation. The Corporation owns two commercial fishing vessels but lacks skilled fishing crew. Meanwhile, the KFIC should change from its current total dependence on finances for its operation and management to management through shareholding. More than 880 Kenyan fishermen with maritime training can fill the skills and knowledge gap in Zanzibar's offshore fishing industry; SDBEF and the MBEF can work bilaterally to provide employment opportunities for trained Kenyan fishing boat crews. Currently, the Revolutionary Government of Zanzibar sends fishing boat crews to South Africa for STCW training, while the MBEF wants to train fishing boat crews in Kenya. The BMA and the KMA are accredited by the IMO to train and certify trainees on STCW. The Ministry of Mining, Blue Economy and Maritime Affairs could work with Zanzibar to provide training for offshore fishing crews.

Fishermen are involved in fisheries management through the Shehia Fisheries Commission. The Shehia Fisheries Commission is only engaged in fisheries management and is chaired by the Regional Commissioner. The Shehia concept is recommended for co-management in Kenya; BMUs should only have fisheries management functions. In Kenya, BMUs perform more functions such as fisheries management, MCS, quality control, beach sanitation and marketing. Too many functions make BMUs inefficient; it is recommended that only one function, fisheries management, be assigned to BMUs.

(3) Reporting the results of the second third country training (Zanzibar)

On April 29, 2024, a W/G meeting was held where the results of the second third-country training (Zanzibar) were reported. The team leader of the third-country training participants presented the results using the presentation materials (Appendix 11). It was particularly recommended that the participants, led by the team, prepare a proposal for the construction of a fish landing site and market similar to the Malindi fish market. A subcommittee was established, with the task of drafting an outline within a few months and submitting it to SDBEF through the chairperson. After being presented to the PS and receiving approval, the outline will be submitted to JICA through the necessary channels. The outline will propose that the facility consist of a landing site, market, and office building (including rooms for fisheries officers), and the candidate site should be supported by data such as fish catch records, the number of fishing vessels, and the number of fishers.

2.7. Strengthening the Training Implementation System of C/P Organizations

As part of the activities related to Outcome 6, "The system for conducting training at counterpart

institutions is strengthened." efforts were made to enhance the training content independently implemented by the C/P organizations. This included refining and newly creating training materials. Additionally, discussions were held at a wrap-up seminar with Kenyan stakeholders regarding the project's outcomes and strategies for enhancing the capacity of marine and fisheries support personnel, including the strengthening of support organizations through capacity building. The future training programs were also considered. Details are as follows:

2.7.1. Creation of the Video Book

In this project, lectures and field site visit programs conducted during the domestic training sessions were recorded on video. Initially, the concept was to edit these videos and share them through a cloud service with individuals beyond the training participants, aiming to widely disseminate the training content. However, although the recordings from the first domestic training were uploaded to a cloud space, due to a lack of time, budget, and human resources required for editing, the raw video clips were simply provided as is. This approach failed to create a finished product that would be easily understandable for external audiences. From the second session onwards, while video recording continued, the decision was made to forgo further uploads to the cloud space.

Despite these circumstances, we continued recording with the revised objective of compiling the training records from all sessions, including past ones, into a digital product by organizing them into an easily understandable "video book" based on each training topic. This new video book concept was initiated halfway through the project, after the completion of two of the four planned domestic training sessions. The capacity for each session was set at 10 trainees, and it was estimated that around 40 people would participate in total. However, there were approximately 100 personnel from KeFS, SDBEF, and the fisheries departments of the coastal counties assigned to coastal areas, meaning that less than half of the potential trainees would be covered.

From the results of the two training sessions, the program began to be recognized as particularly effective for the orientation of new staff, and it was anticipated that similar training programs would be in demand even after the project's conclusion. However, it became clear that there were limited resources available to implement such training programs, particularly in terms of budget, making it difficult to continue running training programs on the same scale as this project. In fact, during the W/G meeting held just before the second domestic training, the SDBEF branch director requested, "We only need per diem for two people, so please allow three participants." This request reflected the recognition of the effectiveness of the training program but also hinted at an intent to have all personnel under the branch complete the training before the project ended, signaling that continuing similar training after the project would be realistically difficult.

Additionally, since each institution had different training needs and implementation resources, when conducting their own new staff training, they would not need to cover all the training topics. Instead, they could structure the program efficiently by focusing on what was most important. Therefore, editing the videos for each topic to create individual standalone video modules, and compiling these into a "video book," was considered a way to improve convenience, allowing each organization to use the materials according to their specific needs. The proposal for this concept was made and received basic approval at the W/G meeting held during the dispatch for the third domestic training.

After the completion of the third domestic training, actual video editing began. Through trial and error, a template video was produced for one topic. During the fourth domestic training, additional video clips necessary for the video book were filmed, and editing work such as removing unrelated parts and adding English subtitles for Swahili-language segments was carried out. Ultimately, a video book covering the themes outlined in the table below (Appendix 12) was completed.

Table 27. ‘Video Book’ title of this training

No	Title
1	Dry Dagaa Fish Processing
2	Fish processing at Huawen
3	Fisheries Management and Development Practice Lecture
4	Kijiweni HDPE cage system
5	Mariculture pond farming in Kibokoni
6	Offshore Fishing Techniques
7	Quality Control Fish Testing Laboratory
8	Seaweed farming and processing
9	Seaweed farming lecture
10	Solar Cool and Drying Facility in Mwazaro
11	Fishing Gears and Techniques - Lecture
12	Fish processing in Kenya - Lecture by KFIC
13	Crab farming in Kenya
14	Banca Boat
15	Sea harvest
16	Fisheries Climate change - Pascal Lecture
17	Mariculture Development in Kenya - Lecture
18	Status of fisheries resources and lost opportunities - Lecture
19	Overview of Marine Protected Areas - Lecture
20	Role of KCGS - Lecture
21	Overview of Blue Economy – Lecture

2.7.2. Wrap up seminar

The wrap up seminar was held on September 5, 2024, at the Muthu Nyali Beach Hotel, with a total 46 participants, including key stakeholders such as SDBEF and KeFS from Nairobi, as well as CECMs from various counties. During the seminar, the project’s outcomes were shared, and discussions were held regarding future plans. The project summary, brochure, and program distributed at the seminar are attached as Appendix 13.

During the seminar, questions and exchanges of opinions took place among participants, and the following key points were highlighted.

Firstly, regarding the lack of fish handling techniques, stakeholders from Kilifi County pointed out that Kenya’s export of seafood to the European market is hindered due to poor handling techniques for caught fish. During the current training program, participants had the opportunity to visit private factories with a focus on seafood intended for export. It was emphasized that fishers need to adopt handling practices suited for quality management. Moving forward, there is a need to introduce training programs that instruct proper handling methods in compliance with international standards and the requirements set by seafood export companies. Furthermore, it was encouraged that the government officials who received training under this project share the knowledge they gained with local stakeholders, ensuring that not only fisheries officers but also fishers who directly handle the seafood are able to participate in such training.

Next, in discussions about the bangka fishing boats, there was strong interest in the replication of bangka fishing boat technology, with attendees from Kwale County highlighting the potential for job creation during the construction phase. Questions were also raised about the procurement and maintenance of engines, leading to an agreement that KeFS would take the lead in promoting the replication of bangka boats and disseminating the technology in collaboration with local fishers. Additionally, counties were encouraged to have their communities propose the introduction of these boats. It was confirmed that the engines could be sourced from a local Honda dealership and maintained by local mechanics. The cost of constructing a FRP banca boat was reported to be approximately KES 800,000 (excluding VAT). It was proposed to launch an awareness campaign to inform coastal communities of the benefits of bangka fishing boats and encourage fishers to purchase them. Furthermore, the importance of partnerships to secure funding for the introduced technology was stressed, with KeFS expected to explore partnerships with private companies and seek government funding support.

Overall, it was recommended that the technologies introduced through this project be adopted in other counties to extend their benefits across the Kenyan coastal region. The following proposals were made as the next step: 1) Continuous Guidance: KeFS and county staff will provide ongoing guidance to the BMUs to support the practical application of the knowledge gained during the training, 2) Dissemination of Philippine Technology: the fishing technologies from the Philippines (such as HDPE cages and bangka boats) will be introduced to other BMUs to promote technology dissemination, 3) Monitoring and Promotion: KeFS will work closely with the county governments to ensure effective monitoring and promotion of the technologies, 4) Regional Deployment of Technology: Continuous collaboration with stakeholders will be pursued to expand fishing boat technology to other regions, 5) Collaboration with the KEMFSED Project: Efforts will be made to strengthen collaboration with the KEMFSED project to expand the activities implemented in this project.

3. Lessons learned from the project and recommendations for the future

3.1. Process of Developing Policy for Blue Economy Human Resource in this Project and Issues to be Considered in the Future

The Kenya Vision 2030 and its Third Medium-Term Development Plan (2017-2022) defines the blue economy as an inclusive concept that encompasses not only fisheries and aquaculture, but also tourism, transport, shipbuilding, energy, bioprospecting and underwater mining, amongst other diverse sectors. In order to support the development of the blue economy with such diversity, it is essential to have a cross-sectoral perspective, as well as a deep understanding and practical skills in the respective fields of expertise. The project designed the in-country training program for young fisheries administrators to understand and respond to the current situation as follows.

In analyzing the current situation and identifying issues at the start of the project, the consultants visited the C/P institutions KeFS and SDBEF as well as other blue economy related institutions (KFMA, FLTF, KNLS, KMA, BMA, KPA, KCGS, KWS, NEMA, etc.) to collect information on the role and work of each institution. This confirmed the current situation where fisheries-based activities are mainstreamed for the trainees, while linkages with other sectors are limited. In addition, a questionnaire survey of C/P agency staff revealed that although the concept of the blue economy itself was well recognized among them, there

was a lack of concrete examples and opportunities to learn in the field. In particular, the fact that existing training programs are lecture-based and lack emphasis on hands-on experience emerged as a major challenge.

In the formulation and implementation of the training program, in light of these issues, a hybrid training course was developed, combining (i) lecture-based training with invited lecturers from blue economy-related organizations and (ii) a field-oriented programs to visit the sites of the activities. In the lecture-based training, participants deepened their understanding of the diversity of the blue economy by learning about the activities of government institutions to which they have little contact in their normal work and some related institutions (e.g. KCGS and KFMA). Meanwhile, the field visits focused on traditional fisheries (fishing and aquaculture), but also provided an opportunity to introduce cross-boundary initiatives, such as the SolCoolDry project. However, addressing case studies from sectors outside the fisheries industry, such as tourism and shipping, was limited in terms of relevance and priority. This was due to the fact that the training targets were young fisheries administrators, who first of all had a strong need to strengthen their expertise in their area of responsibility, the fisheries industry.

The field-oriented approach provided the trainees with practical knowledge and the opportunity to directly experience the challenges and situations on the ground. As a result, training participants were able to develop the ability to link the concept of the blue economy to their own work. On the other hand, there were limited initiatives with a view to collaboration and cooperation with other fields, and the training content did not fully reflect the diversity of the blue economy. In particular, the fact that the perspective of emphasizing collaboration with different sectors was not fully integrated into the overall training program emerged as an issue for the future.

The following issues and suggestions for future consideration are presented. (i) In building the capacity of young fisheries administrators, it is first important to strengthen their expertise in their area of responsibility. At the same time, it is also necessary from a long-term perspective to understand the diverse elements of the blue economy and to develop a perspective that enables cooperation with different sectors, (ii) Future training programmes should aim to develop human resources with diverse perspectives by building on traditional fisheries, but also actively incorporating examples from other sectors, such as tourism, transport and energy. (iii) Furthermore, it is hoped that a framework for promoting the holistic development of the blue economy can be established by incorporating a mechanism for collaboration involving fishing communities and businesses from different sectors in the training. (iv) Finally, the next step is to build on the results of this project to strengthen intersectoral cooperation and develop a training system that contributes to the sustainable development of the blue economy.

3.2. The need to Implement Field-Oriented Training

Two-thirds of the project's In-Country Training courses was devoted to programs of field site visits to fisheries Blue Economy activities. In addition, technical specialists were invited from the Philippines to actually build two fisheries technology facilities (Banca fishing boat and HDPE fish cage) that are supporting the advanced fisheries industry of the Philippines, and the training programs included progress monitoring on the impacts of these introduced technologies. The structure of these field-oriented training programs was based on an understanding of the current situation in Kenya's coastal region studied at the

beginning of the project, and was in response to a strong request made during discussions with the Kenyan side in the Working Group meetings. It has been pointed out that there are few opportunities for on-site training in fisheries education in Kenya in general (Nangulu et al., 2021), and the exchange of views on fisheries technology and fishermen through on-site visits is a highly effective training strategy that contributes to capacity building of new civil servants in the fisheries sector who have little field experience. In particular, the staff targeted by this project, who were newly recruited as a result of the Government's policy change to focus on the blue economy, were drawn from a wide range of previous work experiences, including in fields other than fisheries, so it was a highly effective training method for them to exchange views and learn about the realities of the blue economy in the field, which they cannot learn from books or classroom lectures.

3.3. Participatory and Interactive Training Programs Aimed at Capacity Building for Blue Economy Development

The Blue Economy training in this project was implemented based on the concept of long-term and comprehensive benefits to the target population and its society as a whole, taking into account not only economic efficiency but also social and environmental sustainability. The Blue Economy, although limited in scope to water bodies (in this project, the sea area), encompasses an extremely diverse range of activities that utilize the full range of biological and non-living resources, and the management of the people, businesses and public institutions involved in the management of these resources.

The Blue Economy does not have a single correct definition, like a theorem of natural science, but can be conceptualized in a variety of ways depending on how it relates to resources. This is the most significant feature of the Blue Economy and a training plan was developed based on this premise.

Specifically, lecturers were invited from blue economy-related national institutions located in Mombasa, and visits were made to each institution to give lectures on the actual status of their activities and to tour their facilities. They also visited local fisheries activity sites and learned about the actual situation of the blue economy through exchanges of views with local people.

The training methodology was designed to provide as many opportunities as possible for trainees to learn diverse concepts through exposures to different blue economy activities, rather than receiving one fixed blue economy concept. The training did not include a test to measure understanding of the course contents, which is not in line with this training strategy, but instead provided time after the training for self-study in which trainees could voluntarily discuss the content and deepen their understanding of each other, thereby strengthening the learning process.

Trainees were required not only to passively understand the training content, but also to actively participate in training activities and foster a blue economy perspective based on their own education and employment background and the characteristics of current fisheries activities. The trainees were recently employed civil servants of fisheries organizations, selected through a rigorous national civil service recruitment system and thus of high calibre. They have at least a bachelor's degree and a certain amount of working experience and are considered to be suitable candidates who will benefit from the expected training effects of this training, which is based on interactive and proactive learning methods. As part of the training, discussions were also held on aquaculture technologies introduced from the Philippines, in which trainees

set a low priority for training on seaweed farming from a gender equality perspective and gave a high priority to the introduction of fish and mangrove crab farming technologies, which are not generally considered blue economy aquaculture targets. Such decisions by the trainees showed that they were willing to tackle blue economy issues from their own perspectives and made practical decisions through active learning. This attitude confirms that the interactive training method in the project was an effective approach that maximized the trainees' abilities.

3.4. Introduction of Fisheries Technology from South-East Asia

Southeast Asia is a leading fisheries region, producing about a quarter of the world's seafood products. Per capita consumption of seafood in the region is 39.4 kg/year (2017) (Elyssa Kaur Ludher, 2023), which is approximately double the global average. In contrast, per capita consumption in Kenya is only about 5 kg/year, a significant difference from South-East Asia. In the South-East Asian countries, as in Kenya, coastal fisheries resources are over-fished and landings have reached a plateau or are declining. However, the region's demand for seafood is being met by the development of aquaculture production. During this development process, Southeast Asian fisheries and aquaculture technologies overcame the limiting factors in seafood production that Kenya is currently facing, so Kenya has a great deal to learn.

The project introduced advanced fisheries technologies from the Philippines, including Banca fishing boat used in small-scale offshore fishing and HDPE aquaculture cage used for marine fish farming. These technologies were manufactured using locally procured equipment and materials, and were constructed by Filipino and Kenyan technicians working together. The trainees then learned about advanced fisheries technology as part of the training program through demonstrations using locally manufactured equipment.

These technologies not only enhanced the understanding of the trainees, but also had a high impact on the Kenyan side fisheries stakeholders in general through the demonstration of the facilities. As a result, with regard to the banca fishing boats, a private company has taken up a mold for the fabrication of FRP fishing boats, and for the HDPE aquaculture fishponds, KMFRI and the local fishermen's union (BMU) are applying for a pilot project on aquaculture supported by the World Bank. These activities related to technology introduction were undertaken on a voluntary initiative on the Kenyan side, with no financial support from the project.

As far as the fisheries sector is concerned, Southeast Asia's technological superiority is widely recognized, and it is predictable that the transfer of technology to the African region, where sea fisheries and aquaculture are particularly lagging behind, has been highly effective. However, due to the geographical distance, there are few known examples of Southeast Asian technology being transferred to Africa within the framework of JICA's South-South and triangular cooperation in the fisheries sector. Although this project is a training project, it is considered to be highly effective if implemented as a technical cooperation project.

For example, the project made six specific proposals for the introduction of fisheries technology in Kenya, based on successful examples from the Philippines, as shown in Table 19. It is expected that technologies related to Banca fishing boats and HDPE fish cages, which the project was able to implement as a training project for technology introduction, will be realized with the support of Kenyan private resources and other donor agencies. The remaining specific proposals that could not be implemented in the training program under the project are also likely to provide an opportunity to contribute to the development of Kenya's

fisheries industry.

3.5. Advantages of Technology Transfer in Training Projects

Although the Philippine banca fishing vessels and HDPE aquaculture fishpond technology introduced in the project had a high impact on the region through people involved in manufacturing who understood their technological superiority, the project was only a training project and did not have the budget or human resources to implement dissemination activities based on that impact.

Therefore, the project was not able to carry out follow-up activities to promote dissemination, but as a result, it stimulated voluntary initiatives on the Kenyan side. This voluntary initiative is considered to have provided an opportunity to ensure that the introduced technology met the real needs of Kenya. Normally, in technical cooperation projects aimed at technology transfer, positive impact tends to be assumed because the dissemination of the introduced technology is envisaged in advance, and as a result, the project often proceeds to the dissemination stage without checking whether the local voluntary initiative has occurred. However, in training projects such as this project, it is possible to assess the local response to the introduced technology over time, which is an important confirmation as a preliminary stage before proceeding with dissemination activities based on solid needs. In this respect, the introduction of technology through training projects may have advantages over technical cooperation projects.

3.6. Lack of Value Chain Training, Including Marketing Aspects in Fisheries

The project was able to provide training on production and processing processes such as fishing and aquaculture of fish products, but was unable to include training on marketing afterwards.

This was due to the fact that, since the First In-Country Training, the project has been searching for suitable lecturers and destinations, but have not been able to find suitable subjects. The Kenya Fish Marketing Authority (KMFA) plays an important role, particularly with regard to the marketing of fisheries products, but this organization has not yet extended its activities to the coastal areas. This may be due to the fact that the work of government officials in the coastal areas is mainly carried out by the BMUs, and that the public authorities do not have sufficient information on private middlemen with whom they are in competition regarding fish purchases. In other words, the current scope of activities and lack of information from public authorities is a major factor behind the project's inability to provide sufficient marketing training on marine fisheries products. As a result, there was insufficient training to develop a comprehensive understanding of the entire value chain from the status of fisheries resources to reaching consumers, and the training was biased towards specific fisheries technologies and sectors, which is an issue that needs to be reflected on.

3.7. Mechanism for Continuation of Future Training

Ultimately, the training preparation and implementation progressed smoothly on the Kenyan side, and the training was carried out without major issues. However, the implementation of the training incurred costs, including participants' daily allowances, honorariums for lecturers, and fees for hosting visits. A budget of approximately 1 million KES was required. It is expected that it will be very difficult for the respective government agencies to easily allocate such budgets under the current circumstances. Furthermore, the project involved staff from various counties and government agencies, and lecturers were

recruited from a wide range of organizations. Thus, coordinating such cross-organizational training is challenging in the context of the current situation in Kenya.

In response, a video book based on the recorded videos from previous training sessions was compiled as a deliverable. This video book will serve as educational material, allowing the same training content to be accessed for continuous learning.

One of the benefits of the video book is that it can be stored in the cloud, making it accessible anytime and anywhere. This will enable effective learning about the Blue Economy in the coastal areas of Kenya, supporting ongoing education. Furthermore, the project's outcomes can be maximized to contribute to Kenya's sustainable development.

Given that the state of the fisheries sector will continue to evolve, regular updates to the video book will be necessary to remain relevant to current conditions. The editing work for the video book can be handled independently by the Kenyan side, as confirmed during the production of the video book. Updates can be made by having the relevant agencies, through the W/G, review the video book's concept and commission an editor for revisions.

Additionally, the W/G members established by the project were trained as trainers through numerous W/G meetings during the project, gaining experience in preparing, implementing, and revising training programs. They also developed the ability to plan and execute new training programs. Therefore, it is expected that new training sessions, similar to those conducted during the project, can be organized and implemented in the future.

APPENDIX

To the Work Completion Report of the Marine
Fisheries Promotion Advisor Project in Kenya

APPENDIX 1

List of Working Group Members (a) and Philippine
Experts Participated in the Marine Fisheries
Promotion Advisor Project (b)

Appendix 1 a: List of Working Group Members of Marine Fisheries Promotion Advisor (JICA)
Project



MARINE FISHERIES PROMOTION ADVISOR (JICA) PROJECT
WORKING GROUP MEMBERS

Name	Institution	Role
1. Rashid Imam	State Department for Blue Economy and Fisheries	Chair
2. Elizabeth Mueni	Kenya Fisheries Service	Co-chair
3. Hendricah Nabwire	Kenya Fisheries Service	Focal person/ Secretariat
4. Muswaib Ali	Kenya Fisheries Service	Member
5. Dr. David Mirera	Kenya Marine Fisheries Research Institute	Member
6. James Ndiritu	Kenya Fishing Industries Corporation	Member
7. Irene Angore	County Directorate of Fisheries, Kilifi	Member
8. Mealii Mwaruwa	County Directorate of Fisheries, Kwale	Member
9. Bernard Olweny	County Directorate of Fisheries, Tana River	Member
10. Omar Kai	County Directorate of Fisheries, Lamu	Member
11. Asha Mlingo	County Directorate of Fisheries, Mombasa	Member

Appendix 1 b: List of Philippine Experts Participated in the In-Country Training of the Marine Fisheries Promotion Advisor (JICA) Project in Kenya

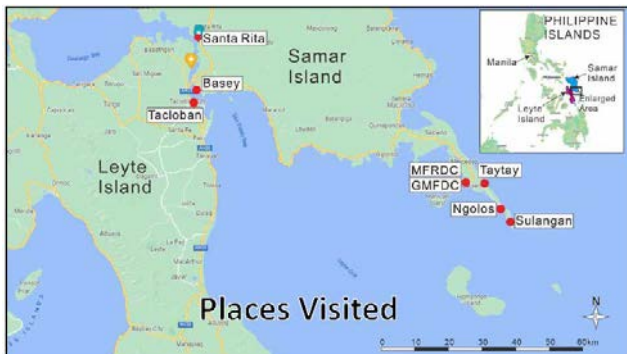
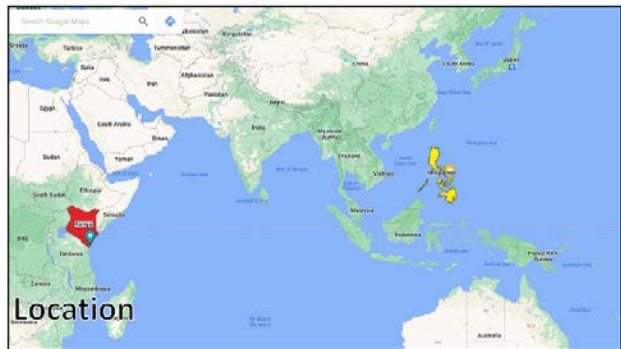
Name	Institution	Training Type	Topic
Dr. Hannibal M. Chavez	Regional Director, Region 8, Bureau of Fisheries and Aquatic Resources	Online Lecture	(Overall supervision)
Nonita S. Cabacaba	Chief Science Research Specialist, Marine Fisheries Research and Development Centre, National Fisheries Research and Development Institute	Online Lecture	(Supervision)
Nelia G. Tomayao	Centre Chief, Guiuan Marine Fisheries Development Centre, Region 8, Bureau of Fisheries and Aquatic Resources	Online Lecture	(Supervision)
Christine Gresola	Information, Education and Communication, Bureau of Fisheries and Aquatic Resources Region 8, the Philippines	Online Lecture	Philippine and Eastern Visayas fisheries
David N. Cosmiano, Jr.	Guiuan Marine Fisheries Development Centre, Bureau of Fisheries and Aquatic Resources Region 8, the Philippines	Online Lecture	Milkfish fish hatchery operation and fry production
Susan V. Borromeo	Mataro Aqua Farm, Basey, Samar Province, the Philippines	Online Lecture	Milkfish nursery operation in ponds, and Milkfish fish cage culture operation
Visenta Z. Projimo	Bureau of Fisheries and Aquatic Resources Region 8, the Philippines	Online Lecture	Seaweed culture: the Eastern Visayas experience
Cristan Joy Campo	Marine Fisheries Research and Development Centre, Guiuan, National Fisheries Research and Development Institute	Online Lecture	Mangrove crab nursery farming
Dan de San Miguel	Provincial Fisheries Officer for Eastern Samar, Bureau of Fisheries and Aquatic Resources Region 8, the Philippines	Online Lecture	Small scale fishing activities in Eastern Samar Pacific, and Wooden boat construction
		On-site Training in Kenya	Demonstration of Philippine Banca Boat Operation in Kenya
Ronnel Jose G. Macabocsit	Construction of Philippine Banca Boat	On-site Training in Kenya	Construction of Philippine Banca Boat in Kenya
William Reorizo Jr.	Engineer, Assistant Vice President for Projects, INCA Philippines Inc., Manila, the Philippines	Online Lecture	High Density Polyethylene (HDPE) marine cages in the Philippines
		On-site Training in Kenya	Design and field supervision for construction of a HDPE fish cage in Shimoni, Kenya
Crisanto Hugo Saavedra	Engineer, Project Foreman, INCA Philippines Inc., Manila, the Philippines	On-site Training in Kenya	Construction of a HDPE fish cage in Shimoni, Kenya

APPENDIX 2

Fisheries Situation in the Eastern Visayas Region of the Philippines

Small-Scale Fisheries and Aquaculture in Eastern Samar in the Philippines

Recommendation to Incorporate presentations by Filipino government officials into Kenya Blue Economy Training



Why the Philippines?

- Natural environment resembles
- Coastal fisheries resources depleted
- Fishing deep water off the coast
- Developed aquaculture in the coastal water

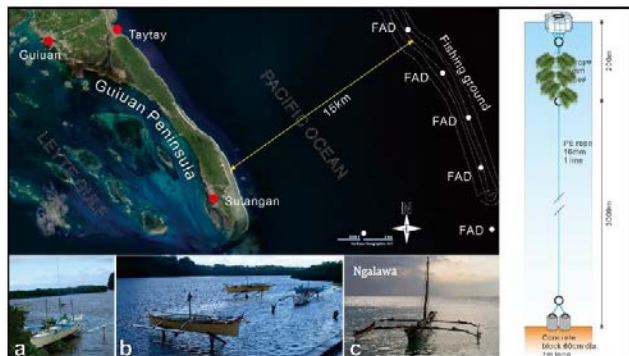


- Near future of Fisheries and Aquaculture situations in the Kenyan coast
- Lessons they went through could be learned



Small-scale tuna fishery

Taytay village, Eastern Samar



- Use of ice for fishing and transportation of fish to market



Milkfish and Crab Farming

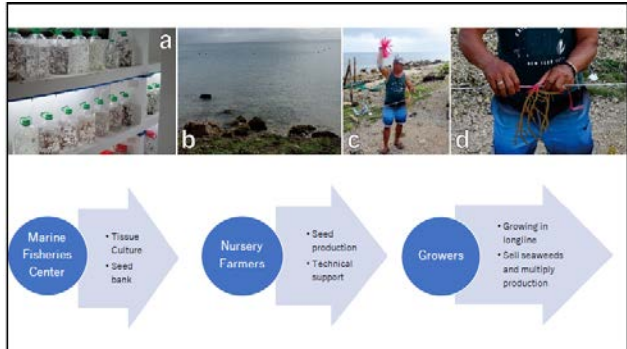
Guiuan marine fisheries development center and Basay, Eastern Samar





Seaweed Farming

Guiuan Marine Fisheries Center and Ngolos, Eastern Samar



Incorporating Virtual Presentations from GMFDC in the Blue Economy Training



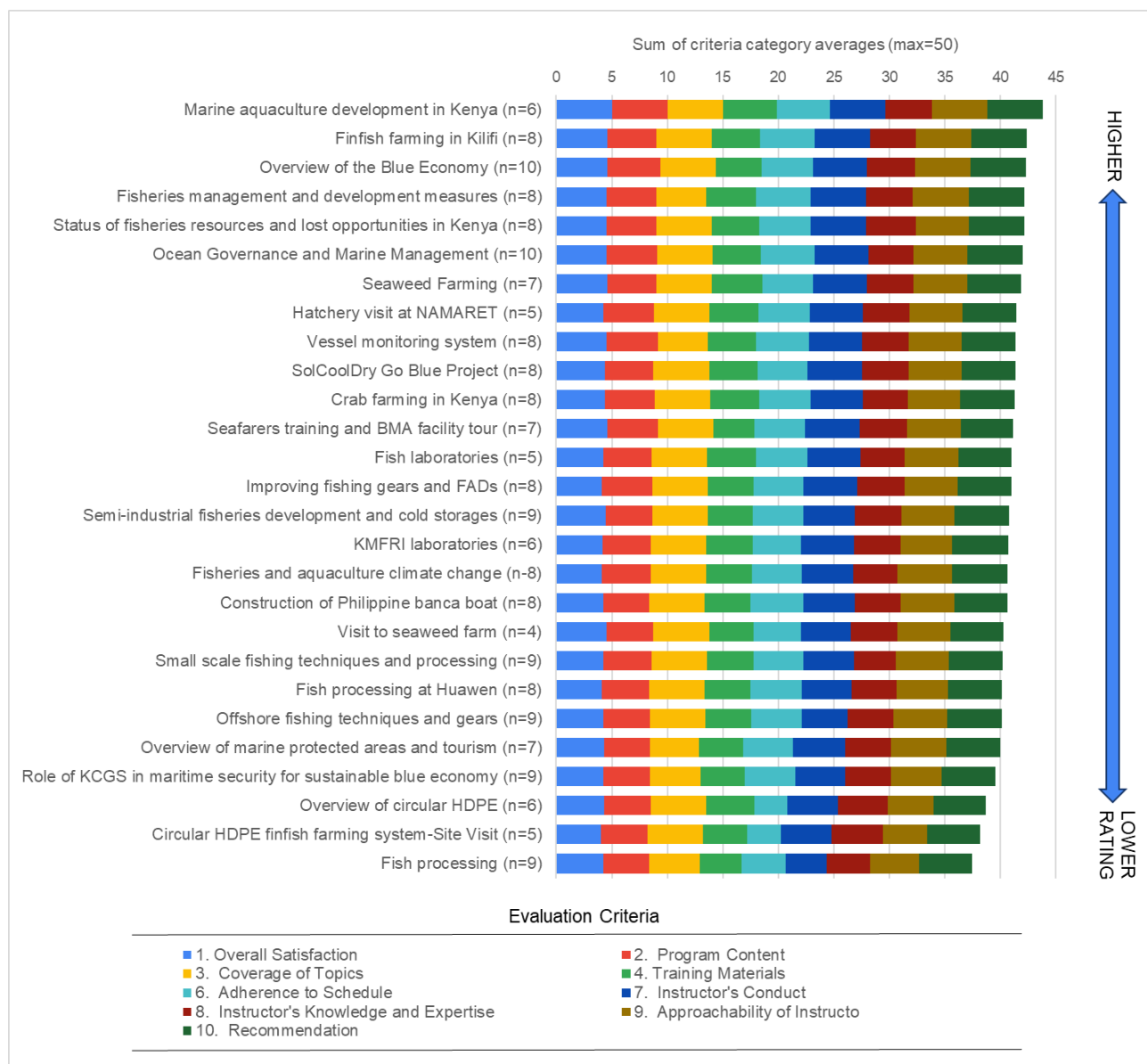
What needs to do

- Includes presentations on the Philippines situations in the training for the selected subjects:
 - 1) milkfish farming, 2) mud crab farming, 3) seaweed farming, and 4) small-scale deep-sea fishery
- Resolve to include Virtual Presentations on the Philippine situations in the training in the current working group meeting and, ask SDBEF to issue a request letter to the government of the Philippines

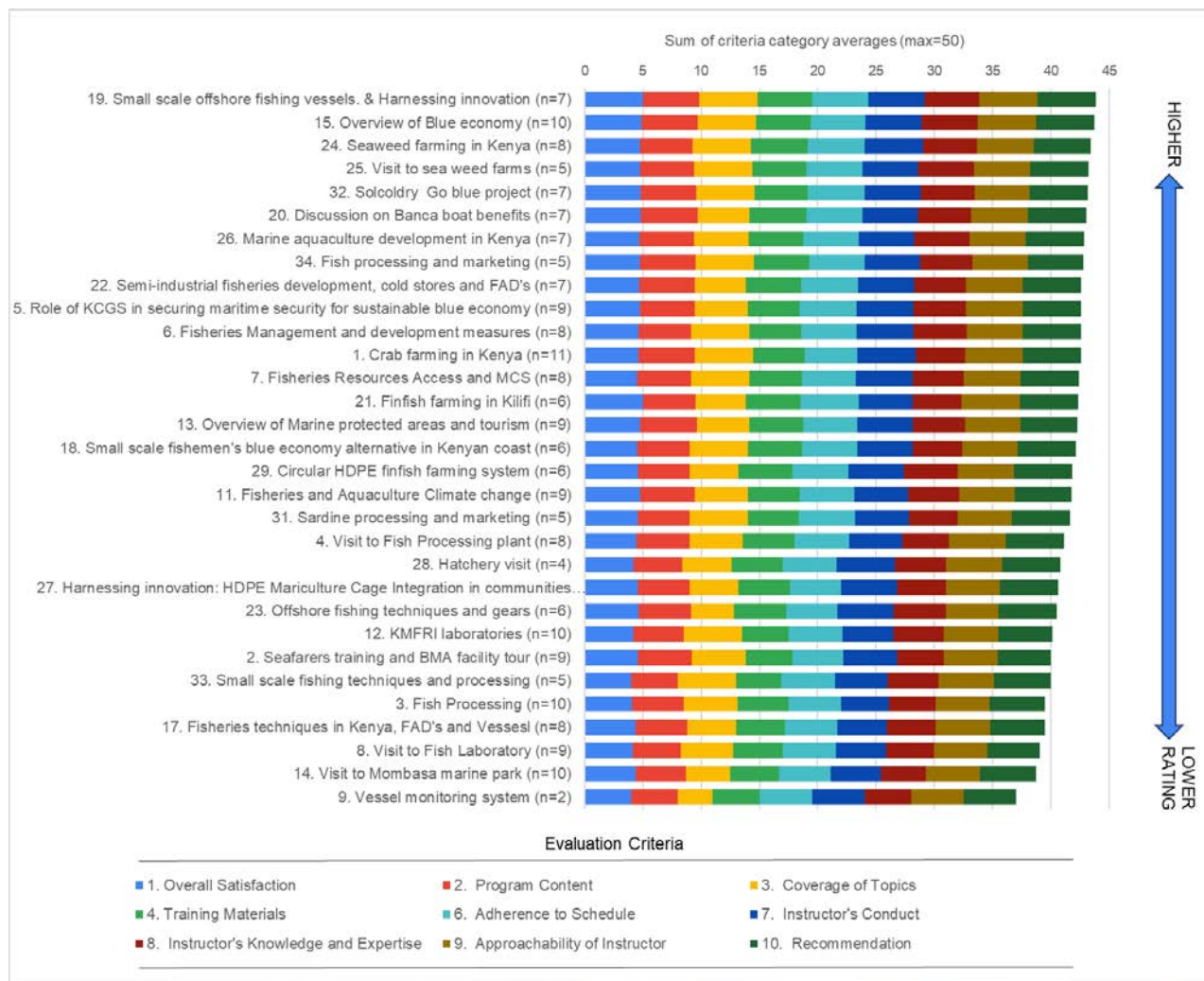
APPENDIX 3

Evaluation by training participants
of the In-Country Training Programs

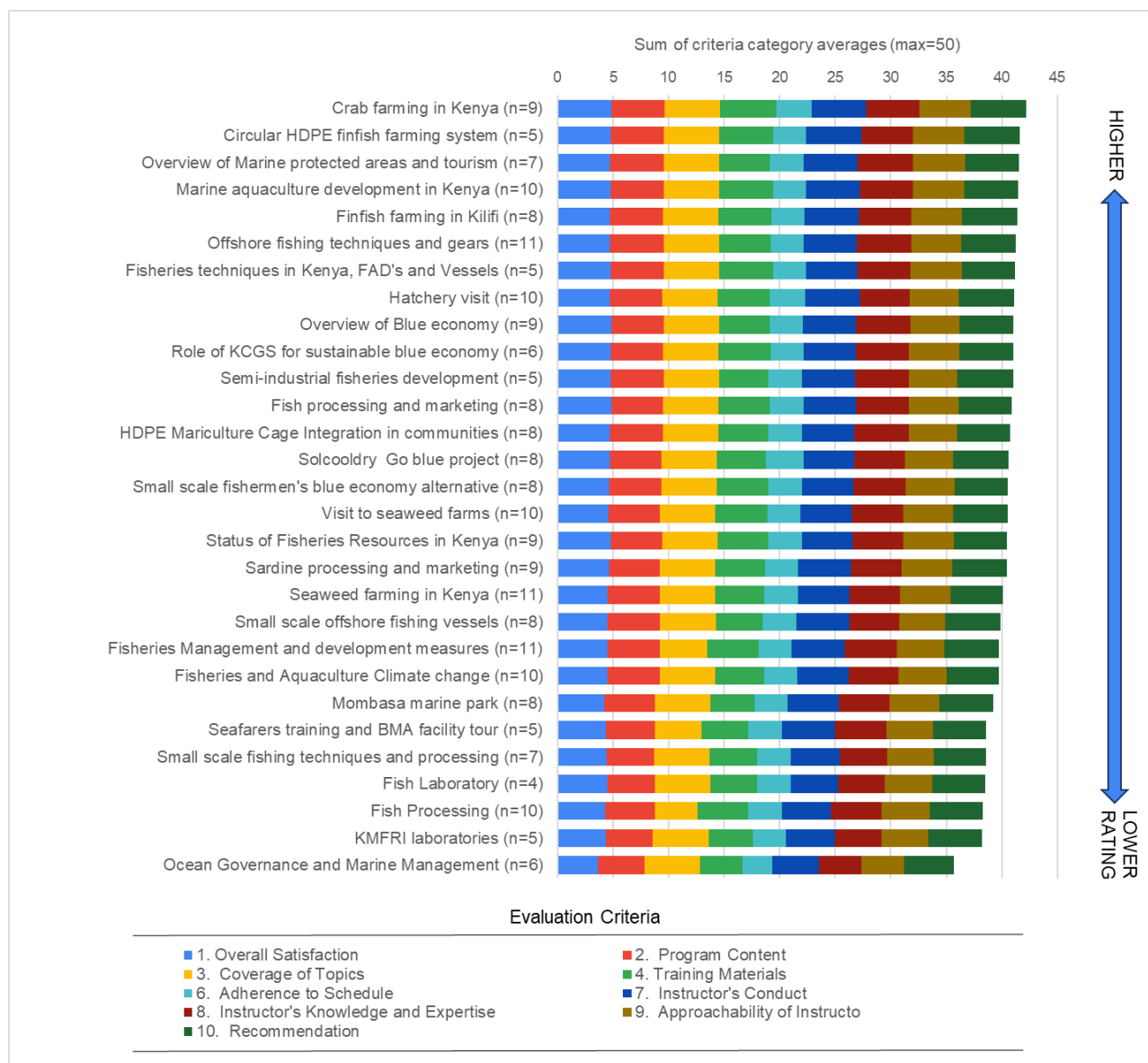
Appendix 2-1: Evaluation of the Second In-Country Training



Appendix 2-2: Evaluation of the Third In-Country Training



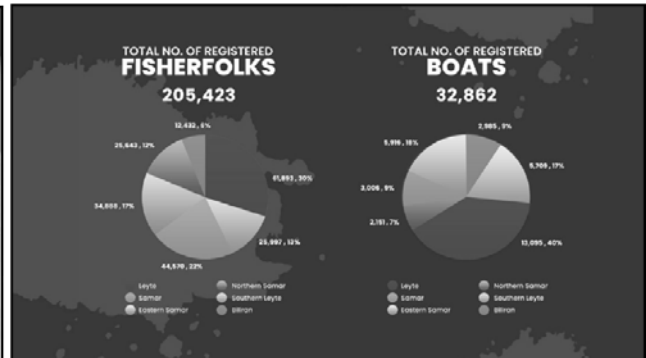
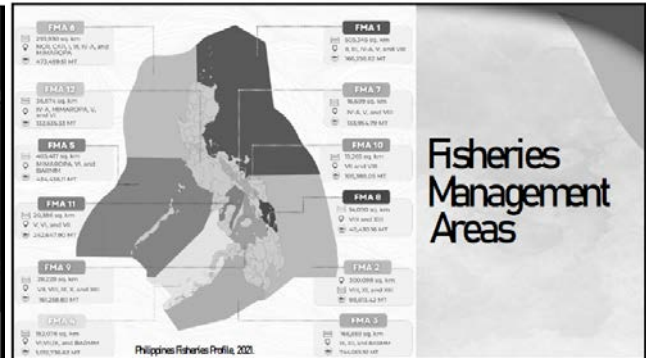
Appendix 2-3: Evaluation of the Fourth In-Country Training



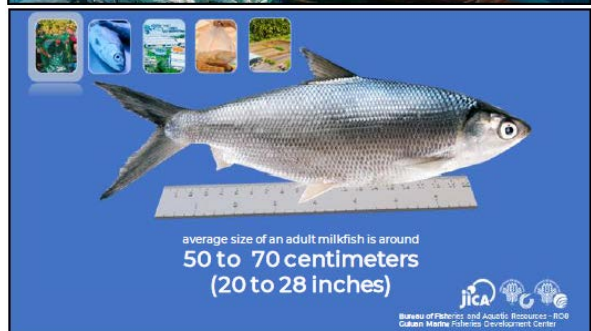
APPENDIX 4

Online Lecture Materials
on the State of Philippine Fisheries

Appendix 4-1: Fisheries Situation in Eastern Visaya of the Philippines



Appendix 4-2: Milkfish Hatchery Operation and Fry Production



LIFE CYCLE OF MILKFISH

EGGS OF MILKFISH

Eggs and embryos: Fertilized milkfish eggs are pelagic, spherical, 1.1-1.25 mm in diameter. Embryonic development is typical of teleost and takes 20-35 hours at temperatures of 26 - 32°C and salinities of 29-34 ppt.



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LIFE CYCLE OF MILKFISH

NEWLY HATCHED LARVAE

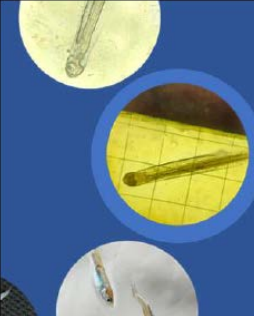
Larvae: Milkfish larvae are pelagic. At hatching, the yolk-sac larvae are of 3.5 mm total length (TL); three days later at 27-30°C, they begin to feed when the eyes have become fully pigmented, the mouth has opened



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LIFE CYCLE OF MILKFISH

DAY OLD LARVAE



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LIFE CYCLE OF MILKFISH

21 DAYS OLD FRY

Post larval/fry: Milkfish 'fry' or 'seed' (to the aquaculturist) are larvae approaching metamorphosis and the end of the pelagic interval within a narrow range of 10-17 mm TL



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LIFE CYCLE OF MILKFISH

JUVENILE MILKFISH

Juveniles and sub-adult: Milkfish larger than 20 mm have acquired the characteristic shape and definitive structures of the adult of the species and are considered juveniles. They bear the complete fin-ray complement, a forked caudal fin, scales, and silvery coloration



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LIFE CYCLE OF MILKFISH

ADULT MILKFISH

Adult Milkfish: Adult milkfish are large (to 15 meter or 15 kg), long-lived, silvery and streamlined, pelagic and schooling



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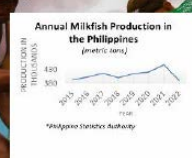
MILKFISH HISTORY

- Cultured for the past 300 - 700 years in Indonesia, Taiwan, Philippines and Hawaii
- Early practices involved capturing wild milkfish fry from estuaries and raising them in brackish water ponds or fish pens near the coast
- In 1970s, significant investments have been made in the Philippines to support milkfish industry

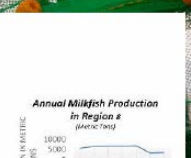


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Annual Milkfish Production in the Philippines (metric tons)



Annual Milkfish Production in Region 8 (metric tons)



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SIGNIFICANT MILESTONE IN THE HISTORY OF MILKFISH FRY AND FINGERLING PRODUCTION

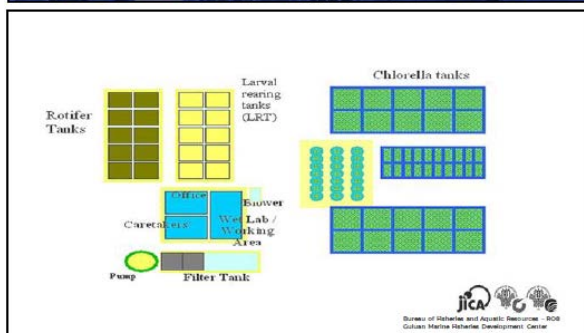
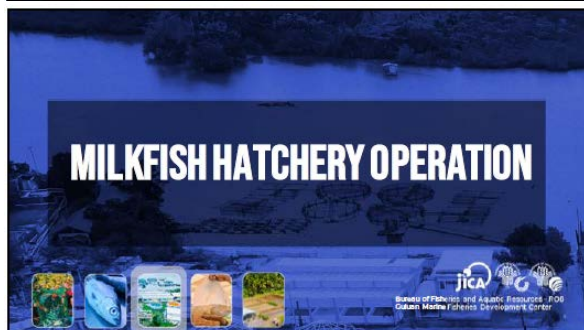
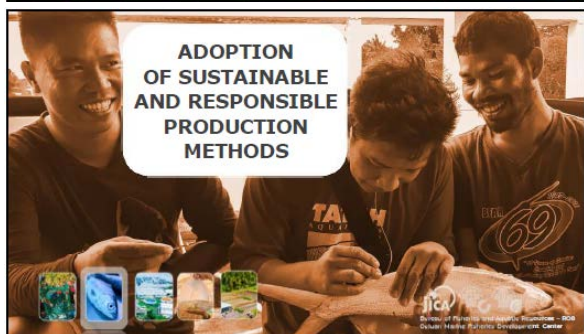


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TRADITIONAL CAPTURE-BASED FRY COLLECTION



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1. Broodstock Management:

a. Selection of high-quality broodstock based on size, health, and reproductive performance.

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c. Monitoring broodstock for signs of maturity and readiness for spawning

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b. Prepare culture vessels or tanks with suitable growth conditions, including appropriate lighting, temperature, salinity and nutrient levels.

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d. Maintain and monitor the culture

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Important Environmental Parameters Required by Green Algae

Salinity : 25-30 ppt
Temperature : below 30° C
pH : 7.5-9.0

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b. Providing optimal nutrition and suitable environmental conditions to maintain broodstock health and reproductive capabilities.

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2. The production of natural food:

Culture of Microalgae:

a. Obtain a culture of microalgae strains, such as *Chlorella* or *Nannochloropsis*.

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c. Inoculate the culture vessels with the microalgae starter culture.

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e. Harvest the microalgae by either batch or continuous harvesting methods

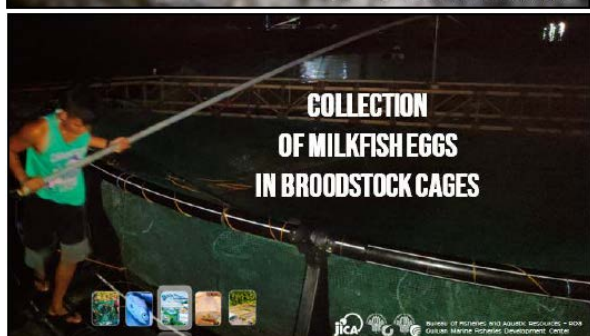
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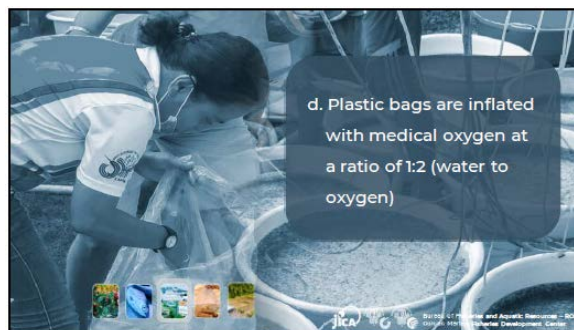
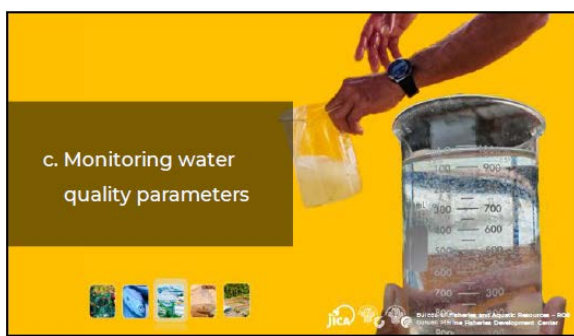


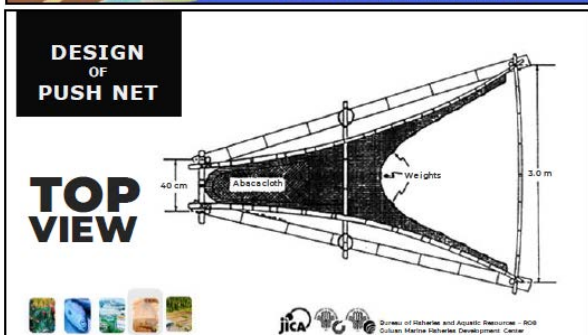
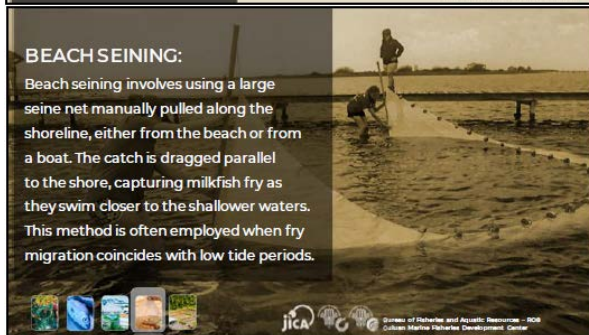
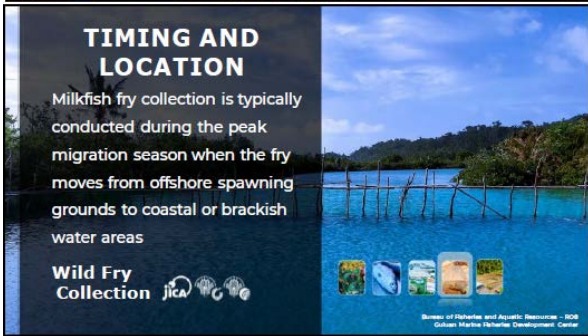
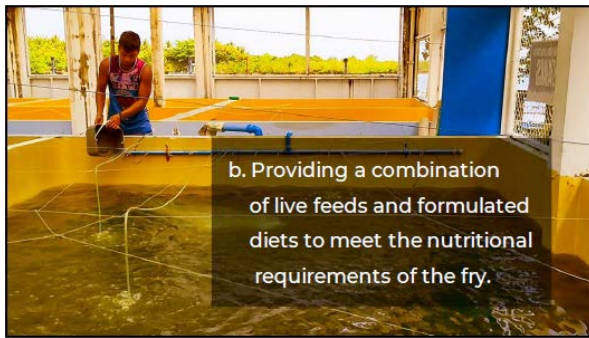
Culture of Rotifers:

a. Set up rotifer culture tanks or vessels

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Cebu Marine Resource Development Center







SIDE VIEW



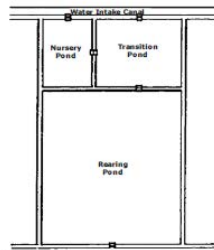
Bureau of Fisheries and Aquatic Resources – DOB
Culian Marine Fisheries Development Center



Journal of Interpersonal Violence 30(12)



Office of Fisheries and Aquatic Resources - R08
Gulf of Mexico Fisheries Development Center



Bureau of Fisheries and Aquatic Resources – RO8



Bureau of Fisheries and Aquatic Resources - RO8

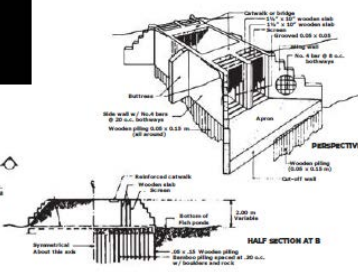
- Site selection
- Deployment
- Pushing Motion
- Collecting the Fry



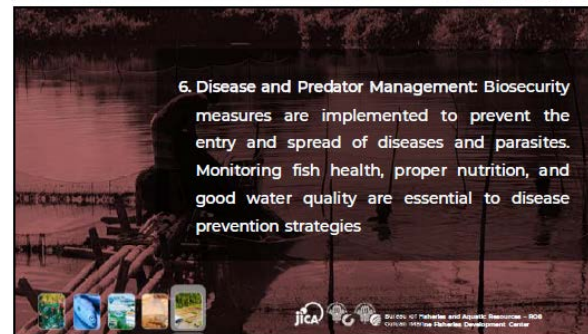
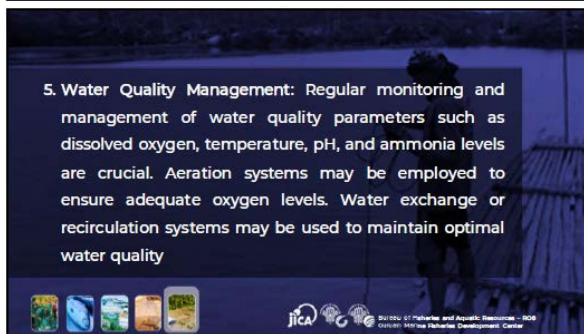
Division of Fisheries and Aquatic Resources – RO6
 OCEAN MARINE Fisheries Development Center

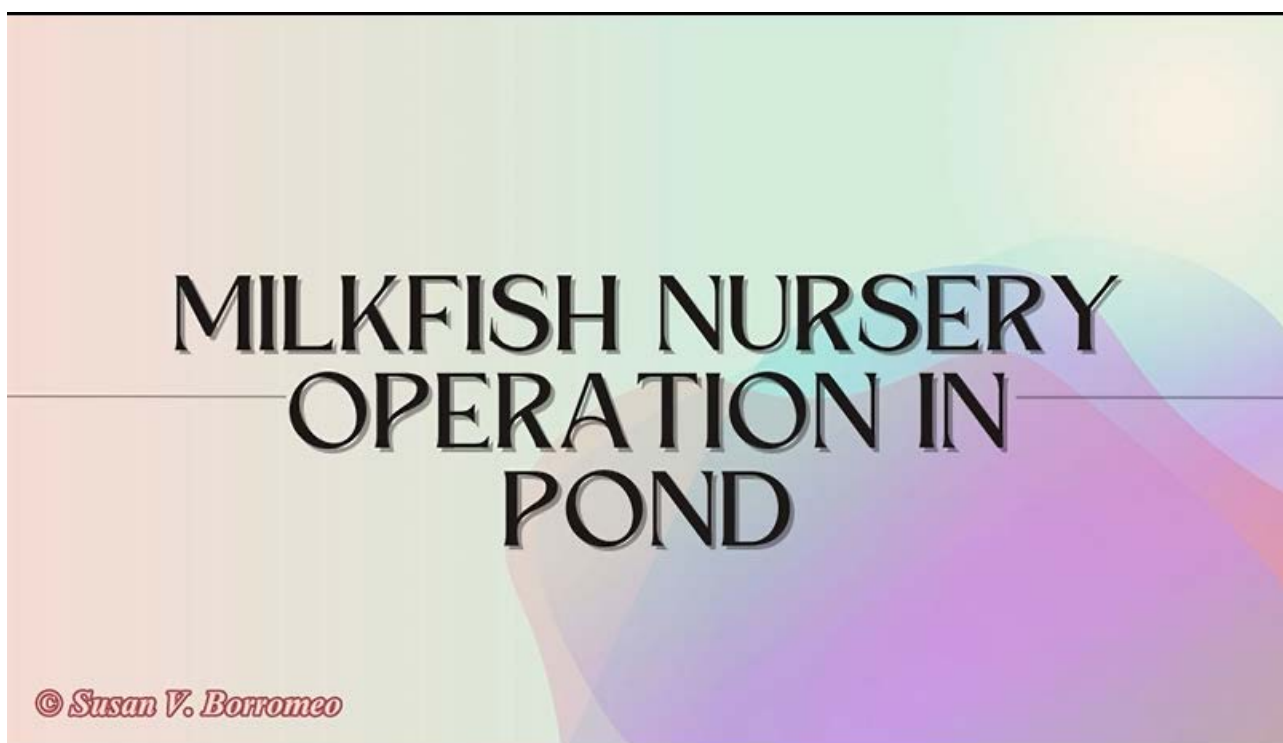
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Office: Marine Fisheries Development Center

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Queen Maria Fisheries Development Center

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National Marine Fisheries Development Center[illegible]

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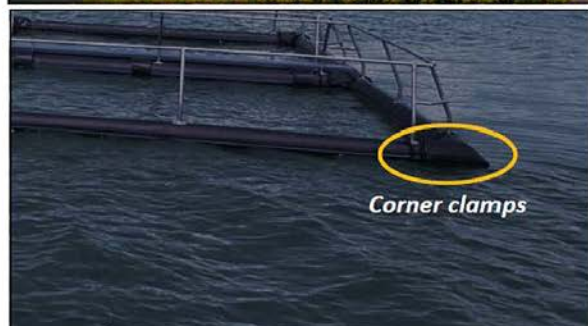
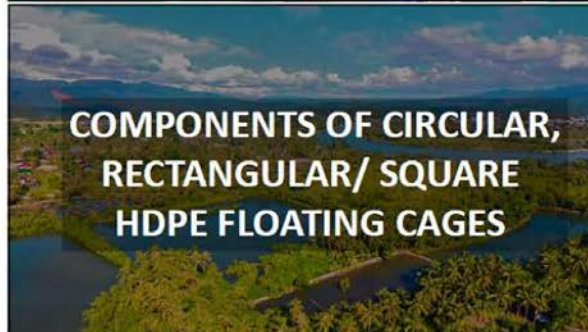
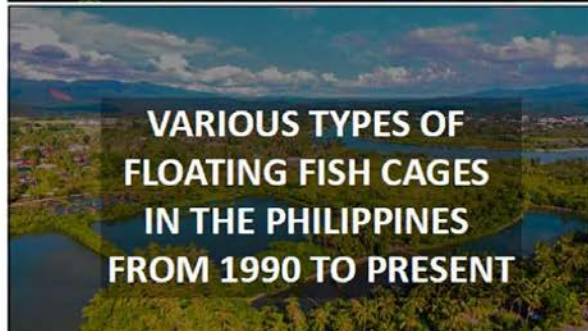
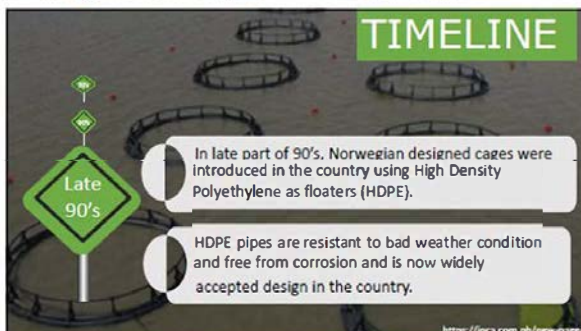


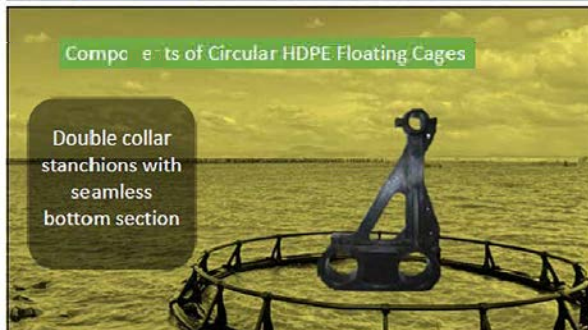
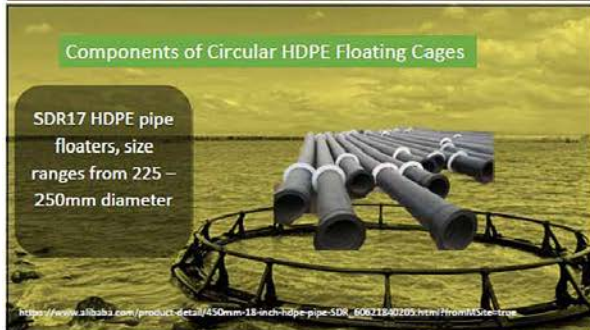
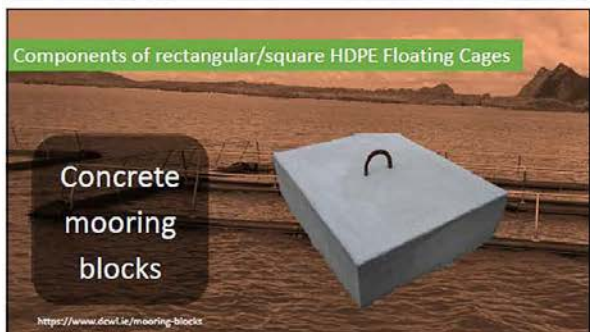
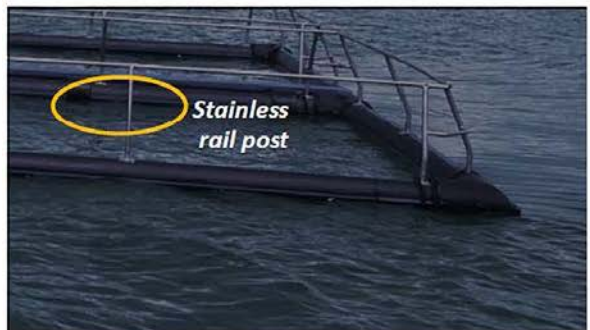
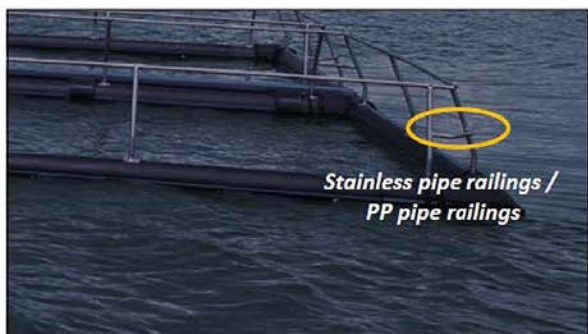
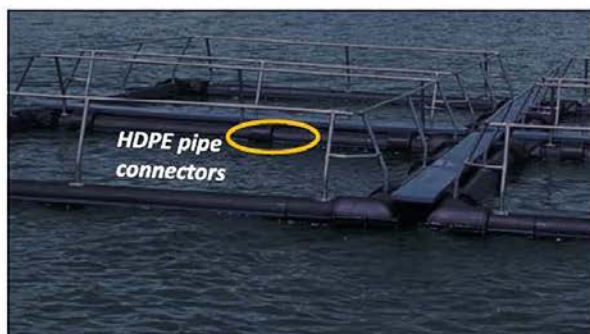


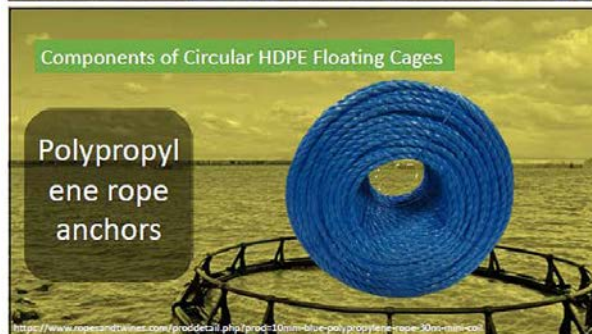
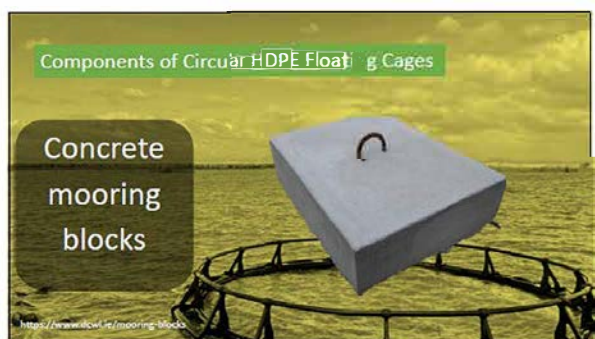
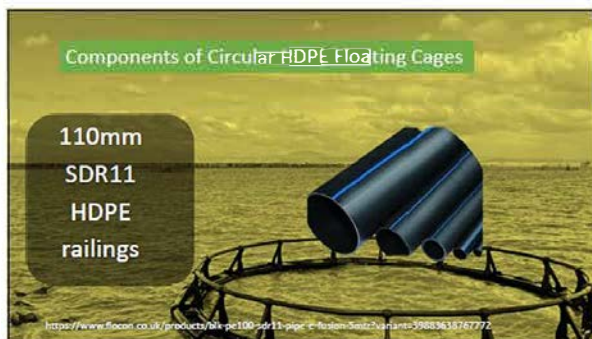
Video presentation link (Limited Access): <https://youtu.be/1rplWtWV4-I>

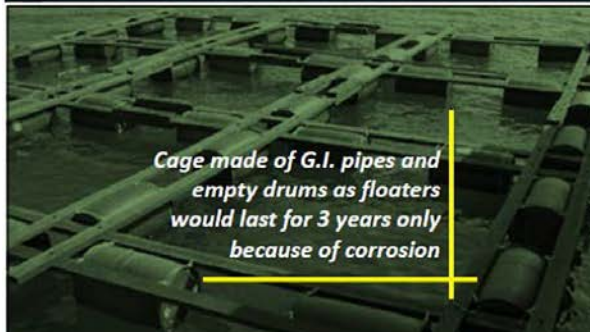
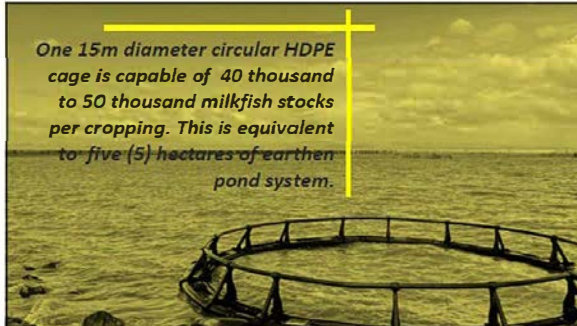
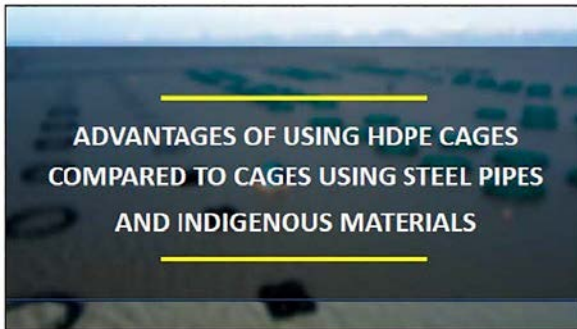
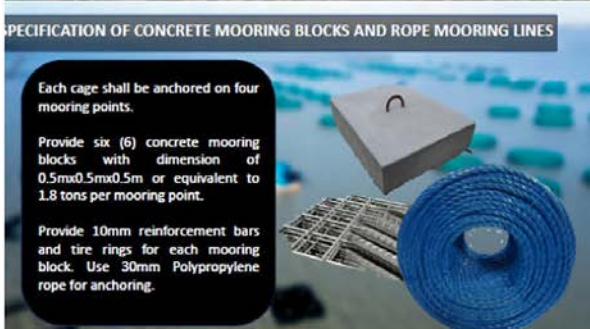
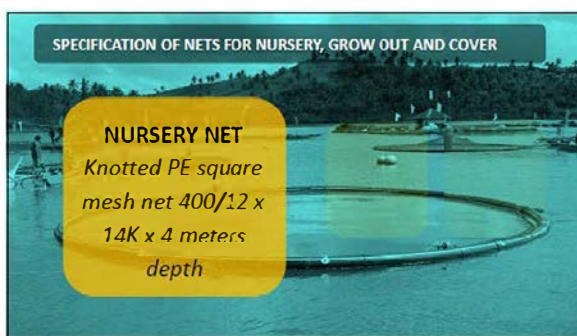
Appendix 4-4: High Density Polyethylene (HDPE) Marine Cages in the Philippines













INCA EXPERIENCE IN FABRICATION AND INSTALLATION OF HDPE CAGES



Our company, INCA Philippines Inc. started the supply, fabrication and installation of HDPE cages both for private and government projects in the late 90's.



There are about three HDPE cage suppliers in the Philippines including INCA. During the aftermath of typhoon Yolanda last 2014, JICA provided funds as assistance for the rehabilitation of Aquaculture Industry in the Philippines.



JICA consultants have inspected and visited our installed HDPE cages to choose the best design of HDPE cage in the country



Among the three local suppliers, INCA HDPE cage design was chosen by JICA consultants as the best design



INCA Philippines, Inc. is now the supplier of HDPE cages using Bureau of Fisheries and Aquatic Resources (BFAR) and JICA funds in the country



As to INCA exposure to supply HDPE cage abroad, The Ministry of Agriculture and Fisheries of Papua New Guinea has tapped the services of our company to supply, deliver, and install HDPE cages in their country



THANK YOU

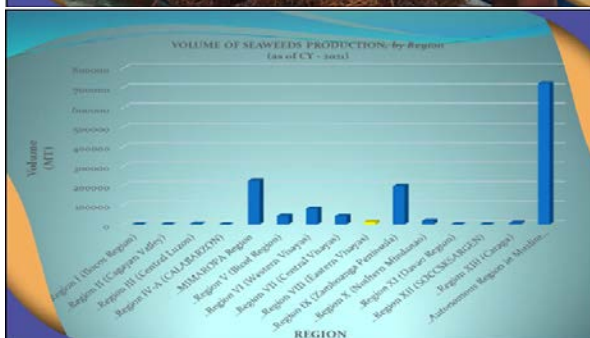
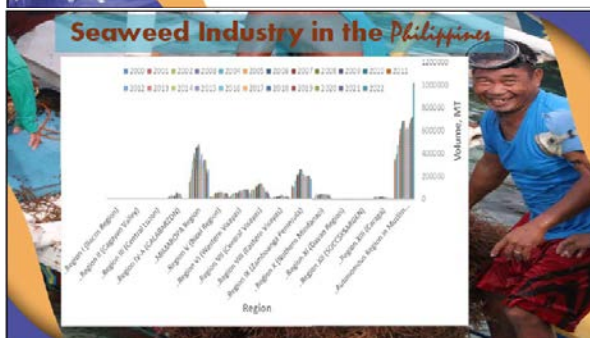
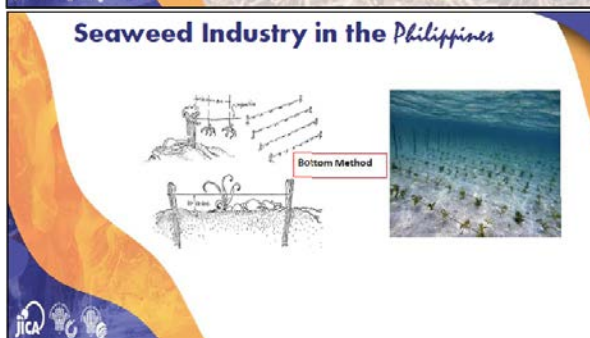
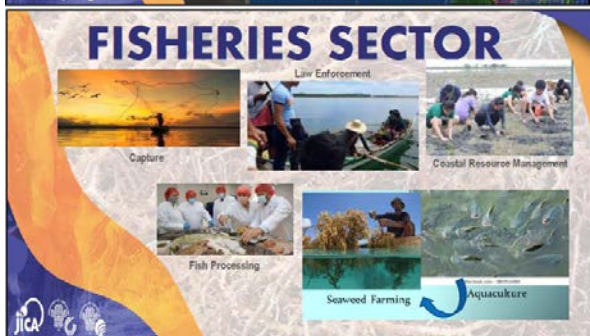
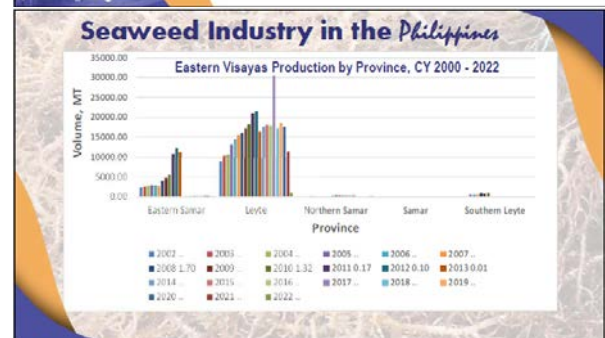
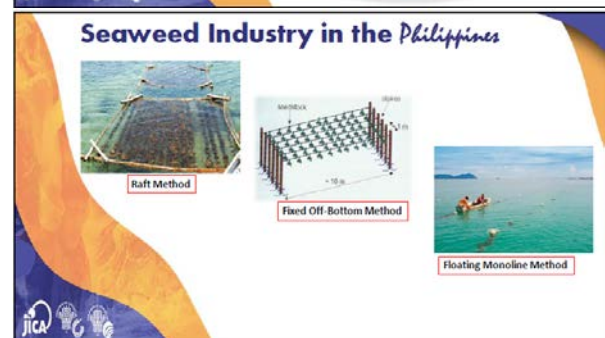
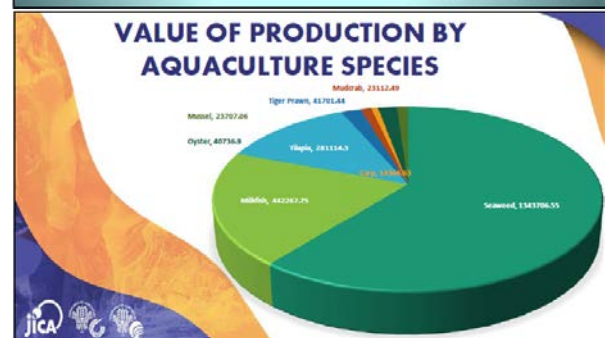


Video presentation link (Limited Access): https://youtu.be/sk5vVL8we_c

SEAWEED CULTURE:
The *Eastern Visayas*
Experience

JICA UN Women UNICEF

Presenter: Vicenta Projimo





Philippine Seaweeds Industry

Comprise 60 – 70% of the total aquaculture production

Export value at \$250 million in 2019

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Philippines as the pioneering cultivator of the carrageenan-bearing seaweeds Eucheuma

An aggregate of 700,000 hectares of potential farmable area

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200,000 fisherfolk households dependent on the industry and 170,950 related jobs supported by the sector



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Seaweeds Industry in Eastern Visayas

Dawakon Reef is Region 8's major seaweed-producing area with coverage of more or less 1,000 hectares



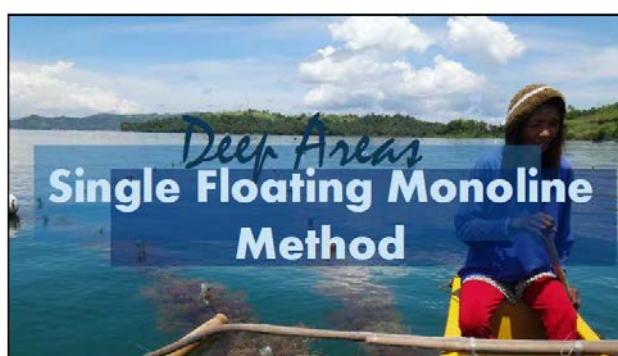
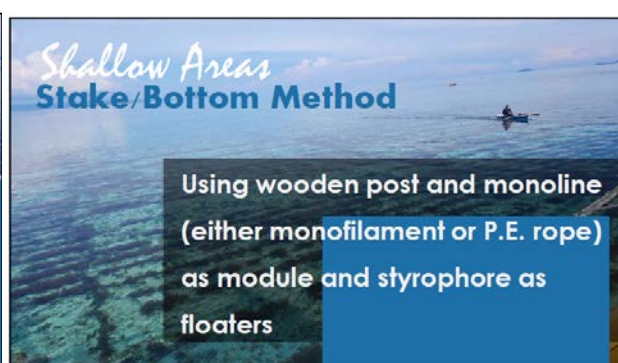
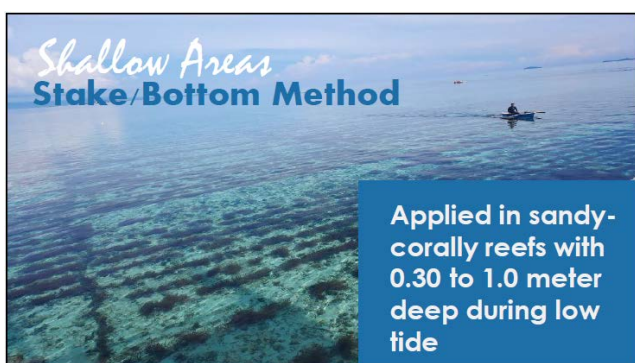
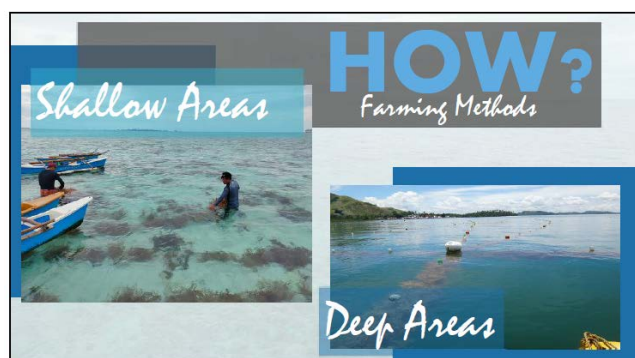
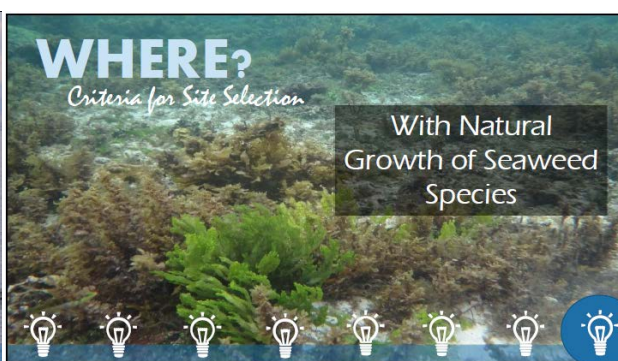
Seaweed Industry in the Philippines

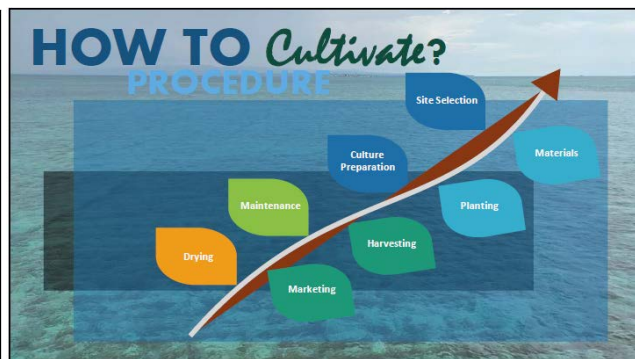
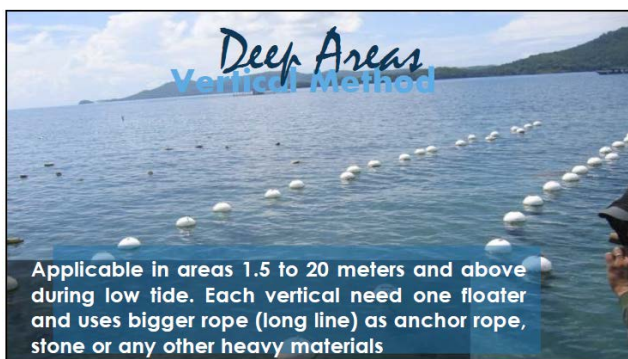
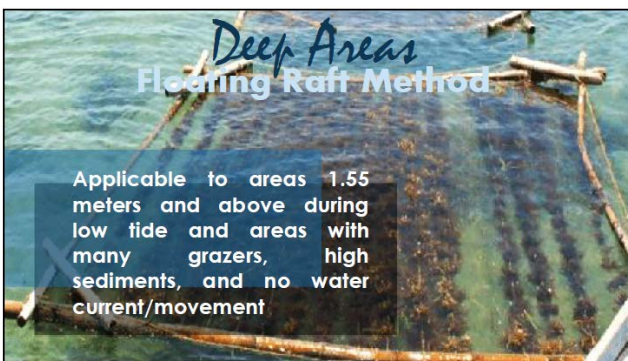
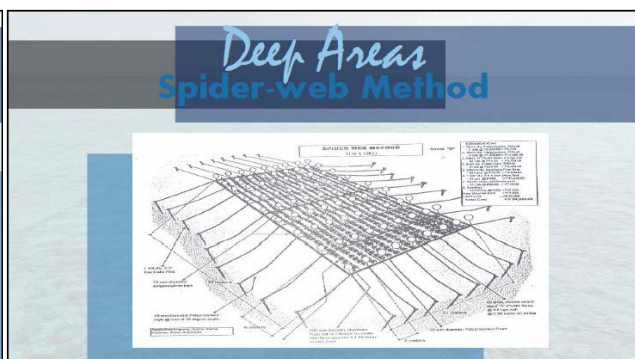
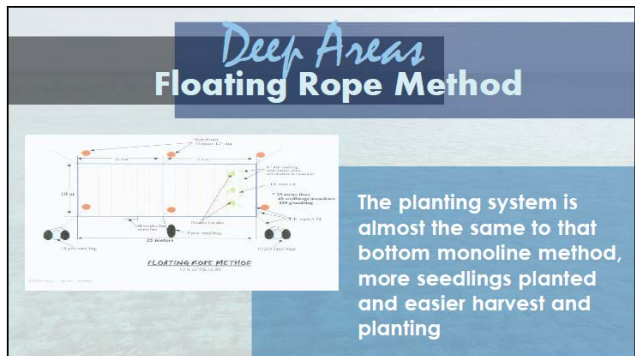
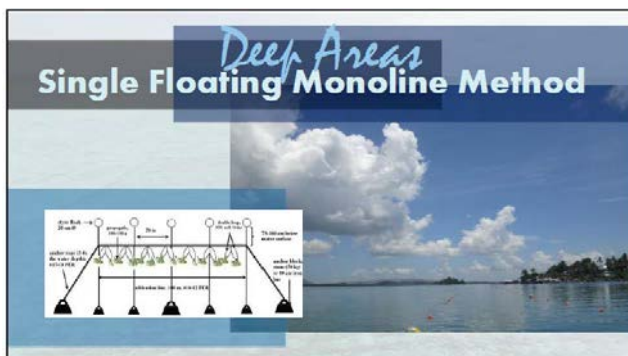
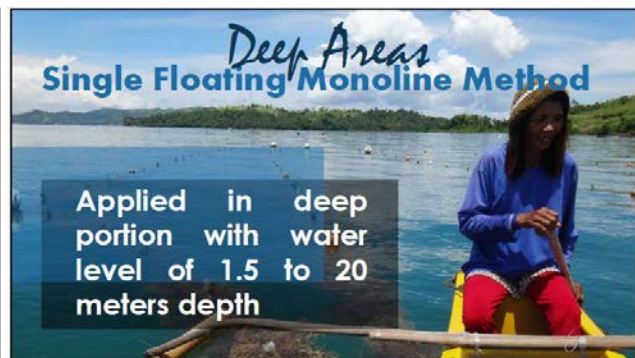
Threats, Challenges, Opportunities & Ways Forward

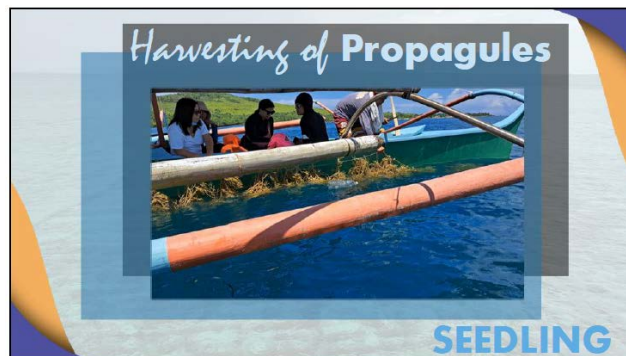
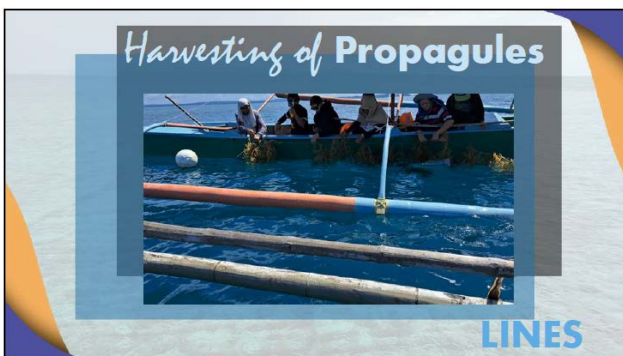
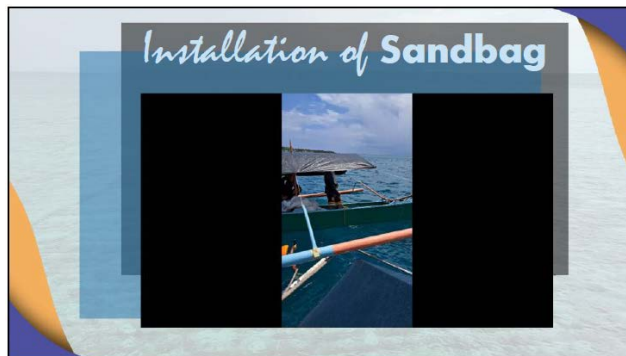
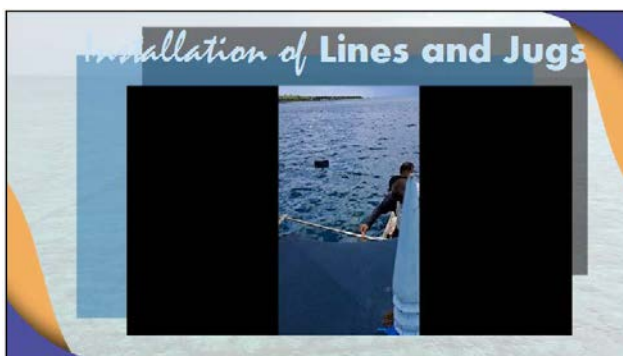
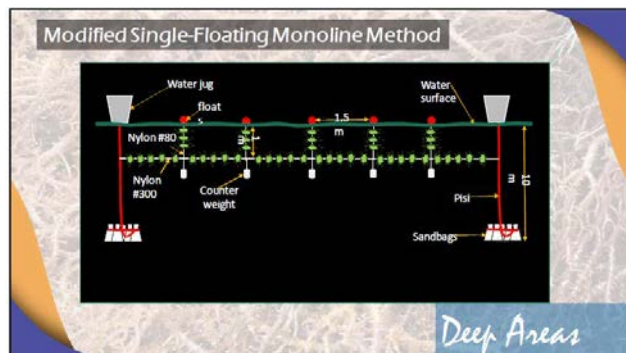
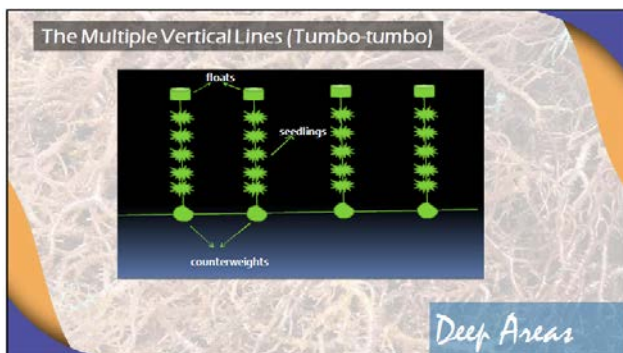
- Low market resilience to price fluctuations
- Diseases & other crop problems
- Informational part of demand
- Cooperative work of converging gov't agencies, LGUs & NGOs

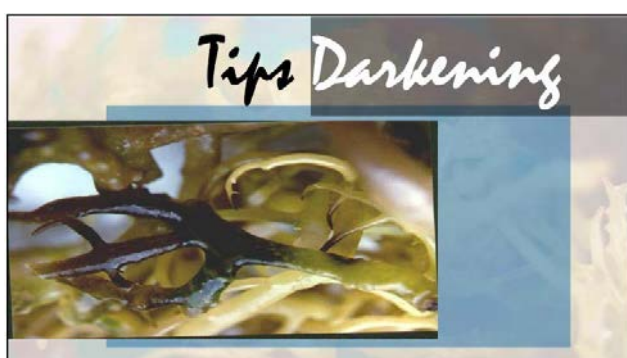
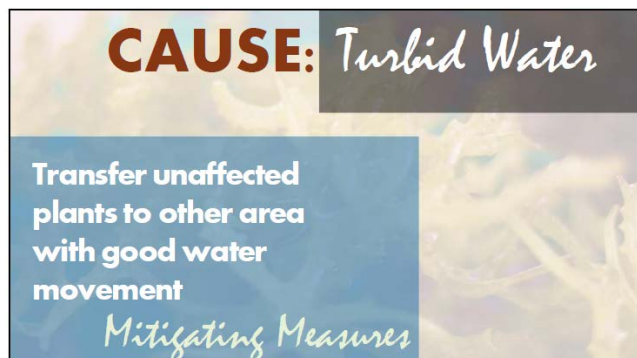
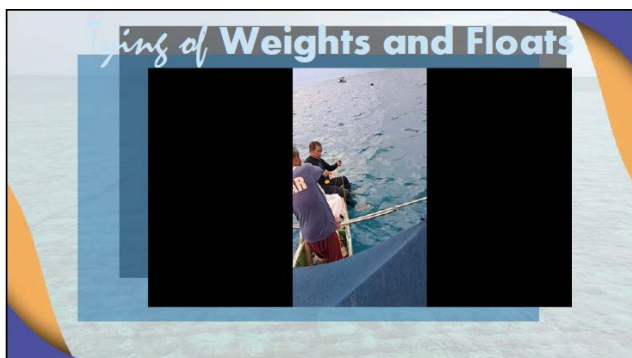














CAUSE:

Entangling of
the Thallus Tips

Loosen the string

Mitigating Measures

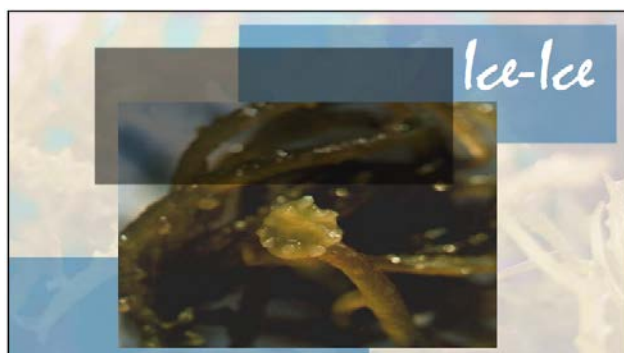


CAUSE:

Presence of
Micro-Grazers

Manually remove
grazers

Mitigating Measures



CAUSE:

Unfavorable Weather Condition
Prolonged Exposure

Cut Affected
Portion

Mitigating Measures

CAUSE:

Unfavorable Weather Condition
Prolonged Exposure

Lower or Lift the
Plant

Mitigating Measures

CAUSE:

Unfavorable Weather Condition
Prolonged Exposure

Transfer unaffected plants to
other area with good water
movement

Mitigating Measures



CAUSE:
Unfavorable Weather Condition
Prolonged Exposure

Cut Affected Portion
Mitigating Measures

CAUSE:
Unfavorable Weather Condition
Prolonged Exposure

Lower or Lift the Plant
Mitigating Measures

CAUSE:
Unfavorable Weather Condition
Prolonged Exposure

Transfer unaffected plants to other area with good water movement
Mitigating Measures

CAUSE:
Unfavorable Weather Condition
Prolonged Exposure

Transfer unaffected plants to other area with good water movement
Mitigating Measures

Seaweed REPRODUCTION



Asexual REPRODUCTION

This can occur through fragmentation, where a piece of the parent plant breaks off and grows into a new seaweed, or through spore production, where spores are released and grow into new seaweeds



Sexual reproduction in seaweeds involves the production of male and female gametes, which fuse to form a zygote

Sexual REPRODUCTION

Sexual REPRODUCTION

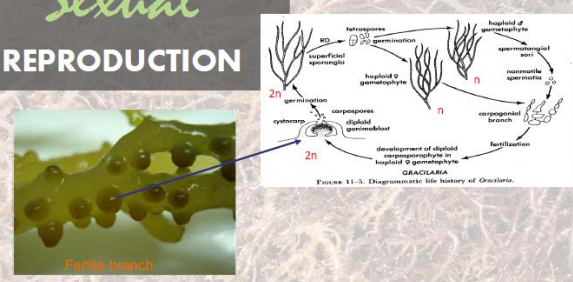
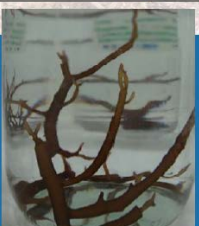


FIGURE 11-5 Diagrammatic life history of *Gracilaria*.

PRODUCTION OF Laboratory-grown Propagules

BRANCH CULTURE






PRODUCTION OF Laboratory-grown Propagules

SPORE-SHEDDING TECHNIQUE







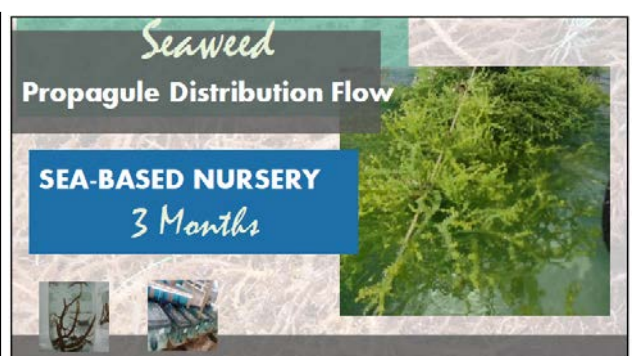
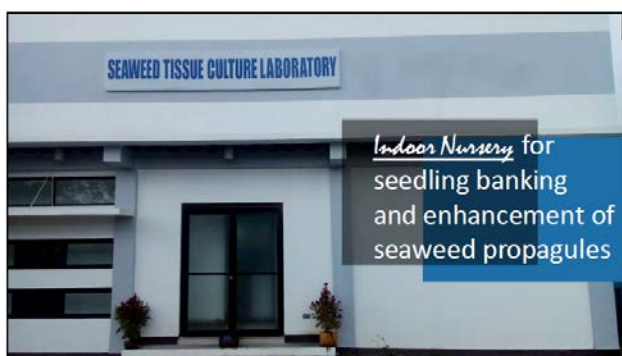

2020 S¹CL Stock Maintained

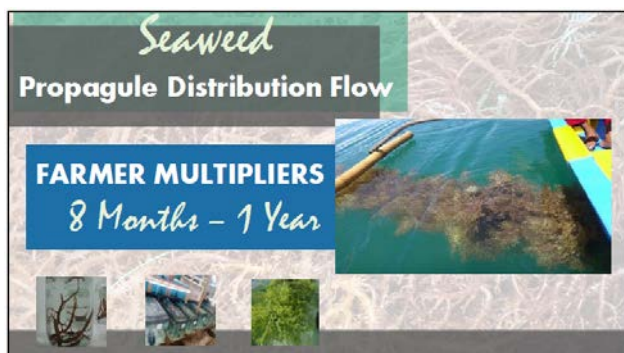
Date Established	Org./Municipality/Province	Yearly Production (kgs)	Distribution (kgs)	Remarks/ Observation
October 2, 2015	Sto. Nino, Guuan, Eastern Samar	44.99	11.509	Distributed to land-based and sea-based nurseries and others.

Preparation of materials for culture induction

Growing callus on the surface of embedded medium in nutrient-enriched agar

Seedling stage





INITIAL INVESTMENT

Initial Investment for a single line				
Qty.	Unit of Issue	Item Description	Estimated Unit Cost	Estimated cost
60m	roll	Polyrope, 9mm, No. 18, 200 m.	1,870.00	561.00
100m	kgs	P.E. rope No. 8, 4mm dia., 200m	490.00	245.00
19	pcs	Empty rice sacks, 50 kgs cap.	25.00	475.00
1/4	kg	Monofilament nylon, #80	420.00	105.00
1	roll	P.E. twine, 400/18,	120.00	120.00
56	pcs	Empty plastic bottles (1.5 capacity)	2.00	112.00
3	pcs	Empty plastic jugs, 20L capacity	225.00	675.00
50	kls	Seaweed seedlings	15.00	750.00
		Total:		3,043.00

SIMPLE COST AND RETURN ANALYSIS

Assumptions:	Weight (kg)
Seedling requirement	75 kg
Weight after 50 days	300 kg
Less: Seedling for the next cropping	75 kg
Biological loss	20 kg
Wet weight	205 kg
Wet to dry ration (7:1)	29.28 kg
Price of dried seaweed/kg	100.00 kg
Sales for 1 cropping	2,928.00



STYROBOXES



Things to prepare....

SEAWEED SEEDLING REFUGEE TANKS



Things to prepare....

KNIFE



Things to prepare....

CULTIVATION LINES



Things to prepare....

RECORDING MATERIALS



Things to prepare....

WHEN TO Harvest



JICA

FOR SEEDLINGS



FOR DRYING



WHEN TO Harvest

DRYING AREA



DRYER




Before Drying...

Wash seaweeds with clean seawater to maintain a high quality product



Remove dirt, plastic straw, debris and other foreign materials





DRYING METHODS

With Flooring:

- ◉ Mat
- ◉ Net
- ◉ Coconut Palm




Off-Ground Level

DRYING METHODS




7:1 Ratio
(fresh to dry)

DRYING PERIOD



40 % moisture
content - depending
on the buyer's demand
(rubbery touch)

DRYING PERIOD



Sunny Days
2 – 3 Days

DRYING PERIOD



Cloudy Days
4 – 5 Days

DRYING PERIOD



DRYING



DOME-TYPE SOLAR DRYER



S O L A R
D R Y E R

Bureau of Fisheries and Aquatic Resources - 8
CRMA Center, Dik, Tacloban City



STORING



Appendix 4-7: Mangrove Crab Farming



Outline

- Introduction to Mangrove Crabs
- Mangrove Crab Aquaculture
- Hatchery
- Wild Crablet Collection
- Nursery
- Cost and Return



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Introduction to Mangrove Crabs

Classification

Kingdom Animalia
Phylum Arthropoda
Subphylum Crustacea
Class Malacostraca
Order Decapoda
Family Portunidae
Subfamily Necronectinae
Genus *Scylla*

- Scylla serrata*
- Scylla tranquebarica*
- Scylla olivacea*
- Scylla paramamosain*

From: S. G. & S. H. (2013) Marine Invertebrates: A guide to the families and genera of the world. CIPD Publishing. doi:10.1016/j.mis.2013.03.001

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Introduction to Mangrove Crabs

Classification

1st National Mud Crab Congress in Iloilo, Philippines 2016

- Resolution on renaming "mud crab" to "**mangrove crab**"

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Introduction to Mangrove Crabs

Classification

Dichotomous key to distinguish species (Keenan et al. 1998)

- inner carpus spine
- bluntness in their frontal lobe spine
- polygonal patterns in the walking and swimming legs
- dactyl prominences

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Introduction to Mangrove Crabs

Classification

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Scylla De Haan, 1883 species native to the Philippines

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Introduction to Mangrove Crabs

Reproductive Biology

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Introduction to Mangrove Crabs

Reproductive Biology



Female maturation

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Introduction to Mangrove Crabs

Reproductive Biology



Colour of Ovary can be seen by Depressing the area between Junction of Abdominal Segment and Carapace gentry.

Female maturation

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Introduction to Mangrove Crabs

Reproductive Biology

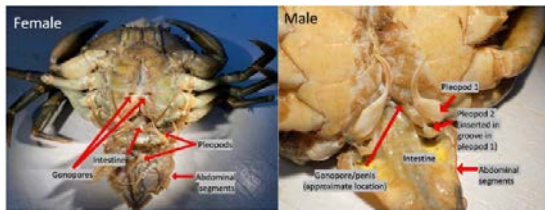


Photo accessed from: <https://wag.washington.edu/crabteam/about/newletter/2022-2/>

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Introduction to Mangrove Crabs

Reproductive Biology

- Males guard mature females, cradling them prior to their moult.
- The male can successfully mate once she has moulted and is soft shelled.
- Copulation, which may last 7–18 hours, the male turns the female upside down.
- The female stays in the protection of the male until her shell is fully hardened.



Baidun et al. 2014. Mating Success of Hybrid Trials Between Two Mud Crab Species, *Scylla tranquebarica* and *Scylla olivacea*

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Introduction to Mangrove Crabs

Reproductive Biology

- A mature female mud crab produces from 1 to 6 million eggs, with the larger species producing larger numbers of eggs, and larger individuals typically carrying more eggs.
- Females retain sperm after mating so that 2 or even 3 egg masses can be produced without the further intervention of a male.



2-day berried crab

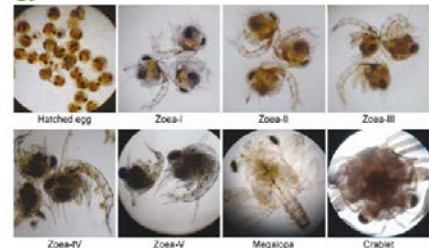
7-day berried crab

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Introduction to Mangrove Crabs

Reproductive Biology

- Fertilized eggs develop into 5 zoeal stages, then into megalopa and eventually into crab instar in 21 days.

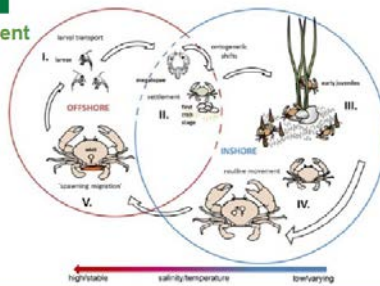


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Introduction to Mangrove Crabs

Life history/development

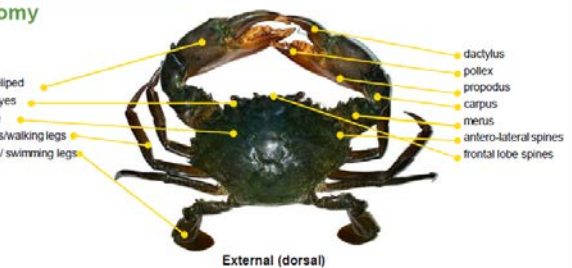
- Females move offshore to efficiently hatch and disperse larvae.
- Zoea are planktonic
- Megalopa starts to settle but also drifts with current
- Crab instar begins to settle in seagrass and mangrove areas.



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Introduction to Mangrove Crabs

Anatomy



External (dorsal)

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Introduction to Mangrove Crabs

Anatomy

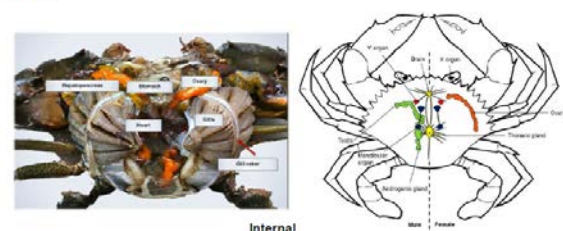


External (ventral)

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Introduction to Mangrove Crabs

Anatomy



Internal

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Introduction to Mangrove Crabs

Habitat and distribution

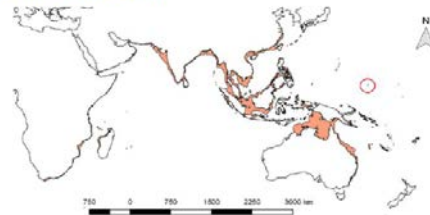
- The preferred habitat of mud crabs is mangrove forests or swamps, typically associated with sheltered tropical to subtropical estuaries and embayments.
- Larvae and juveniles from marine to brackishwater habitat.
- Adults in brackishwater to freshwater habitat
- Females travel to oceanic waters.



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Introduction to Mangrove Crabs

Habitat and distribution



Global distribution of mangrove crabs

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Introduction to Mangrove Crabs

Habitat and distribution

Species	Habitat	Distribution
<i>S. serrata</i>	Mangrove forests inundated with full oceanic water salinity, can tolerate lower salinity	Pacific and Indian Ocean, Red Sea. Most widespread species
<i>S. tranquebarica</i>	Mangrove forests and coastlines inundated with reduced salinity seawater	Pacific and Indian Ocean, South China Sea, widespread species associated with <i>S. olivacea</i>
<i>S. olivacea</i>	Mangrove forests and coastlines inundated with reduced salinity seawater	Pacific and Indian Ocean, South China Sea, widespread species associated with <i>S. tranquebarica</i>
<i>S. paramamosain</i>	Various habitats including shallow coral rubble, subtidal flats and estuarine ponds, mangrove forests.	South China Sea, Java Sea

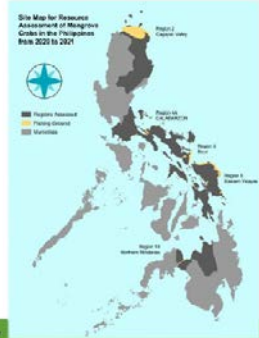
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Introduction to Mangrove Crabs

Habitat and distribution

Local distribution (Philippines)

- S. serrata* is most abundant in the Philippines, occupying areas that are exposed to high salinity or oceanic water.
- S. tranquebarica* and *S. olivacea* are abundant in inner waters.
- S. paramamosain* have sightings due to importation but is not native to the Philippines.



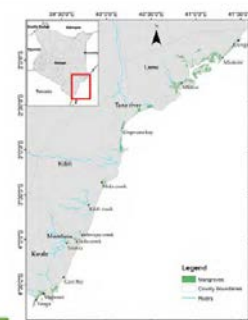
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Introduction to Mangrove Crabs

Habitat and distribution

Local distribution (Kenya)

- Only one species (*S. serrata*) has been identified in Kenya (Fratini and Vannini, 2002) through samples taken from Mida creek, Gazi Bay and Lamu.
- Only few genetic studies have been done in this area to provide clear indications on the exact number of mangrove crab species along the Kenya coast.



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Introduction to Mangrove Crabs

Feeding

- Mud crabs are top benthic predators and feed on sessile or slow-moving benthic macroinvertebrates, mainly gastropods, crustaceans, and mollusks.



Percentage composition of natural food of *Scylla serrata* of different ontogenetic stages, Indonesia

Food item	Juveniles	Subadults	Adults
Unidentified organic matter - meat	42.00	46.30	61.09
Inorganic sand/shell	9.46	15.04	17.18
Plant, algae & sea grasses	13.05	12.88	16.00
Fish meat & hard parts	17.41	12.18	19.24
Mollusc	9.21	7.18	8.58
Crustacean	8.20	5.16	4.56
Unidentified organic matter - wood	8.57	1.88	2.34

Source: La Sana et al., 2007.

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Introduction to Mangrove Crabs

Cannibalism

- Cannibalism among mud crabs is a behavioral trait that as yet is poorly understood
- It currently presents a major problem for culturing them in open systems at anything other than low density.



Cannibalism in mud crab
Photo from RAS Aquaculture Accessed May 17, 2023

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Introduction to Mangrove Crabs

Migration & movement

- Mud crabs are more active nocturnally.
- The spawning migration of female mud crabs from the mangrove forests to offshore habitats has been well documented and seems to be a behaviour shared by all *Scylla* spp.
- Mud crabs also move from mangrove forests to nearby reef flats and seagrass beds to feed on a routine basis.



Bernied *Scylla serrata*.
Photograph from Mann et al 1999"
"Mann, Asakawa T., & Blackshaw, A.W. (1999). Performance of mud crab *Scylla serrata* broodstock held at British Island Aquaculture Research Centre

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Introduction to Mangrove Crabs

Economic Importance

Aquaculture production of mangrove crabs (FAO FIGIS, 2015)

Country	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Cambodia	0	0	0	15	20	20	20	40	40	50
China	97,463	93,103	101,529	113,852	115,881	115,829	121,458	128,583	158,071	140,738
Taiwan	240	247	221	185	170	225	165	122	89	26
Indonesia	4,379	5,516	6,631	7,642	7,516	9,557	8,153	14,163	11,898	13,591
Malaysia	102	141	86	71	14	8	20	42	14	36
Myanmar	0	0	0	484	460	150	150	200	200	0
Philippines	6,861	7,800	9,308	11,625	13,730	14,438	15,731	16,360	15,794	16,160
Singapore	37	81	47	0	0	0	7	42	114	137
Thailand	15	0	11	23	41	45	50	100	100	100
Vietnam	0	0	0	0	0	0	12,300	18,000	13,000	13,000

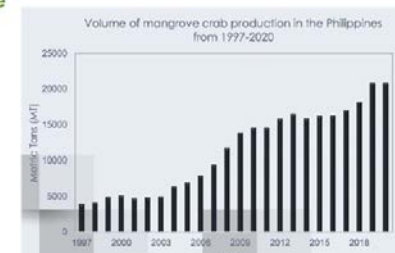
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Introduction to Mangrove Crabs

Economic Importance

Local production

- In the past three years (2020-2022), Philippine production of mangrove crabs ranged from 23,000-27,000 MT with a price value of USD 200M -250M.



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Introduction to Mangrove Crabs

Economic Importance

Local production

• Aquaculture production were highest in Northern Mindanao, Central Luzon, Western Visayas, and Bicol regions, where high areas of ponds concentrate.

• Northern Mindanao produces highest *S. tranquebarica*.

• *S. serrata* aquaculture in Pacific areas.

Aquaculture production of mangrove crabs in the Philippines (PSA 2016)

Region	Production (mt) per year		
	2013	2014	2015
National Capital Region	0	0	0
Cordillera Administrative Region	0	0	0
Ilocos Region	8.75	11.19	12.13
Cagayan Valley	52.57	50.85	41.47
Central Luzon	2,086.68	2,068.89	1,179.81
CALABARZON	25.04	26.39	35.42
MIMAROPA	5.85	6.24	7.60
Bicol Region	3,512.33	3,518.49	1,291.06
Western Visayas	3,689.29	3,824.45	3,882.11
Central Visayas	4.93	4.71	4.33
Eastern Visayas	653.34	485.72	295.33
Zamboanga Peninsula	227.63	235.36	254.37
Northern Mindanao	7,428.97	7,719.39	8,836.11
Davao Region	3.44	1.63	2.62
SOCOROSANGEN	6.58	6.40	6.64
Campas Region	131.66	109.77	107.93
ARMM	83.36	84.75	85.17

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Introduction to Mangrove Crabs

Economic Importance

Market and trade

<i>Scylla serrata</i> (male)	Price (Php)	Price (KSh)
• M2 (200g)	300	730
• M3 (300g)	300-420	730-1025
• M4 (400g)	300-450	730-1100
• M5 (500g)	300-450	730-1100
• M6 (600g)	300-450	730-1100
• M7 (700g)	500-600	1220-1470
• M8 (800g)	600-700	1470-1710
• M1 (1kg)	700-1000	1710-2440



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Introduction to Mangrove Crabs

Economic Importance

Market and trade

<i>Scylla serrata</i> (female)	Price (Php)	Price (KSh)
• OS3 (300g)	600	1470
• OS4 (400g)	700	1710
• OS5 (500g)	700-800	1710-1950
• OS6 (600g)	700-800	1710-1950
• OS7 (700g)	900-1000	2200-2440
• OS8 (800g)	900-1000	2200-2440



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Introduction to Mangrove Crabs

Economic Importance

Market and trade

<i>Scylla serrata</i> (immature female)	Price (Php)	Price (KSh)
• BKL C-40 (65% yellow)	300	730
• BKL B-70 (85% yellow)	350	850
• BKL A-90 (100% yellow)	500	1220
• BBR reject (50% egg)	300-400	730-980
• BBR 1 reject (w/o 1 claw)	300-400	730-980
• BBRX (no eggs)	300-400	730-980



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Mangrove Crab Aquaculture

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Mangrove Crabs Aquaculture

Planning

- The national government is taking a key role in aquaculture planning to underpin national aspirations and growth targets for their respective industries.
- Philippine Bureau of Fisheries and Aquatic Resources (BFAR)
- Implementing national policies and regulations, which will flow down to provincial areas.



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Mangrove Crabs Aquaculture

Planning

Section 2. Use of areas released for fishpond development.

- "No person shall occupy or use any portion of areas released for fishpond development as defined, without first securing a permit, contract or lease in accordance with the provisions of this Order."



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Mangrove Crabs Aquaculture

Planning

Section 28. Grounds for cancellation of ASC or FLA

- violation of existing fishery laws
- dissolution of juridical person
- fraud information in documents
- failure to submit yearly report
- failure to pay rentals and surcharges
- transfer of lease without prior approval of BFAR
- non-adherence to Good Aquaculture Practices
- abandonment, non-development or underutilization

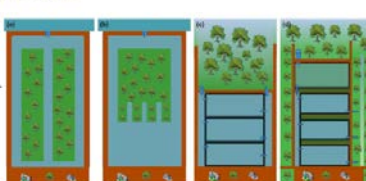


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Mangrove Crabs Aquaculture

Environmental considerations

- Mangrove crab aquaculture is conducted in low density culture
- In Vietnam, integrated mangrove-aquaculture systems.



Shrimp-based livelihoods in mangrove silvo-aquaculture farming systems

Boeng, M.H., Nguyen, T.H., Guzman, A.J., Tran, M.T. and Tran, M.N. (2014). Shrimp-based livelihoods in mangrove silvo-aquaculture farming systems. *Rev. Aquacult.* 6: 43-60. <https://doi.org/10.1111/raq.12072>

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Mangrove Crabs Aquaculture

Environmental considerations

- In the Philippines, guidelines for sustainable mangrove crab aquaculture has been developed by BFAR.



Sustainable mangrove crab farming in pens

Palacio, D.D., De la Santa MA., Palencia MA. 1999. Pen culture of mud crabs in mangroves. *Aquaculture Extension Manual* No. 26. Aquaculture Department, Southern Luzon Fisheries Development Center.

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Mangrove Crabs Aquaculture

Environmental considerations

- Environmental assessments are usually conducted by national agencies.
- Mud crab culture are low-risk and therefore assessments are simple and relatively low cost.



Mangrove and environmental impact assessments

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Mangrove Crabs Aquaculture

Socio-economics

- Mangrove crab farming entails a relatively low investment but at the same time very profitable.



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Mangrove Crabs Aquaculture

Socio-economics

- In many countries, mangrove forests have been lost due to aquaculture ponds, but the potential utilization of mangrove forests for mud crab aquaculture reverses this trend, and provides an added incentive for reforestation programs.



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Mangrove Crabs Aquaculture

Socio-economics

- Polyculture of crabs with milkfish can also provide an alternative business model.



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Mangrove Crabs Aquaculture

Socio-economics

- The apparent resistance of mud crabs to diseases affecting shrimps in many parts of Southeast Asia has enabled shrimp pond infrastructure to be profitably utilized again.



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Mangrove Crabs Aquaculture

Logistics

Factors/aspects to be considered include:

- transport (air, sea and road)
- availability of staff
- accommodation
- political stability;
- supplies
- services available
- power and water supply
- proximity to markets
- potential for flooding or other natural disasters to affect operations.



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Crab Hatchery

Mangrove Crabs Hatchery

Biosecurity

- The design of a mud crab hatchery needs to incorporate features that provide adequate biosecurity for broodstock and larvae, as well as any live feeds cultured within the facility.



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Mangrove Crabs Hatchery

Water treatment

Water management

- regular monitoring of water quality
- bacteriological analysis
- UV-treatment
- chlorination
- ozonation
- ultrafiltration



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Mangrove Crabs Hatchery

Natural Food

- A phycology laboratory and facility is needed for the culture of:
 - Microalgae (*Chlorella* sp.)
 - Rotifer (*Brachionus* sp.)
 - Artemia



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Mangrove Crabs Hatchery

Broodstock

- Keeping mud crab broodstock healthy, well fed and stress-free is essential for successful larval production.
- The broodstock are typically held in a maturation tank for a period of several weeks or more.
- Communal rearing of broodstock



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Mangrove Crabs Hatchery

Incubation and hatching

- Once a female spawns, it should be transferred to an incubation system where the water quality and hygiene conditions can be controlled to a high level.



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Mangrove Crabs Hatchery

Larval rearing

- Hatched larvae are usually placed in at least one-tonner fiber glass tanks or in larger 10-tonner concrete tanks.



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Mangrove Crabs Hatchery

FEEDING AND WATER MANAGEMENT

Day 1 to 30

Activities: Feeding, Rotifers, Artemia, Formulated diet, Mussel/fish, Addition of Microalgae, Water Management, Water replacement, Prophylaxis

1-15 rotifers, 15-20 rotifers, 20-30 rotifers, 30-40 rotifers, 40-50 rotifers, 50-60 rotifers, 60-70 rotifers, 70-80 rotifers, 80-90 rotifers, 90-100 rotifers

Formulated diet: 100,000, 100,000, 100,000, 100,000, 100,000, 100,000, 100,000, 100,000, 100,000, 100,000

Water Management: 100,000, 100,000, 100,000, 100,000, 100,000, 100,000, 100,000, 100,000, 100,000, 100,000

Prophylaxis: 100,000, 100,000, 100,000, 100,000, 100,000, 100,000, 100,000, 100,000, 100,000, 100,000

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Wild Crablet Collection



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Wild crablet collection

Fisheries Administrative Order No. 264 of 2020

- Catching, possession, transporting, selling, trading and exporting of crablets, juveniles and berried crabs are regulated in Philippines.
- to support sustainability and protect the wild population from depletion.

Republic of the Philippines
Department of Agriculture
OFFICE OF THE SECRETARY
Cultural Plaza, 1000
Quezon City, 1100 Philippines

FISHERIES ADMINISTRATIVE ORDER NO. 264 Series of 2020

SUBJECT: REGULATION ON THE CATCHING, POSSESSION, TRANSPORTING, SELLING, TRADING AND EXPORTING OF MANGROVE CRABLETS, JUVENILE MANGROVE CRABS AND GRAVID MANGROVE CRABS (p/17/199)

WHEREAS, Section 121 of the Republic Act No. 8550 as amended by RA No. 12054 provides for the rational and sustainable development, management and conservation of the fishery and aquatic resources in Philippine waters including the Exclusive Economic Zone (EEZ) and in the adjacent high seas, consistent with the principal objective of maintaining a sound ecological balance, promoting and enhancing the quality of the environment;

WHEREAS, gathering of mangrove crablets to mangrove areas from the wild for aquaculture and exportation purposes had gone rampant and unregulated over the years, which may lead to stock depletion and growth overfishing;

WHEREAS, the three most common species of mangrove crabs in the Philippines are *Squilla serrata*, *S. longimanus* and *S. alcocki*. The *S. alcocki* is the most prevalent in aquaculture industry, the *S. serrata* and *S. longimanus* are mostly collected from the wild;

WHEREAS, some areas in Northern Luzon, Mindanao, Eastern Visayas, Northern Mindanao, Cagayan region, and Zamboanga region have already adopted regulations on

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Wild crablet collection

FAO 264 of 2020

- Use of wild crablets is not sustainable in many countries
- their removal is having a negative impact on wild populations of mud crabs.



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Wild crablet collection

FAO 264 of 2020

Section 2. Registration of Mangrove Crablets Gatherers, Consolidators, Traders and Growers.

- "Registered consolidators, traders and growers shall only buy/collect mangrove crabs from gatherers registered under F I s h and with license/ permit from the LGU".



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Wild crablet collection

FAO 264 of 2020

Section 3. Prohibition

Unlawful to catch, possess, transport, trade, sell and export

- wild-sourced mangrove crablets and mangrove crab juvenile
- mangrove crablets <12 centimeters c carapace width
- gravid, breeder and spawner mangrove crab
- wild-sourced mangrove crablets and juvenile mangrove crabs.



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Wild crablet collection

FAO 264 of 2020

Section 4. Exemption (with license, permit, and local transport permit)

- Crablets 5cm CW or bigger for local aquaculture
- Crabs 12cm CW or bigger including gravid crabs for hatchery purposes
- hatchery-sourced crabs for soft-shell production (>10cm CW)
- hatchery-bred crablets from a BFAR-registered facility
- collection for research and academic purposes



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Wild crablet collection

Site and conditions

- In the Philippines, crablet collection occurs in narrow sheltered bays or coves with high mangrove vegetation.
- Larvae are also attracted to a relatively lesser saline waters that receive freshwater from nearby rivers.



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Wild crablet collection

Gear

- Improvised or locally made push nets, called "sudsod" are used in the collection of crablets.
- shallow sandy-muddy mangrove areas are a good site for collecting crablets



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Wild crablet collection

Sizing of crablets

- due to experience, gatherers have familiarized the shape of juvenile mangrove crablet and learned to distinguish those that are not mangrove crab crablets.
- mangrove crab crablets have an oblong-shaped carapace (CW wider than CL)



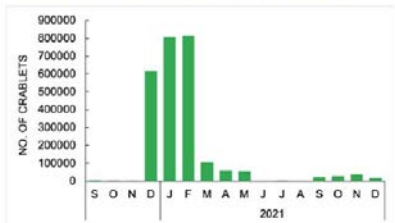
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Wild crablet collection

Crablet Production

Crablet harvest in Bicol and Eastern Samar regions from 2020-2021

- Crablet abundance peaks from January to May
- A minor peak also occurs from September to December
- Almost no crablets are collected from June to August



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Wild crablet collection

Sizing of crablets

- Fly-size (<0.5 cm CW):
 - Php 1-10 (KSh 2-24)
- TX-size (0.5-1 cm CW)
 - Php 2-7 (KSh 5-17)
- Peso-size (2 cm CW)
 - Php 4-10 (KSh 10-24)
- Matchbox-size (3-4 cm CW)
 - Php 15-25 (KSh 37-60)



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Wild crablet collection

Packing and transport

- Crablets are placed in a small disposable plastic food tubs/containers with a wet sand.
- Lid of plastic containers are perforated to allow air inside.
- density is 200 ind./container



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Wild crablet collection

Packing and transport

- containers are secured using a rubber band and are placed in a carton box with holes.
- extra cartons are used to fill in gaps to prevent spillage of the contents during transport.
- transport of crablets should be utmost 24 hours.



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Wild crablet collection

Packing and transport

- crablets can also be packed in plastic bags with seawater, oxygen and shelter.
- a styrobox is preferred especially for air travel.



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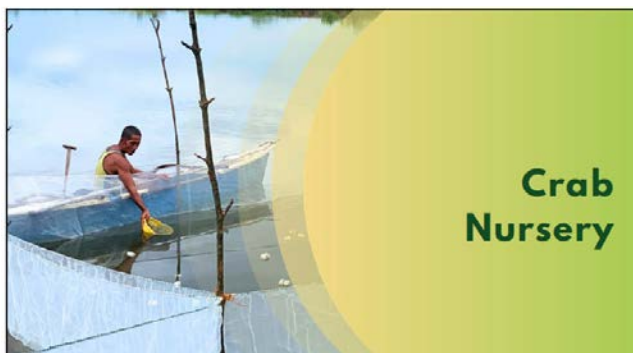
Wild crablet collection

Packing and transport

- in some areas in the Philippines, crablets are also packed in carton boxes lined with plastic sheet or cellophane, and with a wet cloth



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Crab Nursery

Mangrove Crab Nursery

Nursery Options



TANKS



POND

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Mangrove Crab Nursery

Nursery Options



NET CAGES

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Mangrove Crab Nursery

Nursery in net cages

Nursery is the intermediate phase between the hatchery and grow-out phases. Major activities include:

- pond preparation
- net cage fabrication
- nursery shed construction
- Phase 1 Nursery
- Phase 2 Nursery



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Mangrove Crab Nursery

Pond Preparation

- Drying for at least a week to allow oxidation of inorganic compounds, kill other organisms.
- Tilling to expose more surface area of the soil.
- Control of pests and undesirable species using teaseed at 20-30 ppm (mg per li) depending on its potency or ammonium sulfate plus hydrated lime at 1:3 ratio (10-14 to 50-60 g quicklime per sqm).



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Mangrove Crab Nursery

Pond Preparation

- Ponds will be flooded and flushed up to 30 cm and water will be held for 1-2 days, and then be drained again.
- Lime will be applied on pond bottom and dikes at 100 g calcium carbonate per sqm or 20-30 g calcium oxide per sq m. This accelerates the decomposition of organic matter and improves efficiency of fertilizer.
- Several days will be allowed to pass prior to the application of fertilizers. Chicken manure will be provided at 100 g per sqm. Water will then be admitted into the pond.



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Mangrove Crab Nursery

Nursery shed

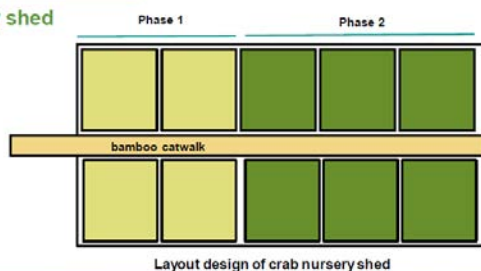
- After pond preparation, nursery shed can be constructed.
- bamboo is commonly used in construction
- nursery should be covered with black net and coconut fronds to minimize light penetration



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Mangrove Crab Nursery

Nursery shed



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Mangrove Crab Nursery

Net Cages

- fine mesh nets (~1 mm mesh size) with a dimension of 5m x 5m x 1m are made.
- black nets (3-4mm mesh size) with 5m x 5m x 1m dimension are also made.

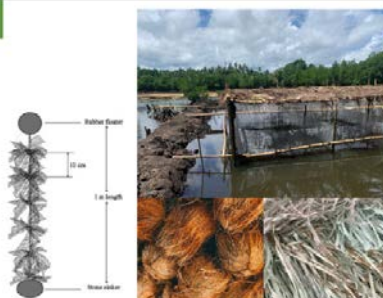


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Mangrove Crab Nursery

Net Cages

- nets are installed in the nursery shed.
- the bottom side of the net is set close to the substrate in order the mud to enter the cage.
- a vertical B-net pompoms can also be made as shelters for the crabs
- native materials such as coconut husks or stalks



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Mangrove Crab Nursery

Stocking

Nrsery Phase	Net cage	Stocking	Densit	tyl crablet s	Dzeation
Phase 1	Fine mesh net (5m x 5m x 1m)	1000 ind./cage	0.5-0.6 cm CW up to 1.5-2.0cm CW		3-4 weeks
Phase 2	B-net (5m x 5m x 1m)	200 ind./cage	1.5-2.0cm CW up to 2.5-4.0cm CW		3-4 weeks

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Mangrove Crab Nursery

Stocking

- crablets have to be acclimatized by placing the container on the surface of the pond water for at least 20 minutes
- crablets are then gently released into the net cage.



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Mangrove Crab Nursery

Feeding

- Satiation or 100% of total weight of stocked crablets per day.
 - Commercial shrimp feed
 - Chopped mussel meat,
 - low value fish,
 - Snail or shell meat,
 - Chicken entrails
- Feeding can be done 70% during the night and 30% during the day.
- feeds are ground manually or using a blender



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Mangrove Crab Nursery

Maintenance

- nets are checked weekly to see if there are holes and possible escape of crablets.
- nets must also be regularly washed especially the sides to prevent fouling
- excess food and shells should also be collected



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Mangrove Crab Nursery

Water quality

- Optimal conditions for their growth and survival appear to be at:
 - 30 degrees Celsius
 - Salinity of 10-25 ppt
- Salinity >36 ppt have been reported to have a detrimental effect on crablets growth.



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Mangrove Crab Nursery

Growth and survival

- Phase 1 nursery
 - Survival: 50-90%
 - Growth: 2 cm CW
- Phase 2 nursery
 - Survival: up to 80%
 - Growth: 4 cm CW



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Mangrove Crab Nursery

Packing and transport

- Crablets smaller than 2.0 cm CW are transported in oxygenated plastic bags with cool water (24°C).
- Crablets of more than 2.0 cm CW are transported in boxes with wet cloth or sand.
- Crabs are better transported early in the morning, late afternoon or during cool weather.



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Mangrove Crab Nursery

Problems

- extreme weather such as typhoons, heavy precipitation, high temperature
- escape of crablets from damaged nets
- mortality due to cannibalism
- diseases mainly due to parasite, fungal infection
- White spot syndrome virus disease but do not cause mortality.



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Mangrove Crab Nursery

Diseases



bacterial shell disease

shell discoloration

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Mangrove Crab Nursery

Diseases



shell fouling



algal encrustation

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Mangrove Crab Nursery

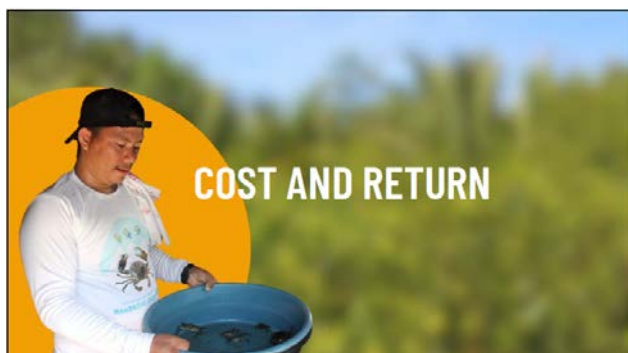
Diseases



gill commensals and parasites (*Octolasmis* sp. barnacle)

gill discoloration

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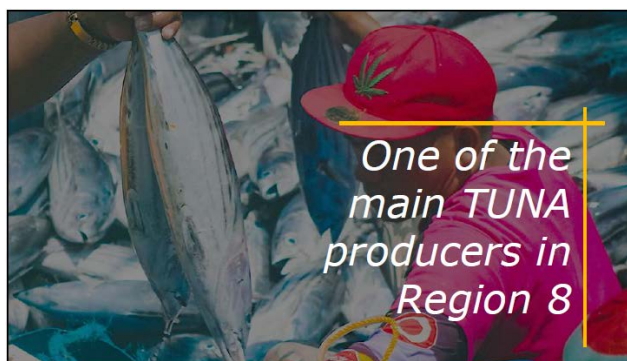
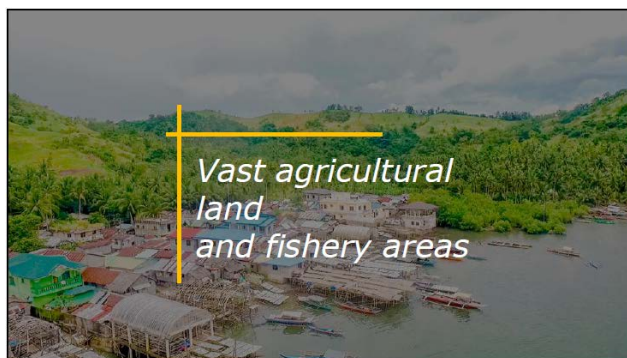
Cost and return				
Cost and return				
Simple cost and return analysis for small-scale nursery				
Total cost	:	Php 56,400		
Revenue	:	Php 90,000		
Net profit	:	Php 33,600		
ROI	:	59.6%		
Payback period	:	1.68		

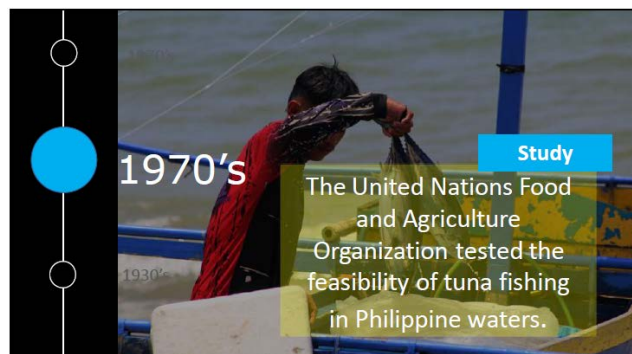
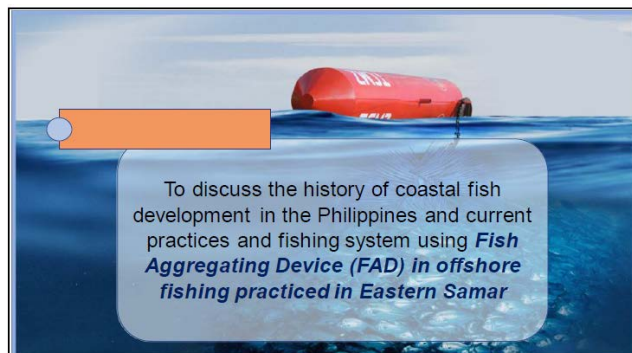
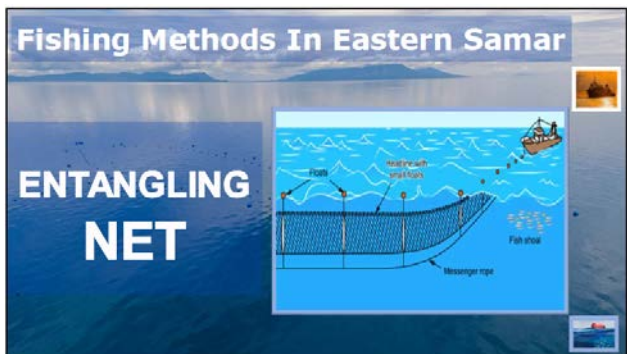
Cost and Return Per Activity Cycle	Quantity	Unit	Price per Unit	Lifespan (in Yrs)	Total Value
TOTAL REVENUE					
Volume of the Product Sold	3000	pcs	30.00		90,000.00
A. Fixed Cost					
Elmo mesh net	8	bundle	7,000.00	1	56,000.00
B-net	10	bundle	8,000.00	1	80,000.00
Caembon	200	pcs	150.00	1	30,000.00
Other materials	1	set	2,000.00	1	2,000.00
B. Operating Cost					
Crabbits	6000	pcs	2.50		15,000.00
Feeds	3	sack	1,200.00		3,600.00
Labour	2	months	3,000.00		6,000.00
Harvesting Cost	1	pat	1,000.00		1,000.00
Maintenance and Repairs	1		1,000.00		1,000.00
TOTAL COST					56,400.00
NET INCOME OR PROFIT					33,600.00
RETURN ON INVESTMENT					0.59674
PAYBACK PERIOD					1.68

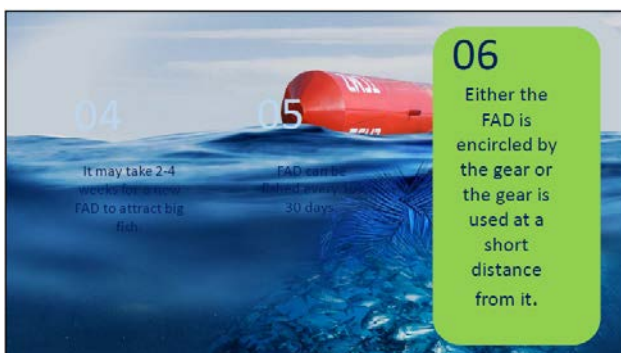
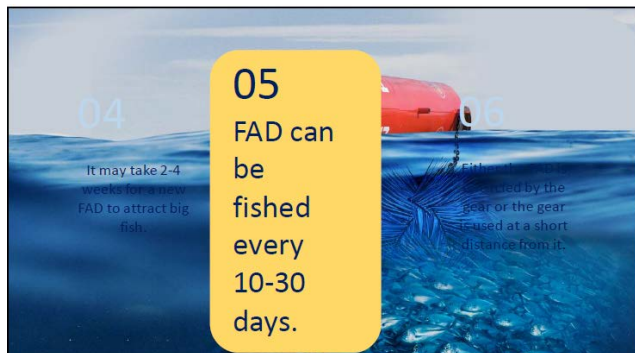
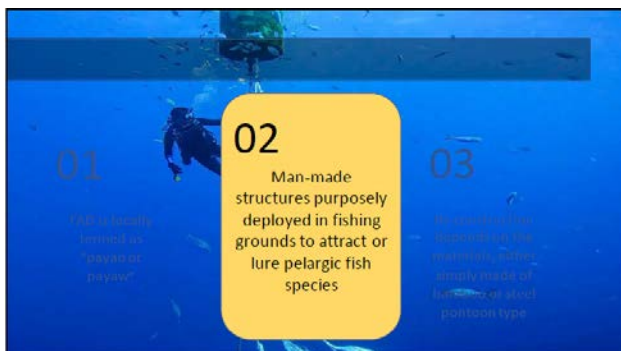
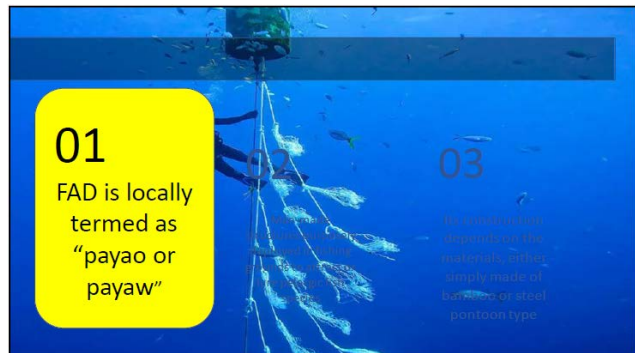
Cost and return				
Cost and return				
Sample financial plan/ projected income statement of a larger nursery operation				
	2023	2024	2025	
PROJECTED REVENUES				
Crabnet Production (pcs)	100,000	150,000	200,000	
Price per crabnet (Php)	27	27	27	
Total Projected Revenues	2,700,000	4,050,000	5,400,000	
PROJECTED PRODUCTION COST				
Production Cost				
Crabnet supply	800,000	800,000	1,200,000	
Nursery setup expenses	300,000	300,000	300,000	
Depreciation	-	-40,000	-50,000	
Improvement of nursery setup	-	100,000	100,000	
Agricultural supplies	200,000	200,000	200,000	
Repair and maintenance expenses	30,000	30,000	50,000	
Salaries and Wages (Farm workers, prod. staff)	960,000	960,000	960,000	
Total	2,090,000	2,400,000	2,700,000	
Operating Cost				
Salaries and Wages (Admin, mgt, other staff)	144,000	144,000	144,000	
Transportation expenses	100,000	100,000	100,000	
Communication expenses	24,000	24,000	24,000	
Other supplies	50,000	50,000	50,000	
Total	318,000	318,000	318,000	
Total Projected Production Cost	2,408,000	2,718,000	3,018,000	
NET INCOME	292,000	1,332,000	2,382,000	
Operating Ratio	6.1581	9.3289	0.4411	

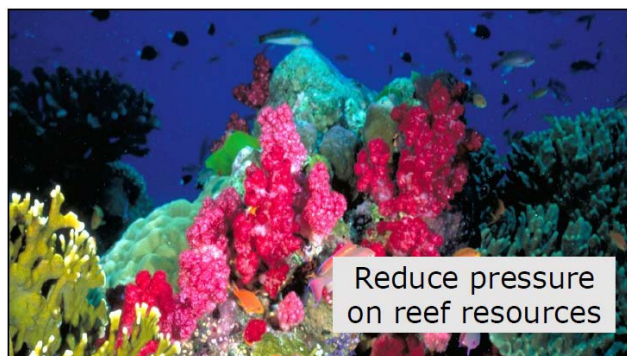
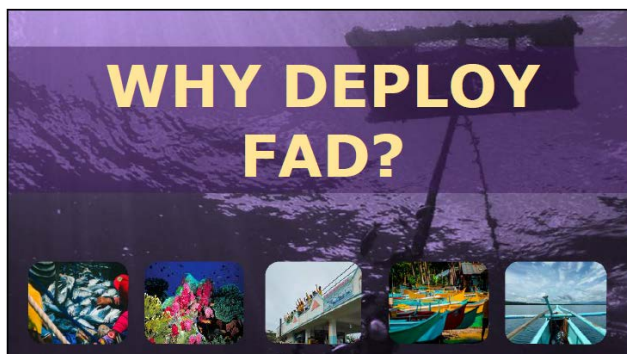
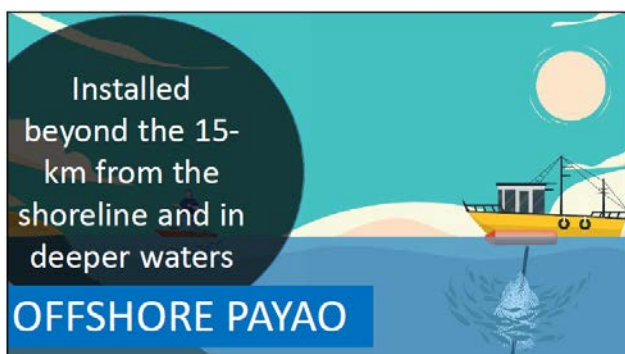
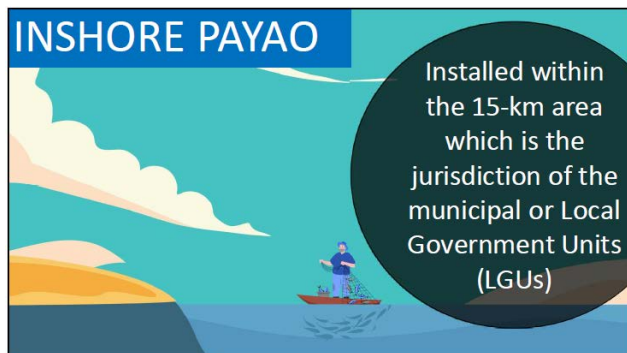
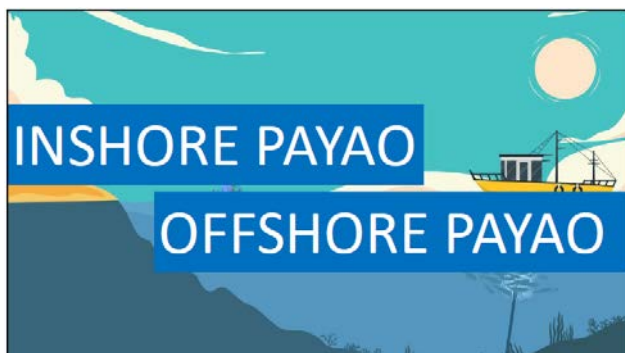


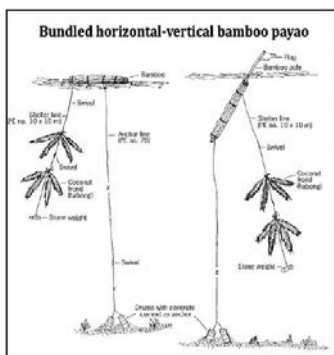
Appendix 4-8: Small-Scale Fishing Activities in Eastern Samar Pacific





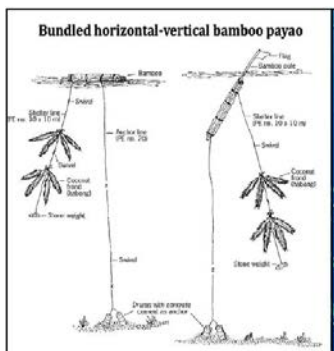
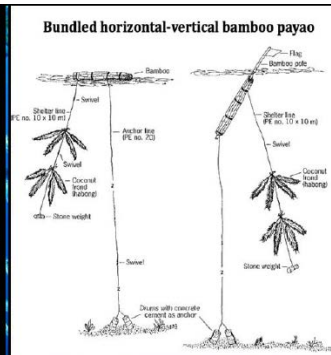






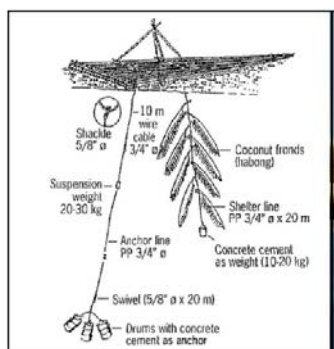
Use of rattan or interior rubber tyres to tie vertical and horizontal bundled bamboos

Anchored in the sea floor by means of boulders or big stones covered with nets, sacks, and woven rattan baskets



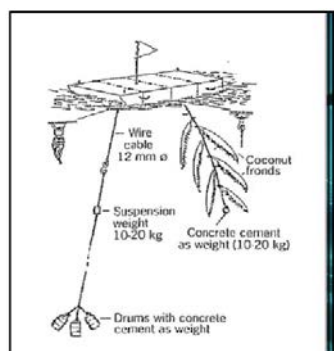
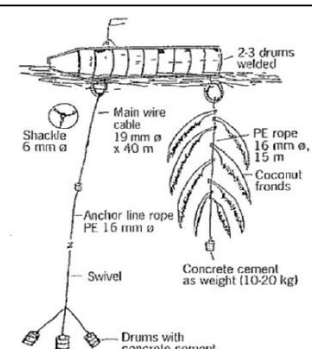
The original anchor line is made of rattan or sliced exterior of rubber tyres twisted and joined together

DEEP WATER PAYAO



BAMBOO PAYAO

GALVANIZED-DRUM PAYAO



REGULAR STEEL PAYAO

DEEP WATER PAYAO COMPONENTS AND COST



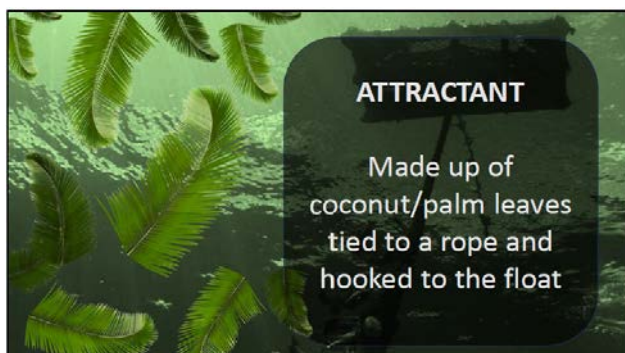
MOORING LINE

Consists of cable near the heater, an anchor drum, a swivel joint, a hanging weight, and a polypropylene or polyethylene rope.

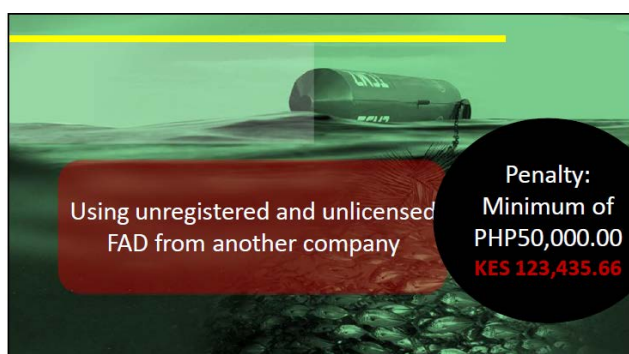
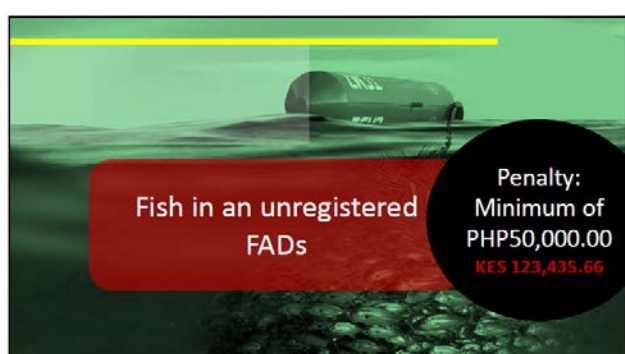
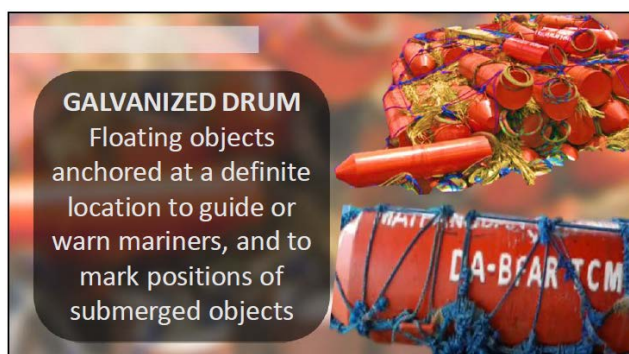
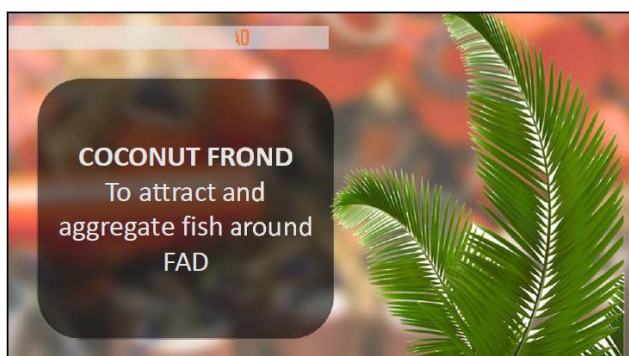
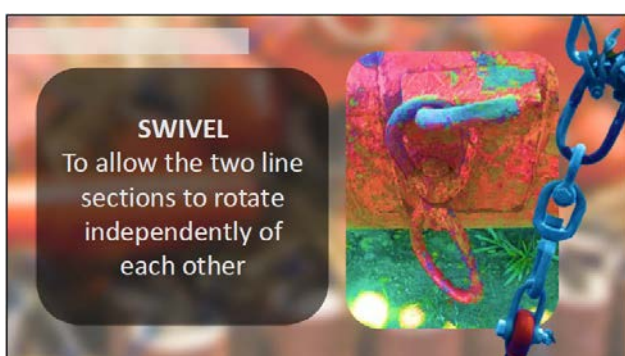
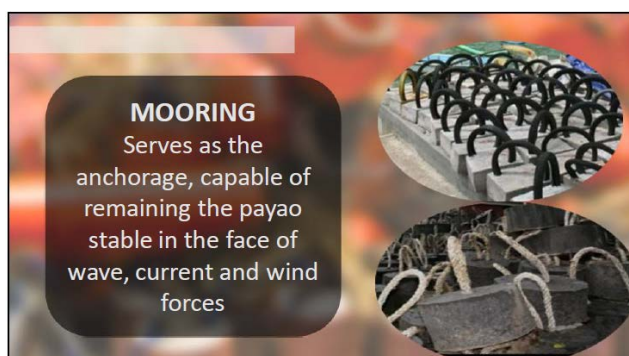
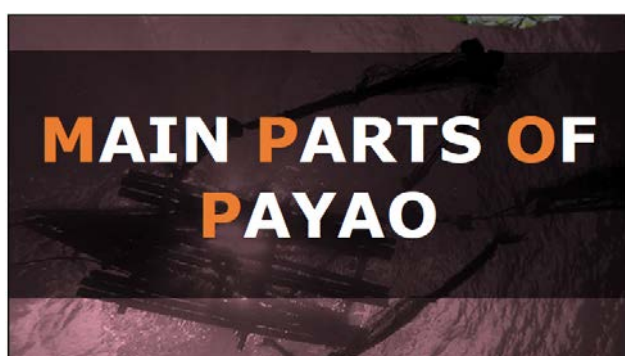
ANCHOR

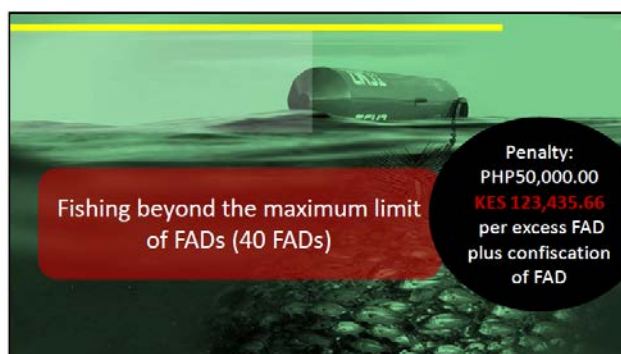
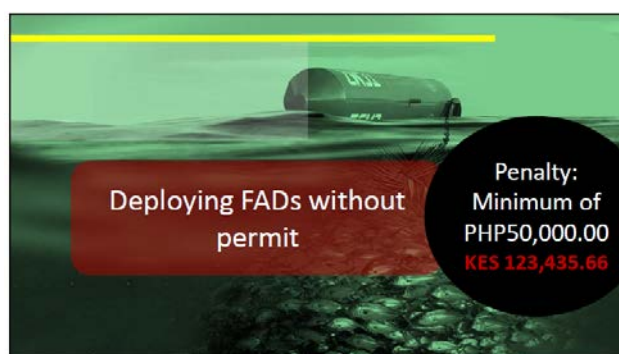
Consists of one to eight cement drums with a capacity depending on depth





DEPTH	PRICES	PRICES
Varies from 300 meters to 5,000 meters.	Estimated from PHP 200,000.00 - 300,000.00	Estimated from KES 489,071.31 - 733,606.97
		





BOTTOM SINKER
Center weight

Material: Concrete cement
Size: $\Phi=5m \times .5m$
Quantity: 1 pc
Unit Price: 2,500.00

Total: PHP 2,500.00
KES 6,092.70



TOTAL COST:
PHP 334,300.00
KES 815,420.05

Sharing scheme between Payao owner and Commercial Fishing Vessel




Gross income

PHP 300,000.00

- 50,000.00

Net income

PHP 250,000.00

Deduct CFVs expenses from landing site to the location of payao

Divide net income to (3) parts with the ratio of 2:1

PHP 250,000.00

3

CVF owner

boat staffs

Payao Owner

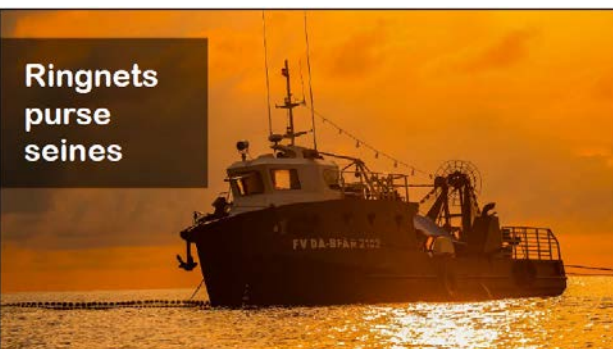
CFV = PHP 166,700.00
Payao = PHP 83,300.00

CFV = KES 406,261.46
Payao = KES 203,008.88

FISHING GEARS ASSOCIATED WITH PAYAO



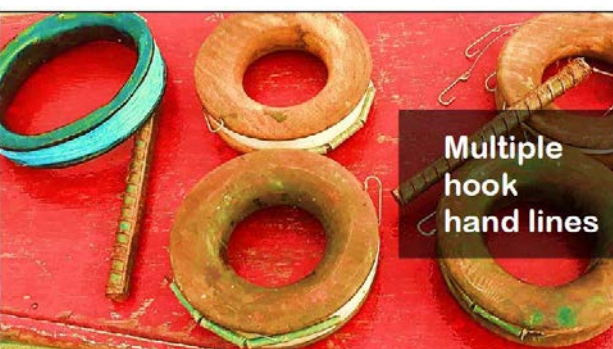
Ringnets purse seines



Single Hook and lines

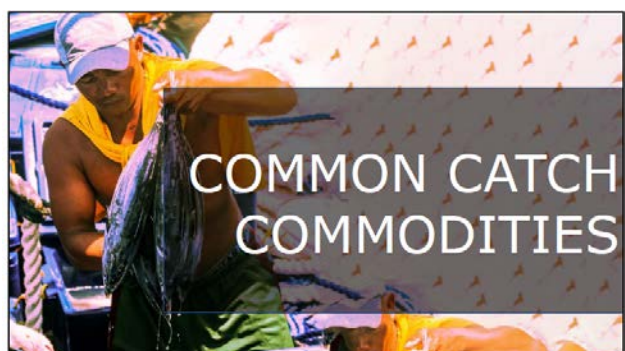
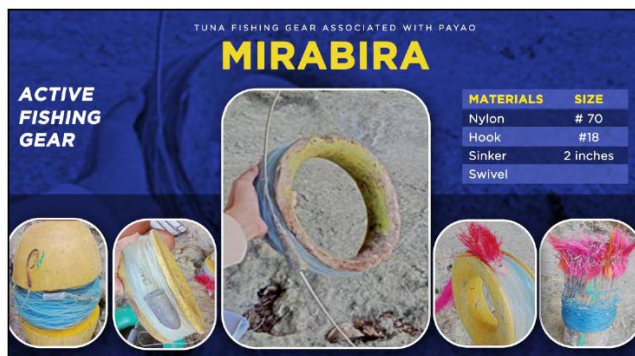
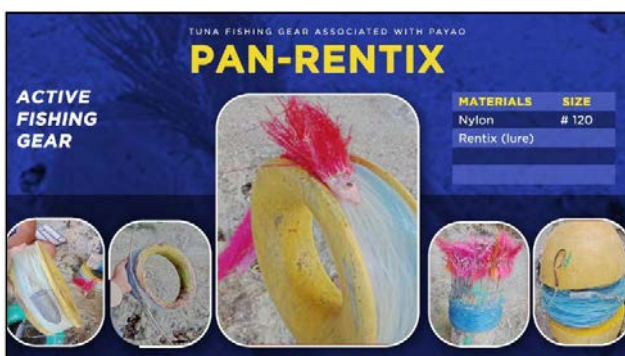
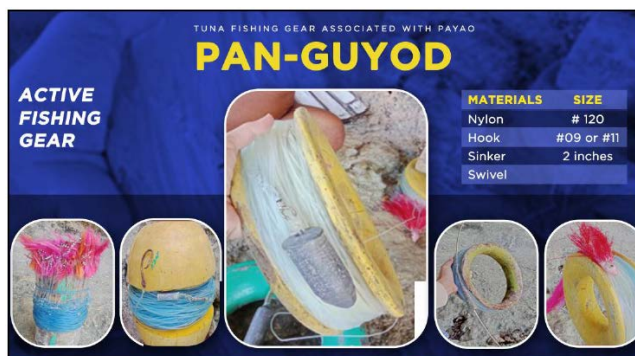
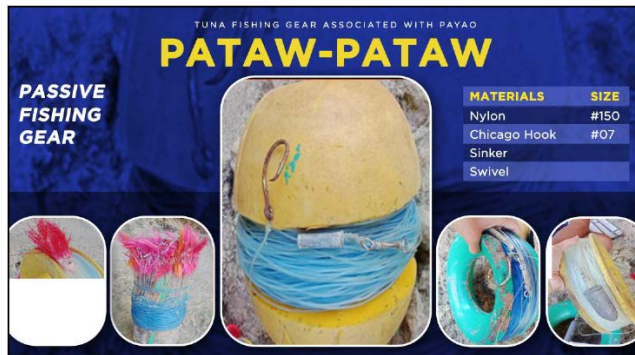
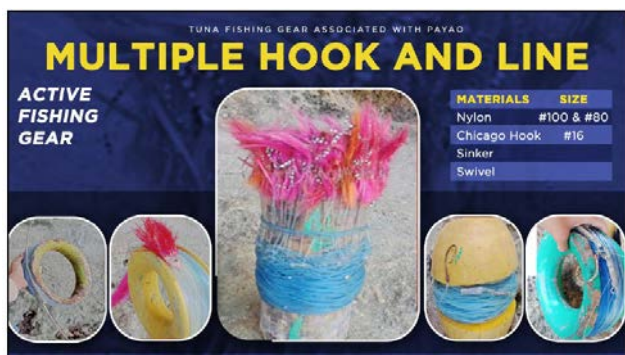


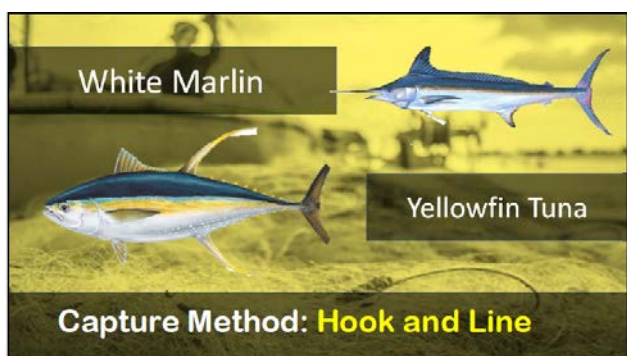
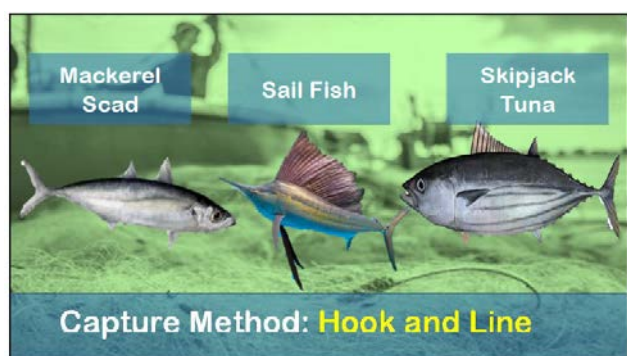
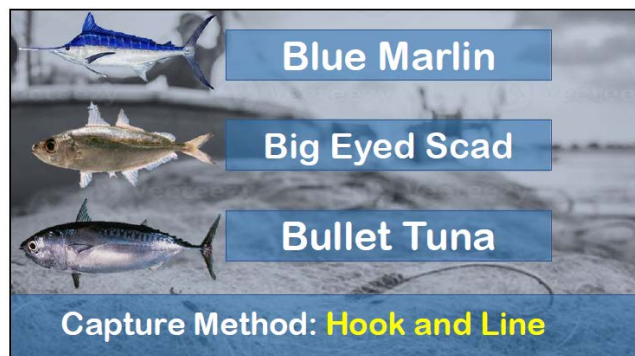
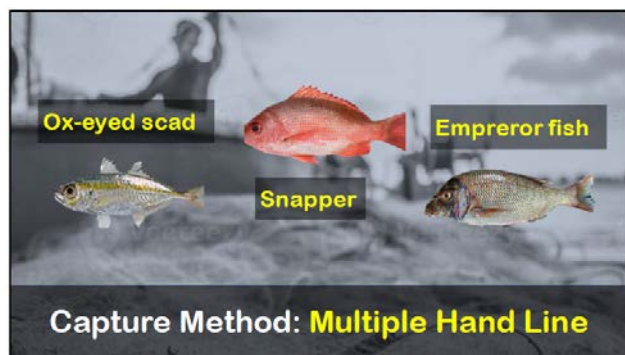
Multiple hook hand lines



TUNA FISHING GEAR ASSOCIATED WITH PAYAO

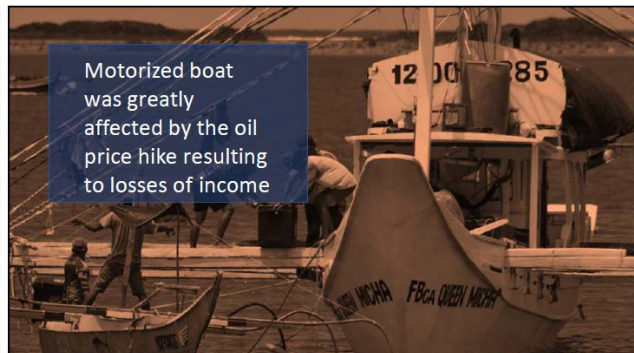




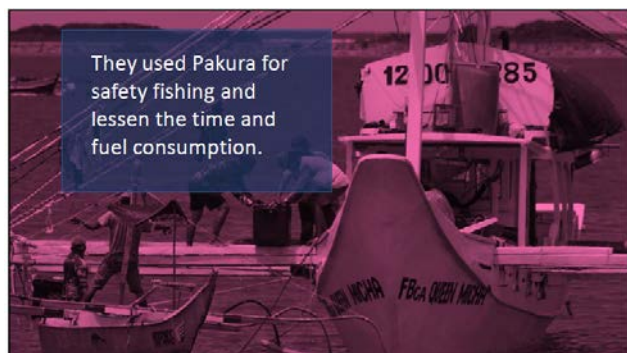




Fisherfolk help each other to carry the boat to the shore or towed them to the fishing ground



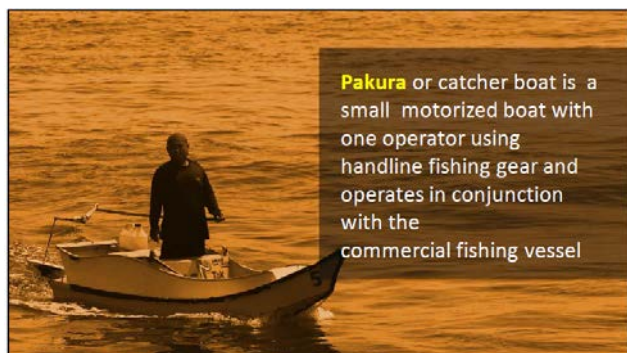
Motorized boat was greatly affected by the oil price hike resulting to losses of income



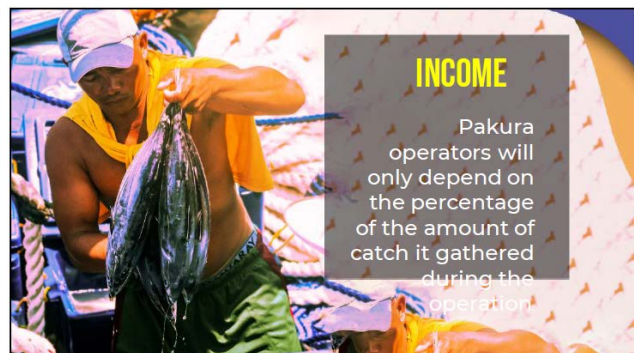
They used Pakura for safety fishing and lessen the time and fuel consumption.



USE OF
PAKURA



Pakura or catcher boat is a small motorized boat with one operator using handline fishing gear and operates in conjunction with the commercial fishing vessel

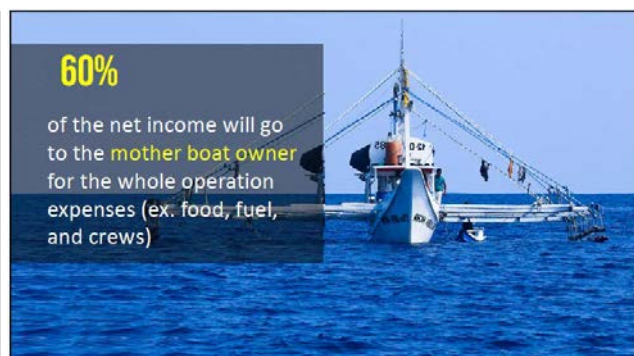


INCOME

Pakura operators will only depend on the percentage of the amount of catch it gathered during the operation

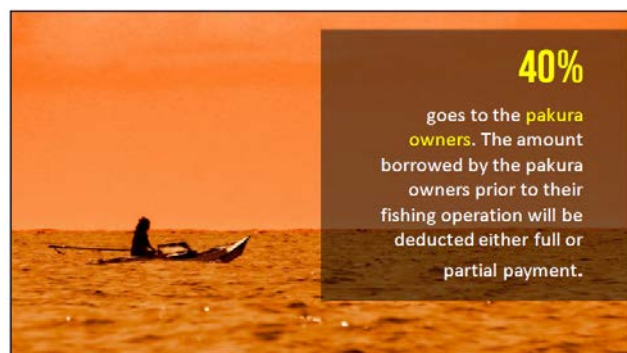


SHARING SCHEME
BETWEEN THE
PAKURA OWNER
AND CFV



60%

of the net income will go to the **mother boat owner** for the whole operation expenses (ex. food, fuel, and crews)

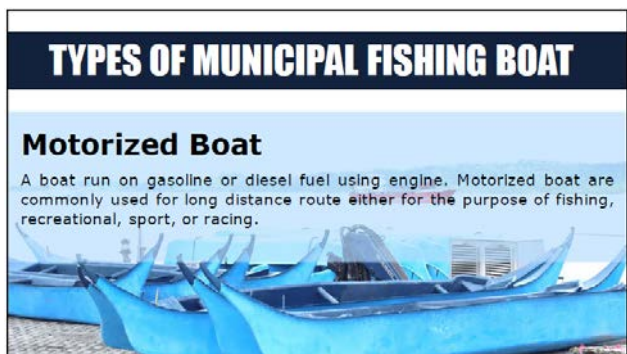
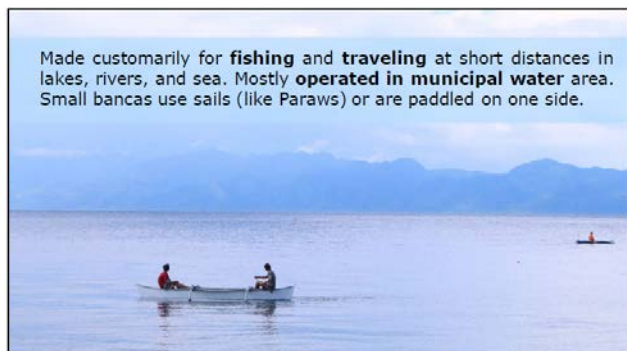
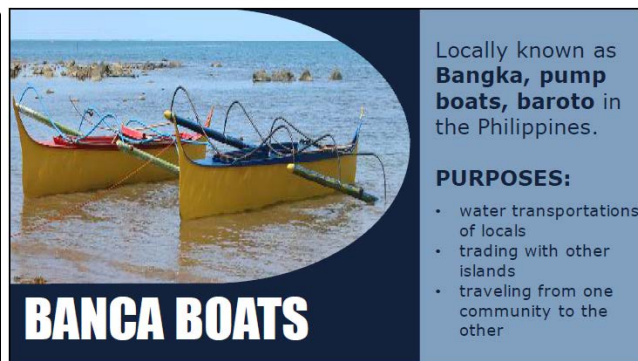


40%

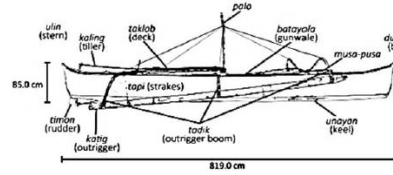
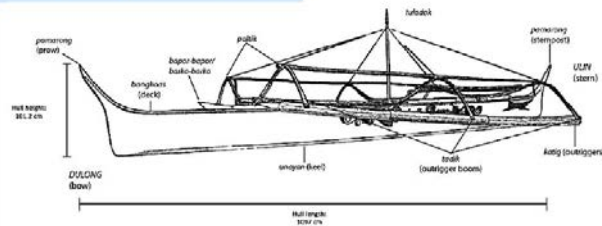
goes to the **pakura owners**. The amount borrowed by the pakura owners prior to their fishing operation will be deducted either full or partial payment.

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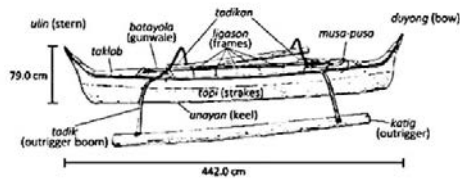


Pump Boat



Dinorado

Baloto/Baroto



Materials in Boat Construction

- Wooden keel "unayan" the flooring of the boat
- Marine plywood- to cover the skeleton of the banca (pan tapi)
- Lumber 1"x2"x10' for the construction of the hull frame
- Bamboo poles- is the outrigger of the boat
- Monofilament nylon - for tying the bamboo poles to the boat (outriggers)
- Marine Epoxy resin- used as putty to paste or cover the marine plywood (maselya) to make the hull stronger
- Paint- to paint the wooden parts of the boat to protect it and last longer.



Materials in Boat Construction

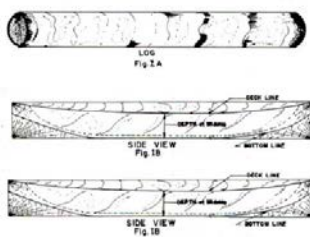
- Copper wire nails - used to fasten the plywood to the wooden lumber
- Bolts & nuts- to secure the connected parts of the boat
- Engine- a machine used to convert its energy into mechanical force and motion, thus, it helps to move the boat faster from one place to another
- Shaft - for connecting the engine for stability.
- Propeller - (pala) guides and thrusts the movement of the boat
- Rudder- " timon " attached to the propeller and maneuvered by the boat operator to change the direction of the boat



PROCESS OF CONSTRUCTING BANCA

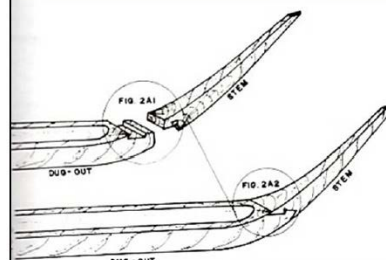


1. Shaping out the dug-out.



Mark the deck and base line using ink and remove the unwanted portion with axe or saw. Draw a breadth line and hollow canal. Then chop the outer portion of the breadth line and carve the hollow canal with an axe.

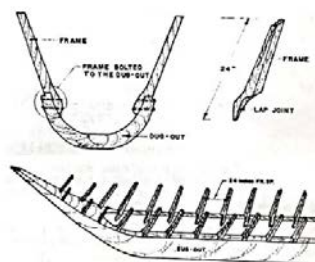
2. Joining the stem and dug-out.



Make a stem according to the desired shape for bow and stern and connect them to the dugout using marine/weldwood epoxy to stick.

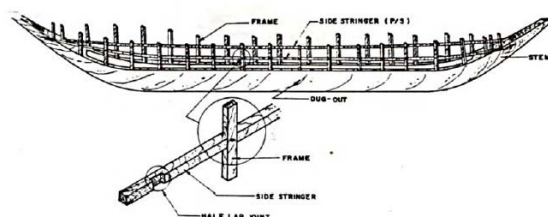
3. Fastening the frame or rib to the dug-out.

Cut a dugout frame with lap joint that fit to the top side of the dugout and connect them with GI carriage bolts.

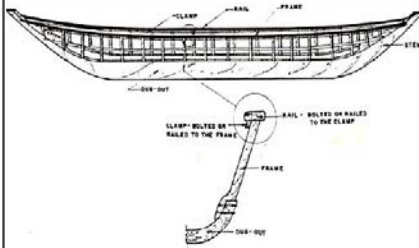


4. Fastening the stringer the frames.

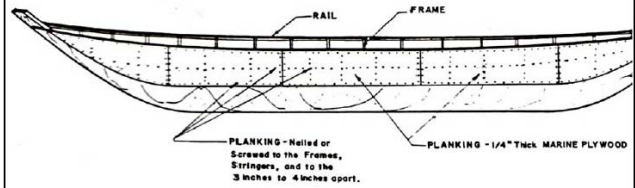
Fasten half lap of stringer at every intersection of the frame with nail or glue.



5. Fastening the clamp and nail to frames.



Fasten clamp on the top of the frames and nail it every frame.
Install the rail at the top of clamp and frames with carriage bolt.

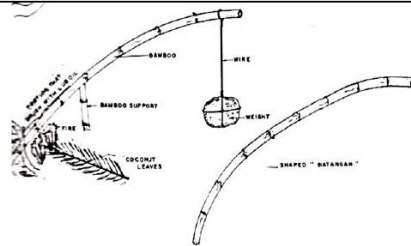
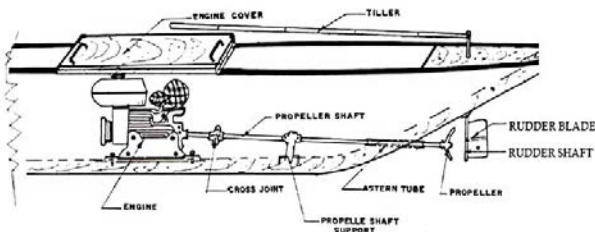


6. Planking

Plank the 1/4 inch thick durable marine plywood with copper nail/wood screw.

7. Engine Installation and Astern Assembly.

Position/place the engine in a considerable distance away from the stern of dug-out. Install a tiller and engine cover to protect the engine inside.



8. Bending of the outrigger beam.

Bent the bamboo by putting weight on the end while the other end is fix to an improvised grip and apply heat to bent.

CONSTRUCTION OF BANCA IN GUIUAN, EASTERN SAMAR



Photographs taken from YODISFILE, 2019 (<https://www.yodisphere.com/2021/02/rainpo-boat-building-cultur.html>)



APPENDIX 5

Proposed Six Technology Transfer Programs from the Philippines

Technology Transfer from the Philippines

JICA Fisheries Promotion Advisor Project for
Blue Economy Training in Kenya

Construction and Installation of HDPE marine cage

- Milkfish and rabbitfish are being cultured on a trial basis in a floating cages at Kijiweni, Shimoni. The low strength of the cage frame made of wood and steel is becoming a problem due to the effects of ocean waves and current. A circular cage made of high-strength material of HDPE pipes will be constructed in this program.



Nursery operation for mangrove crab seedling production

- Demand of mangrove crab are high in all coastal counties, but the shortage of seedlings for farming or fattening is the bottleneck for extension of the farming practice. This program will introduce the Philippine method of nursery culture system for supply of mangrove crab seedlings.



Longline seaweed farming method

- The off-bottom cultivation method in Kenya has large diurnal variations in the farming environment and is susceptible to diseases, resulting in lack of healthy seedlings for expansion of culture areas. A Philippine-style longline system will be introduced off the coast where the culture environment is stable.



Sluice gate construction for earthen fish ponds for finfish nursery

- There are fishponds suitable for finfish and crab nursery to produce seedlings for aquaculture operations at Kibokoni, Kilifi creek. Those ponds are supplied with seawater through pipe systems which have limited water exchange capacity. A wooden sluice gate will be constructed under the supervision of the Project according to the design prepared by a Philippine specialist based on his/her site inspection.



Construction of a Philippine banca-type boat for offshore fishing

- There are surplus fishing resources off the coast of Kenya, but artisanal fishermen cannot reach the offshore fishing grounds due to the insufficient navigational capacity of their fishing vessels. This activity will for building a Philippine banca-type fishing boat that are affordable for small-scale fishers and enable them to reach the offshore fishing ground.



Offshore fishing method with FAD (fish aggregating device)

- Introduction of semi-industrial fishing boat in association with FADs technology is on-going at Mtwapa by SDBEF with FAO. In this activity, a Philippine-type low-cost FAD will be constructed and installed at the same fishing ground of semi-industrial fishing boat for sharing the harvests.



APPENDIX 6

List of Equipment and Materials Required for
the Construction of Banca Boat and HDPE Cage
in Kenya

Appendix 6-1: Cost of Bangka Boat Construction

Summary

Part	amount
Anchor	7,400
Boat frame	70,600
Body of Banca	213,687
Engine	76,629
Safety	4,500
For tying	4,325
Labour , security and storage	230,000
Miscellaneous	18,370
Outrigger support	36,140
Shaft and housing of shaft	25,450
Tools	70,691
Transport	22,110
Total	779,902

Detail Expenditure Record for Construction of Banca Boat

Item	Part	Supplier	Contact	UP	QTY	Total
Anchor 4kg	Anchor	Maimun	25422412617	2400	1	2,400
Rope 14mm x 50m	Anchor	Maimun	25422412617	5000	1	5,000
Chain saw service	Boat frame	Martin Kenga	254728290875			12,300
Timber for Keel (Mango tree, cutting and transport)	Boat frame	Elius Ziro	254707253725			35,000
Chain saw service	Boat frame	Martin Kenga	254728290875			2,300
Wood for banca boat	Boat frame	Martin Kenga	254728290875			21,000
Copper nails 1", 1.5",2",2.5'	Body of banca	Maimun	25422412617	4500	8	36,000
Pencil Staedler 5b	Body of banca	Naivas		90	6	540
Sharpener	Body of banca	Naivas		21	1	21
Denatured alchohol	Body of banca	Fecy	254748296015	800	20	16,000
Epoxy Resin	Body of banca	After hope	254717992724	1600	8	12,800
Antifouling red	Body of banca	Hardware and general	254733624999	17980	1	17,980
Standard thinner	Body of banca	Hardware and general	254733624999	600	1	600
Acrylic paint	Body of banca	Hardware and general	254733624999	6080	2	12,160
Acrylic paint	Body of banca	Hardware and general	254733624999	6080	2	12,160
Acrylic hardener	Body of banca	Hardware and general	254733624999	2400	4	9,600
Acrylic thinner	Body of banca	Hardware and general	254733624999	3400	2	6,800
paint brush 4"	Body of banca	Hardware and general	254733624999	330	1	330
paint brush 3"	Body of banca	Hardware and general	254733624999	160	1	160
paint brush 2"	Body of banca	Hardware and general	254733624999	160	1	160
paint brush 1"	Body of banca	Hardware and general	254733624999	80	3	240
Paint roller	Body of banca	Hardware and general	254733624999	400	4	1,600
Sand paper	Body of banca	Hardware and general	254733624999	100	3	300
Paint roller handle	Body of banca			400	2	800
Marine plywood	Body of banca	Hardware and general	254733624999	7340	6	44,040
Timber for work bench	Body of banca	Tanza Timber	25426028234			2,996
Epoxy Resin	Body of banca	After hope	254717992724			38,400
Honda gx390 engine	Engine	Sunuk	254774145444	72529	1	72,529
Engine oil	Engine	Sunuk	254774145444	800	1	800
Marine grease	Engine	Sunuk	254774145444	2200	1	2,200
Fuel (to test engine)	Engine					1,100
life jacket	Safety	Maimun	25422412617	1500	3	4,500
monofilament nylon	For tying	Maimun	25422412617	575	1	575
1.60mm * 100 yards						
monofilament nylon	For tying	Maimun	25422412617	3750	1	3,750
3.00mm * 100 yards						

Item	Part	Supplier	Contact	UP	QTY	Total
Labour for videography	Labour	Darshad Salim	254793927643			2,000
Labour for data recording	Labour	Bunu Ali	254726780611			2,000
Deposit for boat construction service	Labour	Shalrick(Pwani boat makers)	254723403702			107,500
Shella BMU service charge	Miscellaneous	Yunus Aboud	254720172441			3,000
Warning tape	Miscellaneous	Raghib Store	254748188917			390
Tents	Miscellaneous	Kevin		4500	3	13,500
Lights (for overtime work)	Miscellaneous					1,570
PVC pipes	Outrigger	Mohammed supplies	254733941633	7000	4	14,000
Assorted goods (GI pipe, Extension reel, Nylon Rope, Nails)	Outrigger	Raghib Store	254748188917			17,640
Bamboo logs for Paltic	Outrigger	Mary Charles	25403213774	1500	3	4,500
Shaft threading and engine mod	Shaft					8,000
Stainless steel rod, Stainless stell rube, aquapipe ppr	Shaft	Doshi	254722411555			17,450
Tools G-Clamp 12"	Tools	Doshi	254722411555			5,481
Tools 1054465	Tools	Multitools kenya	254715047983			15,500
Tools 1054464	Tools	Multitools kenya	254715047983			27,250
Toolbox and padlocks	Tools	Noorani	-			3,700
Fevicol adhesive Glue	Tools	Raghib Store	254748188917			950
Blower	Tools	Raghib Store				6,250
Electrical cable	Tools	Malindi Frank	254721255097			900
Planner Inco	Tools	Raghib Store	254748188917			9,880
Drawer runner	Tools	Raghib Store	254748188917			180
Tools 1054469	Tools	Multitools kenya	254715047983			600
Transport of materials to malindi	Transport	Kessy Kaiko	254726882888			13,000
Courier service (for marine epocy)	Transport	Fargo courier	254703077000			1,035
Transport of materials to Malindi (Malindi town to shella beach)	Transport	Idarus Abubakar	254716638848			1,000
Transport of materials to Malindi (Malindi town to shella beach (bamboo))	Transport	Idarus Abubakar	254716638848			500
Courier service (for marine epocy)	Transport	Fargo courier	254703077000			2,525
Transport tuk tuk	Transport	Idarus Abubakar				1,250
Transport for banca wood	Transport	Martin Kenga	254728290875			1,800
Transport for shaft threading	Transport					1,000

Appendix 6-2 : Cost of HDPE Cage Construction

SUMMARY

Category	Amount
Cage frame single collar	165,050
Cage frame fabrication tools	107,750
Grid mooring	471,000
Grid mooring and cage installation tools	19,320
Net fabrication	394,130
Net fabrication tools	13,110
Mooring raft	42,320
Mooring raft fabrication tools	5,530
Transport of materials	33,140
Others	56,060
Labour	120,800
Mooring blocks	13,500
Mooring blocks and net weight	80,900
Moring blocks form	40,500
Net weight	8,700
labour	26,250
	1,598,060

Detail Cost for Construction of Banca Boat

Item	Construction part	Supplier	Contact	Unit	UP	QTY	Total
Cage frame single collar							
HDPE Pipe	Cage frame 10 m D 225 mm * 12 m length	Maimun	25422412617		46350	3	139,050
POLYSTYRENE SHEETS	Cage frame 10 m D 4' by 4' by 4"				2600	10	26,000
Cage frame fabrication tools							
Transport for Butt fusion machine and gen set	cage frame fabrication tools	Martin Musembi	254792631999	Trip	30000	2	60,000
complete Butt fussion machine hire	cage frame fabrication tools	Martin Musembi	254792631999	Day	12500	2	25,000
Spanner 30 -32	cage frame fabrication tools	Jalaram	254723338478	pcs	1400	2	2,800
Adjustable spanner	cage frame fabrication tools	Jalaram	254723338478	pcs	1050	1	1,050
combined spanner	cage frame fabrication tools	Jalaram	254723338478	pcs	550	4	2,200
electric chain saw	cage frame fabrication tools	Vivian Tech	254728347404	unit	15000	1	15,000
Chain saw oil	cage frame fabrication tools	Shell Danka	254795962467	litre	600	0.5	300
Gloves	cage frame fabrication tools	Bin Ahmad Hardware	254780868575	pairs	100	6	600
Compass saw	cage frame fabrication tools	Bin Ahmad Hardware	254780868575	pcs	800	1	800
Grid mooring							
POLYPROPYLENE ROPE	Grid mooring 28MM * 180 m white	Maimun	25422412617		60000	1	60,000
POLYPROPYLENE ROPE	Grid mooring 24MM * 180 m white	Maimun	25422412617		45000	7	315,000
POLYPROPYLENE ROPE	Grid mooring 16MM * 90 M white	Maimun	25422412617		17500	4	70,000
Tension Buoy (used)	Grid mooring 25 cm Diameter	Maimun	25422412617		1500	12	18,000
200 L drums	Grid mooring	Noordin	254715004664	pcs	2000	2	4,000

Item	Construction part	Supplier	Contact	Unit	UP	QTY	Total
200 L drums	Grid mooring	Abdulaziz chemicals	254733289450	pcs	2000	2	4,000
Grid mooring and cage installation tools							
Panga	Grid mooring and cage installation tools	Jalaram	254723338478	pcs	300	1	300
Blade sharpener (Ingco accessories)	Grid mooring and cage installation tools	Bin Ahmad Hardware	254780868575	pcs	500	1	500
silicon Gun	Grid mooring and cage installation tools	HEMYS general Hardware	254757272556	pcs	300	1	300
Silicon clear	Grid mooring and cage installation tools	HEMYS general Hardware	254757272556	pcs	250	2	500
Boat	Grid mooring and cage installation tools	Ocharo					7,000
Boat	Grid mooring and cage installation tools	Abdallah Darusi					3,000
Boat	Grid mooring and cage installation tools	Abdallah Darusi					7,720
Net fabrication							
KNOTTED PE NET	net fabrication 380/60 * 2" * 150 MD * 50 Yards	Maimun	25422412617		95000	2	190,000
KNOTLESS PE Net	net fabrication 380/18 * 1" * 180MD * 50 Yards	Maimun	25422412617		40000	3.9	156,000
PE Rope	net fabrication 10mm*200 m white	Maimun	25422412617		4500	3	13,500
PE Rope	net fabrication 8 mm * 200 m white	Maimun	25422412617		2500	3	7,500
PE Rope	net fabrication 5mm * 200 m white	Maimun	25422412617		1500	2	3,000
PE Rope	net fabrication 6mm * 200 m white	Maimun	25422412617		1850	3	5,550
Netting needles small	net fabrication	Maimun	25422412617		100	25	2,500
Netting needles medium	net fabrication	Maimun	25422412617		200	25	5,000
Nylon Twine	net fabrication 210/60 PLY	Maimun	25422412617		500	8	4,000
Nylon Twine	net fabrication 210/21 PLY	Maimun	25422412617		500	6	3,000
Snap hooks	net fabrication	Irene	254723363603	pcs	340	12	4,080
Net fabrication tools							
Big scissors	net fabrication tools			pair	250	3	750
Utility knife	net fabrication tools	Multi tools	254715047983				700
Stanley tape measure 5 m	net fabrication tools	Jalaram	254723338478	pcs	1100	1	1,100
multipurpose torch +butane gas canister	net fabrication tools	Jalaram	254723338478	set	3480	2	6,960
Butane gas canister	net fabrication tools	Jalaram	254723338478	can	1100	1	1,100
Scissors	net fabrication tools	Bin Ahmad Hardware	254780868575	pair	900	1	900
Tolsen steel measuring tape 50m	net fabrication tools	Multi tools	254715047983	pcs	1600	1	1,600
Mooring raft							
Monofilament	Mooring raft # 1.60 mm * 500 yards	Maimun	25422412617		4500	4	18,000
200 L drums	Mooring raft	Noordin	254715004664	pcs	2000	8	16,000
4" by 4" L 12' wood	Mooring raft	Abdallah Darusi	254741462777	pcs	700	8	5,600
Bolt/locknut/2 flat washer	mooring raft 0.5 *10	Jalaram	254723338478	pcs	170	16	2,720
Mooring raft fabrication tools							
Dotted gloves	mooring raft fabrication tools	Jalaram	254723338478	pair	75	6	450
Drill bits 3/8	mooring raft fabrication tools	Jalaram	254723338478	pcs	480	1	480
Tolsen Industrial Hamme Drill 650 W	mooring raft fabrication tools	Multi tools	254715047983	pcs	4000	1	4,000

Item	Construction part	Supplier	Contact	Unit	UP	QTY	Total
Wood Drill Bit 12"	mooring raft fabrication tools	Bin Ahmad Hardware	254780868575	pcs	600	1	600
Transport of materials							
Transport for Drums, nets and ropes	Transport Light transport 1.2T	Kessy	254726882888	Trip	11000	1	11,000
Transport from Maimun to Shimoni stage	Transport	Mahmoud		trip	200	1	200
Transport for snap hooks	Transport	Irene	254723363603	trip	640	1	640
Transport for 4" by 4" wood	Transport	Abdallah Darusi	254741462777	trip	1300	1	1,300
Transport of pipes and styrofoam sheets to Shimoni	Transport	Sammy	254713629909	Trips	20000	1	20,000
Others							
Hose chip 3"	Others	Jalaram	254723338478	pcs	115	4	460
Plastic tube welding machine	Others	Bin Ahmad Hardware	254780868575	pcs	8000	1	8,000
Gasoline Generator	Others	Digital city ltd		unit	34000	1	34,000
Generator cables	Others	Kilojen electricals		pcs	1500	2	3,000
Lock Box	Others	baghdad textile	254722620989	pcs	1400	1	1,400
Padlocks	Others	baghdad textile	254722620989	pcs	100	2	200
Canvas tent	Others	Kevin	254798455242	pcs	4500	2	9,000
Labour							
Labour	Labour	Ocharo	254721616510		1600	1	1,600
Labour for net fabrication	Labour 10 net makers local and 2 KMFRI supervisor	Locals					10,400
Labour for net fabrication	Labour 10 net makers local and 2 KMFRI supervisor						10,400
Labour for net fabrication	Labour 10 net makers local and 2 KMFRI supervisor						10,400
Labour for cage fabrication	Labour 10 net makers local and 2 KMFRI supervisor and 1 community chairman						11,200
Labour for cage fabrication	Labour 10 net makers local and 2 KMFRI supervisor						10,400
Labour for net fabrication	Labour 10 net makers local and 2 KMFRI supervisor						10,400
Labour for placement of Mooring blocks	Labour 10 locals	Abdallah Darusi					20,000
Labour	Labour 4 locals at 1000 and 2 KMFRI at 1500	Ocharo					7,000
Labour	Labour 4 locals at 1000 and 2 KMFRI at 1500	Ocharo					7,000
Labour	Labour 4 locals at 1000 and 1 KMFRI at 1500	Ocharo					5500
Labour	Labour 4 locals at 1000 and 1 KMFRI at 1500	Ocharo					5500
Labour	Labour 4 locals at 1000 and 1 KMFRI at 1500	Ocharo					5500
Labour	Labour 4 locals at 1000 and 1 KMFRI at 1500	Ocharo					5500

Detail Cost for Mooring blocks construction

Item	Construction part	Supplier	Contact	Unit	UP	QTY	Total
Labour							
Foreman	Labour Supervisor for the construction	Abdalla Darusi	254741462777	day	2000	3	6000
Labour for Mooring block construction	Labour Casual	Omar Mkulu	254791061480	day	750	3	2250
Labour for Mooring block construction	Labour Casual	Nassoro Bakari	254748790010	day	750	3	2250
Labour for Mooring block construction	Labour Casual	Masudi Bakari	254790146375	day	750	3	2250
Labour for Mooring block construction	Labour Casual	Ng'ombe Abdalla	-	day	750	3	2250
Labour for Mooring block construction	Labour Casual	Kassim Athman	254110545982	day	750	3	2250
Labour for Mooring block construction	Labour	Ali Kassim	254741518056	day	750	3	2250
Labour for Mooring block construction	Labour Casual	Omar Bakari	254112240943	day	750	3	2250
Labour for Mooring block construction	Labour Casual	Kassim Bakari	-	day	750	3	2250
Labour for Mooring block construction	Labour Casual	Bakari Mneyto	254790255692	day	750	3	2250
Mooring blocks							
Galvanised wire	mooring blocks #16	Hardware professors	254796892000	kilos	3	300	900
Used tire rings	mooring blocks	Cosmas Munyoli	254720956165	pcs	150	84	12600
Mooring blocks and net weight							
River Sand	mooring blocks and net weight	Azuberi Yahaya	254757866110	ton	625	4	2500
Gravel	mooring blocks and net weight 3/4"	Danco Hardware	254718669192	ton	4	3000	12000
Polythene	mooring blocks and net weight Black	Danco Hardware	254718669192	metre	80	5	400
Cement	mooring blocks and net weight Bamburi Nguvu	Kona ya Shimoni Hardware	254716501398	50kg bag	770	30	23100
corrugated round bar	mooring blocks and net weight 3/8" by 40 ft	Kona ya Shimoni Hardware	254716501398	pcs	10	1250	12500
Transport	mooring blocks and net weight Gravel from Ukunda to Kijiweni	Mulwa Martin	254745570219	trip	7200	1	7200
Labour	mooring blocks and net weight for offloading gravel	Ng'ombe Abdalla			200	1	200
Water	mooring blocks and net weight Water for concrete	Timah Omari	254796388854	20ltrs	25	120	3000
Transport for the sand	mooring blocks and net weight Lunga lunga to Kijiweni	Azuberi Yahaya	254757866110	trip	7000	1	7000
Transport for the gravel	mooring blocks and net weight Ukunda to Kijiweni	Danco Hardware	254718669192	trip	5000	1	5000
Gravel	mooring blocks and net weight 3/4 "	Phoebe Sombe	254114184313	ton	4000	2	8000

Item	Construction part	Supplier	Contact	Unit	UP	QTY	Total
Mooring blocks form							
Wood nail	mooring blocks form 4"	Kona ya Shimoni Hardware	254716501398	kilos	2	200	400
Marine plywood	mooring blocks form T 1/2"	Kona ya Shimoni Hardware	254716501398	pcs	6	3800	22800
Wood nail	mooring blocks form 1"	Kona ya Shimoni Hardware	254716501398	kilos	3	300	900
Wood nail	mooring blocks form 3"	Kona ya Shimoni Hardware	254716501398	kilos	3	200	600
Wood	mooring blocks form 2" by 3" by 12'	Darusi Adam	254791656868	pcs	12	300	3600
wood	mooring blocks form 2" by 2" by 12'	Darusi Adam	254791656868	pcs	8	300	2400
Transport for the wood	mooring blocks form Fikirini to Kijijweni	Darusi Adam	254791656868	trip	1	1500	1500
Carpentry service	mooring blocks form Mooring Form construction and assembly	Salim Bamiro	254713798535	piece	2000	4	8000
Nails	mooring blocks form 4"	RAJSON Enterprises	254725583893	kilos	1.5	200	300
Net weight							
PVC pipe	net weight waste pipe 8" by 20 ft	Hardware professors		pcs	1	4800	4800
Stainless steel rod	net weight 6mm by 1mtrs	Doshi Hardware	254722411555	pcs	6	250	1500
Welding service	net weight Cutting and welding for net weight	Juma Mwarandu	254715695456	pcs	200	12	2400

APPENDIX 7

Manual on Banca Boat Construction in Kenya

MANUAL ON BANCA BOAT CONSTRUCTION IN KENYA



By

**DAN AMPATIN DE SAN MIGUEL
AND
RONNEL JOSE GAYOSO MACABOCSIT**

2023

A7-1

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Through our collaboration with the Japan International Cooperation Agency (JICA), we take great pride in showcasing and disseminating our knowledge of the traditional boat-making process in the Philippines to the global community. We are sincerely thankful for being selected as their partners in assisting the people of Kenya.

We would like to extend our appreciation and gratitude to the people we worked with in the Philippines and Kenya, for their invaluable contributions to the Banca Boat Project. Their combined efforts and expertise played a significant role in the success and realization of this project.

We would like to extend our thanks to Mr. Cristan Campo for his invaluable contribution to the project. Mr. Campo assisted in translating the step-by-step process of Banca construction from Filipino to English language. He also took part in the planning of the training, preparing the draft of this manual, and assisted in taking photographs of the model banca and its dimensions.

We would also like to express our gratitude to Dr. Kiyoshi Masuda for entrusting us with the responsibility of leading this project. Dr. Masuda's belief in our capabilities and his unwavering support have been crucial in the successful implementation of the Banca Boat Project.

We also would like to express our appreciation to the Regional Director of the Bureau of Fisheries and Aquatic Resources – Eastern Visayas, Dr. Hannibal Chavez, for trusting us and granting us the opportunity to undertake this project in Kenya in collaboration with JICA.

We would also like to acknowledge the hard work and dedication of the entire project team, whose collective effort and collaboration have contributed to the project's success. Their commitment, expertise, and passion were vital in overcoming challenges and ensuring the smooth implementation of the Banca Boat Project.

Lastly, we would like to express our gratitude to the local community in Kenya for their warm reception, cooperation, and involvement throughout the project. Their support and feedback were invaluable in constructing the Banca Boat which helped meet the specific needs and requirements of the community.

INTRODUCTION

This manual contains information on the construction of a 26-foot wooden banca, also known as a fishing boat, for use in Kenya. The design of this boat is intended primarily for use in fishing in lakes, estuaries, and inshore and offshore waters in good weather conditions. This serves as a guide to assist the fisherfolk in understanding the process of boat-making.

Fishing boats are vital for the global food supply and play a significant role in many coastal communities as they serve as their cultural heritage, where fishing has been a way of life for generations. Teaching the fishermen the process of boat making could help them lessen the labor cost. The construction of a wooden banca varies depending on the preference of the owner, usage, and distance of fishing. This banca boat is exceptionally stable due to the outrigger design. Its design is like bancas in Guiuan, Eastern Samar, Philippines which are characterized by high-bend outrigger beams to survive on high seas with big waves. This boat is fuel-efficient and powered by a 16-hp Honda engine that can help Kenyan fishermen reduce fuel consumption and boat production costs.

DIMENSIONS OF 26-FOOT BANCA

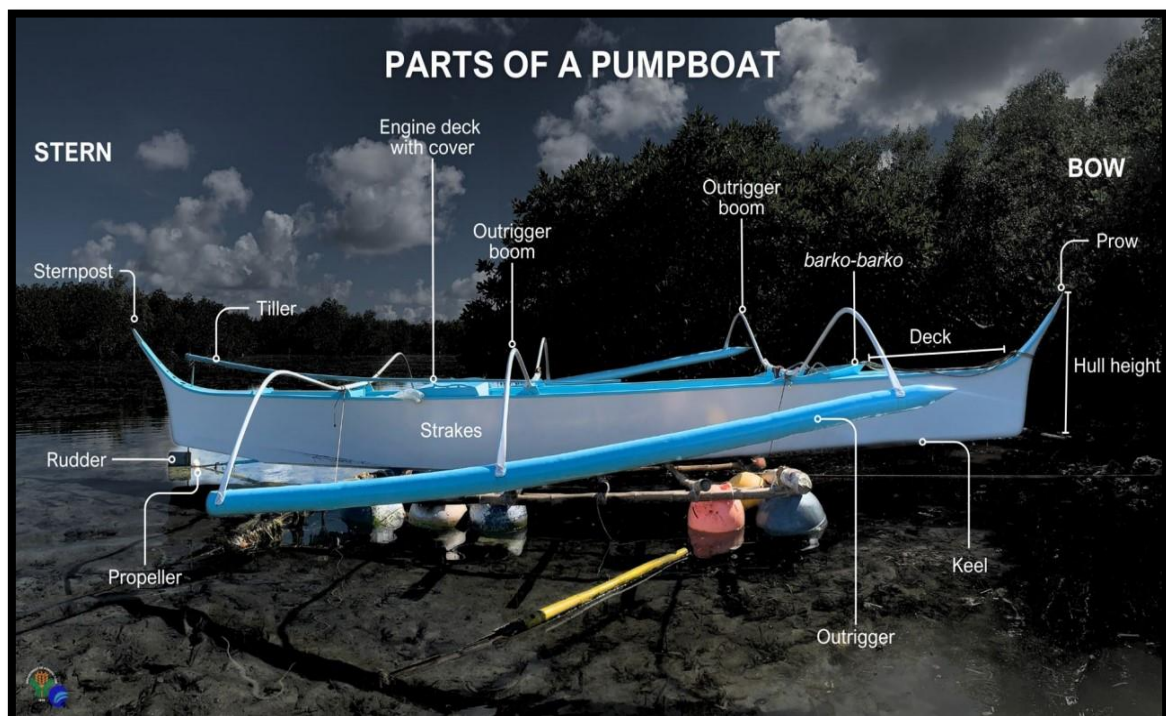


Figure 1. Parts of motorized banca boat.

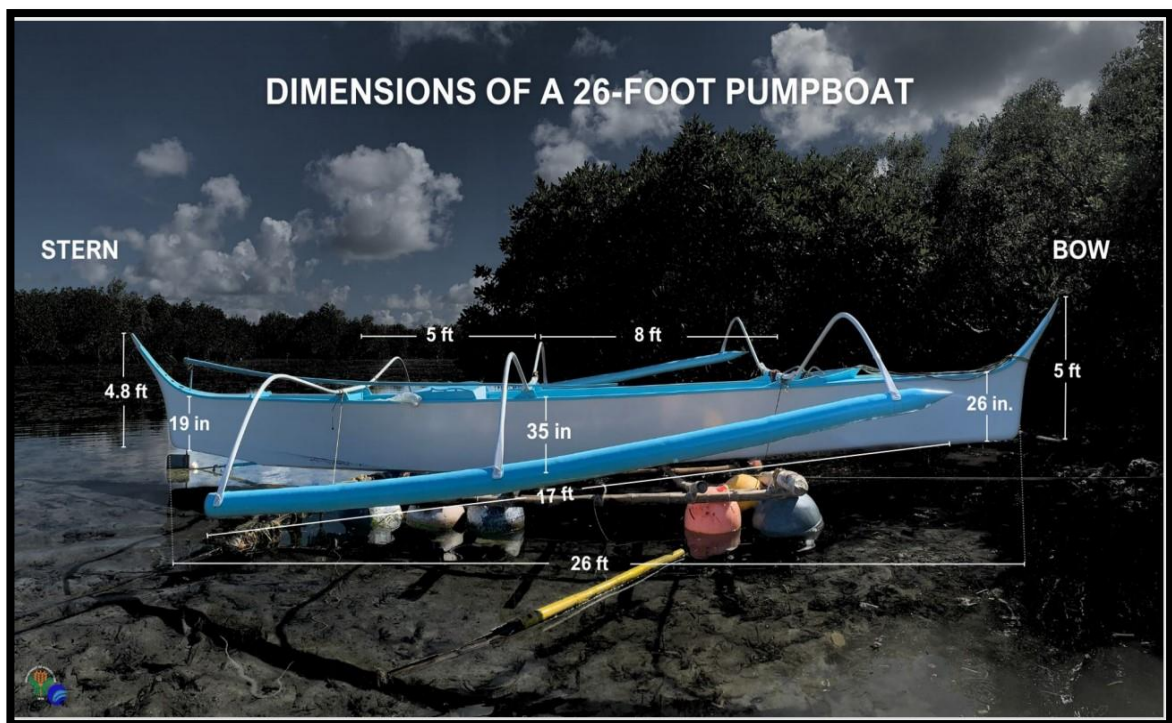


Figure 2. Typical dimensions of a 26-footer banca boat.

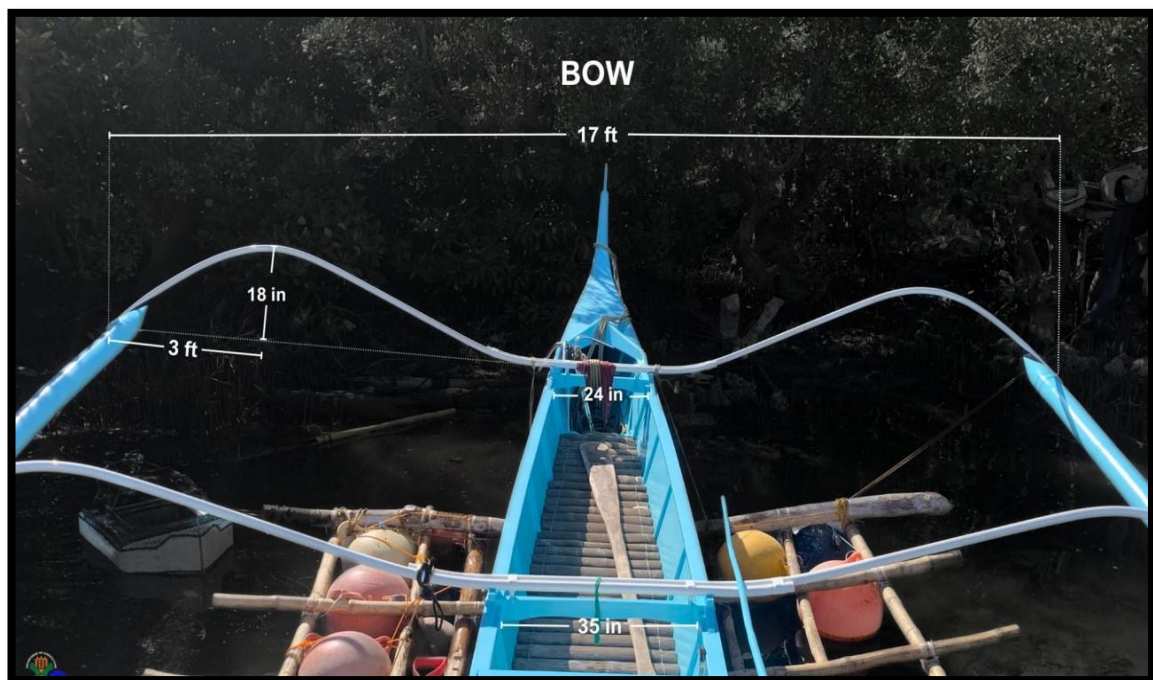


Figure 3. Dimensions of the bow area.



Figure 4. Dimensions of the stern area.

MATERIALS DESCRIPTION AND HANDLING



(Photo taken during the actual cutting of mango tree)

Log for Keel

The keel serves as the foundation or base for the boat. It plays a significant role in providing stability to the boat.



(Source: Glam Ply & Decor)

Marine plywood

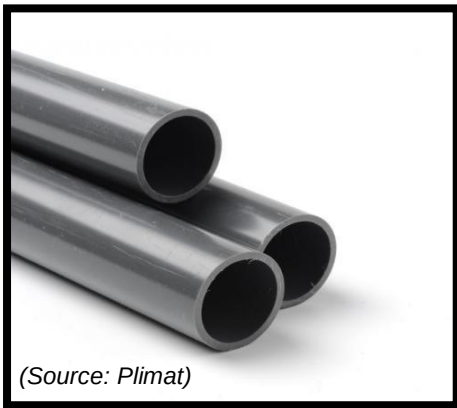
Plywood shields the boat from water by covering and protecting its skeletal structure.



(Actual photo of the ribs/lumber used in Kenya)

Lumber 1"x2"x10'

It is used for the construction of the hull skeleton.



(Source: Plimat)

PVC Pipe

used as the outrigger of the boat. It is inserted with the Styrofoam to enhance its buoyancy.



(Source: DDC Cool Maker & Power Builders Cop.)

GI Pipe

Used as outrigger boom.



(Source: Shop)

Monofilament nylon

For tying the bamboo poles to the boat (outriggers)



(Source: Pioneer)

Marine Epoxy resin

used as putty to paste or cover the marine plywood to make the hull stronger.



(Source: Tools-Paint)

Paint

to paint the wooden parts of the boat to protect it and to make it last longer.



(Source: Classic Boat Supplies)

Copper wire nails

used to fasten the plywood to the wooden lumber.



(Source: iStock)

Bolts & nuts

to secure the installments of engine to the wooden keel.



(The actual engine used in Kenya)

Engine

a machine used to convert its energy into mechanical force and motion, thus, it helps to move the boat faster from one place to another.



(Photo taken from the actual boat made in Kenya)

Rudder

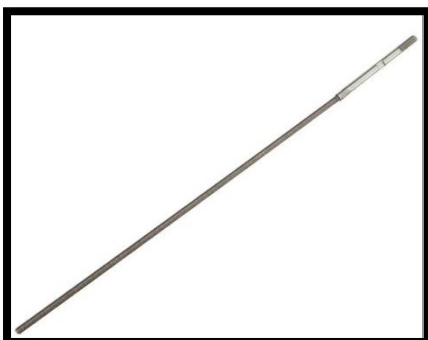
It serves as directional control device that can be maneuvered left or right through a steering mechanism like a tiller.



(Photo taken from the actual boat made in Kenya)

Propeller

guides and thrusts the movement of the boat



(Source: AUS ELECTRONICS DIRECT)

Shaft

A shaft is employed to connect the engine and the propeller in the boat.

TOOLS AND EQUIPMENT

A. POWER TOOLS

- Planer
- Circular saw
- Grinder
- Electric drill
- Drill bit (1/4", 1/2", 1", & 2")

B. HAND TOOLS

Small hammer	Marker (Ink)
Big hammer	Chisel (No. 1/4", 1/2", 1", 1 1/2", & 2")
Hand saw	Hand planer
L-Square	Lapris (Special Planer for edge)
Power tape	Spokeshave
Horizontal Ax	Paintbrush (#4 & #2)
Dug-out ax.	Paint roller
Sandpaper (6 pcs)	
G-clamp (No. 12,8,6, & 4)	

CHALLENGES DURING THE CONSTRUCTION

The absence of a Lawaan-like tree prompted us to use a mango tree instead. Unfortunately, local timber suppliers did not have dried and treated lumber available. As a result, we had to resort to cutting down a mango tree located in an orchard near Malindi. Despite the tree's substantial diameter, its short trunk posed a challenge, preventing us from obtaining the required 26-foot-long lumber for the boat's keel. Aside from that, the wood used was raw timber without undergoing any seasoning process. Despite the usual need for drying to enhance durability, we had no alternative options and proceeded with the construction process using untreated wood. With Ronnel's approval and guidance, we felled the tree and sawed it to produce three pieces of lumber, which served as the material for the boat's construction. The dimensions of the first lumber were 15 ft x 20 inches wide x 4 inches thick for the bow towards the engine bed area; 7 ft x 20 inches wide x 4 inches thick for the engine area; and 4 ft x 20 inches wide x 4 inches thick from the engine area to the stern. These three pieces of lumber were smoothed, carved, and meticulously joined together to form a keel, using a half-lap joint technique with wooden pieces as a nails(dowel) and securing the joints with epoxy.

MATERIALS AND COSTING

Table 1. Detailed expenditure of 26-footer Banca boat in Kenyan Shilling

Date	Item	Description	Category	Supplier	Contact Tel number	unit price	Quantity	Total
ANCHOR								
26/10	anchor	4kg	Anchor	Maimun	25422412617	2400	1	2,400
26/10	rope	14mm*50m	Anchor	Maimun	25422412617	5000	1	5,000
01/11	Chain saw service		Boat frame	Martin Kenga	254728290875			12,300
01/11	Timber for Keel	Mango tree, cutting and transport	boat frame	Elius Ziro	254707253725			35,000
05/11	Chain saw service		Boat frame	Martin Kenga	254728290875			2,300
	Wood for banca boat		Boat frame	Martin Kenga	254728290875			21,000
BOAT FRAME								
26/10	Copper nails	1", 1.5", 2", 2.5'	Body of banca	Maimun	25422412617	4500	8	36,000
26/10	Pencil	Stadler 5b	Body of banca	Naivas		90	6	540
26/10	Sharpener		Body of banca	Naivas		21	1	21
26/10	Denatured alcohol		Body of banca	Fecy	254748296015	800	20	16,000
26/10	Epoxy Resin		Body of banca	After hope	254717992724	1600	8	12,800
26/10	Antifouling red		Body of banca	Hardware and general	254733624999	17980	1	17,980
26/10	Standard thinner		Body of banca	Hardware and general	254733624999	600	1	600
26/10	Acrylic paint		Body of banca	Hardware and general	254733624999	6080	2	12,160
26/10	Acrylic paint		Body of banca	Hardware and general	254733624999	6080	2	12,160
26/10	Acrylic hardener		Body of banca	Hardware and general	254733624999	2400	4	9,600
26/10	Acrylic thinner		Body of banca	Hardware and general	254733624999	3400	2	6,800
26/10	paint brush	4"	Body of banca	Hardware and general	254733624999	330	1	330
26/10	paint brush	3"	Body of banca	Hardware and general	254733624999	160	1	160
26/10	paint brush	2"	Body of banca	Hardware and general	254733624999	160	1	160
26/10	paint brush	1"	Body of banca	Hardware and general	254733624999	80	3	240
26/10	Paint roller		Body of banca	Hardware and general	254733624999	400	4	1,600
26/10	Sand paper		Body of banca	Hardware and general	254733624999	100	3	300
26/10	Paint roller handle		Body of banca			400	2	800
27/10	Marine plywood		Body of banca	Hardware and general	254733624999	7340	6	44,040
28/10	Timber for work bench		Body of banca	Tanza Timber	25426028234			2,996
04/11	Epoxy Resin		Body of banca	After hope	254717992724			38,400
ENGINE								
26/10	Honda gx390 engine		Engine	Sunuk	254774145444	72529	1	72,529
26/10	Engine oil		Engine	Sunuk	254774145444	800	1	800
26/10	Marine grease		Engine	Sunuk	254774145444	2200	1	2,200
16/11	Fuel	to test engine	Engine					1,100
SAFETY								
26/10	life jacket		Safety	Maimun	25422412617	1500	3	4,500
FOR TYING								
26/10	monofilament nylon	1.60mm * 100 yards	for tying	Maimun	25422412617	575	1	575
26/10	monofilament nylon	3.00mm * 100 yards	for tying	Maimun	25422412617	3750	1	3,750
LABOUR, SECURITY AND STORAGE								
02/11	Labour for videography		labour	Darshad Salim	254793927643			10,000
02/11	Labour for data recording		labour	Bunu Ali	254726780611			5,000
31/10	Deposit for boat construction service		Labour and Security service	Shalrick(Pwani boat makers)	254723403702			215,000
MISCELLANEOUS								
31/10	Shella BMU service charge		miscellaneous	Yunus Aboud	254720172441			3,000
02/11	Warning tape		miscellaneous	Raghib Store	254748188917			300
03/11	Tents		miscellaneous	Kevin		4500	3	13,500
16/11	Lights	for overtime work	miscellaneous					1,570
OUTRIGGER SUPPORT								
28/10	PVC pipes		Outrigger	Mohammed supplies	254733941633	7000	4	14,000
28/10	Assorted goods	GI pipe, Extension reel, Nylon Rope, Nails	Outrigger support	Raghib Store	254748188917			17,640
02/11	Bamboo logs for Paltic		outrigger support	Mary Charles	25403213774	1500	3	4,500
17/11	Shaft threading and engine mod		Shaft					8,000

27/10	Stainless steel rod, Stainless stell rube, aquapipe ppr		Shaft and housing of shaft	Doshi	254722411555			17,450
TOOLS								
23/10	Tools	G-Clamp 12"	Tools	Doshi	254722411555			5,481
25/10	Tools	1054465	Tools	Multitools Kenya	254715047983			15,500
25/10	Tools	1054464	Tools	Multitools Kenya	254715047983			27,250
25/10	Toolbox and padlocks		Tools	Noorani				3,700
31/10	Fevicol adhesive	Glue	Tools	Raghib Store	254748188917			950
03/11	Blower		Tools	Raghib Store				6,250
02/11	Electrical cable		Tools	Malindi Frank	254721255097			900
	Planner Inco		Tools	Raghib Store	254748188917			9,880
	Drawer runner		Tools	Raghib Store	254748188917			180
25/10	Tools	1054469	Tools	Multitools Kenya	254715047983			600
TRANSPORT								
27/10	Transport of materials to malindi		Transport	Kessy Kaiko	254726882888			13,000
27/10	Courier service	for marine epoxy	Transport	Fargo courier	254703077000			1,035
28/10	Transport of materials to malindi	Malindi town to shella beach	Transport	Idarus Abubakar	254716638848			1,000
01/11	Transport of materials to malindi	Malindi town to shella beach (bamboo)	Transport	Idarus Abubakar	254716638848			500
04/11	Courier service	for marine epoxy	Transport	Fargo courier	254703077000			2,525
	Transport tuk tuk		Transport	Idarus Abubakar				1,250
	Transport for banca wood		Transport	Martin Kenga	254728290875			1,800
17/11	Transport for shaft threading		Transport					1,000
							Total	779,920

CHARACTERISTICS OF WOODEN BOAT

Wooden boats have a unique and classic appearance that is incomparable to other modern materials. The wood has its own natural grain and texture, which gives the boat unique features that cannot be replicated by synthetic materials. Even though they are made from natural materials, wooden boats can be incredibly durable if properly maintained. Compared to fiberglass boats, wooden boats are easier to customize as they can be formed and modified according to the desired shape.

On the other hand, wooden boats require a lot of maintenance to keep them in good condition. These include regular cleaning, sealing, and painting to prevent rot and decay. In terms of maintenance, they require a significant amount of skill and time to build. Therefore, the maintenance costs associated with a wooden boat can be higher than those associated with a fiberglass vessel. This type of boat is generally heavier than fiberglass boats, which can make them less efficient on the water and less maneuverable.

PROCESS OF CONSTRUCTION

I. Preparing the keel

1. Prepare a 26-foot-long, 20-inch-wide, and 4-inch-thick piece of wood that will be used as the keel of the boat.
2. Using a planer, level and smooth the top side of the wood.
3. Carve the sides of the wood to create the shape of a boat keel with both tapered ends.
4. After carving the sides, carve the inner part to create a shallow cave or dug-in with the inner part deeper than the sides. Provide a 1-inch margin for the sides to allow for the attachment of the ribs. Provide a 2-inch-thick bed in
- 5.

the engine area for the engine bed.

6. Using a chisel, carve in 15 slots on each side of the keel for the attachment of the ribs. Each slot must be $\frac{3}{4}$ inch deep, $1\frac{1}{2}$ inch wide, and 1 inch thick.



Figure 5. Preparing the mango wood for shaping out the dug-out.

One of the important considerations in preparing a keel is the type of wood to use. To maintain the durability and longevity of the keel, the wood must be of high caliber, thoroughly seasoned, and free of defects that would reduce the material's effectiveness. Ideally, lawaan-like wood is the preferred choice for the keel log. However, as lawaan is not available, Mr. Ronnel and the group opted for mango wood instead. The following figures illustrate the process of connecting the three carved pieces of wood to form the keel using a half-lap technique



Figure 6. Measuring and carving the keel to align with the extended keel.

II. Preparation and Attachment of ribs

1. Prepare 30 pieces of ribs with a dimension of $26 \times 1\frac{1}{4} \times \frac{3}{4}$ inch.
2. Smoothen each rib using a planer.
3. Attach the ribs onto the slots on the keel using epoxy.



Figure 7. Preparing the 30-pieces ribs.



Figure 8. Attaching ribs onto the slots on the keel using epoxy

III. Preparation and attachment of the bow and stern.

1. Prepare mango wood (2-inches x 10-inches x 10-feet) for the bow and stern. The bow must be 5 feet long, while the stern must be 4.8 feet long.
2. Draw the shape of the bow and stern on the wood board and cut it using a chainsaw. The shape must follow based on the figure below in which the kind of wood joint is applied.
3. Smoothen the bow and stern using a plainer.
4. Attach the bow and stern to the opposite ends of the boat using epoxy.



Figure 9. Carve out space for the attachment points of both the bow and stern.



Figure 10. Attaching the stern of the boat with a 2-inch x 10-inch x 4.8 feet piece using epoxy.

IV. Preparation and attachment of stringers.

1. Prepare two pieces of 28-foot-long wood strips (1-inch thick and 2-inch wide) for stringers.
2. Smoothen the strips of the 28-foot-long wood using a planer.
3. Place the stringer perpendicular to the ribs in the middle.
4. Using a pencil, mark the area at which the ribs and stringer intersect.
5. Carve $\frac{1}{2}$ inch deep on the middle of each rib at which it intersects with the stringer.
6. Carve also $\frac{3}{4}$ -inch deep on the stringer where it intersects with the rib.
7. Assemble the stringer and ribs. Attach each rib to the stringer using epoxy.
8. Using a planer, smoothen the outer part of each rib-stringer intersection so that each intersection is leveled.



Figure 11. Fastening half lap of stringer at every intersection of the frame with epoxy.

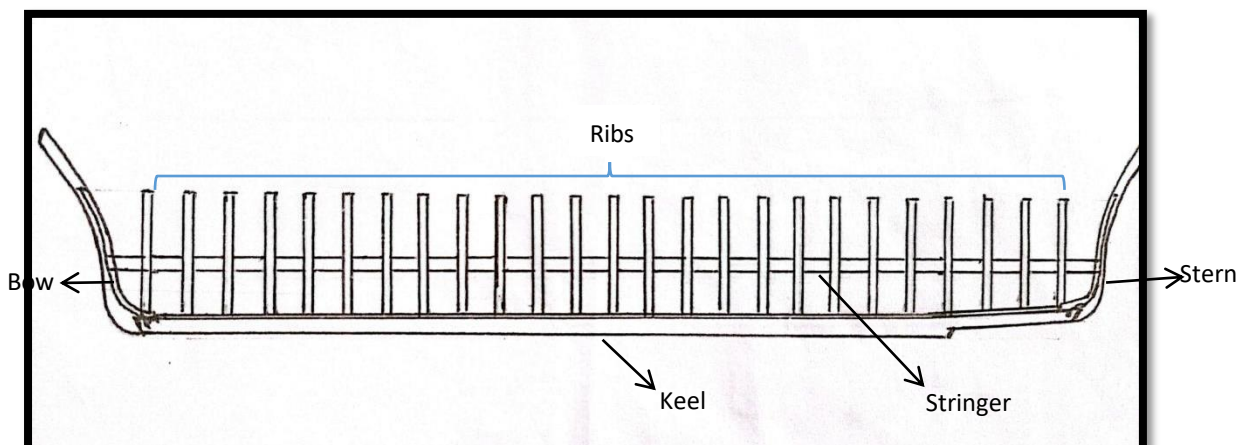


Figure 12. Sketch of the skeletal structure of the boat with attached ribs, stern & and bow, and stringers.



Figure 13. Joined the ends of the two gunwales and secured them to the stern.

V. Attachment of plywood to the boat frame.

1. Prepare 6-pieces of $\frac{1}{4}$ -inch-thick marine plywood (4x8 feet).
2. Cut this plywood into 22-inch-wide sheets for the strake of the boat.
3. Chisel a $\frac{3}{4}$ inch-thick carving along the outer margins of the keel, bow, and stern to provide a joint to attach the plywood.
4. Form or cut the pieces of plywood based on the shape of the boat, from the bow to the stern.
5. Attach the plywood to the frame of the boat using epoxy, then fasten each joint with copper nails. Do this also on the strake-keel area.



Figure 14. Measuring and planking of plywood to the boat frame.

VI. Preparation of the gunwale (batayola)

1. Prepare mango lumber (1-inch x 3-inch x 30-feet).
2. Smoothen the lumber using a planer.
3. Carve the underside of the gunwale with a groove that runs along its length. This is where the gunwale is conjoined with the plywood. The groove must be 1 ¼ inch away from the outer edge of the lumber.
4. Lay down the lumber along the length of the boat. Using a pencil, mark the lumber at which it intersects with each rib.
5. Cut slots for the ribs to protrude through the gunwale. Except, the first two ribs from both the bow and stern, as well as the fourth ribs from both ends which must protrude. The selected areas are to be protruded specifically to accommodate the outrigger stand.
6. Carve the underside of the gunwale to the shape and dimension of each tip of the remaining protruding ribs.
7. Assemble or attach the gunwale to the frame, and make sure that each joint slot of the rib fits the carvings on the gunwale. Only apply epoxy at the ends of the gunwale.



Figure 15. Photo showing the part of the gunwale. Excess ribs should be cut to attach the gunwale on top of the frame.



Figure 16. Using a pencil mark the lumber and carve it at which it intersects with each rib.



Figure 17. Use epoxy to adhere the gunwale along the upward curbed bow-end part of the boat and secure it in place with a G-clamp for support.

VII. Preparation/Attachment of the braces.

1. Prepare mango lumber (2-inch x 4-inch x 8 feet).
2. Smoothen the lumber using a planer.
3. Cut the lumber into 3 pieces. Shape the braces so they will fit the width at the stern, bow, and middle areas.
4. Cut each end of the brace to fit for attachment to the gunwale.
5. Attach the braces to the gunwale using epoxy and fasten with copper nails.



Figure 18. This photo showed the braces attached in the inward part of the stern. This serves as the support system of the boat.



Figure 19. The ends of the braces were trimmed to fit for attaching to the gunwale.

VIII. Construction of bow and stern deck

1. Using the same method as above, prepare and attach braces at the bow deck and four braces at the stern deck.
2. Paint the inner parts of the bow and stern deck with marine epoxy, and then another coating with quick-drying enamel or epoxy paint. Let it dry.
3. Cover the deck with marine plywood. Cut the marine plywood based on the shape of the bow and stern decks. Attach the plywood using epoxy and copper nails.



Figure 20. Planking of plywood on (A) bow and (B) stern deck of the boat.

IX. Making the barko-barko/wave breaker, outrigger boom stands and engine cover.

1. Prepare lumber to make the outrigger boom stands and engine cover.
2. Shape the lumber as shown in the figure below.
3. The engine cover must be made from lumber and plywood. The size must fit the width of the boat and must secure the engine properly.
4. Attach the outrigger boom stands using epoxy and fasten with copper nails the bow deck and 4 braces at the stern deck.



Figure 21. Constructing of barko-barko in Bow area.



Figure 22. Constructing cover engine.

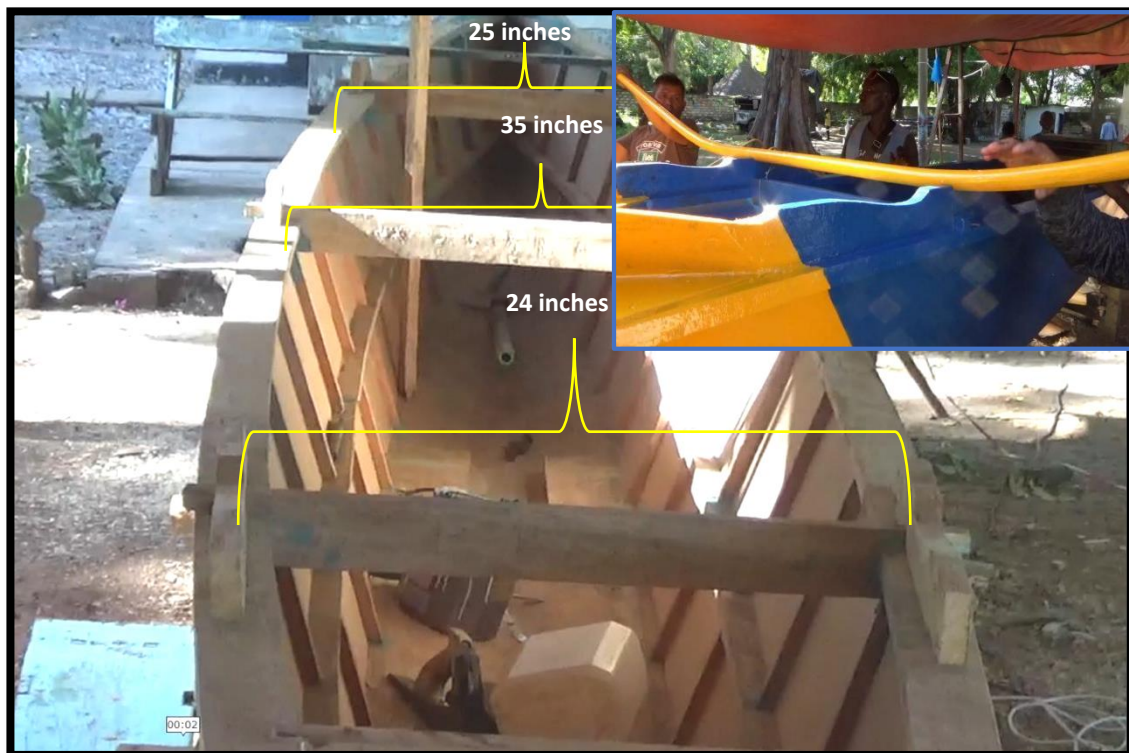


Figure 23. Actual photo of outrigger boom stand.

X. Painting of the boat.

1. Paint the entire boat with marine epoxy as the first coating.
2. Then paint another coating using quick-drying enamel or epoxy paint.
3. Let it dry.

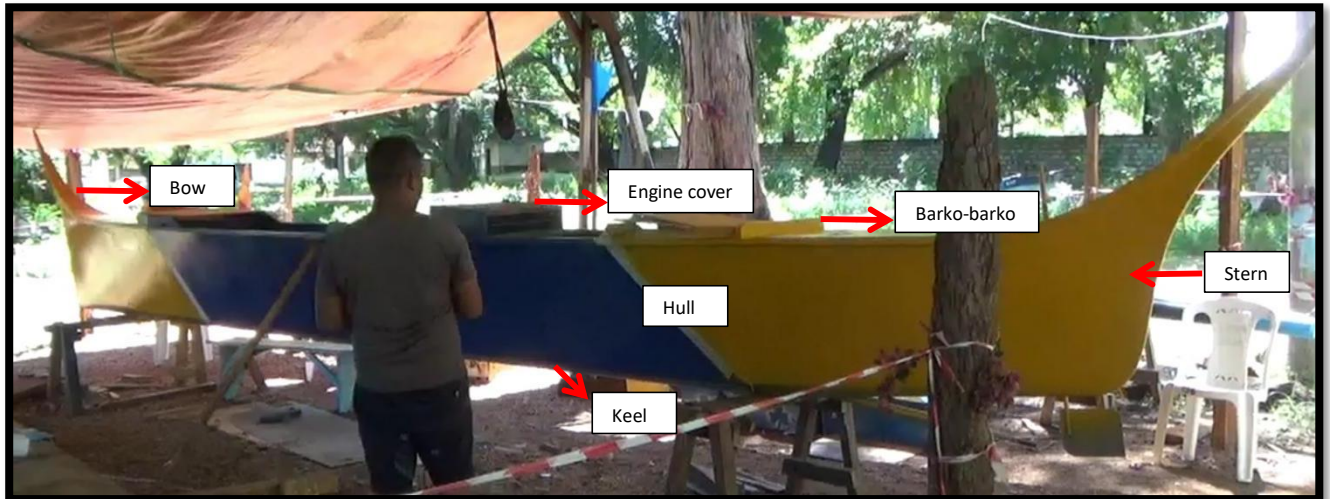


Figure 24. Applying of paint according to the desired color of the boat.

XI. Preparing/attachment of the outrigger booms.

1. While letting the paint dry, outrigger booms will be made.
2. Prepare the 20-foot GI pipes and cut them into two. For this boat, a total of 3 pieces of 10-foot GI pipes will be used.
3. Taper one end of each pipe using a hammer until the end of the pipe is closed and flattened. Make a dent on each side of the tapered end to secure lashings with the outrigger.
4. Bend the pipes manually to achieve the shape.
5. A bending method using tree trunks is shown below. The pipe will be bent at 5-inch intervals.
6. The curvature of each outrigger boom is the same. The highest point must be 18 inches from the axis and 3 feet from the tapered end.
7. However, the height of the bending is different among outrigger booms. The outrigger boom at the bow area must have a height of 4.5 inches, while the height of the bending of the outrigger boom at the stern area must be 2.5 inches.



Figure 25. Bending of outrigger beam using GI pipe material.

Bending a GI pipe for the outrigger boom can be challenging, requiring substantial force to shape the pipe. To accomplish this, at least two people must work to manually bend the pipe around a large tree. The height of the outrigger boom must adhere to the specifications outlined in step number 5 of the process. This dimension is highly important during navigation to ensure the stability of the boat.

XII. Attachment/assembling of the outrigger boom and outrigger.

1. Attach the outrigger booms to the outrigger stands by lashing monofilament nylon.
2. Paint the nylon lashing with marine epoxy.
3. Prepare two PVC pipes filled with polystyrene foam measuring 17 feet long.
4. Attach PVC pipe outriggers to the tapered ends of the outrigger booms. Do this by making a nylon lashing. Coat the lashing with epoxy.



Figure 26. Tie lashing the outrigger boom to the brace below the outrigger boom stand with the use of monofilament nylon.



Figure 27. Lashing the outrigger boom to the outrigger boom stand using monofilament nylon.

XIII. Installation of engine.

1. Bore a slanting hole in the stern area for the tube and propeller. The hole is approximately 6 inches long.
2. Create an engine bed from hardwood with a dimension of 15 in x 8 in x 2 in.
3. Carve the underside of the wood so as to fit with the bed made earlier on the keel.
4. Attach the board to the keel with epoxy and fasten it with copper nails.
5. Attach a stud bolt and log screw to the engine bed using epoxy to help secure the engine.
6. Installed the engine on the engine bed.
7. Make a propeller shaft support or breaker for the tube and shaft. Attach the breaker to the keel.
8. Place the tube in the hole bored earlier. The tube must have a PVC pipe to secure the metal tube and prevent water from coming in.
9. Place the propeller shaft into the metal tube. Assemble the propeller.



Figure 28. Creating an engine bed from a hardwood with a dimension 15 in x 8 in x 2 in.

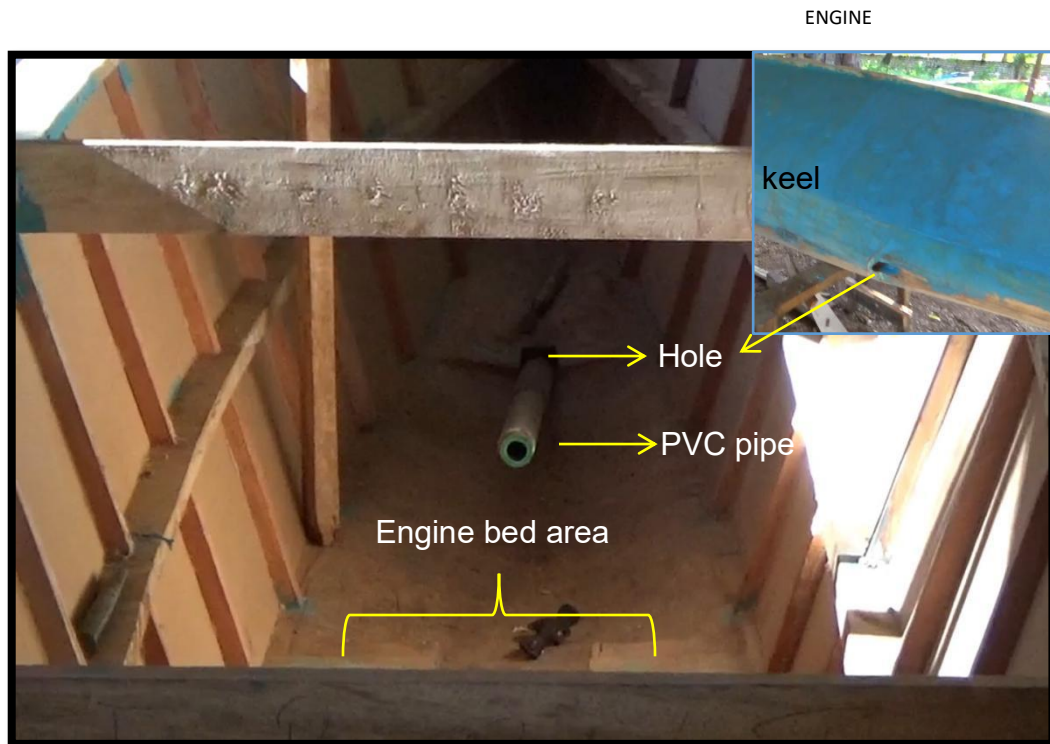


Figure 29. Inserting the PVC pipe into the slanting opening in the stern section.



Figure 30. Creating a support or breaker for the propeller shaft to minimize the vibration of shaft when operating the engine.



Figure 31. Insert the shaft into the metal tube, attach the cross joint to both the shaft and the engine, and finally, assemble the propeller.

XIV. Preparing exhaust pipe muffler for engine.

1. Curve the galvanized iron (GI) pipe with a 1 1/2-inch diameter. Utilize the bent section to make a cut of 12 inches.
2. Weld the exhaust manifold connector to the GI pipe muffler.
3. Secure the galvanized iron (GI) pipe to the engine by using nuts and bolts for connection.

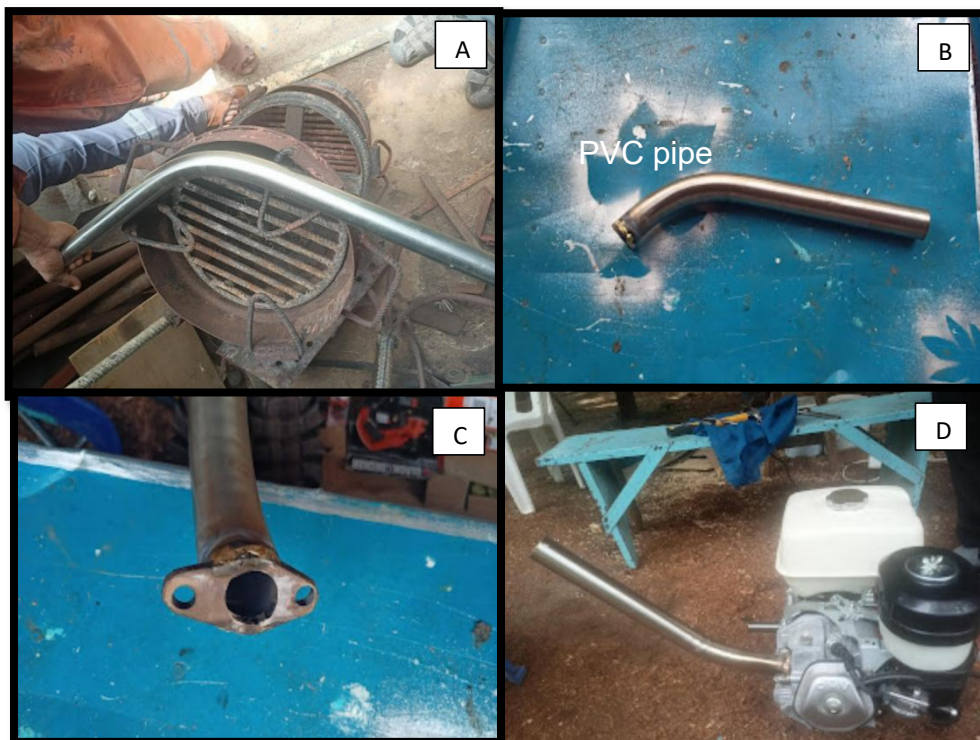


Figure 32. Installation of engine accessories. (A) bending; (B) cutting; (C) Welding; and (D) Securing.

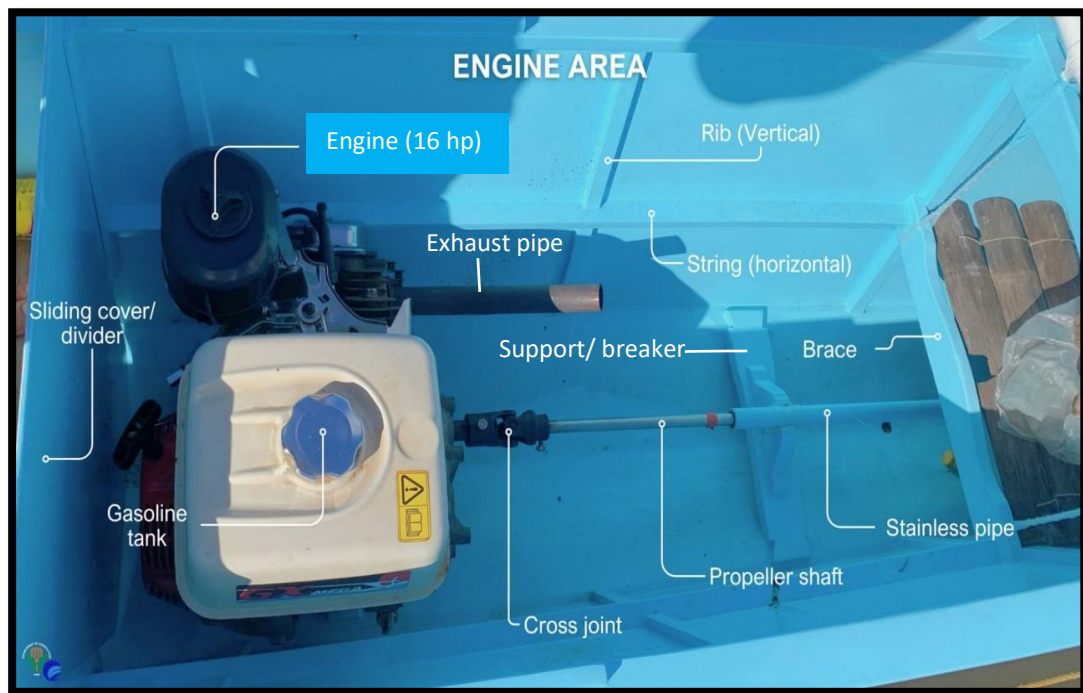


Figure 33. Clearer view of the engine area.

XV. Assembling the rudder.

1. Prepare the metal rudder.
2. Make a hole in the keel at the bottom, going up to the stern deck.
3. Insert a metal tube into the hole and attach it using epoxy.
4. Create a brace to support the metal tube and secure it with a nylon lashing.
5. Insert the rudder and assemble the handle.
6. Prepare a bamboo tiller and assemble it with the rudder handle.



Figure 34. Secure the metal tube to the brace with nylon, then attach the rudder to complete the assembly.

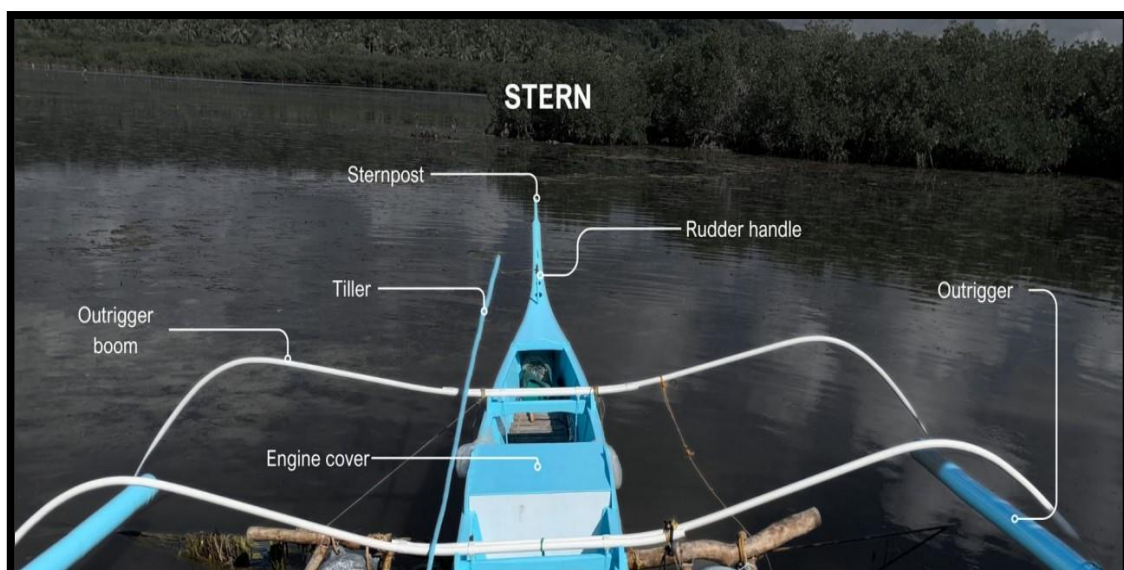


Figure 35. Preparing a bamboo tiller and affix it to the rudder handle.

XVI. Sea Trial Test drive

1. Prepare gasoline for your engine and bring protective gear, if any.
2. Prepare a paddle, as it helps you maneuver and move the boat towards the sea.
3. Drag the boat to a depth of 1-2 meters to prevent the rudder from being damaged.
4. Position the bow of the boat at your target location and start the engine.



Figure 36. Test operation in Kenya last November 2023.

Basic Maintenance for Fishing Boats

Hull

Ensuring the boat hull receives proper maintenance and repair is crucial for maintaining the boat's good condition. The hull of a ship is a secure and waterproof structure that is constructed within the boat's frame to ensure enough safeguarding for the cargo, machinery, and passenger areas. To extend the lifespan of your boat, ensure to inspect for any leaks or damage. If the hull sustains damage, it should be repaired or replaced. Apply a fresh coat of paint to the hull to enhance its resistance against any leaks.

Engine and propulsion system

The engine serves as the propulsion system for the boat, enabling it to navigate in various directions. A minor flaw in the engine could impact the fishing activity. Therefore, it is imperative to regularly maintain fishing boats. Conduct a thorough examination of the engine, fuel system, and exhaust to identify any potential leaks or damage. Before utilizing the boat again, it is imperative to repair and substitute the impaired components.

Oil and filtration devices.

Inspect the engine oil and replace it on a bi-monthly basis. Potential engine problems may occur due to contaminated or adulterated oil moving within your engine. As contaminated oil circulates within your engine, it will leave behind residue, leading to the accumulation of dirt and debris. Over time, this detritus can be amassed within your engine, resulting in obstructions, friction, and excessive heat generation.

Propeller

Ensure that the propeller is firmly and securely attached. Even a minor scratch in the propeller can disrupt the motion of your boat and reduce its efficiency, leading to increased fuel expenses.

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APPENDIX 8

Making a DIY Banca Boat Rudder and Propeller

Appendix 8-1: Making a DIY Pumboat Rudder



Video link (Limited Access): https://youtu.be/DxuEYq7bz_Y

Appendix 8-2: Making a DIY Pumboat Propeller



Video link (Limited Access): <https://youtu.be/WKjIEMhPuAA>