FINAL REPORT

Value Chain Analysis of Aquaculture in the Coastal Counties Economic Block

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VALUE-CHAIN ANALYSIS OFAQUACULTURE IN THE KENYAN COASTAL COUNTIES ECONOMIC BLOCK

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TABLE OF CONTENTS

List of Figures

List of Tables

Gallery of Photos

ACKNOWLEDGEMENTS

The Value Chain (VC) analysis of aquaculture in the JKP (Jumuiya ya Kaunti za Pwani) also named the Coastal Counties Economic Block (JKP) was conducted to map aquaculture value chain prioritized and identified by GIZ in the region. During the value chain analysis, we received a lot of support from various stakeholders and wish in this spirit to pay great compliments to all those who made this exercise a success.

The consultants would like to thank GIZ staff for their technical support during the design and execution of the VCA survey activities as well as their comments and contribution to the report. Sincere gratitude also goes to the officials of Ministry of Agriculture, Livestock and Fisheries in Kilifi, Kwale, Lamu, Mombasa, Taita Taveta and Tana River who accepted to participate in the Value Chain (VC) analysis and provided the information needed to meet the mapping objectives.

Special thanks are also extended to fish farmers, traders/wholesalers, retailers and other Key Informants who accepted to provide the requisite information through interviews and one on one discussion. The key informants included officials from various institutions, namely Kenya Marine Fisheries Research Institute (KEMFRI), Pwani University, Northern Rangeland Trust, World Wildlife Fund, and Line Ministries' Officials from all the six counties.

This report presents the outputs of a value-chain study conducted between February to April 2021 and prepared as part of the "Employment and skills Creation in Africa - Set-Up Phase" for the Multi-donor Action project jointly co-financed by the European Union (EU) and the Federal Ministry for Economic Cooperation and Development (BMZ) and implemented by GIZ. The study was completed by a team of local Value Chain analysis (VCA) consultants from Lamiro Consult Ltd.

A list of all the consulted informants is provided at the end of this report as an annex.

ACRONYMS

BMU	Beach Management Unit
BMZ	Federal Ministry for Economic Cooperation and Development
EACC	East African Coastal Current
E4D	Employment and Skills for Development in Africa
EEZ	Exclusive Economic Zone
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FGDs	Focus Group Discussions
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GoK	Government of Kenya
JKP	Jumuiya Ya Kaunti Za Pwani (Coastal Counties Economic Block)
KCDP	Kenya Coastal Development Programme
KEMFRI	Kenya Marine and Fisheries Research Institute
KIIs	Key Informant Interviews
Km	Kilometers
MSC	Monitoring, Surveillance and Control
NARDTC	National Aquaculture Research Development and Training Centre
NEM	Northeast Monsoon
NEMA	National Environmental Management Authority
NGO	Non-Governmental Organization
RAS	Recirculating aquaculture systems
SME	Small & Medium Enterprises
TVET	Technical, Vocational Education Training
UAE	United Arab Emirates
VC	Value Chain
VTC	Vocational Training Centers

EXECUTIVE SUMMARY

The Blue Economy Project is being undertaken as one component of the European Union (EU) "Coastal Economic Development in Kenya "Action. This is based on a partnership between the EU and the Government of Kenya (GoK) to advance the Blue Economy Agenda through coastal development – the so called "Go Blue" Initiative. A part of the EU Action, in particular its Specific Objective 11, is being implemented by EU Member State Organizations, including Germany through the GIZ.

The main purpose of the project is to contribute to coastal economic development in an inclusive, integrated, participatory and sustainable manner by strengthening *inclusive and sustainable blue economy Value Chains through skills development, matching and value chain development.*

The VC analysis of aquaculture in the Coastal Counties Economic Block JKP was expected to identify specific constraints, inefficiencies in the production processing and marketing of fish in the region. The area of coverage for the VC analysis for aquaculture included Kilifi, Kwale, Lamu, Mombasa, Taita Taveta and Tana River Counties.

GIZ contracted Lamiro Consult Limited to undertake the VC analysis which commenced in February 2021 and completed in April 2021. The actual field data collection was undertaken in February 2021.

The study team adopted a combination of descriptive and applied research design for structured interviews with project key beneficiaries (fish farmers), key partners and staff, County Government officers, research institutions and other Non-Governmental Organizations in the VC, regarding their roles in the aquaculture VC. Project documents were also consulted besides other existing literature on aquaculture and mariculture development.

This report contains six main sections as summarized below:

- Section one: - Introduction; Description of the project and context.
- Section two: - Study approach, methodology and design.
- Section three: - Key Findings – Description and Analysis of Results.
- Sections four: - Stakeholder Analysis.
- Section five: - Upgrading strategies for the JKP's aquaculture; and
- Section six: - Appendices

The key findings of the Final External Project Evaluation are summarized as follows:

- The average annual fish production in the country stands at 165,000 metric tons against a demand of 475,000 metric tons. This implies that there exists a fish demand gap of 310,000 metric tons of fish annually. The gap between demand and production is projected to increase to

360,000 metric tons per year by 2025, resulting in rising prices and a continuing decline in fish consumption.

- The economic performance of the aquaculture sector in Kenya sector is neither well understood nor documented. Tilapia forms the foundation of farmed fish VC in Kenya followed by mullet (10%), carp and catfish.

- At the Kenyan Coast, finfish (milkfish species) makes up the main culture species accounting for about 90% of production followed (KMFRI 2017).

- Under the Blue Economy, Kenya is implementing demonstration projects in all three COAST Project thematic areas: ecotourism, environmental management systems, and reef and marine recreation management. There was no documented Aquaponic establishment in the coast. However, University of Wageningen in partnership with VIA Water a Dutch partner in collaboration with local partners are running some pilots on Aquaponic in central Kenya. This is a very interesting and innovative approach of producing farmed fish as well as crops. The Go-Blue project should identify some opportunities for supporting Aquaponic in the coast.

- The six counties have so far identified projects "that will have high impact" on the region's development on key sectors like fisheries, aquaculture, and maritime security. Other sectors include culture and tourism, spatial land-sea planning and environmental conservation. "Go Blue aims at strengthening inclusive Blue economy value chains, creating wealth and transforming the lives of not just the people living in the coastal areas, but those of other Kenyans as well." Go blue has been streamlined with the CIDPs of all the JKP counties.

- The species selected and prioritized in this value chain study include mud crabs, seaweed, tilapia, prawns, milkfish and sea cucumber.

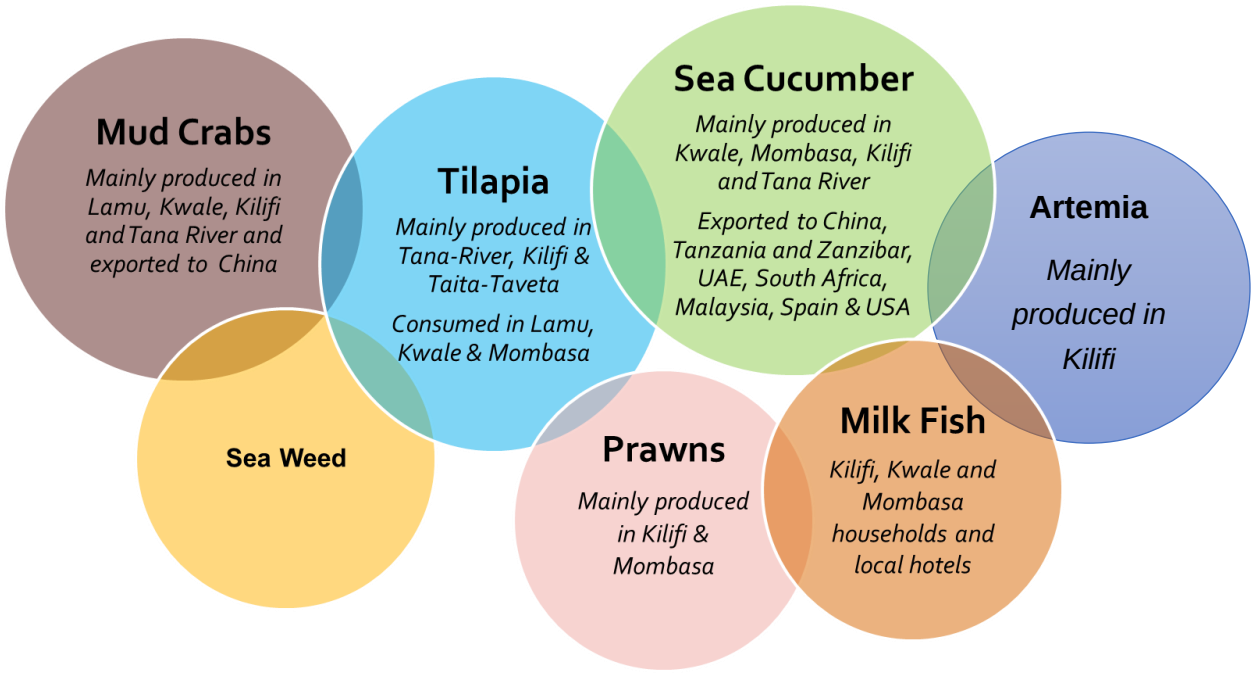
- Majority of the Kenyan mariculture production is done in simple innovative technologies, such as construction of inexpensive (tidal) ponds, pens and cages.

- Fisheries development is therefore an intervention that the GoK agencies intend to undertake as a foundation for national economic transformation by increasing fish production from capture to culture fisheries, reducing post-harvest losses and developing the Exclusive Economic Zone (EEZ) marine fisheries.

- The key impediments to desired growth of the sector includes.
    - Conflicting and absence of government policies.
    - limited technological expertise.
    - impact of donor driven conservation projects.
    - lack of capital investment.

- lack of access to international markets; and

The key value chains prioritized for this analysis:



To help improve this understanding, this report presents the outputs of a value-chain study for the sector in the sections 4 and 5.

1.0 INTRODUCTION AND BACKGROUND

1.1. Overview of the aquaculture and Fish sector in Kenya

1.1.1. Freshwater fish species reared in Kenya

The main cultured species in Kenya's freshwater systems are Nile tilapia (*O.niloticus*), which accounts for about 75% of total fish produced from aquaculture, followed by African catfish, contributing about 14%,common carp (6%) and trout (<1%) of aquaculture production[1]. These species are found in virtually all aquatic systems and have high demand in the local and regional markets.

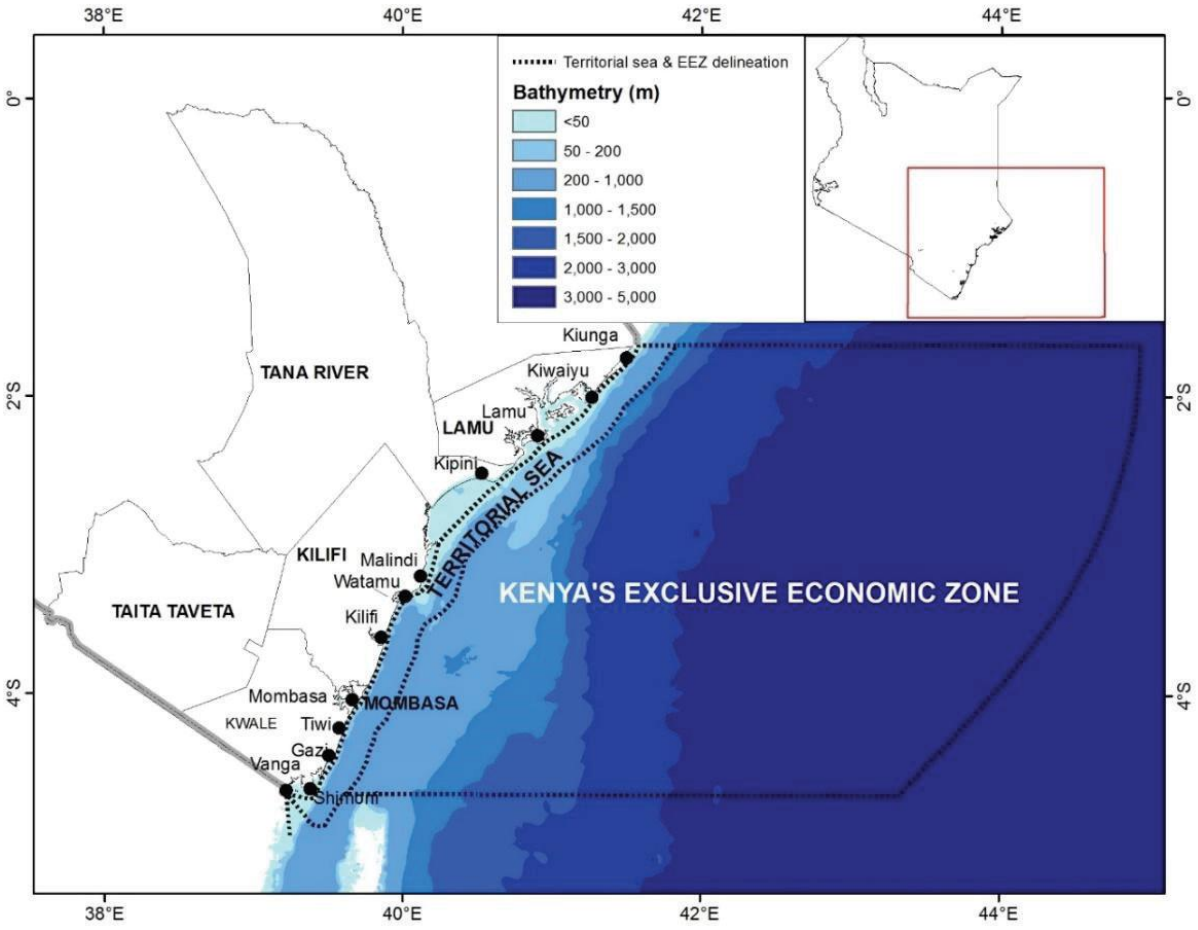
Most tilapia fish farmers in Western Kenya, Taita Taveta and Tana River carry out the farming in monoculture. Polyculture of Nile tilapia and African catfish is often done to control the prolific breeding of the former (N. Jacobi 2013). Other exotic species include common carp (6%), rainbow trout (1%), koi carp, largemouth bass and goldfish. Trout is temperature restricted thus only cultured at temperatures below 19°C mainly in the Mt. Kenya region, in isolated places trout can also be found in Taita Taveta e.g. in the source of the river feeding into lake Jipe. Potential indigenous candidates for aquaculture include African Carps, Lungfish and Tilapia Jipe. Other than the production of food fish, there are great opportunities in ornamental fish culture even though produced in small scale for local and internal markets- for they can be marketed within the East African region and in Europe.

1.1.2. Mariculture in Kenya

Kenya has a coastline of approximately 450 km (270 miles) with more or less a continuous coral reef all along the shoreline. The coast is characterized by the presence of.

- Inland closed lagoon systems namely Mida, Kilifi, Mtwapa and Mombasa and of these Kilifi and Mombasa receive fresh water from perennial rivers and the other two do not have a permanent fresh water supply. These closed lagoon systems open to the sea by a very narrow entrance.
- Open lagoon systems which have many entrances to the sea separated by many islands. These are at Lamu, Gongoni and Shimoni.
- River Estuaries. Tana River estuary is the biggest with extensive acreage of swamp land on either side of the river forming the estuary. In the case of the Sabaki River the banks on either side are steep and as a result open directly into the sea without any swamp or lagoons on either side of the river mouth. In the southern part of the country around Shimoni area there are three smaller rivers opening into the lagoon system around Shimoni. There are also several lakes at the coast, including oxbow lakes especially in the Tana Delta plus lakes Jipe and Challa in Taita Taveta. Apart from providing water for humans and livestock, Kenya's coastal region has immense potential for groundwater resources. Figure 1 shows the Kenya coastal counties and the Kenya EEZ boundary.

[1] FARM AFRICA. Kenya Market led Aquaculture Programme Strategic Environmental Assessment and Environmental Management Plan 2016 Farm Africa .Nairobi.



Map 1: Map of the Kenya coast showing the coastal counties and the Kenyan EEZ boundary (Source; KMFRI 2018)

Mariculture in Kenya has made some progress over the past decades, through development of simple innovative technologies, such as construction of inexpensive ponds, pens and cages. Culture species most commonly farmed at the Kenyan coast includes the finfish (milkfish species) that accounts for about 90% of production followed by the mullet contributing about 10% of the aquaculture production e.g Crabs, Prawns, Milkfish etc (KMFRI 2017).

Under the national development blue print, Vision 2030 and MTEF/P 2013-17, Kenya aims to realize sustainable fisheries development through 'innovation and commercially oriented fisheries sector and improving the value gained in the production and supply chain' so as to improve food security for human wellbeing and attain mid-income economic status by the year 2030.The National Oceans and Fisheries Policy (2008), identifies low utilization of the EEZ for the exploitation of marine living resources as a challenge in the development and management of fisheries resources, Fisheries development is therefore an intervention that the Kenyan government agencies intend to undertake as a foundation for national economic transformation by increasing fish production from capture to culture fisheries, reducing post-harvest losses and developing the Exclusive Economic Zone (EEZ) marine fisheries.

Although some growth in the sector has been noted, mariculture in Kenya has not realized its economic or ecological potential, due to myriad reasons: conflicting and absence of government policies; impact of donor driven conservation projects; lack of capital investment; lack of access to international markets; and limited technological expertise. Most mariculture production over the last decades were not reflected in national production statistics. Harvests were mainly for subsistence and sale to tourist hotels and restaurants (Mirera 2011). The Government has promoted mariculture of prawns, finfish and crabs (KMFRI 2010), and in 2012 the World Bank approved US$ 35 million loan for the Kenya Coastal Development Programme (KCDP) including aquaculture development (www.un-foodsecurity.org).

1.2. Background of the project

The Blue Economy Project is being implemented by GIZ as one component of the European Union (EU) "Coastal Economic Development in Kenya "Action. This is based on a partnership between the EU and the Government of Kenya (GoK) to advance the Blue Economy Agenda through coastal development – the so called "Go Blue" Initiative, part of the EU Action, in particular its Specific Objective 11, is being implemented by EU Member State Organizations, including Germany through the GIZ.

1.3. Specific objectives of the project

The overall objective of the EU Action is to contribute to coastal economic development in an inclusive, integrated, participatory and sustainable manner.

The **specific objective** of the GIZ engagement was to strengthen *inclusive and sustainable blue economy value chains through skills development and matching, and value chain development*. To that end, there arose the opportunity to promote a more sustainable growth and for creating jobs in the blue economy.

The GIZ project has two components.

- Component 1: focusing on skills development and matching; the project will support VC development, in particular the aquaculture VC.
- Component 2; will address the key constraints in skills development for four Blue Economy value chains, and thus, contribute to sustainable economic Coastal development. GIZ will leverage on the capacity built in Kenya through the regional programme "E4D – Employment and Skills for Development in Africa", with the objective to promote employment, raise incomes and improve working conditions through cooperation with business and public sector partners.

1.4. Objectives of the Value Chain Analysis

The overall objective of the assignment was to comprehensively analyze and document the aquaculture value chain Coastal Counties Economic Block. The specific objective of the value chain analysis in the Coastal Counties Economic Block included.

1) Review of existing studies for the aquaculture sector in the counties.

2) Mapping each value chain in detail including main actors, flows of products, consumption patterns, money and information, and supporting organizations.
3) Identification of aquaculture value chain players including feed producers, distributors, hatcheries, (potential) off-takers, fish farmers, aquaponics, researchers, training centers, Vocational Training Centers (VTCs) offering aquaculture trainings, private and public extension services, NGOs active in fish farming etc. their locations, potential partner/model farms and VTCs offering aquaculture.
4) Mapping geographic areas with high potential for the different aquaculture products.
5) Identification and assessment of the state of institutions and other stakeholders e.g., TVET centers and training centers at country level that have potential and are able to scale up aquaculture development.
6) Determination of aquaculture yields (including post-harvest losses), cost and quantity of inputs.
7) Identification of the constraints at each value chain node to competitively service the demand identified e.g., logistics aspect of common facilities and pack house at county level etc.;
8) Identification of the gaps in the value chain and recommendations of the actions to address each constraint/gap.
9) Conducting an **environmental** analysis including impacts generated during production phases, resource depletion and quality of the ecosystem.
10) Conducting a **gender analysis** of women involvement in the Value Chains (VCs), identify the challenges and opportunities for women (and youth) empowerment

2. APPROACH AND METHODOLOGY

2.1. Introduction to Value-Chain Analysis

A value chain is a sequence of related enterprises (operators) conducting activities (functions) so as to add value to a product from its primary production, through its processing and marketing to the final sale of the product to consumers. The functions of each link in the chain involve sourcing inputs, making/producing, and then delivering/selling product to the next link in the chain. The ***Figure 1*** presents the relationships of stakeholders as established during the value chain analysis.

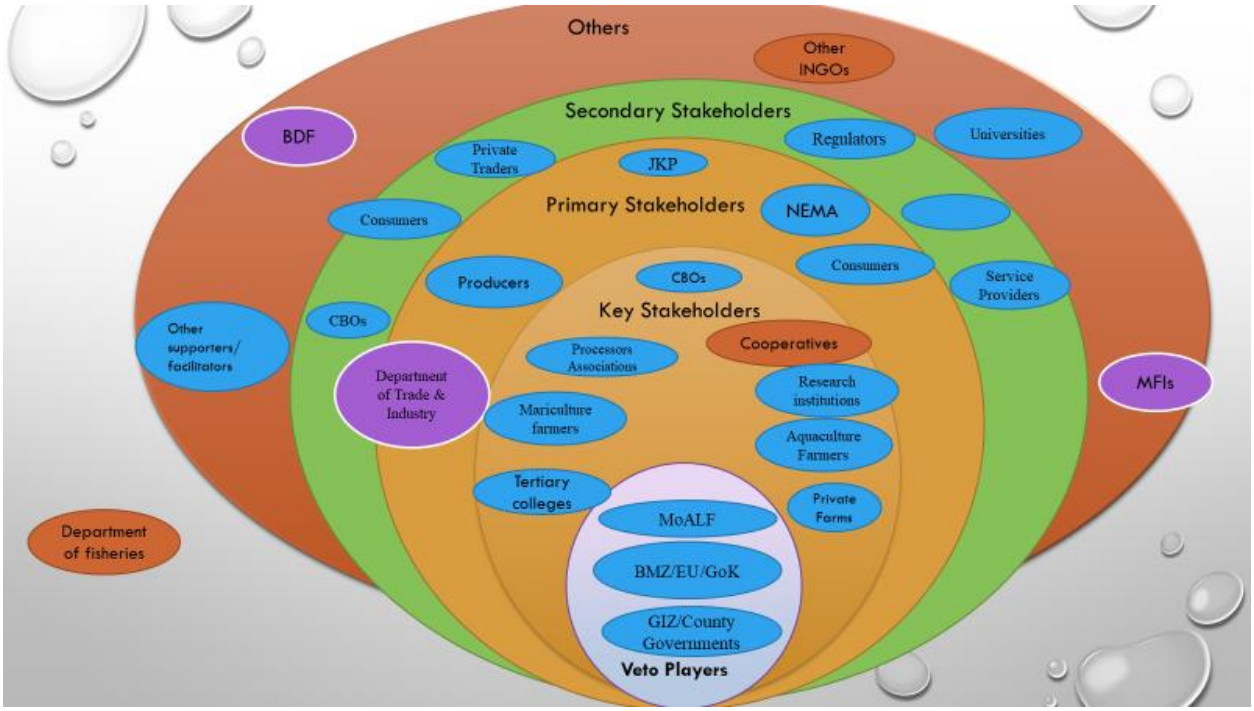


Figure 1: Schematic presentation of the VC relationships

Value chains analysis describe the interactions of firms and processes that are needed to deliver products to end users and aim to identify opportunities for and constraints against increasing productivity. A value chain describes the full range of activities required to bring a product or service through the different phases of production, including physical transformation, the input of various producer services, and response to consumer demand. As such, value chains include the vertically linked interdependent processes that generate value for the consumer. The primary focus of a value chain is on value creation, innovation, product development and marketing. The chain actors who actually transact a particular product as it moves through the value chain include input, fishers, traders, processors, transporters, wholesalers, retailers and final consumers. Value chain analysis focuses on segmenting the different activities that add value in the production and sale of a product or service. The analysis includes but not limited to the following:

- ✓ Identifying dynamic linkages between productive activities, showing where value is added in a production process.
- ✓ Focuses on net value added instead of overall size and gross output.
- ✓ Determine the distribution of value added between activities, both within and between different types of markets.
- ✓ Thoroughly examines information flows among actors in the value chain unlike typical industry analysis.

- ✓ Segment the value chain to allow for better understanding of the constraints and opportunities within each segment, as well as the context in which the chain operates.

Best practice **value chain analysis** is composed of a number of steps, which are both descriptive and analytical in nature. Value chain analysis normally first describes the overall market within which the specific value chain operates. The second descriptive task should be to define the VC itself. This involves considering who is involved, and describes the employment, revenues, profits, and unit product values for those involved in the VC. These steps are presented schematically in ***Figure 2***.

An important component of VC analysis is recognition that support and action for improving performance throughout the VC can be achieved both by those within the VC itself i.e. private sector operators, and by those outside of it i.e. typically government or donors. For businesses in the chain, they can improve performance by reducing costs, increasing outputs, and/or increasing the prices of their products. Typically, mechanisms to do so involve being more efficient at what they do, and improving the quality or form of product being sold to the next link in the VC.

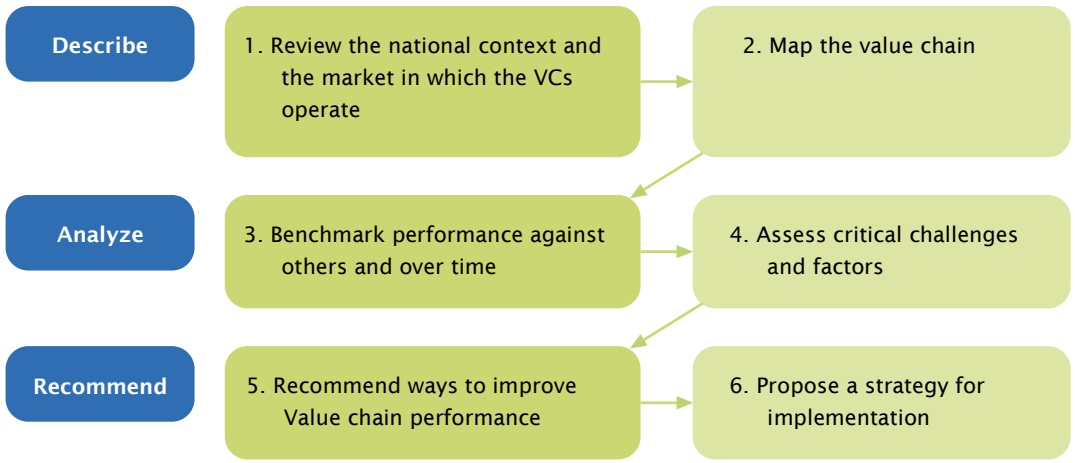
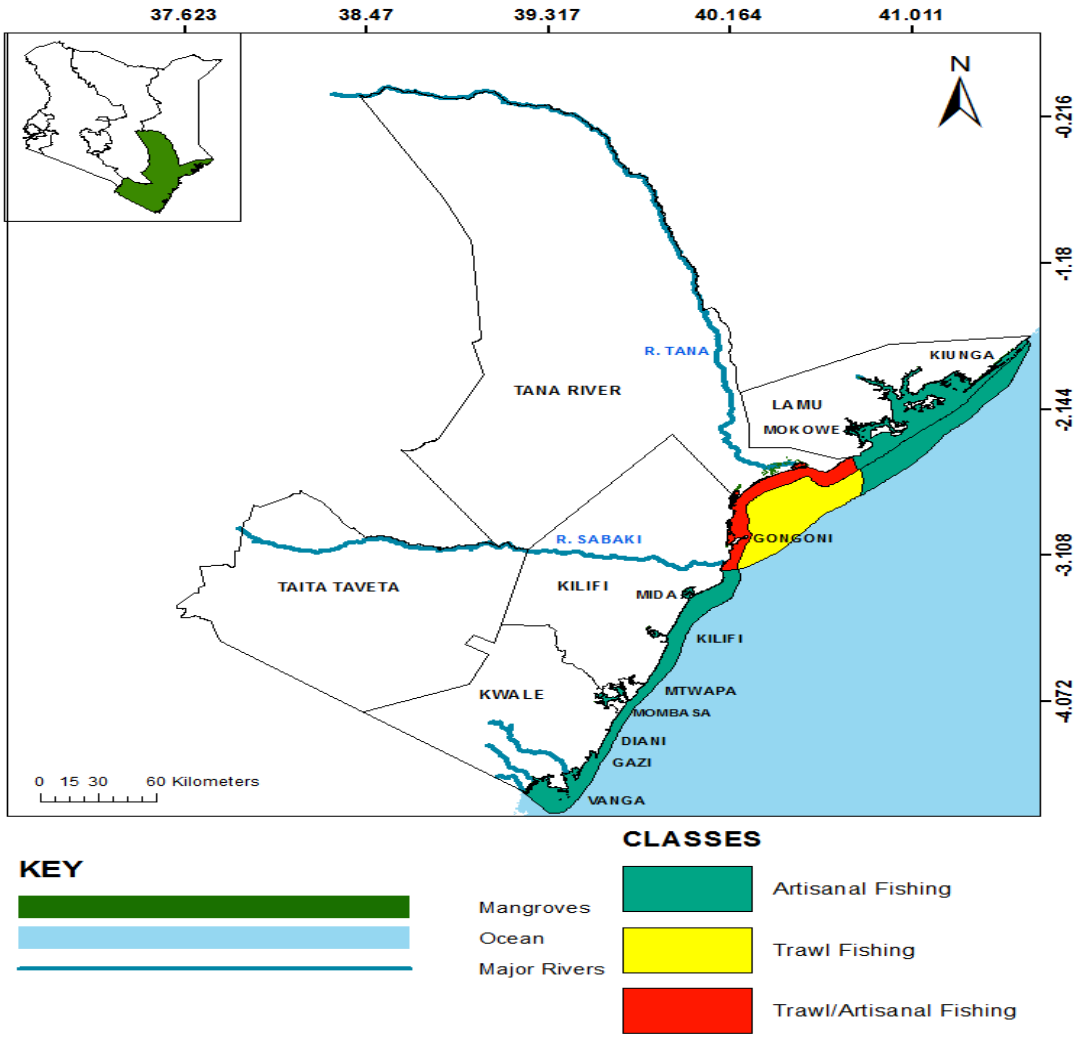


Figure 2: Steps involved in value chain analysis

Source: *EU/GIZ VC Analysis of Aquaculture – JKP, Feb/April 2021*

2.1. Study area

The study area and counties were purposefully determined by the projects. The study was conducted in 6 coastal counties who are members of the Coastal Counties Economic Block (JKP). These counties included Kilifi, Kwale, Lamu, Mombasa, Taita Taveta and Tana River counties. Map 1 shows the counties where the studies were conducted.



Map 2: Kenya coastline showing the area of artisanal and trawl fisheries

Source: Drawn by Noah Ng'isiange, KMFRI -Accessed online 6.4.2021

2.2. Study Design

The VC Analysis adopted a combination of descriptive and applied research design. These two designs were deemed appropriate for this assignment considering its nature and the desired results. This report is the result of three main stages of work completed by the study team.

2.2.1. Stage 1: Planning

Stage 1 involved a number of specific ***planning*** tasks which were completed, as follows:

- A detailed schedule of activities and travel was discussed and agreed by the study team, and appropriate travel arrangements and contacts in the counties were made ahead of the field visits completed during Stage 2;

- A draft report structure for this report was discussed and agreed by the team.
- A household study questionnaire was drafted in English. The study team then discussed the questionnaires and proposed various changes which resulted in the addition/deletion of some questions, and changes to other questions in terms of the phrasing and wording.

The target population for the study were the aquaculture VC actors, farmers' households, traders, processors, input suppliers, research institutions, education and training institutions, government officials from the Ministry of Agriculture, Livestock and Fisheries (MOALF) at national and county levels and other implementing partners operating in the targeted Counties.

2.2.2. Stage 2: Data collection/ Field Work

Stage 2 of this study involved the completion of the ***field work***.

In order to maximize the number of interviews possible during the time available for the field work, and so as to reduce travel time, the general approach taken was to use local data collectors and County Government staff in each of the six counties to arrange for small groups of stakeholders to meet the study team at a central location. This provided the study team with the opportunity to introduce the study and to hold a focus group discussion in plenary, before individual interviews were then conducted with the participants i.e., each member of the six-strong study team sat with a different participant and went through the questionnaire.

The introductory comments and Focus Group Discussions (FGDs), which concentrated mainly on key stakeholder problems and potential solutions, generally lasted around sixty to ninety minutes, as did the individual interviews. Each meeting was thus scheduled to last around half a day, with different sub-sectors invited to different meetings i.e. morning meetings held with fish farmers, before the study team met with fish wholesalers in the afternoon. The field work focused most strongly on fish farmers, but interviews were also completed with fish traders/wholesalers, and some fish retailers. The field work also enabled discussion with a number of fish farmers who run hatcheries, and who make their own fish feed, although specific questionnaires were not completed to assess the costs and earnings specifically of these activities. The study period was unfortunately not sufficient to allow for interviews with stakeholders in the food service sub-sector e.g., restaurants.

The

Table **1**1 provides information on the number of individual questionnaires completed with stakeholders in each of the six counties, along with the number of discussants in the FGDs.

Table 1: Number of stakeholders interviewed per county during the study

County	Fish Farmers		Fish Traders and/or Wholesalers		Fish Retailers		Key Informants
	Q's	FGD	Q's	FGD	Q's	FGD	
Taita Taveta	48	3	6	1	5	-	3
Kwale	14	4	6	-	1	1	4
Mombasa	8	5	12	-	2	-	10
Kilifi	19	3	9	-	1	-	5
Lamu	7	1	1	-	-	-	6
Tana River	5	2	-	1	5	-	4
Total	101	18	34	2	14	1	32

Source: EU/GIZ VC Analysis of Aquaculture – JKP, Feb/April 2021

The targeted value chain in each county was based on a consultative process that involve literature review and consultation with GIZ. As a result, the following value chains were selected for a value chain analysis in each of the counties. Key consideration for selection was the current operational level and potential for upscaling among others. **Error! Reference source not found.**2 shows the final value chains that were selected per county while table 3 shows the rationale for the selection of each value chain.

Table 2: Shortlisted VCs for analysis:

ITEM	COUNTIES					
Value Chain	**Kwale**	**Mombasa**	**Kilifi**	**Tana-River**	**Taita Taveta**	**Lamu**
Seaweed	✓					✓
Mud Crab Fattening	✓		✓	✓		✓
Milkfish	✓	✓	✓			
Prawn	✓	✓	✓			
Fresh water Tilapia		✓	✓	✓	✓	
Sea Cucumber						✓
Artemia			✓			

Source: EU/GIZ VC Analysis of Aquaculture – JKP, Feb/April 2021

Table 3: Final value chain selected with rationale:

	COUNTIES OF FOCUS					
	KWALE	**TANA-RIVER**	**TAITA-TAVETA**	**KILIFI**	**MOMBASA**	**LAMU**
Selected Value Chains	**Milkfish/ Seaweed**	**Tilapia/Crab fattening**	**Tilapia**	**Prawn Salt Water/ Fresh Water Tilapia/Crab fattening**	**Fresh water Tilapia/Prawn/ Milkfish**	**Sea Cucumber Crab fattening**
General Rationale	County developed infrastructure research findings to support Seaweed and processing. Milkfish seeds are locally available. Both have good returns to farmers.	Good market, developed infrastructure-knowledge & skills.	About 600 ponds excavated, Tilapia from other water bodies, ready market in surrounding counties. Knowledge and skills borrowed from ESP.	Prawn production, Tilapia-farming on-going, available hatcheries, Crab fattening on-going. Ready market and favorable prices	Big domestic market for Tilapia, Milkfish & Prawn production on-going.	High prices, available and reliable export markets.
Production	1.8 to 2.6 tons/ha/yr.; 80 tons annually (farmer estimates)	Crab fattening Piloted, Tilapia farming on-going	18.7 tons. Infrastructure available	Over 2 MT/ha/yr. Use cage to culture tilapia and prawns.	400-500kg	Harvested in wild and fattened. Crab hatchery being set up in Kilifi.
Technology to improve	Developed relevant driers and storage. Identify machinery to process and add value to seaweed. (processing and packing)	900 ponds constructed in the Tana Delta. Set up hatchery-quality fingerlings/ and pelleted feeds. Convert Ox-bow Lakes to ponds. Need for ice plant.	Hormone sex reversal will improve production. Introduce cage farming in lake Chala	Introduce intensive pen culture, Value addition on (processing and packing). Improved crab fattening cages to	Introduce cage farming Usage of plastic cages.	Dried technical and infrastructural support for up-scaling seaweed production.
Potential for upscaling	Mostly in mangrove areas + dependent on wild seed) Estimated >300 tons annually	Capacity building to fish farmers.	Reactivate 250 fishponds left idle from ESP.	More than 100 tons of seed available with improved technology	Capacity building of farmers	High. Need for high quality feed for hatchery development

	Develop hatcheries to supply farmers with Milkfish.					
Market (domestic/ export)	There is high demand for Milkfish and Most of the Milkfish is sold fresh.	High demand in Local market.	There is demand from locals as well as other surrounding Counties.	Demand is increasing and mostly unmet	Extension workers carry out fish eating campaigns.	Local/export (initial failed due to market
Infrastructure to support the VCs	Small quantities kept deep freezer, Ice availability, Need for hatchery for seed production	Limited road networks	Total 650 ponds, good roadworks, and accessible local markets.	Wild Seed not available throughout Need for Hatchery support for seed production for farmers	Wild Seed not available throughout Need for Hatchery support for seed production for farmers	Commercial Production and packaging
Opportunities for value addition	Low (consumed fresh, low production of value-added products	Yes- Tilapia is processed by frying	Yes, smoked, sun dried and fried.	Yes, freezing & drying. Prawns can be made into paste	Artisanal processing.	Yes- Available Value addition is needed
Market demand for domestic	High- contribution to food security	Local market served. Contribution to food security.	High- value contribute to food security	High value commodity	High value commodity for domestic and export	Important high nutritive food in hatchery and aquaculture
Funding opportunities	CBOs/self-help groups – depended on donor funds and groups	CBOs/self-help groups – depend on donor funds and groups. Commercial financiers available	Group finance for expansion and sustainability	Groups depend on external support	Progressive but still a challenge. Require external support for upscaling & Marketing.	Companies /farmers still need external support

Source: *EU/GIZ VC Analysis of Aquaculture – JKP, Feb/April 2021*

2.2.3. Stage 3: Data Entry, Analysis and Report Writing

Stage 3 of this study involved ***data entry and analysis***, and ***report writing***.

During this stage, all data from the questionnaires were entered into a spreadsheet and checked for their validity with the different interviewers responsible for completing the individual interviews. The data were then analyzed to generate the data outputs presented in later Chapters of this report.

2.3. Limitations to the Study

Every study has its limitations and invariably for this VC analysis, and invariably, this study was conducted in the Coastal Bloc Counties in order to do an in-depth analysis. The results of the study should therefore not be generalized to the entire country but should be taken and seen as a smaller portion of what is happening in the country. Though an introductory letter clearly stating the mission of the study was circulated way in advance, some of the targeted respondents were not available. It is also worth noting that the disruption caused by the COVID-19 pandemic may have affected the depth and quality of time spent in the process. This may result in misunderstandings or false expectations, based on the interviewing process and skills. There was limitation on obtaining complete datasets for VCs for incisive analysis especially on daily or monthly capture records, emanating from absence of central fisheries database in Kenya. Most of the data was either in the custody of individual officers or were already highly summarized in statistical bulletins. Again, KMFRI being a department only generates records at fish landing beaches only for purposes of research. The study was also limited by the protracted negotiations between the Jumuiya Ya Kaunti za Pwani (JKP), the EU and GIZ to commission the field data collection process. The JKP were eventually not available for interviews.

Notably, the findings in this VC study may face limitations by social desirability bias, which could influence respondents to give incomprehensive answers in order to present themselves in the best possible light. The study period was unfortunately not sufficient to allow for interviews with stakeholders in the food service sub-sector e.g., restaurants.

However, the above constraints were managed to make the study a successful one. The study team adopted call back mechanisms to reach out to respondents coupled with triangulation of data.

3. KEY FINDINGS

In the following chapter you will find the key findings per species;

3.1. Mud crab value chain in Kwale, Kilifi, Tana River and Lamu counties

3.1.1. Overview of Mud crab production

Mud crab fishing is an important livelihood activity for about thousands of households along the coast of Kenya because the fishery is simple and requires little input in fishing gear. Lamu County ranks as the highest producer of mud crabs at 49.7% followed by Kwale 26.9%, Mombasa 11.2%, Kilifi 11.9% and Tana River 0.3%. Recent surveys show that the individual weight of crabs caught ranges between 0.25 - 0.9 kg, which is a marked decline from 0.5-1.5 kg recorded 2-3 decades ago (Fondo et al., 2010). The production trend for mud crabs shows an increase from 90 mt in 1990 to more than 250 mt in 2013. The increasing production is associated with increasing value, possibly as a result of diversification in market outlets for the product (Mirera et al., 2013).

3.1.2. Production/ Harvesting of mud crabs

Many fishermen in Lamu, Kilifi and Tana River Counties are involved in this value chain because of the high value/income of the crabs and the availability of the crabs in most fishing areas, especially near the coral reefs. In Lamu County, crab fishing is done in most of the BMU's. However, the main site where most of the crabs are landed is Faza, where a large number of farmers are dedicated to crab harvesting but also as a result of the huge areas with mangroves and corals providing a suitable environment for crabs to thrive.

Mud crab harvesting is largely done by the fishers within the mangroves (82.4%) and along the shores and on coral reefs (17.6%) within their traditional fishing grounds. Majority of the fishers reported that they harvested on their own (52.8%) while the others harvested with friends or family members (47.2%). The fishers collected mud crabs by hand (57.1%) or use hand nets (27.4%). Harvesting for mud crabs is undertaken throughout the year, with no obvious mud crab season. Mud crab harvesting occurred at different times of the day and night and was dependent on the timing of low tides. The majority of fisheries reported to harvesting only during the day. These facts were shared by Dabaso Crab shack members during their interview.

In Kilifi County, a private investor has made an attempt to establish a mud crab hatchery to aid commercialization of mud crab production in the region. However, as a result of numerous challenges the business has not taken-off. Some of the challenges highlighted include lack of feed for hatched mud crabs, limited technology knowledge, challenges in hatching the mud crabs due to poor technology. At the moment, the investor is seeking professional help to be able to optimize the hatchery operations. Mud crab fattening has only been done on an experimental basis and farmers are not currently involved in the enterprise.

There is a growing concern about the sustainability of the wild mud crab fishery due to the increasing fishing pressure and harvesting of all sizes of mud crabs (including sub-adult and juvenile crabs). This is because the BMUs expected to manage and oversee the management of local fisheries resources often lack capacity to monitor artisanal mud crab fishery since they do not land or operate in designated landing sites. However, this value chain has high potential if the BMU management includes experienced and knowledgeable artisanal mud crab fishers.

Recommendations

Effective management policies for the crab fishery are needed to address the sustainability concerns. Currently, there are no regulations in Kenya that focus on collection of wild mud crabs for aquaculture. There is a need to also address the protection of berried females, and the moulting

stages to promote recruitment. Due to the impacts of mangrove habitat fragmentation, there is also a need to understand the connectivity among local populations through genetic studies.

3.1.3. Supply chain of mud crabs

The mud crab value chain in Lamu, Kilifi and Tana River counties is similar. This is mainly due to the fact that the fishing for mud crabs mainly target the export market and the tourist hotels and restaurant along the coast and other parts of the country. The VCA revealed there were four main types of players involved in the selling of mud crabs: (1) fishers, (2) traders, (3) restaurants (independent, as well as those part of hotels and resorts), and (4) exporters. Other key players in the value chain include boat drivers and owners who provide transport to the fishers, input suppliers, regulatory organizations and those organization supporting fishery development and also offering other services like finances and logistics.

Once the fishermen catch the crab, the crabs are either sold immediately to the buying agents or kept in crabs floating holding cages until the time of sale (Photo 1). The crabs floating holding cages are usually place in the water near the shore until the desired quantities are collected. Security is maintained by the members and night guards.

Photo 1: Crab Holding Cage

Once the desired quantities are bought from the farmers the crab either sold directly to the local restaurants and hotels or transported to Mombasa where the best grades are selected and exported to Asia and Europe through Chinese traders and exporters. The Asia and Chinese market prefer live crabs while the European market prefers frozen crabs. ***Figure 3*** shows the crab value chain

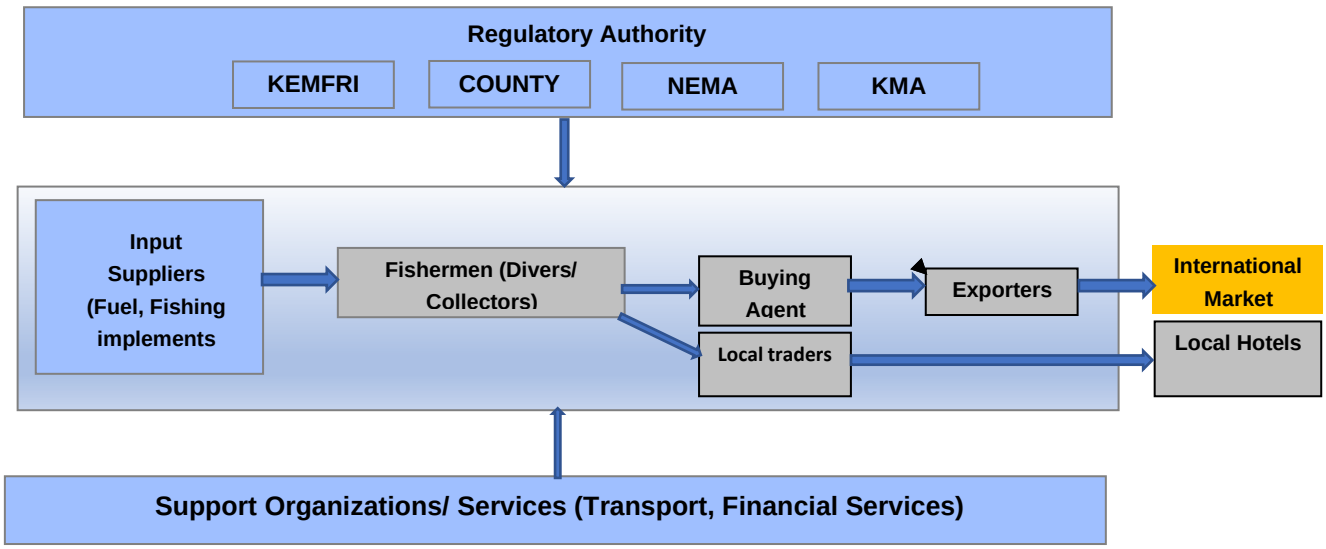


Figure 3: Mud crab value chain in Lamu, Kilifi and Tana River counties
Source: *EU/GIZ VC Analysis of Aquaculture – JKP, Feb/April 2021*

3.1.4. Buyers Requirements

Crabs are sold in three grades. The grades are based on; a) color of the crabs which needs to be green-brown, b) the size of the crabs and c) lack of damages on the crabs as a result of fishing or handling. The prices vary based on the grade of the crabs. The prices for different grades in the counties are shown below.

Average Prices of crabs offered to fishers in Lamu, Kilifi and Tana River counties

Crab Cage income and expenditure statement

- Species: Crab cage farming
- One cage holds 270 crabs
- Crab is fattened for 3 months.
- Young crab of 200gm is bought @550/=
- Pond construction costs: Kshs.2,500
- Food Conversion Ratio (FCR): 1.80.
- Price of Crab: Ksh 3500/kg including transport within Kenya.
- Worker is engaged to tend to the crab cage whole day for 3 months.
- Production cycle length-3 months

Table 4: Crab Business Case

ITEM	QTY-KG	UNIT PRICE	TOTAL REVENUE COLLECTED	
Revenue from sale of 135kg of crabs @3500/kg	135	3,500.00	472,500.00	472,500.00
Fixed costs (Incurred per month))				
Item	Quantity	Unit costs(kg)		
Cage construction local costs	1	885.00	2,500.00	
Salaries	1	10,000.00	30,000.00	
Depreciation costs (Ponds +Materials)	3 months	4,725.00	14,175.00	
Variable costs (costs per cycle)				
Seeds-270 young crabs	200gm	550.00	148,500.00	
Crab Feeds	5.4kg	300.00	145,800.00	
Miscellaneous			23,625.00	
Total variable costs				364,600.00
Gross profit				107,900.00

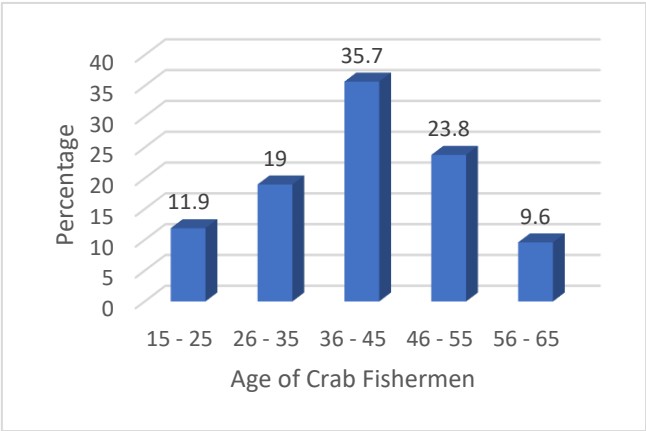
Source: *EU/GIZ VC Analysis of Aquaculture – JKP, Feb/April 2021*

Grade C is mainly sold in the domestic market to the tourist hotels and other restaurants. Photos 2 and 3 show crab being weighed and packaged in Lamu

Photo 2: Crab being weighed sale

Photo 3: Crabs bought by an agent in Lamu

3.1.5. Gender analysis of the mud crab value chain



Crab fishing is mainly dominated by men (91.5%). A higher proportion of female depend on near shore fisheries that are easily accessed by foot, especially during the low tides. The average age of the fishers participating in crab fishing is between 15 – 65 years of age. 35.7% of the fishermen were aged between 36 – 45 years as shown in ***Figure 4***.

Figure 4: Average age of crab Fishermen
Source: *EU/GIZ VC Analysis of Aquaculture – JKP, Feb/April 2021*

3.1.6. Challenges in the mud crabs value chain

The value chain players reported several challenges in different levels of the value chain. Below are some of the challenges reported by the different value chain players.

a) Fishermen

The main challenge reported by the fishermen was low and variable prices of crabs (38%). However, it is important to note that the fishermen also reported low sales in the last 12 months mainly attributed to the impact of COVID-19 on the export markets. The other key concern by the fishermen was the high cost of equipment especially diving equipment (33.5%). The fishermen also reported that they were harassed by local authorities especially during inspection making it difficult for some fishermen to participate in the process. The fishermen also reported lack of capacity to add value as a challenge mainly because sometime the mud crab is rejected by the buyer for several reason thus forcing them to dispose. The capacity to add value will enable the fishermen to consume the product thus reducing the wastages.

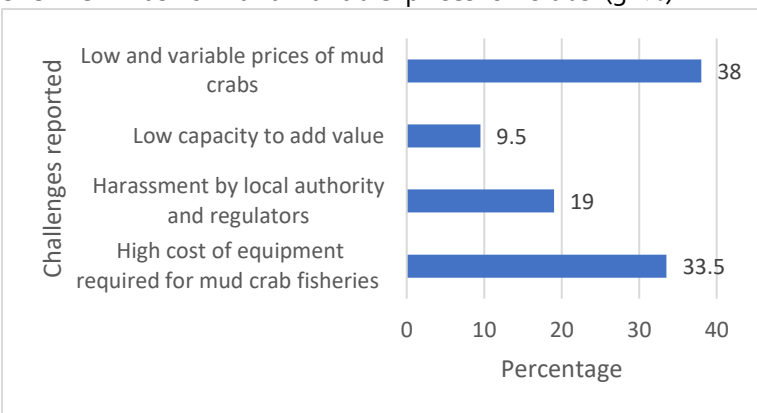


Figure 5: Challenges reported by Fishermen

b) Buying agents

i. Poor handling of crabs before delivery resulting to losses
ii. Low volume of crabs thereby reducing business turnovers
iii. Low local demand for crabs leading to losses especially of grade C.
iv. Huge influx by Chinese buyers
v. Unfair competition from Chinese buyers who have doubled prices.

3.1.7. Proposed interventions to support the mud crab value chain

There are a number of proposed interventions to ensure that the mud crab value chain operate at the optimum level. The proposed interventions include.

i. Collective marketing

Currently, most of the fishermen market their crabs individually despite the fact that they belong to the same BMU's. Collective marketing between fishermen in the same BMU and individual fisher will make it possible for better negotiation of prices. This can be achieved by strengthening BMU's in the coastal region.

ii. Promotion of local Consumption

The mud crab is mainly targeted for the export market and for tourist. While this has provided substantial over the years. It is important to promote local consumption over time. This will also cushion the fishermen in periods when export markets are not available, or the tourist markets are affected

iii. Promotion of mud crab aquaculture

Introduction of mud crab aquaculture will make it possible to reduce pressure but also increase profit to the local fishermen. This will also provide better opportunities to integrate and increase the participation of women in the value chain.

iv. Capacity building for fishermen

There is need for capacity building to improve fishing methods and reduce post-harvest losses reported by the fishermen and buying agent. This will enhance the income from the fishermen and also improve the turn-over of the buying agent.

3.2. Sea Cucumber value chain in Lamu

3.2.1. Overview of the value chain

Sea cucumbers are locally known as "*majongoo*" and occur in the intertidal and sub-tidal zones. Over 40 species of sea cucumbers occur in Kenya, of which about 17 species are harvested (Muthiga *et al*., 2007). The high commercial value species including *Holothuria fuscogilva*, *Holothuria scabra* and *Thelenota ananas* are the most preferred.

They are harvested from different habitats with the majority being in reef lagoons and channels, while the rest are found around the shallow reef areas (edges and flats) and seagrass beds. Production trends over the last 25 years show steadily declined of the catches of sea cucumber. The catches have averaged at about 43 mt annually, with a peak of 227 mt in 1992 and the lowest catch of 6 mt in 2016. The highest volume exported (16 mt) was observed in 2010 with a marked decline thereafter. Sea cucumbers are mainly exported to Hong Kong and China, which are the main markets, although part of the collection ends in mainland Tanzania and Zanzibar and adds to their export volume. China market has a share of about 98% far outstripping the other markets, such as UAE, South Africa, Malaysia, Spain and USA that collectively account for about 2% of export from Kenya.

3.2.2. Production/ Harvesting of sea cucumber

The Sea Cucumber is not commonly fished in most part of Lamu. However, Bwanjumali is the only village and BMU that specializes in sea cucumber fishing. Fishermen go for one or two weeks to fish in the inhabited islands and semi-process while fishing or soon after returning from fishing.

Fishing activities takes place day and night. Many fishermen reported that night fishing catches were higher than day catches.

Sea cucumbers are harvested by hand because they are sedentary, and the choice of fishing grounds is dependent on the target species and the skills of the fisher. Majority of the sea cucumber fishing vessels are traditional canoes (*dau/mtumbwi*), wooden planked vessels (*mashua*), motorized vessels, and outrigger canoes (*ngalawa*). Most of these fishing vessels are owned by entrepreneurs who rent them out to the fishers. Such vessel owners engage fishers who mainly collect sea cucumbers and sell to them. This practice ensures that buyers who own fishing vessels have a constant supply of sea cucumber irrespective of the price on offer. This reduces the quantity of sea cucumbers available for competitive buying and suppresses the price of sea cucumber since fishers are obliged to be loyal to the vessel owner.

Semi- processing of sea cucumber involves gutting, cooking, salting and drying sea cucumbers before selling to the buying agents or middlemen. The semi-processing must be done soon after the sea cucumber are harvested. This makes it easy for the sea cucumber to be stored and transported. There are limited post-harvest losses.

3.2.3. Supply chain of sea cucumber

There exists a large export market for sea cucumber from Lamu. The value chain for sea cumber is fairly short and is wholly targeted to the export market. This is mainly because the fishermen also act as the processors and have specific buying agent(s) that they deliver the sea cucumber to.

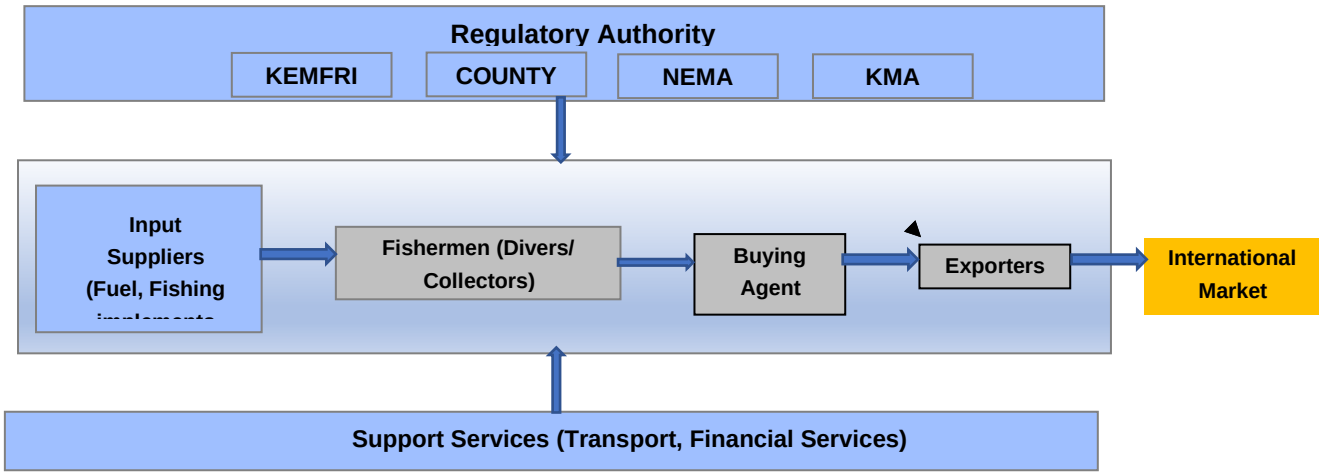


Figure 6: Key Value Chain Players in Sea Cucumber VC

All the sea cucumber harvested is collected from the fishermen by buying agents/ middlemen and transported to Mombasa for export to China (Asia). The export companies have representatives who collect the sea cucumber from the fishermen in Bwanjumali. The buyers are responsible for organizing their own logistics.

Sea Cucumber business case
Assumptions;

- Growth takes 8 Months
- Young sea cucumber is bought @600/= each
- Price of Sea cucumber is 2,500/kg (Semi-processed).

- Production cycle length-8 Months

Sea Cucumber income and expenditure

Table 4: Sea Cucumber Business case

ITEM	QTY-KG	UNIT PRICE	TOTAL REVENUE	
Revenue from sale of 250kg of crabs @2500/kg	250	2500.00	625,000.00	625,000.00
Fixed costs (Incurred per month))				
Enclosure/ Cage construction local costs and Management	1	3,000	18,000.00	
Salaries	1	10,000.00	60,000.00	
Depreciation costs (Ponds +Materials) (15%)	6 months		2,700.00	
Total Fixed costs				80,700.00
Variable costs (costs per cycle)				
Seeds-250 young sea cucumbers	200gm	600.00	150,000.00	
Feeds	Various		50,000.00	
Miscellaneous (15% of Variable cost)			30,000.00	
Total variable costs				230,000.00
Total Cost (Variable cost + Fixed cost)				310,700.00
Gross profit				314,300.00

3.2.4. Buyers Requirements and Consumer preferences

During marketing, the sea cucumbers are graded based on their sizes and quality into three grades that are sold at different prices. The price is highly influenced by the level of processing. The prices of sea cucumber in Lamu are shown in Table 5.

Grade C is the most common grade sold due to the pressure on the resources due to over exploitation of the resources due to high demand. The high demand for sea cucumber in Asia, has led to increased reports of over-exploitation. As a result, fishers land smaller and reproductively immature individuals from the main fishing grounds. There is need to address this challenge through mariculture as well as capacity building to ensure sustainable use of the sea cucumber.

A reduction in the amount of sea cucumber sold has been noted due to the ban on night fishing in Kiunga area of Lamu. Most of Sea Cucumber is exported to the Far East as there is limited local market.

There is no local consumption of sea cucumber for the following reasons.

i. Lack of skills to prepare and cook the sea cucumber
ii. The fish is of high value and therefore the fishermen prefer to sell it to exporters who can afford it and offer better prices.

3.2.5. Gender analysis of the sea cucumber value chain

The sea cucumber fishery is mainly dominated by men. It is only the men who go fishing and the processing activities that takes place during the period when men are away are mainly done by the men. Women are only involved if there are any processing activities conducted in the landing sites. Most of the men involved are aged between 18 and 60 years.

3.2.6. Challenges in the Sea Cucumber value chain

There are a number of challenges that were reported by the fishermen and the buyers.

a) Fishermen

i. High fuel cost and high cost of charge in the revenue share by boat owners
ii. Declining quantities and size of sea cucumbers leading to low prices
iii. Health issues as a result of lack of safe fishing equipment
iv. Lack of professional training on diving

b) Buyers

i. Declining quantity of catch and small sizes of sea cucumber

3.2.7. Proposed interventions to support the sea cucumber value chain

i. Developing a strategy to ensure stock recovery

To enhance sustainability of the sea cucumber value chain a strategy for stock recovery needs to be put in place. This may involve sea ranching to ensure that stock in the area where the ranches are established recover. This strategy will require consistent surveillance from the regulators and the local communities to succeed.

The other strategy which can be adopted is to promote artificial breeding and sea cucumber culture activities in specific areas.

ii. Establishment of harvesting guideline

The fisheries should establish harvesting guideline for sea cucumber fishers to reduce the quantity of small sized cucumber from being harvested for sale. This will guarantee growth and recovery of sea cucumber if the guidelines are applied. In the short-term such measure result in reduction of income among the value chain players but the long-term benefits are huge and ensure sustainability of the fishing operation.

iii. Equipment support for fishermen/ divers

Currently, the fishermen do not go to the deep sea to look for sea cucumbers because they do not have appropriate equipment including powerful boats that they can use to access such area. There is need to work closely with the fishermen to determine the best ways they can be supported to

get the equipment they need to access the areas. The basic equipment like life jacket should be mandatory and the authorities should ensure compliance.

iv. Capacity building for fishermen

Capacity building is required for the fishermen on professional diving and safety regulation. This will guarantee the safety of the fishermen while in the ocean. Also, best practices should be taught to fishermen to start opening the door to co-management of the natural resource. Currently there is no mariculture of sea cucumber going on, it would be interesting to explore the possibilities and develop a good business case for it in suitable sites.

3.3. Seaweed Value Chain in Kwale and Lamu

3.3.1. Overview of the seaweed value chain

The commercial seaweed grown for commercial purposes in Kwale County *Eucheuma denticulatum* (spinosum) *and Kappaphycus alvarezzi* (cottonii*).* The first commercial seaweed farms were established at Kibuyuni in 2009 and have progressively grown in biomass accumulation and a number of interested seaweed farmers. Tumbe is a new seaweed site whose farming began in 2018. Seaweeds are relatively unimportant in the Kenyan diet since they are consumed rarely by coastal people. Seaweed farming has been identified as a good prospect for social and economic development of coastal areas. It is aimed at diversifying livelihood opportunities for low income fishing communities whose livelihoods have been put at serious risk by diminished capture fisheries. According to data obtained from Kenya Coastal Development Project (KCDP), Kenya small scale commercial seaweed cultivation is practiced by over 600 farmers distributed in 4 coastal communities namely; Gazi, Mkwiro, Kibuyuni and Funzi in the southern coast of Kenya.

3.3.2. Production/ Harvesting of sea weeds

In Kwale where a value chain analysis was conducted for seaweed there is limited information regarding the production volume of seed weed in the Kenyan coast. There were six active groups in 6 sites within Kwale Counties. These sites in Kibuyuni, Mkwiru, Funzi, Mkunguni, Mwandamo and Gasi BMU's. However, only Kibuyuni site has remained active in the last one year.

Photo 4: Farmer drying seaweed in Kibuyuni

Kibuyuni site is well developed and has drying shed, store and makeshift value addition equipment (Figure 11). The blue economy project, through the Italian Cooperation, is currently supporting the development of seaweed in Gasi BMU. The project has constructed drying shades and boats that are used to collect seaweed. It was noted that, despite the existence of group, the farmers still worked independently. Once harvested the seaweed is dried and stored by individual farmers.

Photo 5: Common seaweed drying racks and plastic boat used to ferry harvested seaweed

Production is mainly compromised by the continuous long period of product exposure to the air during low tide and Ice-ice disease.

3.3.3. Supply chain of seaweed

Seaweed-Business case

Assumptions

- Cost of seeds to plant 0.5 acres costs KShs. 7000
- Price of seaweed is 25/kg
- Production cycle is 4 months

Table 5: Seaweed Business case

Item	Quantity-kg	Unit price	Total revenue collected
Revenue from Seaweed	2.5Mt	25/kg	62,500
FIXED COSTS (Incurred per month)			
Item	Quantity size	Unit cost (KShs)	Total costs (KShs)
Polythene ropes	1,000	100	10,000.00
Seaweed seedlings/ (Piece) /Stocking)	20kg	350	7,000.00
Bull hummer	1	500	500.00
Gunny Bags	200	50	1,000.00
Knife/panga	18	500	9000.00
Labor	1	9000	9,000.00
Pegs	1tree@100	Need 1,000 trees @ 100	10,000.00
Boat (Hire)	1,000	4,000	4,000/month
Total costs			50,500.00
Gross profit (For All the area harvested			12,000. There will be reduced cost of production for following season as the materials used should last the whole year.

Source: *EU/GIZ VC Analysis of Aquaculture – JKP, Feb/April 2021*

The seaweed produced is mainly dried and used to make value added products like soap for sale to the local communities. However, there are instances where seed material is sold to other groups to propagate. Due to low demand of seaweed for consumption in both the local and international market, there is not much reported on sales.

The market for seaweed product varies depending on the types and size of the product. Some of the value-added product from sea weeds include beauty products, soap and shampoo.

3.3.4. Gender analysis of the seaweed value chain

The seaweed group in Kwale County are predominantly made of women (75%). The women groups have received development assistance from various organizations to establish the seaweed farms. This is mainly because seaweed farming is largely viewed as one of the ways to integrate women into the fisheries value chain along the coast.

3.3.5. Challenges in the seaweed value chain

The farmers reported several constraints during the survey. The constraints reported include.

i. Lack of market for seaweed
ii. Lack of equipment to establish sustainable production
iii. Lack of capacity to manage the seaweed farms
iv. Weak groups participating is seaweed farming

3.3.6. Proposed interventions to support the seaweed value chain in Kwale

There are a number of interventions that are needed to promote and mainstream seaweed farming in Kwale. Some of the proposed interventions include.

i. Capacity building on group dynamics and group management

The VCA revealed that the seaweed farmer group are not active and most of the farmers therefore prefer to operate individually. Most of the groups have had members bolting out for various reasons. There is need to capacity build the groups to enable collective action. This will make it possible to get better deals for input, increase production and therefore be able to get better services from various partners.

ii. Capacity building on seaweed production

There is still need for capacity building of the farmers groups on seaweed production. This will help the farmers in identification of the best site to locate the farms as well as identification and management of diseases. At the moment farmers have reported low yield as a result of poor location of the farms.

iii. Market development for seaweed and seaweed products

Currently, the market for seaweed and see weed products is still low. The products are mainly sold at the local level where it may be a challenge to get better prices. The development and sustainability of seaweed farming is directly related to the availability of market for the products from the farms. Way to promote the product, value addition products and consumption of seaweed at the local level should be prioritized. Options to include it in animal feeds should also

be explored. As e.g. is done with Rabbit Fish where seaweed is grown to feed the rabbit fish held in cages (experimental by KMFRI).

3.3.7. Potential for seaweed development in Lamu and Kwale

Even though seaweed is not one of the active value chains in Lamu County at the moment. There is huge potential for the development and growth of seaweed production in the area. The potential of development of Seaweed value chain are as a result of the following reasons.

i. **Availability of suitable site for seaweed production:** Based the assessment of the fisheries department a number of sites have been identified where seaweed farming can succeed. These sites include Mkokoni, Kiunga, Ndununi, Kiangwe, Mashudwani, Ngiini and Ndau. These sites have lagoons which can easily be used to produce seaweed. A study on the growth of seaweed is necessary before going to scale.

ii. **Availability of market:** In the last few years the fisheries department have received inquiries for seaweed both from domestic market in Mombasa (hotels and processing factories) and international market.

iii. **The water around Lamu have less pollution:** the water around Lamu have less pollution due to limited industrial activities in the area. This makes it a suitable location for production of quality seaweed

iv. **Fertile waters for production of Seaweed:** the EA currents and the Somali Current both converge at Lamu. Lamu is also a beneficiary of the nutrients from the Tana Delta at Kipipini. The current movement and water flow from Tana River Delta make the water in Lamu fertile and therefore suitable for seaweed production.

3.3.8. Octopus Project supported by NRT in Lamu

NRT is currently running 7 conservancies at the coast. Of the 7 conservancies, 4 are marine based. The marine based conservancies include;

i. Pate - Marine
ii. Kiunga – Marine and terrestrial
iii. Lower Tana – Marine and terrestrial
iv. Awer – Marine and terrestrial

Octopus enclosure project

- The project is financed by the Nature Conservancy, FFI and NRT
- It is entirely women led and involve about 160 women actively involved in fishing
- There are 2 octopus enclosures in Pate (Pate Marine Community Conservancy which is made up of women from 10 villages)
- The enclosures cover 115 ha
- The women groups are governed by their own guidelines and laws
- And have rules and regulation relating to benefit sharing and enclosure management
- Additional Octopus enclosures were established 2 weeks ago in Kiunga, Ishikayu and Kiwayu

Priorities/ needs for the women group and the enclosures

- Ensure the enclosure are effective
- Boats for patrol to help in management of enclosures
- Fishing boats for the women groups
- Cold storage – cool boxes and solar freezers
- Support for livelihood e.g. establishment of community kitchens
- Capacity building for the women to manage the groups

In all the conservancies, the main target is to provide financial and technical assistance. Financial assistance involves financing key projects while capacity building involve training on conservation and capacity building of individuals and groups on handling of Octopus.

3.4. Tilapia Value chain in Mombasa, Kilifi, Tana River and Taita Taveta Counties

3.4.1. Overview of Tilapia production

The coastal counties of Kenya have many freshwater inlets, estuaries and coastal waters suitable for development of aquaculture. During Economic Stimulus Project (ESP) in 2010, the government of Kenya constructed over 2000 fishponds within some of the six coastal counties for freshwater tilapia farming. In Mombasa and due to limited space, the county government constructed an additional about 100 container ponds for freshwater fish farming. About 10% of the total ponds in the coast are operational-the rest are not being utilized by the intended farmers. The supply of farmed tilapia is far from meeting the demand and this calls for adequate support for reviving tilapia fish farming in the three coastal counties of Tana-River, Kilifi and Taita-Taveta. Indeed, the culture of farming freshwater tilapia shows positive results that warrant upscaling. There is a lot of freshwater tilapia being consumed in both hotels and households in the coast. Most of these tilapias come from Lake Victoria and imports from China. There is also a very small quantity of saltwater tilapia that is consumed in the coast mainly. Most of saltwater tilapia is from wild catch.

3.4.2. Production/ Harvesting of freshwater tilapia

Production of freshwater tilapia is still not sustainable as respective county governments are supporting acquisition of both seeds and feed to the farmers and therefore not allowing tilapia fish farmers attain commercialization of their ventures. The few hatcheries across the counties produce unsexed fingerlings.

There is room for improvement in production up to 95% if farmers can access mono-sex tilapia fingerlings. Introduction of cages in the large coastal freshwater bodies and dams will enhance production to narrow down the supply gap. Research on the potential culture of tilapia in Lake Jipe with KMFRI is on progress, there are on farm trials of tilapia farming with six fish farmers.

Photo 6: Farmers in Kilifi displaying his harvest

Fish farming is predominantly owned by men whereas the labour force is dominated and provided by women. Unlike Tana River the two counties of Kilifi and Taita-Taveta practice tilapia fish farming exclusively in fishponds while Tana River has a substantial quantity from wild catch.

In Kilifi County, a private investor is establishing a hatchery that will avail all-male fingerlings. The biggest challenge the investor is wary about is actual commercialization of tilapia fish farming. Most if not all farmers get subsidies from respective county governments. There are several gaps that hinder efficiency and cost-effective production which includes limited knowledge & skills on production, adaption and usage of technology but most importantly high cost of feeds.

Photo 7: Raised Fishponds in Taita-Taveta County

There is growing demand for tilapia fish locally as more Kenyans are embracing fish consumption However, there is equal concern on sustainability of the wild catch mainly from Lake Victoria as stocks are getting depleted due to over and undersize fishing, hence the need to quickly revive and scale-up tilapia fish farming in high potential areas like the three coast counties mentioned above.

3.4.3. Supply chain of Tilapia

Supply chain in the coastal region of tilapia variety is mainly predominant in Tana-River, Taita-Taveta and Kilifi counties whereas the other three counties of Lamu, Kwale and Mombasa are consuming counties. The tilapia value chain sub-sector as any other VC has its actors of (1) input suppliers, (2) farmers (3) traders/aggregators, (4) transporters (5) artisanal processors and of course (6) consumers. The regulatory authorities, development partners both local and national governments form part of the supporters/facilitators of the value chain. Most of the tilapia is sold fresh to artisanal processors, hotels and households. The detailed value chain description is presented in **Figure 7**.

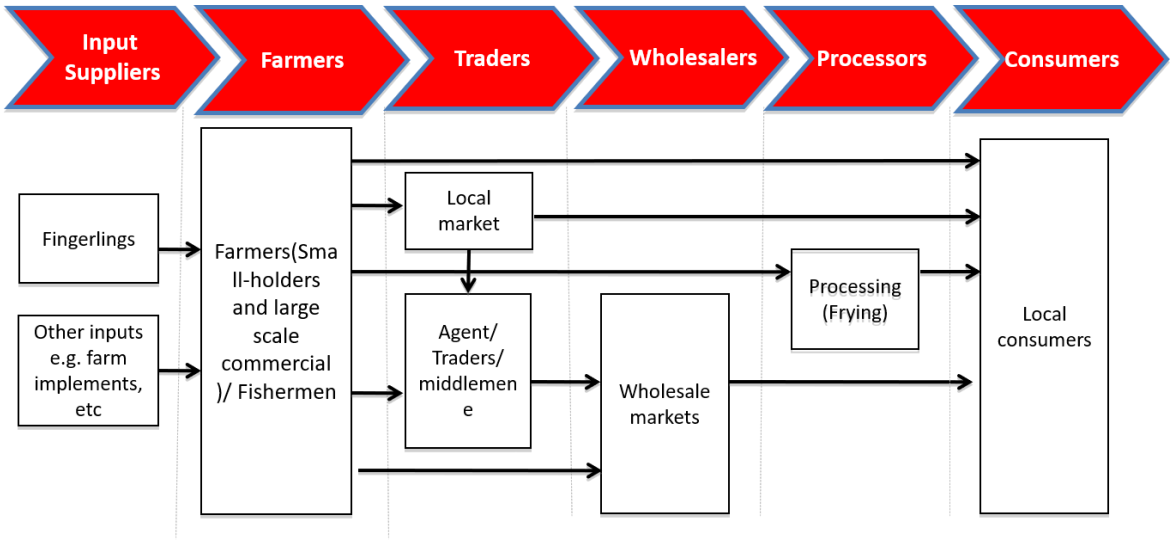


Figure 7: Tilapia value chain in Mombasa, Taita-Taveta and Kilifi Counties

3.4.4. Buyers Requirements

Tilapia is sold in kilograms and in some instance visual estimation of size against value is used. The grade is mainly based on size and colour of the gills. Prices vary from county to county as shown in table 6. All the Tilapia harvested either through wild capture or farmed are sold to the domestic market.

Fishpond income and expenditure statement
Below is a breakdown of the income and expenditure by a farmer who has invested in three 300m² earthen ponds.

Assumptions are:
1. Species: tilapia.
2. Food Conversion Ratio (FCR): 1.25.
3. Pond construction costs: KShs. 130 per m².
4. Price of fish: KShs. 300.
5. Worker is involved in other farm duties and allocates one hour per day to tend to fishponds
6. Production cycle length: 8 months

Table 6: Tilapia Business Case

Item	**Quantity-kg**	**Unit price**	**Total revenue collected**	
Revenue from sale of tilapia	600.00	300.00	180,000.00	180,000.00
FIXED COSTS (Incurred per month)				
Item	Quantity	Unit cost (KShs)	Total costs (KShs)	
Pond construction local costs	900m2	130	117,000	
Salaries	8	1,130.00	9,040.00	
Depreciation costs (Ponds +Materials)	8	650.00	5,200.00	
Variable costs (costs per cycle)				

5-gram tilapia fingerlings (Piece)	3,000.00	10	30,000	
Fertilizer and Lime	8	200.00	1,600.00	
Fish Feeds	750 kg	110.00	82,500.00	
Miscellaneous		12,000.00	12,000.00	
Total variable costs			140,000.00	140,340.00
Gross profit (For 3 ponds, 8 months				39,660.00

Source: FA-KMAP-project-Fish farmer -2019.

3.4.5. Gender analysis of Tilapia sub-value chain

Tilapia fish farming is predominantly owned by men (90%) while the women form most of labour force. Most of the women perform tasks as feeding, cleaning and artisanal processing and are the bulk of tilapia fish traders as these are considered light labour.

3.4.6. Challenges in the tilapia value chain

The value chain players reported several challenges at different links of the value chain. Below are some of the constraints reported by the different value chain players;

a) Fish farmers

i. No hatchery producing sexed fingerlings
ii. Inadequate supply and access to quality fish seeds and feeds as well as access to reliable and timely information
iii. Inadequate provision of extension services
iv. Lack to access to reliable and timely information
v. Limited private investment in aquaculture sub-sector
vi. Slow adoption of modern aquaculture technologies
vii. Portfolio gaps in management skills and technical knowhow among farmers
viii. Lack of adequate marketing infrastructure such as fish auction centers, ice plants, cold room facilities lack of main-grid power to beaches and most of the aquaculture
ix. Low value addition and over reliance in artisanal techniques.
x. Lack of access to affordable credit especially in fish farming enterprises to finance procurement of vital inputs and value addition technologies.
xi. Lack of specific policy in aquaculture to address key issues of supply of key inputs such as fish seeds (fingerlings) and fish feed as well as the certification and marketing of aquaculture products
xii. Limited access to affordable credit
xiii. Lack of enforcement of regulatory frameworks
xiv. Minimal private sector investments in the sub-sector value chain

c) Traders:

i. Traders require proper transportation systems with relevant markets infrastructure
ii. Lack of appropriate storage facilities both at farm and market level.
iii. Supply-High costs sourcing from smaller farmers

3.4.7. Proposed interventions to support the Tilapia Value Chain

There are a number of proposed interventions to ensure Tilapia value chain operate at the optimum level. The proposed interventions include.

i. Collective marketing

Market for Tilapia fish is readily available in the nearby urban centers. Some the fish are sold in the large markets in Mombasa and other surrounding towns while some fish are also sold as far as Tanzania, Taveta being a cross-broader county to Tanzania.

Currently tilapia fish farmers market their fish individually, although they can form groups, stagger their production to have consistent supply year-round and practice collective marketing and benefit from economies of scale

ii. Promotion of local farmed Tilapia Consumption

Tilapia is a delicacy in most homes and hotels in Kenya. However, farmed Tilapia has received minimal preference due notions that farmed Tilapia is not tasty. In the main coastal urban centers, tilapia also has good preference as a fish of choice. The three counties of Kilifi, Taita-Taveta and Tana River where Tilapia production is high should take up the challenge to upscale tilapia production through partnering with development partners, for example there is need to rethink the whole tilapia farming-hatcheries were reported by interviewees to be providing fry to farmers instead of fingerlings with resultant high mortality. The fry takes more time to mature and thus narrows down the profit margins for the farmers.

iii. Capacity building for fish farmers

Lack of proper knowledge, information and skills on Tilapia farming warrants a capacity gaps assessment to identify what gaps exist and how transfer of knowledge and skills could be shared. Issues like pond management is critical for any fish farmer. To improve productivity, returns and profit margins a lot of capacities should be built and enhanced.

3.5. Milk Fish value chain in Kwale, Mombasa and Kilifi Counties

3.5.1. Overview of the Milkfish value chain

Milkfish (*Chanos chanos*) is a culture species along the coast of Kenya. Milkfish production started about the 1980s when it emerged as an interesting by-product of prawn farming. It was not until 2005 when it became evident that milkfish could also be part of the coastal mariculture species in Kilifi, Kwale and Mombasa Districts now counties. Due to its fast growing and availability of fingerings from the wild (Mirera, 2011) it was possible to enhance farming of milkfish. Milkfish, however, has gained popularity and improved in terms of productivity and importance as a mariculture species. Available quality feed has improved the stocking densities leading to increase of annual production. Due to poor management of culture facilities, predation of birds and theft the survival rates are low estimated between 20%-40%. There is a definite need to improve security that would lead to increased survival of Milkfish up to 70%. The consumption of milkfish

has increased warranting increment of production through milkfish farming. Milkfish is mainly sold fresh or chilled. The fingerlings are available only seasonally from the wild (April and October).

3.5.2. Production/ Harvesting of Milkfish

The study carried out last month revealed that milkfish could be farmed in Kwale and Mombasa cost effectively with some production elements improved. Milkfish is produced by community groups. The fingerlings are harvested within Mangrove forest in the wild. The construction of ponds and fittings are easily available. The current ponds are larger and more durable. Milkfish production has evolved from initial 50kg to over 5tons collectively. The age bracket of farmers is between 18 years to 79 years being the oldest. Most of the farmers are not schooled. International Non-Governmental Organizations like FAO have contributed immensely towards development of small-scale milkfish farming in the Kenyan coast. Milkfish farming supports about 1400 directly and 3000 indirectly along the value chain, it has also played its part in terms of spurring infrastructure development within production areas. With improved pond management, feeding regimes, improved quality feed the productivity and production has increased, leading to improved returns to the farmers and other actors along the value chain.

Photo 8: Fisherman display caught milkfish

3.5.3. Supply chain of Milkfish:

Milkfish is mainly sold fresh and/or chilled for immediate future use. The main actors include (1) input suppliers (2) Farmers (3) traders (4) transporters (5) consumers. The international development agencies are play a major role in supporting the milkfish farming initiatives. Farmers are organized into producer groups for purposes of collective purchases and selling. The groups function well but still require strengthening through capacity building. The market of milkfish is mainly households and local hotels. Consumption of milkfish has increased-hence the need for supporting this aquaculture sub-value chain be able to meet increasing demand. Milk fish is sold between KShs. 200 – 300 per kilogram.

3.5.4. Species: milkfish

Assumptions are;

- Pond construction costs: 8 ponds=100,000p/pond
- Growing milkfish in 3 ponds
- Fingerling @15
- Feed is KShs. 100kg/per/pond
- Price of milkfish: KShs. 200/kg
- Worker is engaged for 6 months
- Production cycle length: 6 months

- Each pond takes 6000-fingerlings
- Cost of fingerlings is 15/each
- Feeds are locally formulated

Table 7: Milk FISH-Income and expenditure-business case

Item	**Quantity-kg**	**Unit price- KShs.**	**Total revenue collected**
Revenue from sale of Milk fish	6000	200	1,2000,000/6/months
FIXED COSTS (Incurred per month)			
Item	Quantity	Unit cost (KShs)	Total costs (KSHs)
Pond local costs	5-(40mx50m)	300,000.00	1,500,000.00 original investment by KMFRI for 5 ponds
Salaries	1	15,000.00	90,000.00
Depreciation costs (Ponds +Materials)			180,000/year Pond repair.
Variable costs (costs per cycle)			
Milk fish fingerlings	180000	15	270,000
Fertilizer and Lime	50kg	50 /bag	250
Fish Feeds	100kg/month/pond	1800x3x112	604,800
Miscellaneous	N/A		60,000.00
Total variable costs			1,205,000.00
Gross profit (For All the ponds, 6 months cycle)			295,000.00

3.5.5. Gender in milkfish value chain

The production of milkfish is dominated by men due its nature of production with ponds within the flat mangrove forests. However, the selling and marketing of milkfish is dominated by women who buy and resell to household consumers. The hotels are served by men. It is therefore important to integrate women extensively into the milkfish value chain and enable them own ponds for production.

3.5.6. Challenges in milkfish value chain

The farmers reported several constraints during the analysis. The constraints reported includes but were not limited to:

i. Uncontrolled tidal ocean situations/ raising water levels?

ii. Lack of technical knowledge to manage the earthen ponds in the mangrove flat forest areas.
iii. Identifying predator species of fish during harvesting of milkfish fingerlings
iv. Dependency on wild fingerlings as seed.
v. Lack of quality and reliable supply of affordable feed.
vi. Lack of commercialized value chain and farmers taking ownership
vii. Licensing of the farm is with the Kenya Forestry Service

3.5.7. Proposed interventions to support milkfish value chain

There are a number of interventions that are needed to promote and mainstream milkfish farming in the two (2) counties of Kwale and Mombasa. Some of the proposed interventions include but not limited to;

iv. Capacity building on group dynamics and group management

The VCA revealed that the producer groups were not cohesive and had not embraced collective input purchases and marketing. Many members were dropping out and rejoined groups once a new donor came with support. Lack of good leadership, group governance and management contributed to high membership turnover.

v. Capacity building on milkfish production

Capacity gaps on production, good aquaculture practices and effective choice of pond sites. Transferred knowledges will assist farmers improve production leading to improved earnings and livelihoods. Prawn/Milkfish farming system.

vi. Market development for milkfish:

Market for milkfish is mainly to households and hotels. Awareness and sensitization to the coast public on benefits of consuming milkfish.

Development of milkfish:

i. Milkfish development is an initiative that should be encouraged. Growing areas are available and the government is willing to allow more farmers farm milkfish
ii. Feed and seeds (fingerlings) are available and can be improved in terms of quality and costs.
iii. Market is growing as more people embrace consumption of milkfish
iv. The infrastructure is simple to construct, and expansion space is available.
v. Farmers should embrace commercializing milkfish production and marketing and stop the donor dependency syndrome.
vi. Farmers should be capacity built on behavioral and attitude change as the business belongs to them and not the donor community.

3.6. Prawn value Chain in Kwale Mombasa and Kilifi Counties

3.6.1. Overview of Prawn mariculture value chain

Prawn is a common name for small aquatic crustaceans with an exoskeleton and ten legs, some of which are eaten. Over the years, the way shrimp and prawn are used has changed, and the terms are almost interchangeable. During the study, the two coastal counties of Kilifi and Mombasa

were identified as areas that produced prawn with high potential that required support for prawn production.

Prawn production at the Kenyan coast has been low varying between the semi-intensive and extensive levels as most of the ponds are below 0.1 ha in area while feed is mostly natural with production levels being below 1600 kg/ha/yr. Technologies used in freshwater prawn farming are basically the same as in marine shrimp farming. Hatcheries produce post larvae, which are grown and acclimated in nurseries before being transferred into grow out ponds, where the prawns are fed and grown until they reach marketable size. There appears to be high interest to commercialize and upscale shrimp farming among both Kenyan and foreign investors. Unfortunately, government support in term of technical assistance is limited and some of the keen investors eventually proceed with their plans to produce shrimps for commercial purposes.

3.6.2. Production/ Harvesting of Prawn:

About 15 Community based groups (CBOs) have been involved in prawn farming at various levels mainly in polyculture systems with milkfish or in monoculture systems. Prawn is a delicacy and a high value species. The CBO based or small-scale farms depend mainly on prawn seed from the wild. This poses a major challenge as the seed is insufficient, below optimum growth and the seasonality of wild prawn seed greatly affects the stocking densities and continuous stocking hence farms operating below optimal densities which limits production.

Prawns are harvested by order and sold to traders who are either (exporters, artisanal processors and traders who further sell to hotels and others.

Prawn farming therefore faces challenges in terms of quality and availability of seed and feed. Most of the farming is poly culture systems with milk fish. Farmers lack skills on pond management, low technological skills, capacity and availability of extension workers is low and not consistence.

Prawns are high value species and there is potential if availability of quality seed and improved technology is guaranteed. Although prawns are exported in frozen form, farmed prawns are sold fresh, chilled or frozen to local/domestic markets. There is a small percentage of prawn processing by women who buy prawns from farmers/fishermen and add value through drying. Dried prawns are mostly sold to households. Farmer's lack of knowledge and skills to produce prawns coupled with limited/poor quality feed creates a challenge to farmers who are forced many times to look for substitute feed. There is no adequate and consistent supply of feed. Supply of prawn seedlings is a major challenge to farmers as seeds have to be harvested from the wild.

Photo 9: Freshly harvested prawns in Mombasa

Species: Prawns
Assumptions are:

- Pond construction costs: Ksh 100,000
- Ponds carries-5000 fingerlings
- Price of fingerlings: -10.
- Worker is engaged on monthly basis
- Feed costs 2800/25kg bag
- Production cycle length: 4 months

Table 8: Prawns Business Case

ITEM	QUANTITY-KG	UNIT PRICE	TOTAL REVENUE COLLECTED	
Revenue from sale of Prawns	120	800	768,000	768,000
FIXED COSTS (Incurred per month))				
Item	Quantity	Unit costs(kg)		
Pond construction local costs	1	100,000	800,000	
Salaries	1	300	9,000	
Depreciation costs (Ponds +Materials)	2		20,000	
Variable costs (costs per cycle)				
Seeds	5,000x8	10	400,000	
Fish Feeds	20x 25	2,800x	112,000	
Miscellaneous			3,000	
			53,500	
Total variable costs			597,500	597,500
Gross profit			170,500	170,500

Source: *EU/GIZ VC Analysis of Aquaculture – JKP, Feb/April 2021*

3.6.3. Supply chain of Prawn:

The prawn value chain is made up of actors such as: Input suppliers, farmers, traders, artisanal processors, exporters and consumers. Prawns for the local market are sold fresh, Chilled or frozen while prawns for exports markets are shipped frozen. Lack of infrastructure and relevant facilities like cold rooms create threats to the farmers. Lack of a proper hatchery to serve the farmers with quality seeds is a major challenge as well.

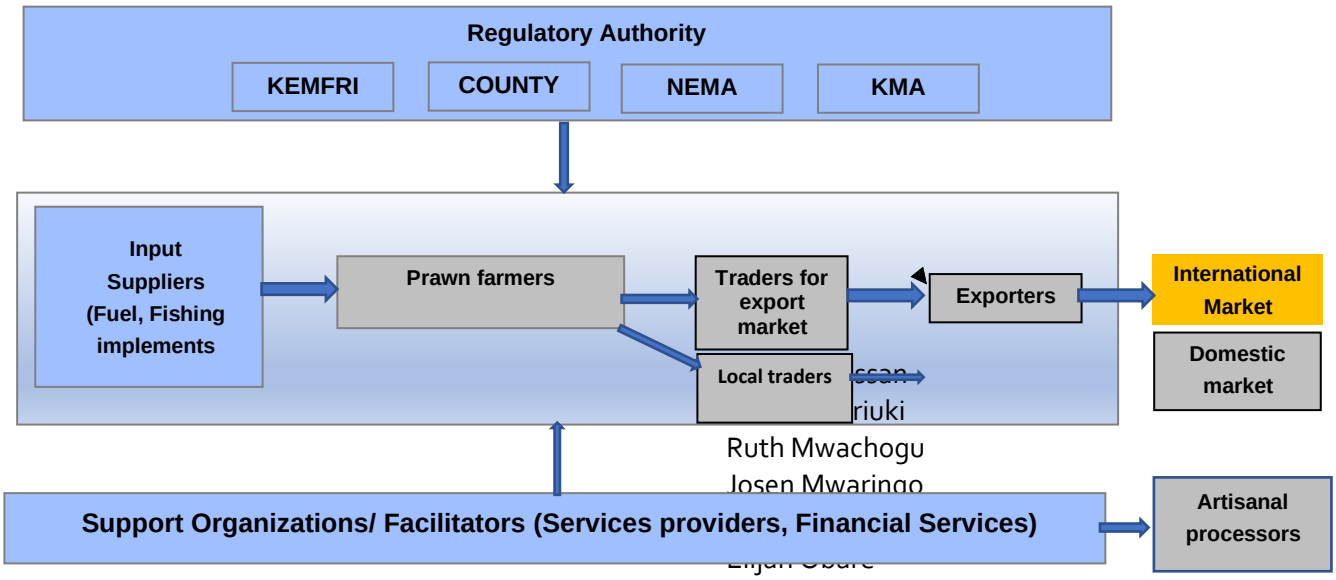


Figure 8: Prawn value chain map

3.6.4. Gender analysis of the prawn value chain

The prawn value chain actors are a good bled of both women and men. The CBOs membership has about 50% representation of both men and women. Women are active across the value chain links from owning ponds, trading, and value addition through drying of prawns for domestic market and are also involved in exporting. Unfortunately, there were no export figures and quantities harvest and traded.

3.6.5. Challenges in prawn value chain

The farmers reported several constraints during the survey. The constraints reported included.

- Lack of quality seed
- Limited supply of quality feeds.
- Limited accessibility of quality raw materials
- Lack of good quality storage facilities
- The need to adapt pump assisted systems
- Lack of equipment to establish sustainable production
- Lack of capacity in knowledge and skill of farmers to manage the production
- Weak governance systems to manage and lead the groups.

3.6.6. Proposed interventions to support prawn:

There are a number of interventions that are needed to promote and mainstream prawn farming in Kilifi and Mombasa. Some of the proposed interventions include.

i. Capacity building on group dynamics and group management

The VCA revealed that prawn farmer groups are not active and most of the farmers therefore prefer to operate individually. Most of the groups have had members bolting out for various reasons. There is need to capacity build the groups to enable collective action. This will make it possible to get better deals for input, increase production and therefore be able to get better services from various partners.

ii. Capacity building on prawn production

There is still need for capacity building of the farmers groups on prawn production. This will help the farmers in identification of the best site to locate the farms as well as identification and management of diseases. At the moment farmers have reported low yield as a result of poor location of the farms.

iii. Market development for prawns

Currently, the market for prawns is relatively low. The products are mainly sold at the local level where it is a challenge to get better prices. Both domestic/export markets require further development with good promotional interventions including sensitization on benefits of consuming prawns.

3.7 Artemia/Brine shrimp (*Artemia franciscana*)

3.7.1. Overview of Artemia mariculture value chain

Artemia are small aquatic crustaceans that thrive in salty habitats such as salt lakes, coastal lagoons and evaporation salt works. They usually have a high level of protein, and have been found to be the best food for baby fish commonly known as fry.

According to Kenya Marine and Fisheries Research Institute, when food is scarce and salinity is high, artemia produces hard-shelled eggs known as cysts, and in favorable conditions they hatch young ones known as *nauplii.* These cysts are able to withstand near-total dehydration, losing more than 97 percent of their water content. All their life processes stop and they enter a state of suspended animation called anhydrobiosis, a bizarre stopover between life and death. The cyst can last for over 30 years before hatching.

Artemia has been used globally as food for larval fish to improve fish larviculture production in hatcheries and ensure high production of quality larval fish seeds. To feed fish fry, the cysts are incubated in aerated seawater with enough light and hatch into *nauplii* after 24 hours. The *nauplii* are harvested and fed on baby fish and can as well be used as a protein source to formulate aqua-feed for grow-out fish.

In the salt industry, Artemia which is a filter feeder, feeds on algae thus cleaning the water. This eventually enhances the quality and quantity of salt produced thus lowering the cost of salt production. Artemia produces cysts that are very valuable in the international market, currently at about USD 60 per kilo. In other countries such as China and Vietnam, Artemia has been used to improve the livelihood of local people, hence delivering people from poverty and malnutrition. Fortunately, Artemia populations have been existing in the Kenyan and Tanzanian Coast for more than three decades, thanks to the Kenyan-Belgium Project (KBP), implemented by Kenya Marine and Fisheries Research Institute (KMFRI) and University of Ghent. However, the Artemia in Kenya has not been adequately exploited for local aquaculture production. Currently, artemia cysts are only used by a few hatcheries in East Africa and are expensive since they are imported from Asia, America or Europe. In Kenya a kilo of artemia costs KShs. 7, 000.

3.7.2. Production of Artemia

Artemia production in Kenya *Artemia* is mainly produced in the commercial and artisanal salt pans owned by salt producing companies in the Malindi area along the Kenyan coast. In Kenya, controlled *Artemia* production is done in coastal salt works in which sea water salinity is increased by evaporation. *Artemia* is cultivated in permanent and seasonal units. The ponds are small sized (about 100 m^2) with depths ranging from 0.1 m to 0.6 m. and are largely managed individually. The permanent salt works are much more complex systems with a number of joined evaporation ponds and crystallizers; the size of the ponds is between few to several hundreds of hectares having a depth of 0.5 m to 1.5 m. Sea water is pumped into the first pond and flows to the other evaporation ponds by gravity.

In doing so, the salinity is raised due to increasing evaporation of water. *Artemia* occurs in ponds at medium salinity levels, i.e. minimum 80 g/L and maximum 140 g/L; cyst production happens in the ponds with salinity between 80 to 250 g/L.

In a single season of 6 months, 1 ha of Artemia pond can produce about 38 kg dry weight of cysts which is equivalent to 5,320 USD at a market rate of 140 USD/kg of packaged Artemia. Besides cyst production, one hectare can produce 250 Kgs of Artemia biomass whose value is estimated at USD 1.7/kg of Artemia biomass. Thus, there is a potential for developing Artemia farming as a viable economic activity at the Kenyan north coast since it blends well with salt production.

3.7.3. The economic potential of Artemia

Bog potential exists for production of good quality Artemia cysts in Kenya (10000 ha salt-works) Further KMFRI has demonstrated technical feasibility of Artemia production. The occurrence of *Artemia* at the coastal Kenya is a great opportunity, providing a chance to increase food production and create employment through enhancing emerging mariculture initiatives, such as mullet, milkfish, crabs and prawns, which seem to perform better in ponds than in natural waters.

More profits can be derived from improved salt quality, production of *Artemia* biomass and cysts at the same time using same labour, land and management. The Kenyan coastal local community development centres, which have already developed to some extent, could become targets of demonstration of *Artemia* farming activities to improve the lives of rural communities.

Stiff competition and scarcity for freshwater in Kenya limits freshwater aquaculture and has contributed to food insecurity. On the other hand, *Artemia* presence could be harnessed to boost marine fish farming.

Table 9 : Annual potential production of Artemia cyst in Northern Kenya Coast

Farmers/Salt Producing companies	Total Acreage	Projected Annual Production (Kg Dry wt.	Projected Annual Sales of Dry Cysts (Ksh)
Artisanal farmers	50	500	5,000,000
Private salt producing companies (7)	6,744	30,000	300,000,000

Source- Ngarari, M, M and Mirera O. D (2018). *Artemia* policy brief: *Artemia*/Brine shrimp (*Artemia franciscana*) production in Kenya "*Towards efficient larval rearing in hatcheries"*003/2018. KMFRI.

The *Artemia* pond culture in Kenyan coast involves both men and women. Despite fishing being the main economic activity in the region, dwindling capture fish stocks and low income generated has forced many people to seek other alternatives, *Artemia* culture may be the solution for this problem to boost aquaculture sector and hence food security

3.7.4. Production Challenges of Artemia

The production of *Artemia* by artisanal farmers in the north coast is hampered by a couple of issues that include:

- The fact that most of the small holder farmers are cut off from the open sea water by commercial salt farmers making it difficult for them to access recharge water Kenya lacks a cyst processing machine and thus the Kenyan cysts have a limited access to the market
- Farmers lack access to capital investment to expand their farms
- Predation of *Artemia* nauplii by birds, fish and other predators hamper production.
- Equipment wear out quickly as a result of the salinity in the culture area. This is a unique enterprise so not easy to get specialized equipment in the country
- Land ownership along the salt belt makes it difficult for small scale farmers to venture into this sector which can be quite beneficial to them
- The commercial salt works emphasize more on the salt production as compared to *Artemia* production since the latter is more tedious to harvest and brings a handful of income as compared to the former. This makes *Artemia* production in the salt farms unpopular yet there's great production potential in these commercial farms

3.7.5. Proposed interventions to support Artemia

i. Capacity building on artemia production

Artisanal brine shrimp farmers should be trained on improved methods of Artemia culture to further improve their livelihoods. This will enhance their ability to engage in production. The capacity should target to unlock the potential of *Artemia* by encouraging the local communities to invest in production.

ii. Promotion of *Artemia* farming

The need to promote *Artemia* farming along the coast of Kenya as an alternative livelihood to improve the economy of the coastal communities that have been documented to live below

poverty levels. There is need for public private partnerships between the *Artemia* farmers, private investors and research/national government/county government arms. The collaboration between artisanal and commercial salt producers should be enhanced to provide an enabling environment for *Artemia* production e.g. utilization of bigger space in the commercial farms for artemia production.

iii. Market development for Artemia

The primary focus is to develop local and international markets for Artemia. This will guarantee the farmers of income and encourage investment in *Artemia* farming.

4. STAKEHOLDER ANALYSIS

A stakeholder analysis was undertaken to identify and detail the stakeholders impacting the targeted aquaculture value chain at the coast. The analysis helped to identify key stakeholders in the sub-sectors and potential contribution to the development of the sector.

The analysis identified several stakeholders who are essential for the sustainable fisheries management of aquaculture in the coast. Based on the results of interviews and deepening, 21 stakeholders were involved in the management of aquaculture in the coast. Table 6 shows the roles of each stakeholder.

Table 10: List of Key stakeholders and their responsibilities

INSTITUTION	KEY FUNCTION AND RESPONSIBILITY RELATED TO AQUACULTURE
Ministry of Agriculture, Livestock and Fisheries,	Overall management and regulation of the sector, setting policy, legislation (decrees, laws, regulations) Manages all capture fishery activities. The management measures currently in place involve monitoring, control and surveillance (MSC), fisheries development, appraisal, improvement, and statistical data collection, etc.
Ministry of Lands	Licensing of all fish farms and hatcheries, leasing of land within 200m of lakes, data collection, extension/training, capture of wild fry,
State Department of Fisheries and Blue Economy	Designation of suitable aquaculture areas, running of government hatcheries and feed mills
Ministry of Water Resources and Irrigation (MWRI)	Approval for inlet, outlet and quantities of water used by farms, approval of farm establishment
Ministry of Defense (State Department of Defense)	Approval of cage farming at sea
Kenya Marine and Fisheries Research Institute	Undertakes research in "marine and freshwater fisheries, aquaculture, environmental and ecological studies, and marine research including chemical and physical oceanography", in order to provide scientific data and information for sustainable development of the Blue Economy
Jumuiya Ya Kaunti Za Pwani - JKP,	As a bloc, its aim is to position counties to realize their potential and exploit opportunities for accelerating inclusive economic growth by optimizing their regional comparative advantages and economies of scale.
The Kwetu Training Centre	Its mission is being implemented in the entire Coast Province through initiatives that empower communities to embrace innovative strategies for livelihoods enhancement, natural resources management and climate change mitigation as well as safeguard to human rights and dignity. Capacity building and funding

Coast Development Authority	Promote sustainable economic exploitation of coastal and marine resources
World Conservation Society (WCS)	Has been involved in marine conservation since 1991. Protects and restores aquatic ecosystems and the species by investing in ocean protection, sustainable fisheries, and marine species conservation.
National Environmental Management Authority (NEMA)	Regulates and manage environmental issues as regards agriculture as well as Impact assessment of fisheries programmes
Sport Fishing/Angling Clubs	Responsible for all issues affecting the sport including legislation, fisheries and environmental issues.
Association of Hotel keepers and Caterers	Manage, Lobby & Advocacy for its members with the government. It creates a conducive business environment for players in the hospitality industry by influencing decisions within institutions and economic systems.
Coast Tourism Association	Develop both inbound and outbound tourism as well as advocacy on issues that result in sustainable and responsible tourism &business growth in the region.
Beach Management Units	Co-manage the Beaches with the Fisheries Department Responsible for fisher-vetting, monitoring, security, marketing and development of landing sites in partnership with the government and other development partners.
Beach Associations/Conservation Groups, Cooperatives	Manage and lobby for its members
The Kilifi Agricultural Training Centre (ATC)	It's an Agricultural training center (ATC) for farmers in Kilifi and other counties. It plays a key role in disseminating knowledge, technologies, and agricultural information, as well as in linking farmers with other stakeholders in the economy.
Kenya Bureau of Standards	The Kenya Bureau of Standards has instituted fish processing quality assurance measures for both internal and external markets. Strict quality control procedures such as the Hazard Analysis Critical Control Point (HACCP) are in force in all fish processing plants to guarantee the quality of Kenya's fish and fish products. International best practices are employed at all stages of fish production, handling, processing, packaging, storage and distribution.
World Conservation Society (WCS)	Has been involved in marine conservation since 1991 in the western Indian Ocean primarily through the Coral Reef Conservation Project & Western Indian Ocean Project
Fish Processors and Exporters Association	Manage and support its member, Lobby & Advocacy for its members
Northern Rangeland Trust	NRT has been involved in livelihood support program for small businesses e.g. fish traders, Capacity building on sustainable fisheries, promoting conservation of mangroves and other fish species and implementing fishery projects e.g. developing enclosure for crabs
World Wildlife Fund	WWF are involved in promoting conservation of mangroves and fish species, capacity building on sustainable fishing for BMU's and infrastructure development to support fishermen e.g., building fish processing zones

Source: *EU/GIZ VC Analysis of Aquaculture – JKP, Feb/April 2021*

In order to better manage aquaculture resources, several objectives must be determined that is related to all stakeholders. Some of the common objective that the stakeholder can work together to achieve include.

a) sustainable aquaculture product
b) increasing fisherman income, and
c) Increasing fisherman catches.

4.1. Research, Education and Training

The Kenya Marine and Fisheries Research Institute is the State Corporation dedicated to conducting research in all the Kenyan waters and the riparian areas including the EEZ in the Indian Ocean. The Government of Kenya has four Aquaculture Research Institutions namely the Sagana Fish Farm, Kirinyaga County, Kiganjo Trout Farm Nyeri County, Moi University Department of Fisheries, Eldoret and the KMFRI Mombasa Kenya.

There are two types of training for aquaculture.

i. Training of farmers, which is part of extension, and is done through the National Aquaculture Research Development and Training Centre NARDTC and its sister centers spread across the country. Apart from providing on-site extension and training to farmers, the NARDTC is also equipped with facilities (hatcheries, laboratories, different types of ponds for research and culture) that can host students either for industrial attachment (internship) or research. In addition, the center has hosted large projects such as BOMOSA and PD/A CRSP whose findings are packaged as extension products for farmers. NARDTC currently focuses on developing the entire aquaculture supply chain in collaboration with the private sector and is also key in helping county governments to realize faster sustainable growth in commercial aquaculture. The other training center is Ukweli Training Institute which offers some courses on aquaculture farming.

ii. The second type is educating graduates who will work in aquaculture as extension officers, researchers or in Training of Trainers. This education has been carried out by universities and diploma colleges. Training and extension have focused on production: pond management, culture systems, breeding, feed formulation and farm management.

Below are the details of Universities and TVET Institutions in Kenya that offer academic programmes in fisheries and related field.

a) Universities

Table 11: Universities and TVET Institutions offering academic programmes in fisheries

S/No	University	Undergraduate Programme	Graduate Programme	Reference
1	University of Nairobi	BSc Fisheries and Aquaculture	MSc Fish Science	http:www.uonbi.ac.ke/uon_programmes-type
2	Kenyatta University		MSc Fisheries Science	http://www.ku.ac.ke/index,php/academics/academic-programmes/masters-programmes-a-z
3	Egerton University	BSc Applied Aquatic Sciences		http:// egerton.ac.ke/index.php/Summary-of-Programmes/summary-of-programmes.hmtl
4	Maseno University		MSc Aquatic Science	http://maseno.ac.ke/index/index.php?option=com_comtents&vie=articleid=114&Itemid=150

5	Technical University of Mombasa (TUM)	BSc Marine Resource Management BSc in Applied Biology	PhD Fisheries	http://.tum.ac.ke/programmes/degree
6	Pwani University	BSc Marine Biology & Fisheries	MSc Fisheries Management & Aquaculture PhD Fisheries Management & Aquaculture	http://www.pu.ac.ke/index.php/academics/
7	Kisii University	BSc Applied Aquatic Sciences	MSc Fisheries Management & Aquaculture PhD Fisheries Management & Aquaculture	http://www.kisiiumiversity.ac.ke/index.php?option=com_content&view=article&id=117&catid=33&Itemid=101,
8	South Eastern University	BSc Fisheries Management and Aquaculture Technology		http://www.seku.ac.ke/index.php/academics/academic-programmes
9	University of Eldoret		MSc & PhD in Fisheries with option in Aquaculture.	FAO Fisheries and Aquaculture-National Aquaculture sector Overview –Kenya. http: www.fao.org/fishery/countrysector/naso_kenya/en

Source; FAO 2016 and interviews from this study

b) TVET Institutions Offering Certificates/Diploma in Fisheries, Aquaculture and the related disciplines

Table 10: TVET Institutions Offering Certificates/Diploma in Fisheries & Aquaculture

S/No	Institution Name	County	Course
1	Ramogi Institute of Advanced Technology	Kisumu	Aquaculture
2	Railway Training Institute (RTI) Kisumu Marine School	Kisumu	Marine related studies at both Craft and Certificate level for inland fisheries
3	Kisumu Maritime Training Center	Kisumu	Coxswain Training (Privately owned)
4	Kenya Wildlife Training Institute Naivasha	Nakuru	Certificate in Aquaculture Diploma in Fisheries and Aquatic Sciences
5	Indian Ocean Maritime Training Center, Watamu	Kilifi	Short courses on maritime issues
6	National Maritime Centre of Excellence. {Proposed}	Kwale	Centre will be for the development of capacities on governance, justice, law, order and security; human resource and labor; research and sciences; maritime and shipping; offshore energy and extractives; and living marine resources once completed and commissioned
7	Matuga ATC	Kwale	This is ATVET center with proposed Courses in Fisheries. It still under Construction
8	Bandari College	Mombasa	Diploma in Mechanical Engineering Production Option Craft & Diploma in Electrical & Electronic Engineering Craft & Diploma in Maritime Studies **NB most of the training equipment even though available but are fairly obsolete***
9	East African Center for Maritime Affairs	Mombasa	Short courses
10	Kwetu Training Centre	Kilifi	Offer short several courses on aquaculture farming

The following Kenyan government facilities have also been used for extension, farmer training production of fingerlings in their location in the country:

- National Aquaculture Research Development and Training Centre (NARDTC), Sagana, currently referred to as Sagana National Fish Culture Farm, in Central Kenya
- Kisii fish farm training center, western Kenya
- Kiganjo trout farm, central region of Kenya
- Ndaragua trout farm, central Kenya
- Chwele fish farm, in western Kenya
- Lake Basin Development Authority, in western Kenya
- Wakhungu fish farm, in western Kenya
- Sangoro Research Station, in western Kenya
- Kabonyo fish farms, in western Kenya
- Kegati Research Station, in western Kenya
- Ngomeni fish farm, in the coastal region.

5. UPGRADING STRATEGIES FOR COASTAL ECONOMIC BLOC AQUACULTURE

5.1. Sustainable expansion of production /profits meaning lowering cost of production

In the face of declining catches per unit effort from wild capture, mariculture could offer an alternative source of supply to wild capture and could help reduce overall fishing effort in the JKP region. There are also strong domestic and export markets for mud crabs and Sea cucumber, yet production is limited at present. With this in mind, it is proposed that production is increased. In the case of mud crab an increase in the capacity of hatcheries is crucial in order to enable the expansion of cage culture for mariculture. To ensure expansion is sustainable, it is important that potential negative impacts are assessed and that management strategies are put in place to reduce these impacts.

5.2. Research about production practices and mitigation of negative impacts of production

To optimize the efficiency of production, it is critical that a rigorous and locally relevant knowledgebase is developed. This should include research on relevant aspects of production at both the hatchery and farm level. In addition, to minimize the risks involved in the expansion of production, research should be carried out to assess potential and actual negative impacts of mariculture activities. Increasing the capacity of local researchers to carry out this research would be highly advisable, in order to ensure its sustainability.

5.3. Development of production input markets and advisory service providers

Various types of input are essential for effective and efficient production at farm and hatchery level. Currently, the majority of inputs, such as feeds and Artemia, are expensive and need to be purchased from elsewhere. Developing low-cost local distribution of these inputs would make production more efficient. Likewise, advisory services need to be improved, to enable potential farmers to learn the production practices required to start cage culture and to ensure that best practice is adopted by new and existing farmers.

5.4. Cost-saving opportunities for mud crab/milk fish hatcheries

There is need to support the establishment of a mariculture hatchery similar to the freshwater hatcheries in other parts of Kenya instead of relying on wild catch. Energy costs at hatchery level (especially inshore ones) and ponds are significant and there is a reliance on diesel generators. Identifying appropriate solar technologies and other ways of reducing diesel costs will increase the profitability of these operations and may help increase the rate of their expansion.

Access new markets and consider certification options

There are many export markets that are interested in purchasing mud crabs, lobsters, seaweed. Further research is necessary to identify specific buyers and their requirements. Certification to standards, such as Global GAP Aquaculture, should also be considered.

Focus should be made beyond the farm level. Most aquaculture regulations and certification schemes focus on the individual farm level. But having many producers in the same area can lead to cumulative environmental impacts—such as water pollution or fish diseases—even if everyone is following the

law. Spatial planning and zoning can ensure that aquaculture operations stay within the surrounding ecosystem's carrying capacity and can also lessen conflicts over resource use.

Develop processing

There are some large processor-exporter companies in the Kenyan Coastline. If appropriate markets could be identified, there could be opportunities for processing the produce into other product formats, such as gutted, filleted and skinless. Opportunities for SMEs to produce these formats should also be explored.

Business management

Improvements in generic business management skills will underpin growth and development of all actors in the chain that wish to improve existing businesses, expand or target new markets.

Basic Bookkeeping

Knowledge and skills on basic bookkeeping for actors of specific value chains is critical. The most vulnerable actors are the fish farmers, artisanal processors and traders. The actors must know whether they are making money or not. This position can only be clearly understood if business records are kept and accessible. A capacity gap analysis and a developed capacity development framework will address this constraint.

Access to finance

Some SMEs will require access to affordable finance for investment and working capital in order to expand, produce new products and access new markets. **New finance elements can be explored:** Instead of embedded credit for the procurement of equipment (from IFP to fisherfolk) which creates dependencies and is limited in its potential impact, formal credit products would be introduced to finance the procurement of the containers. Given they ultimately stand to benefit from the investment through larger supplies and higher quality, IFPs could still subsidize part of this investment cost. This would also help ensure the buy-in of these channel captains. Instead of cash transactions, the model calls for the combined introduction of new savings options (ATMs on the beaches, boat-based mobile banking) and financial literacy training, mostly to deal with the increased working capital requirement (ice procurement) and cash flows (manage for profitability). Working capital needs are also related to the increased role of agents, who take on multiple roles. This could be in the form of bank overdraft facilities or invoice discounting (factoring).

***Leverage the latest information technology*.** Developments in satellite and mapping technology, ecological modeling, open data, and connectivity mean that global-level monitoring and planning systems that encourage sustainable aquaculture development may now be possible. A platform integrating these technologies could help the Kenyan government improve spatial planning and monitoring, help the industry plan for and demonstrate sustainability, and help civil society report success stories and hold industry and government accountable for wrongdoing.

ANNEXES-01

List of Potential Value Chain Actors & Stakeholders:

Name	Designation	Name	Designation
Leonard Njihia		Jane Amimo	
Hassan Yusuf	NRT- Deputy Director	Dr Marianne Maghenda	
Hassan Bwanamkuu	WWF- project officer	Albert Bodo Miyumo	
John Ochengo	KEMFRI	Harrison Mganga	
Fumo Bakari	Faza Station and BMU	Elijah Kiswania	
Prof. Julius Manyala	University of Eldoret (Involved in most stock assessment and Fisheries studies in Lamu) -	Mrs Gibran	
Haller Foundation Zoe Kremer		Mr Nyaki	
GIRN Youth Group		Naomi Kinyanzi	
Bernard Inha		Kilelengwani Farmers Group	
Nelson Ondego		Dulla	
Moses Githaiga	Milk Fish/Farmer	Moto Youth Group Mchawala	
Joan Kwaka	Project Manager	Alirali	
Dr. David Mirera		George Odera	
Dr. Marianne Maghenda	Deans Taita-Taveta University	Tulizana selfhelp group	
Jane Amimo	Fish Trader	Christopher Kahayu	
Albert Bodo Miyumo	Fish Hatchery Owner	Muungano Fish Women Group	
Joan Kwaka		Mariam M. Said	
George Odera		Marvin Gathu	
Harrison Mghanga	Farmer	David Mwangi Wahome	
Christine Manga		Msambweni Primary School	
Kwetu Training Centre		Mivumoni Catholic Church	
Pwani Hatrchery Paul Murage	Director-Pwani Fish Farm & Hatchery	Ukunda Catholic church	
Justine A.	Crab Hatchery	Makongeni Baraka self-help group	
Dabaso Creek Conservancy	Mud Crab Fattening	Dr Bernard M Fulanda	
Mtoni Prawn Hatchery		Caleb Kiptoo	
Bernard Iha		Martin Kiogora	
		Dr David Mwireria	
Joseph Kighamba		Christopher Ingala	
George Odera		Juma Mwarandani	
Nelson Ondego		Jane Njoki	
Ihaleni Mariculture		Philip Mputhia	

Name	Designation
Upendo Women Group	
Shibe Delta Group	
Rose mwangemi	
Said Abeid	
Dahabu	
Umoja Mariculture	
Mtongari Mariculture	
Wanyani Fish farmersOshan farm Takaungu	
Jamal Mohammed	
Kilifi G.K Prisons	
Rama Mbui	
Ian-Mtoni Hatchery	
David Shekhe	

Name	Designation
Mohammed Masambo	
Mwamraa M Mwakiraa	
Said Chirunga Juma	
Hassan Bonzo	
Davis Mwangoma	
Mwinyi Hassan	
Martin Muriuki	
Ruth Mwachogu	
Josen Mwaringo	
Yvonne L Muyia	
Elijah Obare	
Florence Mwangonya	
Esther Arunga	

Annex 2: Individual Farmer Survey Questionnaire

The questions in this questionnaire are for project work only and the findings of this study will provide information on baseline activities on farmers in this region. The information you provide will be treated with utmost confidentiality.

Your assistance in answering the questions truthfully and accurately will be highly appreciated

Enumerator's Name				Enumerator's Code			
GPS Coordinates				Date of Interview		Start Time	End Time
				...../...../2021			
County		Sub-County		Location		Village	
Value Chain Assessed							

Section A: Farmer Demographic Characteristics

1.	Name of respondent			Contacts	
2.	Age of Respondent		3. Gender	1= Male 2=Female	
4.	Marital status	1=Single, 2=Married, 3=Divorced, 4=Widow (er)			
4b	Type of Household	1=Single woman led, 2=Polygamic household, 3= Extended household, 4= Youth led household			
5.	Educational Level attained	1=No education, 2=Primary, 3=Secondary, 4=Tertiary			

Section B: Basic Information on Aquaculture

No	Variable label		Answer	Instructions
6.	How long have you been in the fish farming business?	1=≤1, 2=2-5, 3=6-10, 4=11-15, 5= >16		
7.	Have you or any of your family member had formal training (Formal Fish Farming Education) in fish farming?	1=Yes, 2=No		
8.	Is fish farming your major occupation?	1=Yes, 2=No		
9.	If No to Q8, which of the following is your major occupation	1=Farming, 2=Salaried employment, 3=Self-employed off-farm, 4=Farm worker, 5=Pensioner, 6=Other (Specify)_____		

Section C: Production Information

10	Land Ownership	01 = Purchase, 02 = Lease, 03 = Share production, 04 = Government, 05 = Others (Specify)		
11	If Lease (rental) from Q10, how much did you pay as the rental cost of the land annual	....		
12	If Purchase from Q10, how much did you buy the land (Note the size and year of purchase)	....		
13	If share production from Q10, please indicate the type of the agreement			
14	If Government from Q10, please, how much would you have paid as rental cost for the same piece of land?	....		
15	What is your source of fingerlings	01 = Government institution, 02 = Private institution, 03 = Other (Specify		
16	Type of cultural system	01 = Monoculture, 02 = Multiple culture, 03 = Companion cropping, 04 = Other (Specify		
17	What is the cost of fingerlings used			

Species	Cost per Kg	Total Cost per year

18

Species	No of times stocked per production cycle	Total harvest in kg per cycle

Section D: Pond Management

No	Variable label		Answer	Instructions
19	Did you use fertilizer on your pond during production	1= Yes, 2= No		
20	If Yes to Q19, state the type, source and quantity of fertilizer used:			

Check	Type	Source	No. of times applied/year	Amount used in Kg/year
	Commercial fertilizer			
	Poultry Faeces			

		Cow Faeces			
		Other:			

21 What is the cost of fertilizer used to fertilize the ponds

Type	Cost per Kg or Bag	Total cost per year
Commercial fertilizer		
Poultry Faeces		
Cow Faeces		
Other:		

22	What is the type of pond used?	01 = Earthen, 02 = Concrete, 03 = Cage Pond, 4= Other (Specify):		
23	What is the total number of ponds used?			
24	What is the total pond surface?			
25	What is the average cost of constructing your ponds?		....	
26	What is the source of water for your pond?			

Check	Source	Cost involved
	Rain-fed	
	Seepage water/spring	
	Stream water	
	Ocean water	
	Other	

27	Do the sources supply water throughout the year	01 = Yes, 02 = No		
28	If No to Q26, how do you ensure regular supply of water?			
	....			
29	What types of feed do you use?			

Check	Type of feed	Source	No of times fed	Amount fed
	Commercially formulated feed			
	Locally formulated			
	Cereal bran			
	Other (Specify)			

30 What is the cost of feed that you use?

Check	Type of feed	Cost per Kg or per bag
	Commercially formulated feed	
	Locally formulated	
	Cereal bran	
	Other (Specify)	

31 What your average labour cost per production cycle

Description of Production cycle (Describe for each species)	Average labour cost/ Month

32	What method(s) do you use to harvest your pond?	01 = Partial harvesting, 02 = Complete harvesting, 03 = Both		
33	What equipment do you use for harvesting?	01 = Net, 02 = Chemical, 03 = Both, 4= Other (Specify)		
34	Where do you market your fish	01= Farm site, 02 = Local market, 03 = Export, 04 = Delivered to customers, 05 = Institutional buyers		
35	In what form do you market your fish?	01= Fresh, 02 = Processed (please state the type): Smoked, Dried, Fried (.....%)		
36	What activities (value-Capturing) do you perform on the produce before selling to the buyer?			

Activities	**Whether performed**	
Cleaning	01 = Yes, 02 = No	
Smoking	01 = Yes, 02 = No	
Frying	01 = Yes, 02 = No	
Icing	01 = Yes, 02 = No	
Sorting	01 = Yes, 02 = No	
Storage	01 = Yes, 02 = No	
Transportation	01 = Yes, 02 = No	
Others (Specify)	01 = Yes, 02 = No	

37	How do you market your fish	1=Individually 2=Collectively 3= Other (Specify)		
38	Why do you prefer to market the way you do?	List reasons here:		
39	If you sell collectively, who do you market with?	1=Individual farmers within the village 2=Individual farmers in neighbouring villages 3=Groups within the village 4=Groups outside the village		
40	Do you have any contractual agreements with buyers?	1=Yes, 2=No		
41	If yes, what type of contract	01 = Verbal Contract, 02 = Written Contract, 03 = Other (Specify)		

42	Who determines the prices of the fish you sell?	1=Farmers (self) 2=Middlemen/broker 3=Trader/buyer 4=Others, please specify		
43	What are the marketing challenges that you experience?			
	Marketing Constraints/ Challenges	**Tick any that is applicable**		
	Lack of transport	☐		
	High cost of transportation	☐		
	Poor village infrastructure (roads, communication network)	☐		
	Lack of marketing information (prices, market outlets, quality, quantities, value addition)	☐		
	Poor pricing (low, unstable, lack of bargaining power)	☐		
	No market outlets	☐		
	Small quantities of produce	☐		
	Exploitation by brokers/middlemen	☐		
	Others (*please specify)*	☐		
44	What would be required for you to succeed in aquaculture?			
	.....			

Section E: Access to Inputs and Services

No	Variable label		Answer	Instructions
45.	Do you have access to veterinary services? (health assistance)	1= Yes, 2= No, don't know who, 3=Not available/too far		If 2, skip to 43
46	If yes, from where did you get that service?	1= Gov't veterinarians, 2=Private veterinarians, 3= Shops or market, 4= Others (Specify):		
47	Did you pay for the service?	1= Yes, 2= No		
48	If no, who paid for the service?	.....		
49	Do you have anybody who advises/trains farmers about aquaculture? (Extension services)	1=Yes, 2=No		If 2, skip to 54
50	Which organization does s/he come from?	1= Farmer group 2=Government extension officers 3=NGO's 4=Other (Specify)		

51	If trainer comes from NGO, what is the name of the NGO?	.....		
52	In the past 12 months how many times did you receive advise/training (visited) by service providers?	1=Once 2=Twice 3=Thrice 4=Four times 5=Five times 6=More than five times		
53	Are you satisfied with the service offered by the person/organization?	1=Yes, 2=No		

Section C: Farmer Organization and Group Governance

No	Variable label							Answer	Instructions
54	Are you a member of an aquaculture farmer group?	1= Yes, 2= No							If 2,Skip to
55	What is the name of your group?								
56	How many members are in your group?	Total	.....	Men	.....	Female	.....		
57	What are the main areas of focus of your farmer group?								
58	Why did you join the farmer group?								
59	In your view do you benefit by being a member of the farmer group?	1=Yes, 2=No							
60	What are the benefits that you enjoy by being a member of the farmer group?								
61	What contribution do you make to your farmer group?								

Section D: Gender roles

62. Who in your household makes decisions about the following aspects of aquaculture farming?	
Type of Activity	**Who makes decisions about each aspect (code a)**
Feed purchase	
Fingerling's purchase	
Fertilizer purchase and use	
Manure purchase and use	
Land use	
Pond's construction and use	
Tool's purchase	
Other infrastructure……	
Smart phone	
Code a) Who makes decisions? 1= male head of household, 2=female head of household, 3 = other male HH member(youth), 4= other female HH member (youth), 5= male farm worker, 6= female farm worker, 7= senior male and female jointly, 8= any household member, 9=other specify	

63. Who in your household owns the following income and financial assets aspects of aquaculture farming?	
Type of Asset	**Income/Financial aspect (code a)**
Profits	
(Re-) investment	
Sales	
Market(ing)	
Own consumption	
Gifts/giveaways	
Household budget	
Aqua business budget	
Code a) Who makes decisions? 1= male head of household, 2=female head of household, 3 = other male HH member(youth), 4= other female HH member (youth), 5= male farm worker, 6= female farm worker, 7= senior male and female jointly, 8= any household member, 9=other specify	

64. Who in your household owns the responsible for the following aspects of aquaculture farming?	
Type of Asset	**Labour/time division aspect (code a)**
(Pond) design	
(Pond) construction	
Major repairs	
Daily feeding	
Slashing	
Record keeping	
Buying fingerlings	
Harvest fingerlings from the wild	
Marketing	
Code a) Who makes decisions? 1= male head of household, 2=female head of household, 3 = other male HH member(youth), 4= other female HH member (youth), 5= male farm worker, 6= female farm worker, 7= senior male and female jointly, 8= any household member, 9=other specify	

65. In the above where do the men see opportunity for women to increase access/involvement?
.....
.....
.....

66. In the above where do the women see opportunity for them to increase involvement?
.....
.....
.....
.....

Annex 3: Focus Group Discussion Guide for Farmers

Facilitator's Name		Number of participants	.....Males .....Female	
GPS Coordinates		Date of Interview	Start Time	End Time
		...../...../2021		
County	Sub-County	Location	Village	
Value Chain Assessed				

Input Supply

1. What is the main input you need for aquaculture production?
2. What are your major needs/opportunities in the areas of input cost, quality, and availability?
3. Who are your most important suppliers and what do you buy from each?
4. Are there problems in obtaining some important inputs? Explain.
5. What can be done to ensure you are able to obtain the input you need for production?
6. Have you ever purchased inputs jointly with other farmers? Explain.

Production

1. What kind of species are commonly kept by farmers? And why?
2. What is the average number of ponds that farmers have (Get an estimate of the average sizes of each pond)
3. What are the main challenges to aquaculture production?
4. What should be done to address each of the challenges listed?
5. What is the percentage of women who participate in production?
6. What is the percentage of youth and women who participates in production?

Market Access, Trends, and Governance

1. To whom do you sell your fish (agents, wholesalers, exporters, retailers, direct to consumers, etc.)? What percentage goes to the different categories of buyers?
2. What are the prices for the fish for each of the buyers?
3. Describe the relationships you have with these buyers (who determines what to produce, product specifications, prices, and quantity purchased?). How much input do you have?
4. What do you see as your main needs in accessing markets?
5. Do you ever collaborate with other farmers on marketing your fish?
6. Do women and youth play any role in marketing? which roles do they play if any

Finance

1. Where do you go when you need money for your aquaculture business?
2. Do you get credit from input suppliers? What are the terms?
3. Do you get production financing from your buyers? What are the terms?
4. Do you have need for additional financing at the moment? If so, what would it be used for?
5. What sources (formal or informal) have you approached for loans, and what have been the key problems, if any?

Farmers' organization

1. Are you aware of any groups or associations in your area?
2. Are you a member of any groups or associations? What is the name of the group? When was the group formed? When did you join the group? Is the group legally registered and How many registered members does the group have?
3. What benefits / services do you get through the group or association?
4. Do you face any problems working in a group? If yes, what are the problems/ how do you solve them?
5. How can the association / group be of better help to your community / its members?
6. For those who are members of any groups, are women involved in leadership of the group? (provide a %)

Final Open-Ended Questions

1. What are the major incentives you have for investing in the value chain?
2. What risks or constraints do you face in making these investments?

Annex 4: Interview Guide for County Government Officials

Enumerator's Name				Enumerator's Code		
GPS Coordinates				Date of Interview	Start Time	End Time
				...../...../2021		
County		Sub-County				

Section A: Respondents details

a.	Name of respondent			Contacts	
b.	Position held		c. Gender	1= Male 2=Female	

1. What is the importance of the aquaculture sector to the economy of this area? (food security, incomes and exports)
2. What role does county government currently play in the aquaculture sector in this area? Has this role changed overtime and why? (research, extension, input distribution, credit, production, transportation, processing, marketing)
3. In particular, what is the capacity of your livestock department? How many staff are available, which roles do they serve and how are they facilitated?
4. How about the private sector, what role does it currently play in the aquaculture sector in this area? Has this role changed overtime and why? (research, extension, input distribution, credit, production and market information, production, transportation, processing, marketing)
5. Do you know of any CBOs/NGOs operating in this area with focus to the aquaculture sector? Which are they and what do they do?
6. What do you see as being constraints to increased performance of the aquaculture sector in this area?
7. Which strategic interventions has county government so far put in place to boost production in this area? (inquire about the short-term and long-term actions)
8. What more does county government need to do to increase aquaculture production in this area?
9. What documentation do you have on aquaculture production in the area that you could share with us?
10. Has any organization conducted a value chain analysis on the aquaculture sector in the area in the last 2 years?
11. Which organization conducted the value chain analysis?

Annex 5: Interview Guide for Development Organization

Enumerator's Name			Enumerator's Code		
GPS Coordinates			Date of Interview	Start Time	End Time
			...../...../2021		
County		Sub-County			

Section A: Respondents details

a.	Name of respondent			Contacts	
b.	Position held		c. Gender	1= Male 2=Female	
d.	Organization				

1. For how long have you operated in the county and in which sub-counties are you?
2. Which activities, both humanitarian and developmental, have your organization been engaged in?
3. Based on your own assessment of the area what are the major aquaculture value chains?
4. What are key needs for aquaculture farmers in the region?
5. Has your organization ever been involved in the development of aquaculture value chains? (If No, skip the next question).
6. If yes, how was your organization involved (or still involved), where and for what period of time?
7. What were some of the challenges your organization faced in the development of these value chains?
8. In your development work do you have any specific focus to women and the youth?
9. What has been the impact of your organization's involvement on the development of these value chains?
10. What still needs to be done to further in input supply, production and marketing to develop any of these value chains and by whom?
11. What other opportunities have you identified for supporting farmers in aquaculture in this region
12. Do you know of any organization operating in this area with focus on aquaculture? Which are they and what do they do?
13. Opportunity for partnership /collaboration in future work on the selected value chain
14. Has any organization conducted a value chain analysis on aquaculture in the last 2 years?
15. Do you know any organization planning to work of the opportunities identified?

Annex 6: Interview Guide for Traders/Exporters

Traders Survey Questionnaire

The questions in this questionnaire are for project work only and the findings of this study will provide information on baseline activities of aquaculture traders in this region. The information you provide will be treated with utmost confidentiality.

Your assistance in answering the questions truthfully and accurately will be highly appreciated

Enumerator's Name				Enumerator's Code			
GPS Coordinates				Date of Interview		Start Time	End Time
				...../...../2021			
County		Sub-County		Location		Village	
Value Chain Assessed							

Section A: Traders Demographic Characteristics

1.	Name of respondent			Contacts	
2.	Age of Respondent		3. Gender	1= Male 2=Female	
4.	Marital status	1=Single, 2=Married, 3=Divorced, 4=Widow (er)			
5.	Educational Level attained	1=No education, 2=Primary, 3=Secondary, 4=Tertiary			

Section B: Basic Information on Suppliers and clients

No	Variable label		Answer	Instructions
6	Which aquaculture commodities do you trade in?	1=Fresh, 2= Processed, 3= both		
7	Who are your main suppliers?	1=Individual producers, 2=Associations (groups) of producers, 3= brokers, 4=Others.....		
8	What is the purchase price for the different products?	**Product** / **Purchase price**		
9	What determines the price you purchase at?	....		
10	How do you communicate information to your suppliers regarding your requirements in terms of quantity of fish, weight, delivery dates, etc	....		
11	What difficulties do your suppliers have in meeting your demands?	....		
12	How do you work with your suppliers to ensure that they satisfy your requirements for quality?	....		
13	What changes would you like to see your suppliers make?	....		
14	What are the difficulties suppliers have in making these changes?	....		

15	What are volumes traded annually (indicate whether processed or fresh)?	**Product** | **Annual Volume** | | | | | |	
16	Who are your main clients (buyers)?	**List clients here:**	
17.	What are the average volumes you sell to each category of client per month?	**Client** | **Average volume** | | | | | |	
18.	How do you learn about your clients' preferences? (Order quantities, types of product preferred, standards, quality requirements, delivery dates)	....	
19	What are the steps you usually take to ensure that you meet your clien ts' specifications, including delivery date and quality?	....	
20	Do you have any challenges complying with the client's needs?	....	
21	What type of storage do you have currently?	....	
22	What is your storage capacity (in kg)?	....	
23	What is the average price (per kg) of the products that you sell?	**Product** | **Average price** | | | | | |	
24	How do you arrive at the sale price for the commodities traded?	....	
25	What are some of the key factors affecting the sale price of the products you sell?	....	
26	What are the major challenges you face a s a trader in this region	....	

Annex 7: Interview Guide for Processors

Survey Questionnaire

The questions in this questionnaire are for project work only and the findings of this study will provide information on baseline activities on farmers in this region. The information you provide will be treated with utmost confidentiality.

Your assistance in answering the questions truthfully and accurately will be highly appreciated

Enumerator's Name						Enumerator's Code		
GPS Coordinates						Date of Interview	Start Time	End Time
						...../...../2021		
Sub-County		Ward		Location		Sub-location		

Section A: Processor Demographic Characteristics

1.	Name of respondent		Contacts	
2.	Age of Respondent	3. Gender	1= Male 2=Female	

Section B: Basic Information on Aquaculture

No	Variable label		Answer	Instructions
6.	How long have you been a processor?	1=≤1, 2=2-5, 3=6-10, 4=11-15, 5= >16		
7	Who are your main suppliers?	1=Individual producers, 2=Associations (groups) of producers, 3= brokers, 4=Others.....		
8	What quantity of do you buy and what are the prices?			

Type of Fish	Quantity purchased / week	Price/ kg

9	What determines the price you purchase at?	....		
10	Do you have any special requirement for your suppliers?	1=Yes, 2=No		
11	If Yes in 10, please specify the requirements?	....		
12	Do you have customer contract with producers?	1=Yes, 2=No		
13	If yes in 12, what type of contract do you have with your suppliers?	01 = Verbal Contract, 02 = Written Contract, 03 = Other (Specify)		
14	In which months does the demand and supply of fish increases/decrease? (if the processor deal with more than on types it may be good to ask about the demand and supply of the specific types of fish)			

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
High Demand												
Low Demand												
High Supply												
Low supply												

15	What caused the fluctuation in supply and demand?	…… …… …… ……	
16	What activities (value-Capturing) do you perform on the produce before selling to the buyer?	**Activities** / **Yes or No** Cleaning Smoking Frying Icing Sorting Storage Others (Specify)	
17	What are volumes of fish processed per week?	**Product** / **Volume/ week**	
18	Where do you sell the processed fish?	1=Individual buyers, 2=Hotels/Restaurants 3=Traders/retailers 4=Others (Specify)	
19	What do you do with unsold fish?	…… …… ……	
20	What are the major challenges of processing and marketing fish in your area?	…… …… ……	