Analysis of the Livelihood Aspects of the Seaweed Value Chain in Zanzibar

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EXECUTIVE SUMMARY

This research report is a part of REPOA's linkage with the Organisation of African, Caribbean and Pacific Group of States (OACPS) under a two-year funded programme titled: "Targeted Support to Strengthen Capacity of Policy Makers, Exporters and Trade Associations to Assess and Review Trade and Related Economic Policies to Promote Trade Competitiveness and Diversification for Widening Trading Opportunities with the EU." The programme was done in collaboration with the International Institute of Social Studies at Erasmus University, Rotterdam (ISS). Due to COVID 19, this research commenced in February 2021. General purpose of the study was to analyse the seaweed value chain in Zanzibar and ultimately coming up with policy recommendations for scaling up the competitiveness of the seaweed sub sector.

The Seaweed Study Process

This study has passed through different phases and incorporated different research methods as follows:

1. **Inception Phase:** The Inception report was prepared in February 2021 and submitted to REPOA and ISS for approval.
2. **Focus Group Discussions (FGDs):** Four FGDs were conducted on 24th and 28th March 2021 in Unguja and Pemba Islands respectively involving 10 focus group discussants per FGDs to get information that could also be useful in preparing questionnaire. The FGDs with seaweed farmers and processors were conducted at Paje and Bweleo Villages (Unguja) and Tumbe village (Pemba).
3. **Pre-testing questionnaire:** The structured questionnaire was developed in April 2021 and pre -tested to seaweed farmers at Bweleo and Chukwani villages in Unguja Islands in May 2021.
4. **Listing exercise:** Based on the list of seaweed villages provided by the Ministry of Agriculture, Irrigation, Natural Resources and Livestock, Zanzibar, a sample of villages to be surveyed was drawn wherein seaweed farmers were listed. The seaweed farmers listing exercise was conducted in May and June 2021 and involved 11 villages from Unguja and 22 villages from Pemba. During the listing exercise, meetings were conducted with seaweed farmers, highlighting, among others, the purpose of research and calling on the farmers to participate fully in the research. The meetings were done in nine villages in Unguja Islands, which were Kilindi, Potoa, Pongwe, Nyamanzi, Bungi, Kajengwa, Chukwani, Uzi and Ng'ambwa.
5. **Training:** Prior to data collection, three days training to enumerators was conducted in June 2021 at Ministry of Blue Economy and Fishery at Pemba office to create a common understanding on the questionnaire and survey approach in general.
6. **The Survey:** A study managed to survey a total of 2,290 seaweed farmers out of a sample of 2400 seaweed farmers from 32 villages out of sample of 33 villages in Zanzibar. 1,672 and 618 seaweed farmers were surveyed in Pemba and Unguja respectively around July, August, and November 2021 - making a response rate of 95.4 percent. The villages surveyed in Unguja Islands were Kilindi, Bungi, Potoa, Pongwe,

Nyamanzi, Muungoni, Kajengwa, Chukwani, Uzi, Urowa and Ng'ambwa and Pemba Islands were Tumbe Mashariki, Tumbe Magharibi, Mtemani, Mjini Wingwi, Micheweni, Shumba Mjini, Sizini, Kinowe, Shanake, Tondooni, Makangale, Chokocho, Maziwa Ng'ombe, Kiuyu Mbuyuni, Gando, Kiuyu Minungwini, Kambini, Mchanga mdogo, Fundo, Chwale, and Kwale.The sample was drawn from a total population of 15,527 seaweed farmers across Zanzibar islands whereby Unguja and Pemba presented 11,705 and 3,822 seaweed farmers respectively.

7. **Key Informant Interviews:** The interviews were conducted with seaweed companies involving ZANEA, AZ Company, and HM Rashid Company. The interviews were also conducted to prominent persons in the seaweed industry including government officials who deal with seaweed farmers and individuals with many years of experiences in seaweed business.
8. **Field Work Observation:** During the study, many areas related to seaweed farming were visited including seaweed farms at the sea, drying and storage areas, as well as seaweed warehouses.
9. **Stakeholder's meeting:** A meeting involving 50 stakeholders was conducted on 21st December 2021 at the Ministry of Agriculture, Irrigation, Natural Resources and Livestock at Pemba office. The meeting had the purpose to collect more information for clarification on the data collected from the survey. Seaweed farmers and government officials participated in the meeting.

Research Findings

1. Out of the total 2,290 seaweed farmers (1,672 Pemba, 6,18 Unguja) surveyed, there was a response rate of 95 percent, about 91 percent of them were female. Proportion of males engaging in seaweed farming in Pemba (30 percent) was higher than that of Unguja (9 percent). Seaweed farmers were found in all age groups, with the greatest concentration in 36-49 age group (i.e., 40 percent). The difference in age distribution between male and female was insignificant.
2. On average, about 66 percent of farmers perceived that about 75 percent of the households in the surveyed villages were engaged in seaweed farming. As the days passed by, number of seaweed farmers seemed to increase in some villages as noticed during FGDs at Tumbe. However, in some villages the number seemed to decrease drastically especially in Unguja Islands, as noticed in Nyamanzi, Kilindi and Potoa villages. By the time the survey was conducted, people in Fukuchani village did not engage in farming seaweed anymore.
3. Nearly half (47 percent) of the surveyed seaweed farmers had not attended formal education at all, whereas share of females among females with no formal education was slightly higher (48 percent) than males (45 percent) among males. The share of seaweed farmers with no formal education was considerably high in Pemba (59 percent) as compared to Unguja (17 percent). The majority of those who attended school had primary education as their highest level of education.
4. The results show that 97 percent of the seaweed farmers considered income from seaweed farming not satisfactory even though about 95 percent of them took the

seaweed farming as their main activity. The mean price of seaweed sold for the last time by the time the survey was conducted was TZS 596 per kilogram.

5. With regards to quality issues, 98 percent of the farmers reported that there was no institution that obliged them to conform to quality standards. Farmers have not adopted Good Agricultural Practices (GAP). Drying process being the very important quality factor for seaweed; yet about 69 percent of the seaweed farmers dry their seaweed on the ground (sand), very few of them use local mats (2 percent), plastic mates (2 percent), floor (3 percent), or drying racks (3 percent) a situation that compromises quality of Zanzibar seaweed.
6. The seaweed industry is being extremely impacted by climate change. Farmers reported that productivity of seaweed has reduced as there exists strong winds, diseases, and deaths of the seaweed thus making farmers to always search for new plantation areas i.e., moving further into the sea. The presence of diseases and perishability of the seaweed were reported in many villages including Kajengwa, Kilindi, Potoa, Uzi, Ng'ambwa, Makangale and Tumbe.

   Further, seaweed farming results into huge deterioration of trees since majority of seaweed farmers are using pegs made from trees especially mangrove trees. It is estimated that to produce 1.5 tons of seaweed per season, one need to have 1000 nylon ropes and 600 pegs whereby pegs lasts for 6 up to 12 months. Therefore, a lot of seaweed farmers are replacing hundreds of pegs after every 6 to 12 months for ages.
7. Farmers spent many hours in sea water yet nearly all of them (95 percent) do not take any protective gear during their work. Few of them wear simple shoes and sometimes go with no shoes. 59 percent of the famers reported to experience seaweed health related problems such as overall body pain, swelling of legs, chest and spinal cord pains, cuts from harmful seaweed organisms and loss of eyesight.
8. Despite being in existence for more than 30 years commercially, farmers have been using the same traditional way of farming. Farmers usually use wooden pegs where nylon ropes are tied upon. Some places where sea ground being rocky area, tools such as crowbar, iron rods and plastic buckets and bags filled with sands and stone grave are used as anchors for tying ropes as noticed in some villages in Pemba. Also noticed in Kiuyu Mbuyuni, Makangale, Mjini Wingwi, Fundo and Tumbe. The farmers also use the crowbar and a hammer to create a hole where wooden pegs are inserted. To help buoyancy of seaweed, farmers use plastic bottles and drums.
9. About 60 percent of seaweed farmers reported that there are specific challenges facing women in the seaweed industry. The work seemed to be heavy to them especially during their pregnancies and in some areas, the walking distance from the village to the sea is very long. For example, in Kiuyu Mbuyuni (5 km), Maziwa Ngo´mbe (4 km), Shanake (5 km) and Kajengwa (about 2 miles) considering that the same women are culturally responsible to fully engage themselves in family work as well. In some villages traditionally, women do not go to the sea during their pregnancies and menses. Seaweed farmers at Kajengwa reported that there are no spaces at nearby sea where they could build a room/hut to exchange clothes when they get wet since the

places they used before have been taken for tourism investment.

10. Some economic activities were reported to impact seaweed industry. 65 percent of the seaweed farmers confirmed that fishing activities were destroying their farms. Other economic activities that were reported to impact seaweed industry was tourism investment specifically in Unguja Islands such as Uroa and Pongwe villages - where seaweed farmers reported that the swimming pool water coming from hotels to the sea have chemicals that cause their seaweed to become rotten and perish.
11. The local market for seaweeds is seasonal. Farmers do not have guarantee on the timing of selling their seaweed. Some farmers were paid once they sold their seaweed while others reported having to wait up to three to four months before getting paid. The local seaweed exporters haven guarantee on selling seaweed to international market. For example, a local seaweed company exporting seaweed to China said they have no contract with the buyer (i.e., according to the local company, the Chinese seaweed importers do not want to enter formal contract), hence there is no guarantee or projection of their sales to that international market.
12. There is little knowledge and information about the seaweed industry and very big information gap among seaweed value chain actors. The research revealed that while some villages such as Bweleo and Paje, where seaweed farmers are engaging in value addition activities to produce different products that sell at good price, in some other areas people have no information regarding the different uses and benefits of seaweed – such that the majority (87 percent) have not used seaweed for their own consumption. Some seaweed farmers were found to only know the personal name of the agent to whom they were selling their seaweed but did not know the name of the seaweed company that the agent was representing. The detailed market information seems to be unknown to seaweed actors, especially those at low level of the seaweed value chain.
13. The farmers do not have trust in the measuring process of seaweed by buyers. Almost in all surveyed villages e.g., Uzi, Ng'ambwa and Chukwani, farmers were claiming about the measuring process where they reported that the weight recorded for a bag of seaweed always come in whole number, there is no quarter or a half. When a seaweed company agent in Pemba was asked about why they do not consider a half or a quarter during measuring process of seaweed, the reply was that they do not pay for quarter or a half as a compensation for sand and dirties that are present in the seaweed.
14. In terms of policy and institutional framework, there exist many national plans covering the seaweed industry including Zanzibar Development Vision 2050, Zanzibar Development Plan 2021-2026, and the Blue Economy Policy 2022. It was found that there are seaweed committees at almost every Shehia, however, most farmers are unaware of them, and the committees seem to be inactive.
15. Main challenges posed by seaweed buyers were infrastructure (port congestion, roads, and power), high taxation, lack of education by seaweed farmers, improper handling of seaweed by farmers and slow handling of documentation and permits by relevant authorities in Government.

Key Recommendations

1. **Strengthening policy and institutional framework:** This should involve reviewing regulatory environment governing seaweed subsector and strengthening policies and regulations to promote the sector such as regulations on quality and adopting good agricultural practices, reviving, and strengthening seaweed farmers committees and cooperatives.
2. **Investing in Education:** Introduce Training the Trainers (TOT) program to selected seaweed stakeholders at Shehia (local area) level and staffs responsible for seaweed sector with detailed M & E framework for making follows up. The trainees will be responsible to train seaweed farmers from time to time on different aspects related to seaweed industry including quality issues, value addition and farming technologies and swimming and dive skills. Special program to emphasize the seaweed society into sending their children to school and adult education should be promoted.
3. **Introduce Experimental Phase for Seaweed**: Two or three -year experiment aiming to generate information, among others, by understanding clearly best production period and areas for seaweed, good farming methods and value addition technologies, production needs and world market demand and prices would seem relevant. The experiment preferably should involve different activities such as capacity building programs, seaweed site selection, research on the seaweed sectors and application of research outcomes with emphasis on knowledge and information sharing across the seaweed value chain actors.
4. **Investing in Quality Management:** Relevant quality bodies such as Zanzibar Bureau of Standards (ZBS), Government Chemist and Zanzibar Food and Drug Agency (ZFDA) should be strengthened through capacity building programs and acquisition of laboratory equipment so that they have necessary parameters for grading seaweed to maintain good quality. The bodies and other relevant institutions should set up quality standards for seaweed value chain to be followed by seaweed stakeholders including farmers and company agents. The Ministry responsible for Agriculture needs to emphasise on Sanitary and Phyto Sanitary measures.
5. **Putting in Place Supporting Infrastructure:** Infrastructure such as power supply, water and roads should be more reliable. Other infrastructure such as seaport, rubble roads ending to seaweed farms, storage facilities including the use of solar dryers, moisture regulators and testers, construction of seaweed warehouses, stairs and drying places including stony floor, bakery and exchange rooms for women should be considered.
6. **Introduce Environmental programs:** The seaweed projects need to take into consideration and incorporate aspects from environment such as marine conservation and tree planting programs to sustain the seaweed sector and reducing the effect of climate change.
7. **Strengthening collaboration among actors:** Seaweed sector is affected by other sectors including tourisms, agriculture, education, fishing, and health. There is a need to have very strong collaboration between all stakeholders that affect directly or indirectly to enhance the development in the seaweed sector sustainable. Stakeholders who take and implement interventions geared to promote the seaweed sector need to work

collaboratively to manage well resources for seaweed sector and curb effectively the many challenges affecting the seaweed sector.

ACRONYMS

EU ACP	European Union- Africa Caribbean Pacific
FAWE	Forum for African Women Educationalists
FAO	Food and Agriculture Organisation
FGDs	Focus Group Discussions
GDP	Growth Domestic Product
HBS	Household Budget Survey
ILFS	Integrated Labour Force Survey
ISS	International Institute of Social Studies
IT	Information Technology
MCAs	Marine Conservation Areas
M & E	Monitoring and Evaluation
MTID	Ministry of Trade and Industrial Development
MSMEs	Micro Small and Medium Enterprises
REPOA	Research for Poverty Alleviation
ZIPA	Zanzibar Investment Promotion Authority
ZPC	Zanzibar Planning Commission
WIO	Western Indian Ocean

CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER ONE

INTRODUCTION

1.1 Background

Zanzibar is composed of two main sister Islands (Unguja and Pemba) and other small Islands covering a total area of 2,654 sq km. The population of Zanzibar is estimated to be 1,889,773 (Population and Housing Census, 2022). The Zanzibar economy for the year 2021 grew at 5.1 percent from 1.3 percent in 2020. The GDP composition by sector in 2021 showed that among the four main economic sectors of Zanzibar, services sector was the leading one with a contribution of 45.3 percent of the total GDP followed by agriculture, forestry and fishing sector which had a contribution of 27.1 percent of the GDP (Office of Chief Government Statistician, 2021). The contribution of agriculture sector increased from 22.8 percent of the GDP in 2020 to 27.1 percent in 2021 while that of the services sector within the same period decreased however tourism has remained to be the main source of revenue for Zanzibar.

Agriculture, forestry, and fishing is the sector that engages most employed persons at 36.2 percent (Household Budget Survey, 2020) in Zanzibar. According to the Poverty Assessment Report (2015), more than half (56.2 percent) of the population of Zanzibar in rural areas were engaged in agriculture. Major cash crops that are grown for export are cloves and seaweed. Seaweed is the third largest contributor to GDP behind cloves and tourism. It is estimated that about 25,000 persons in Zanzibar are engaged in seaweed farming and that women account for about 80 percent of the total seaweed farmers (Zanzibar Development Plan, ZADEP, 2021-2026).

Historically, wild seaweed existed many years in Zanzibar, but commercial farming of red seaweed started in 1989 after two private companies imported Eucheuma seaweed from Philippines and

established two pilot firms at Jambiani and Paje villages on Unguja Island (Msuya, 2011). Later, seaweed farming spread to other areas of Unguja and Pemba and currently Pemba accounts for 90 percent of the total seaweed production (Zanzibar Development Plan, ZADEP, 2021-2026).

Zanzibar farms two main varieties of seaweed which are *Cottonii* and *Spinosum*. The *Cottonii* is of high quality and fetches slightly higher price than Spinosum. However, Zanzibar produces high amounts of *Spinosium* because this seaweed grows at shallow water which is easier for seaweed farmers. The higher priced *Cottonii* is more vulnerable to environmental changes compared with low priced *Spinosium* thus leading to death of *Cottonii* (Msuya, 2006). Production of two varieties of seaweed in Zanzibar for the year 2015 to the year 2021 is shown in the Table 1.1below:

Table 1. 1: Seaweed Production by Species from 2015 to 2021

Year	E.*Spinosium* Seaweed		E.*Cottonii* Seaweed		Total	
	Quantity Tons	Value TZS. Mil.	Quantity Tons	Value TZS. Mil.	Quantity Tons	Value TZS. Mil.
2015	16,665.1	9,408.6	58.2	59.9	16,723.3	9,468.5
2016	11,113.5	4,932.6	1.2	1.3	11,114.7	4,933.9
2017	10,955.0	4,381.8	26	35.3	10,981.0	4,417.1
2018	10,296	4,211.8	129	147.1	10,424.9	4,358.8
2019	9,559.2	5,535.5	104	132.2	9,663.0	5,667.7
2020	8,668.2	5,200.9	116.4	186.2	8,784.6	5,387.1
2021	10,446.6	6,268.0	84.2	134.8	10,530.8	6,402.8

Source: *Office of the Chief Government Statistician - OCGS, 2021*

Seaweed is widely used as food, production of hydrocolloids, as fertilizers and soil conditioners, animal feed, fish feed, biomass for fuel, cosmetics, wastewater treatment and integrated aquaculture (FAO, 2003). In Zanzibar, about 99 percent of the seaweed are exported in raw form. Major markets for Zanzibar seaweed are Denmark, USA, Spain, France, China, South Korea, Philippines, and Vietnam. Despite being one of the priority sectors in the blue economy agenda of Zanzibar, the seaweed sub-sector has been facing many challenges including climate change, diseases, low levels

of technology and value addition, lack of standards, inadequate drying facilities, low price, inadequate storage facilities and working tools.

1.2 Statement of the Problem

Commercial farming of seaweed in Zanzibar started about four decades ago and currently employs about 25,000 persons (Zanzibar Development Plan, ZADEP, 2021-2026). Seaweed in Zanzibar has provided many socio-economic benefits to seaweed farmers including provision of money for buying food, construction of houses and paying for children education (Msuya, 2011). In the early days of its introduction, both men and women participated equally in the commercial farming of seaweed, however, over time there has been an increasing exodus from the sector by men (Msuya, 2012) making this sub sector to be dominated by female where currently they account for more than 80 percent of the total seaweed farmers. The main reasons behind the exodus have been found to be low prices, lack of regular (daily) earning opportunities in seaweed and presence of more attractive opportunities in tourism sector especially along the coastal side of Unguja where tourism is well developed (Msuya, 2012).

Having employed a considerable number of poor people and the fact that the seaweed industry in Zanzibar ranks 3rd position in contribution to GDP proceeded by tourism and clove, interventions are usually taken to improve this sector which is currently facing many challenges major ones being low price, climate change and low value addition (Msuya, 2006, 2007, 2011; Msuya et al. 2022). Being the priority sector in the *Blue Economy* agenda of Zanzibar, the sector has been receiving various supports from the Revolutionary Government of Zanzibar (RGoZ) in collaboration with her stakeholders including private sector and development partners. Such supports are in the form of financial support, capacity building programs and provision of equipment to seaweed farmers and entrepreneurs including boats and processing machines. Currently, RGoZ is building seaweed processing plant in Pemba Islands to help seaweed farmers and entrepreneurs to get more income from value addition technologies thus improving their livelihood.

Despite the many interventions taken, yet the sector has not reached its full potential. In the world market of seaweed, Zanzibar ranked 8th position in terms of volume but was out of top ten lists in terms of value whilst China and Indonesia ranked 1st and 2nd positions worldwide in terms of volume and value of seaweed respectively (FAO, 2018). The world market of seaweed prefers *Cottonii* species over *Spinosium* whereby currently at both local and international markets, the price of *Cottonii* is more than double than that of *Spinosium*, yet the production of *Cottonii* in Zanzibar has declined from 116.4 tons in 2020 to 84.2 tons in 2021 while that of *Spinosium* has increased from 8,668.2 tons in 2020 to 10,446.6 tons in 2021 (Office of Chief Government Statistician, 2021). Further, seaweed value addition uses about 1 percent of the volume of seaweed produced in Tanzania (including Zanzibar), whilst majority of the seaweed is still sold to overseas buyers, as unprocessed raw material for industrial purposes (Msuya, 2022).

Research on seaweed sectors have been conducted in Zanzibar focusing on different aspects such as socioeconomic benefits of seaweed, methods of farming seaweed, environmental aspect of seaweed (Msuya, 2006, 2007, 2011; Msuya et al. 2022, Makame et al. 2021) however in-depth research to analyse the seaweed value chain is needed in order to produce findings that could be useful in preparing tailor made interventions for curbing the existing challenges facing the seaweed industry thus increasing its competitiveness. The findings of this research also add literature to the existing body of knowledge on the seaweed sector and are useful references for future studies.

1.3 Existing Policy and Institutional Framework

Zanzibar has adopted a number of plans and policies that have an impact on seaweed subsector. The seaweed sectors together with tourism are developed sectors of Zanzibar within the blue economy sector. Some of the policy frameworks are mentioned below:

1.3.1 Zanzibar Development Vision 2050: Under Pillar I Economic transformation, blue economy is one of the priority areas with

strategic direction to effectively coordinating and managing the development of the ocean and its endowments for significant contribution to economic prosperity. The vision inspires to exploit marine related resources and products sustainably and industrial value addition including commercialisation of fisheries and aquaculture.

1.3.2 Zanzibar Development Plan, 2021-2026 ZADEP: Within the five years from the year 2021, Zanzibar aspires to have sustainable exploitation of marine-related resources and products within an operational blue economy framework guided by marine spatial planning, environmental preservation, and clear investment procedures.

1.3.3 Zanzibar Blue Economy Policy 2022: The Policy aims at promoting sustainable development, environmental stewardship, and improved livelihoods through the coordinated and sustainable utilisation of the ocean and other blue resources.

1.3.4 Zanzibar Industrial Policy 2019 -2029: The policy measures for the blue economy are: to assist light fish and aquaculture product processing enterprises in the development of business and investment plans and marketing strategies, to promote improvement in processing and the use of improved equipment among fish and aquaculture enterprises, to support companies to improve quality and safety of products to better access regional and international markets, to strengthen safety and quality policies in order to comply with overall sanitary requirements and safety of fish products according to e.g. OIE WTO and FAO Codex, to create regional reference laboratories that meet the norms for main markets and other related infrastructure and build the capacity of the actors of the value chain.

1.3.5 Zanzibar Trade Policy 2006: Zanzibar is in mission to develop a strategically diversified, dynamic and competitive trade regime; encourage and facilitate private sector participation; establish modern administrative systems based on the latest information and communications technologies for enhancing competitiveness and efficiency of the economy; ensure optimal utilization of free trade, including free port facilities, with initial focus on marine & agro products, tourism and EPZ products as the principal growth sectors.

1.3.6 The Micro, Small and Medium Enterprise Policy 2020: The broad objective of the Micro, Small and Medium Enterprise Policy is to create a conducive environment that will develop in a partnership and consultative manner MSMEs activity in Zanzibar, in fostering job creation and income generation and maximizing value added through supporting them in their efforts to improve performance and competitiveness.

1.4 Purpose and Objectives of the Study

The general purpose of the study is to analyse the seaweed value chain in Zanzibar and propose policy recommendations for scaling up the competitiveness of the seaweed sector. Specifically, the research seeks to identify socio economic characteristics of seaweed farmers, practices, issues, and their effects on seaweed farming and determining policy recommendations potentially for scaling up the competitiveness of the seaweed sector, particularly focusing on export market.

1.5 Organisation of the Report

After the Chapter on Introduction comes Chapter Two that describes Methodology, Chapter Three describes Socio-demographic Profile, Chapter Four explains about Seaweed Farming in Zanzibar Community followed by Chapter Five presenting Quality, Safety and Marketing of Seaweed, Chapter Six describes Income and Expenditure on Seaweed Farming, Chapter Seven describes Finance and Organisations while Chapter Eight concludes with Conclusion and Recommendations.

1.6 Ethical Clearance

Prior to the commencement of the research, permission was sought from the Revolutionary Government of Zanzibar through the Second Vice President's Office and the Office of the Chief Government Statistician, Zanzibar.

CHAPTER TWO

METHODOLOGY

2.0 Overview

The study uses a multimethod approach, namely focus group discussions (FGD), Key Informant (KI) Interviews, observation in the field, document analysis (textbook, journals, dedicated websites, national plans) and collection and analysis of quantitative primary data (survey). Prior to the survey, four FGDs were conducted in March 2021 involving 10 focus group discussants per FGD making a total of 40 focus group discussants. The FGDs were conducted to get initial information about the seaweed industry. The FGDs involved a mixture of both male and female seaweed farmers as well as processors. The FGDs were conducted at Paje and Bweleo villages (Unguja) and Tumbe village (Pemba). All the FGDs were recorded using voice recorder upon the consent from the respondents. The FGDs took place at respondents' business premises and homes. Information generated from the FGDs was used in preparing different topics covered in the survey questionnaire in April 2021. Next, the structured questionnaire was pre-tested to seaweed farmers at Bweleo and Chukwani villages in Unguja Islands in May 2021.

2.1 Sampling Design and Size

The survey involved a population of seaweed farmers carrying out their activities in Zanzibar. The survey population was divided into three domains which represented female farmers from Unguja and Pemba while male seaweed farmers from both Unguja and Pemba formed a single domain. The distribution of these geographical-sex domains is shown in Table 2.1

Table 2. 1:Summary of population of seaweed farmers per domain

Domain	Population of seaweed farmers in Zanzibar		
	Male	**Female**	**Total**
Pemba	4,112	7,593	11,705
Unguja	328	3,494	3,822
Total	**4,440**	**11,087**	**15,527**

The survey deployed a two-stage cluster sampling with probability proportional to size selection. *Shehias* (local areas) were taken as clusters where a sample of them was drawn based on their sizes during the first stage. These shehias formed the primary sampling units of the survey. There is a total of 75 *shehias* (out of 388 *shehias*) which have been identified to be the population of the topic. Out of all these *shehia* (clusters), 33 were selected to be included in the survey.

In the second stage of sampling, samples of seaweed farmers were selected from each *shehia* using a systematic selection method. The selection was made from the list of all seaweed farmers which have been recorded from each of the selected *shehias*. From each cluster, a sample of 50 seaweed farmers was selected. The size of the cluster sample taken was chosen by balancing the cost and precision since lowering the sample take per cluster tend to rise the precision of the estimate but increases the cost of enumeration due to increase in number of clusters to be selected for the study.

The sampling frame which was available for this study comprised of the individual respondents at *shehia* level. Analysis of this sampling frame showed large variability in terms of number of individuals between clusters and therefore some of the clusters were selected more than once for inclusion in the survey because of their size. This was so because of the probability proportional to size selection method in which larger clusters had higher probability of being

selected compared to smaller ones. Therefore, some of the clusters had multiple samples taken, that is: 100, 150 or 200 depending on their size.

To meet requirements for the actual sample size and sample take per domain, the total sample size was slightly adjusted to the nearest multiple of 50. This adjustment resulted in a slight increase of sample size which further increased the precision of the final estimates. The sample size for the survey was determined for each domain independently. In determining the sample size, the following parameters were used:

- Proportion of population with the characteristic of interest was unknown and thus 0.5 was used for yielding an optimum sample size.
- Margin of error was set to be 0.05.
- Design effect of the proposed design was 1.5.
- Non-response rate was assumed to be 5 percent.
- Since the population was known, a finite population correction (fpc) was applied to adjust the calculated sample size.
- The total sample size was the sum of the domain sample sizes.

  Equation 2.1 was used to calculate the domain sample size for the survey:

$$n = Deft^2 \times \frac{(1/P - 1)}{\alpha^2} \qquad (2.1)$$

where n is the sample size, Deft is the design effect, P is the proportion of target population with the characteristic of interest and α is the margin of error. Equation 2.1 yields the same sample size for whatever size of the target population. To take population size into consideration, a finite population correction was applied to adjust the final sample size. The finite population correction was calculated using equation 2.2:

$$n = \frac{n_\circ}{1 + n_\circ / N} \quad (2.2)$$

where n is the adjusted sample size, no is the originally calculated sample size and N is the population. Applying these equations and taking into consideration the adjustment for non-response, the sample sizes for each of the three domains is presented in Table 2.2:

Table 2. 2: Summary of population and selected sample individuals per domain

Domain	**Net Sample Size**	**Sample adjusted for fpc***	**Sample adjusted for non-response**
Pemba (Female)	900	805	847
Unguja (Female)	900	716	753
Unguja & Pemba (Male)	900	739	778
Zanzibar	**2,700**	**2,260**	**2,378**

*Finite population correction

Adjusting the total sample size of 2,378 to the nearest multiple of 50 (which was the sample take per cluster), this yields a total sample of 2,400 individuals. These individuals were selected from 33 clusters as explained earlier.

2.2 Data collection

Based on the list of seaweed producing villages provided by the Zanzibar Ministry of Agriculture, Irrigation, Natural Resources and Livestock, a sample of villages to be surveyed was drawn wherein seaweed farmers were listed. The seaweed farmers listing exercise was conducted in May and June 2021 and involved 12 villages from Unguja and 21 villages from Pemba. The villages surveyed on Unguja Island were Kilindi, Bungi, Potoa, Pongwe, Nyamanzi, Muungoni, Kajengwa, Chukwani, Uzi, Urowa and Ng'ambwa and on Pemba Island

Tumbe Mashariki, Tumbe Magharibi, Mtemani, Mjini Wingwi, Micheweni, Shumba Mjini, Sizini, Kinowe, Shanake, Tondooni, Makangale, Chokocho, Maziwa Ng'ombe, Kiuyu Mbuyuni, Gando, Kiuyu Minungwini, Kambini, Mchanga mdogo, Fundo and Chwale.

During the listing exercise, meetings were conducted with seaweed farmers, highlighting, among others, the purpose of research and urging the farmers to participate fully in the research. The meetings were conducted in nine villages in Unguja Islands. These villages are Kilindi, Potoa, Pongwe, Nyamanzi, Bungi, Kajengwa, Chukwani, Uzi and Ng'ambwa and were very useful in generating more information about the seaweed industry.

Prior to data collection in the field, a three-day training for enumerators was conducted in early July 2021 at the office of the Ministry of Blue Economy and Fishery at Pemba to create a common understanding on the questionnaire and survey approach in general. The study managed to survey a total of 2,290 respondents out of a sample of 2,400 respondents from 32 villages (out of sample of 33 villages in Zanzibar), making for a response rate of 95 percent. Importantly, during the listing exercise, it was found that farmers in Fukuchani village in Unguja no longer farmed seaweed hence the survey was not conducted in this village.

Next, 1,672 and 618 seaweed farmers were surveyed in Pemba and Unguja, respectively around July, August, and November 2021. The survey questionnaires were developed in English and translated into 'Kiswahili', the local language that was used to collect information from the respondents during the whole study. The survey questionnaire focused on the following topics: (1) socio-economic characteristics of farmers, (2) seaweed farming practices, (3) marketing information and income, (4) economic activities, (5) health and safety, (6) associations, processes, and management, (7) finance, saving and credit services, (8) quality and standards, (9) the Zanzibar Seaweed Cluster Initiative (ZaSCI) and (10) challenges. The survey questionnaires took at least 30 minutes to complete and included both open and closed questions. The survey took place in various locations including at respondents' homes, open spaces in the villages

and at the beaches. One or two days before the interview, the local leader (*Sheha*) and/or seaweed committee leader was informed about the fact that the research team would be coming to their village. Once the research team reached the village, names of the selected farmers were announced in front of the farmers and list of names were put on the wall of house of local leader or any place where many people pass. This was done especially in Pemba where farmers had no access to internet. In Unguja, the list of the selected farmers was sent to the farmers or community leaders through WhatsApp a few days before the start of the survey.

Face to face semi-structured interviews were conducted using 'Kiswahili language' with at least 15 Key Informants (10 male and 5 female) including government officials, seaweed buyers, Zanzibar Seaweed Cluster Initiative, seaweed committee leaders and seaweed farmers with vast knowledge and experiences in the seaweed industry. The KIs were selected using non-probability sampling through purposive sampling. During data collection at the field, some potential KIs were identified through suggestions from farmers thus embracing a snowball method. The KIs covered the topics as outlined in the survey questionnaire and some new ones. Topics covered under KIs with seaweed companies (buyers), for example, included (1) operation of the company's business, (2) relationships between buyers and their stakeholders (3) challenges from farmers, and (4) challenges from the institutional framework. Other topics covered under KIs with community leaders and knowledgeable person were relationships between buyers and company agents, the selling process of seaweed, the price, and markets of seaweed. The KIs were conducted at various locations including respondents' offices and open spaces in the village. The research team recorded responses from KIs and observations in notebooks.

During the field work, the research team also observed various environments surrounding the seaweed industry. However, observed how the farming was conducted at the sea, post harvesting processes such as transportation, drying, measurement, and selling of seaweed to the company agents. The team also observed the way 'tie tie' were

prepared and the way seaweed were tied on the nylon ropes. Different tools that were used in seaweed farming activities were observed such as wooden pegs, iron rods, hammer, nylon ropes, drying racks, small boats etc.

2.3 Survey data analysis

Quantitative data from survey was collected through the Cspro data entry program and analysed as descriptive statistics using the Statistical Package for the Social Science (SPSS) and 265 Microsoft Excel. Qualitative data collected from transcripts of KI, FGDs, meetings and observations were collected manually, summarised, and analysed. The survey also used secondary data to complement primary data.

CHAPTER THREE

SOCIO-DEMOGRAPHIC PROFILE

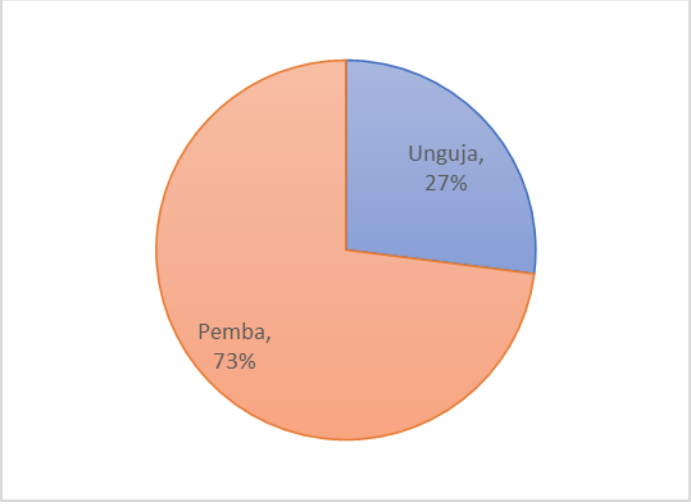
3.0 Overview

Socio-economic characteristics of seaweed farmers are important factors to be assessed as they might affect the seaweed farming. This section presents socio economic characteristics of the seaweed farmers with regards to location of the community, sex, age, marital status, education level, disability status and average household size.

3.1 Location of the community

This study managed to interview a total of 2,290 individuals from two Islands of Zanzibar. Out of this interviewed population, 73 percent which is equivalent to 1,672 respondents were from Pemba Island while the remaining 27 percent (618 respondents) were from Unguja Island, Figure 3.1.

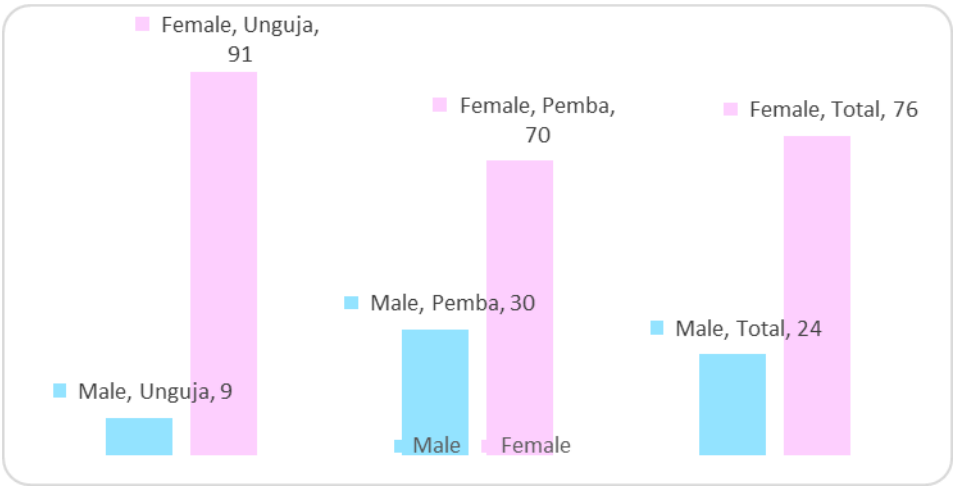
Figure 3. 1: Distribution of respondents by locality



3.2 Age by Sex distribution of the population

Majority of seaweed farmers across both Islands were female (Figure 3.1). About 76 percent of the total seaweed farmers surveyed were female. This is in line with previous studies from Samoa Islands where seaweed was found to be traditionally a women's asset (Anderson et al. 2023), with women historically responsible for all harvesting, processing and marketing of seaweed contrarily to studies from Indonesia where it was reported that both men and women contributes equally to most processes in seaweed production (Fitriana, 2017; Kunjuraman, V et al. 2019) whereas studies from Philippines and Wagina Islands reported that men carry 60 percent and 68 percent of the seaweed farming respectively (Bacaltosi et al. 2012 and Kronen et al 2010). However, generally, Agriculture and Fishery sector recorded a decline in employment for both males and females in Zanzibar, whereby males declined from 38.3 percent (ILFS 2014) to 23.4 percent (ILFS 2020/21); while females declined from 44.3 percent (ILFS 2014) to 22.2 percent in ILFS (2020/21).

Figure 3. 2: Percentage distribution of respondents by location and sex



Across the two Islands, more men in Pemba (30 percent) were engaging in seaweed farming than those of Unguja (9percent). During FGDs at Unguja, male discussants reported that:

"For us men, fishing activities are far better than seaweed farming because in fishing we get money immediately, there is no waiting for tomorrow or a day after tomorrow," (Anonymous, farmers at Bweleo village during FGDs on 24th March 2021).

These results are in line with studies by Msuya (2011, 2017**)** who revealed that men especially in Unguja do not prefer seaweed farming because they need money on a daily basis, as they find it to be time and labour intensive. Coupled with low prices, men were more attracted by fishing and activities triggered by tourism. In Pemba, many men still farm seaweed because of a lack of alternatives compared to Unguja where developed tourism provided the increased alternatives to the people living in Unguja (Msuya, 2012).

Seaweed farmers were found in all age groups, with the greatest concentration in 36-49 age group (40 percent). The difference in age distribution between male and female was insignificant. Other age groups with high proportions of seaweed farmers were 50-64 age group (27 percent) and 25-35 age group (22 percent). The age structure of seaweed farmers indicates that the sector comprises of many economically active persons which is good sign for implementation of interventions targeting to improve the seaweed industry, see Table 3.1 and Table 3.3.This result corresponds with study by Valderrama (2013) which indicated that about 60 percent of the surveyed seaweed farmers in two regions in India were middle aged individuals (31–50) years that is usually receptive to new ideas and is capable of implementing them.

Table 3. 1: Percentage distribution of respondents by age and sex

Age group	Sex		Total
	Male	Female	
Under 18	1	1	1
18 – 24	6	6	6
25 – 35	20	23	22
36 – 49	37	41	40
50 – 64	30	25	27
65 +	7	4	5
Total	100	100	100

Table 3. 2: Percentage distribution of respondents by age and locality

Age group	Unguja	Pemba	Total
Under 18	0	1	1
18 – 24	3	7	6
25 – 35	21	23	22
36 – 49	49	36	40
50 – 64	24	27	26
65 +	3	6	5
Total	**100**	**100**	**100**

3.3 Marital status

About 83 percent of seaweed farmers were married whereby proportion of male was high (89 percent) than female (82 percent), see Table 3.3

Table 3. 3: Percentage Distribution of respondents by marital status and sex

Marital status	Male	Female	Total
Single/never married	9	6	7
Married	89	81	83
Widow/divorced/separated	1	7	5

Widow/death	1	6	5
Prefer not to state (don't read)	0	0	0
Total	**100**	**100**	**100**

Across the two islands, the proportions of married seaweed farmers were slightly high in Pemba (85 percent) than Unguja (79 percent) while the latter experiencing large proportions of seaweed farmers who are widow (17 percent) than the former (8 percent), see Table 3.4

Table 3. 4: Percentage Distribution of respondents by marital status and locality

Marital Status	Unguja	Pemba	Total
Single/never married	4	7	7
Married	79	85	83
Widow/divorced/separated	10	4	5
Widow/death	7	4	5
Prefer not to state (don't read)	0	0	0
Total	**100**	**100**	**100**

Majority being married implies that income earned from seaweed is very important for sustaining family life. This is in line with findings from Integrated Labour Force Survey-ILFS 2020/2021 showing that married males and females constituted higher proportions of persons aged 15 and above (52.2 percent and 52.9 percent respectively).

3.4 Education level

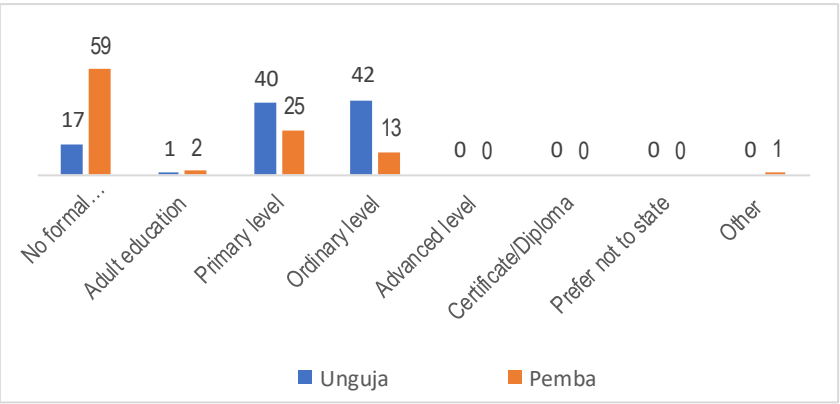
Nearly half of the seaweed farmers had not attended to school at all (47 percent) whereas proportion of females in total females with no formal education was higher (48 percent) than males (45 percent) in total males. The majority of those who attended to school had primary education as their highest level of education (Table 3.5).

Table 3. 5: Distribution of respondents by level of education and sex

Highest level of education	Male	Female	Total
No formal education	249	834	1,083
Adult education	17	24	41
Primary level	161	508	669
Ordinary level	125	350	475
Advanced level	0	2	2
Certificate/Diploma	1	1	2
Prefer not to state (don't read)	1	1	2
Other (specify)	1	15	16
Total	**555**	**1,735**	**2,290**

Across the two Islands, the number of seaweed farmers with no formal education was considerably high in Pemba (59percent) as compared to Unguja (17 percent). For those seaweed farmers who attended formal education, the majority of them in Unguja Island had secondary level education (42 percent) while those of Pemba had primary level education (25 percent), see Figure 3.3. This is parallel to the study by Ronald Bet et al. (2015) who found that majority of the interviewed seaweed farmers (60 percent) in Unguja Island had a secondary education.

Figure 3. 3: Percentage distribution of respondents by level of education and locality



Besides having low or no formal education, many of the respondents confirmed to have received religious education from religious teaching classes (madrassa). The low level of education has greatly impacted practices in seaweed industry. Challenges present such as limited use of documentation and technologies; quality control issues, lack of market information and low negotiation power on price could be attributed to limited education by seaweed farmers.

3.5 Disability status

Table 3.7 indicates the disability status of seaweed farmers. About 2 percent of seaweed farmers had disability whereby proportion of males in total males with disability was high (3 percent) than females in total females (2 percent). The types of disability reported were mainly difficulties in seeing and hearing. The same types of disabilities were the main disabilities confirmed to face older people in Zanzibar (Household Budget Survey, 2019/2020) whereas findings from the Integrated Labour Force Survey 2020/2021 confirmed that proportions of persons in Zanzibar who have visual impairment, hearing impairment, and physical (walking) disability were 1.8 percent, 1.0 percent, and 0.3 percent respectively.

Proportions of disability among seaweed farmers across the two islands is the same, see Table 3.6.

Table 3. 6: **Percentage distribution of respondents by disability status, sex and locality**

Sex/Location	With disability	Without disability	Total %
Male	3	97	100
Female	2	98	100
Total by sex	2	98	100
Unguja	3	97	100
Pemba	2	98	100
Total by locality	2	98	100

3.6 Household Size

Table 3.7 indicates the number of members in households across the two Islands. According to Household Budget Survey, 2019/2020, the average household size in Zanzibar is 5.3.

Across the two Islands, the household size of the surveyed seaweed farmers in Pemba was higher than that of Unguja. This result agrees with the findings from Household Budget Survey 2019/2020 that indicated Pemba districts having larger household size than Unguja districts, whereas Chakechake district in Pemba had the largest household size of 6.5.

Table 3. 7: Percentage distribution of respondents by households and locality

Household size	Unguja	Pemba	Total
1	1	0	1
2	4	2	2
3	7	3	4
4	12	6	7
5	23	9	13
6	13	12	12
7	16	14	14
8	10	16	14
9	9	14	13
10+	5	24	20
Total	**100**	**100**	**100**

CHAPTER FOUR

SEAWEED FARMING IN ZANZIBAR COMMUNITY

4.0 Overview

This chapter describes seaweed farming practices, types of seaweed farmed, farming methods, extent of household farming seaweed, time use, growing period, demand, prices, experiences in seaweed farming and trainings.

4.1 Seaweed Farming Practices

Table 4.1 shows that majority of farmers in Zanzibar farmed seaweed as family members whereby percentage of male in total males (68 percent) was more than percentage of females in total females (49percent) farming as family.

Table 4. 1: Percentage distribution of farming practice by sex

Question		**Male**	**Female**	**Total**
Are you farming seaweed	*Alone/individual*	26	42	38
	cooperatives/association	3	3	3
	Family	68	49	54

Across the two Islands, majority of seaweed farmers in Unguja farmed seaweed individually (68 percent) whereas in Pemba, majority of them farmed as family (64 percent) as shown in Table 4.2. Either some seaweed farmers were using combination of two or all the three approaches. Previous studies from Indonesia confirmed that seaweed farming was conducted as family business (Fitriana, 2017). Contrarily, Larson et al. 2023 reported that in Samoa Island seaweed farms were not seen as something to be developed as a private/family business,

rather, as communal/village business, managed by a village appointed committee.

Table 4. 2: Percentage distribution of farming practice by locality

Question		**Unguja**	**Pemba**	**Total**
Are you farming seaweed	*Alone/individual*	68	27	38
	cooperatives/association	1	4	3
	Family	27	64	54

4.2 Types of Seaweed Farmed

Spinosium is the main species of seaweed farmed in Zanzibar. About 87percent of the total seaweed farmers farmed *Spinosium* only while very few farmed *Cottonii* only (1percent) as indicated in Table 4.3. Since *Spinosium* fetches low price (TZS 500 -TZS 700) as compared to *Cottonii* (TZS 1,800 to TZS. 2,000), this has translated into low income earned by the seaweed farmers. According to (Msuya 2011), the world market prefers *Cottonii* over *Spinosum* because gel extracted from *Cottonii, kappa carrageenan*, is stronger than that extracted from *Spinosum, iota carrageenan.*

Table 4. 3: Percentage distribution of seaweed types by sex

Question		**Male**	**Female**	**Total**
What type of seaweed are you farming?	*Spinosium only*	89	86	87
	Cottonii only	1	1	1
	Both almost equally	1	1	1
	Mainly Spinosium few Cottonii	8	10	10
	Mainly Cottonii few Spinosium	1	2	1
	Other type (please specify)	0	0	0
Total		**100**	**100**	**100**

Table 4.3 revealed that more females were farming at least *Cottonii* type of seaweed (14 percent) as compared to males (11 percent) whereas *Spinosium* type of seaweed may survive in shallow waters,

currently *Cottonii* survive only in deep sea water. This indicated that female farmers were also engaged in deep sea farming. Some villages farming *Cottonii* species were found to be Chokocho, Makangale, Wingwi, Fundo (Pemba) and Uroa (Unguja).

Table 4. 4: Percentage distribution of seaweed types by locality

Question		**Unguja**	**Pemba**	**Total**
What type of seaweed are you farming?	*Spinosium only*	74	92	87
	Cottonii only	0	1	1
	Both almost equally	1	1	1
	Mainly Spinosium few Cottonii	25	4	10
	Mainly Cottonii few Spinosium	0	2	1
	Other type (please specify)	0	0	0
Total		**100**	**100**	**100**

Across the two Islands, proportion of seaweed farmers farming at least *Cottonii* type of seaweed was high in Unguja (26 percent) as compared to Pemba (8 percent), see Table 4.4.

4.3 Farming Methods

Seaweed farmers used line or off bottom method more often than floating method. This can be attributed by the fact that *Spinosium* is the species that dominates seaweed farming in Zanzibar and can grow in shallow intertidal lagoons. The reasons to using line or off bottom method were found to be due to the ease of using and learning, being less costly, easy to get support from others, no fish grazing, no risk of drowning, no swimming and dive skills required, less walking distance in the sea, no transport devices required e.g. boat, with no exposure to oceanic currents, good growth of seaweed and largely due to lack of awareness of other methods. The challenge for using this method was that pegs could easily get destroyed by strong winds and sea weeds may decay during summer season due to high water temperatures near the shore.

Farmers confirmed that planting seaweed at high water level using floating method may help to reduce die offs due to heat as well as dirties because these dirties would pass beneath the seaweed thus providing higher production. This is in line with the study by (Msuya, 2007) who reported that floating line method has advantage of reducing die-offs that occur using the line or off-bottom method. The author further explained that floating line plots also act as fish-aggregating devices and by using '*dema*' traps, seaweed farmers can also harvest a substantial number of fishes. Despite the advantages, farmers reported that farming seaweed at high water level using floating method is more expensive as it requires tools such as boat and buoys, requires swimming and dive skills and seaweed can be easily grazed by fish.

3.4 Extent of Household Farming Seaweed

About 66 percent of seaweed farmers perceived that over 75 percent of the households in their village were engaged in seaweed related activities (Table 4.5). Either same perception was held by seaweed farmers across both Islands.

Table 4. 5: Percentage distribution of extent of household farming seaweed by sex

Question		**Male**	**Female**	**Total**
To what extent are households in this community involved in seaweed-related activities?	*All households*	10	8	8
	Over 75% of households	62	67	66
	About half (50%) of households	15	12	13
	Less than half (50%) of households	13	13	13
Total		**100**	**100**	**100**

However, proportion of seaweed farmers perceived that people continue to engage in seaweed farming as they were five years ago - was almost equal between male and female.

Table 4. 6: Percentage distribution of perception about people involvement in seaweed industry in five years by sex

Question		**Male**	**Female**	**Total**
Are the people of this community farming seaweed as much as they were 5 years ago?	*Yes*	67	62	63
	No	33	38	37
Total		100	100	100

An average of 63 percent farmers perceived that people were farming seaweed as much as they were five years ago (Table 4.6) and an average of 78 percent farmers perceived that people were farming seaweed as much as they were one year ago (Table 4.7).

Table 4. 7: Percentage distribution of perception about people involvement in seaweed industry in a year by sex

Question		**Male**	**Female**	**Total**
Are the people in this community farming seaweed as much as they were last year? (January to December 2020)	*Yes*	82	76	78
	No	18	24	22
Total		**100**	**100**	**100**

Across the two Islands, proportion of farmers believing that more people were engaged in seaweed farming was 65 percent in Unguja Island, much lower than that of Pemba (82 percent). Table 4.8 illustrates this as follows:

Table 4. 8: Percentage distribution of perception about people involvement in seaweed industry in a year by locality

Question		**Unguja**	**Pemba**	**Total**
Are the people in this community farming seaweed as much as they were last year? (January to December 2020)	*Yes*	65	82	78
	No	35	18	22
Total		**100**	**100**	**100**

Results showed that more seaweed farmers perceived that people were joining seaweed farming as the time passed by. This situation has been

noticed in Pemba at Tumbe village during FGDs. Researchers noticed the presence of many seaweed farmers at age of 20's and 30's. However, the perception that people were running away from seaweed industry should not be neglected. During FGDs in Unguja, seaweed farmers at Paje and Bweleo maintained that people, especially youth did not prefer seaweed farming and the number of seaweed farmers were decreasing. During listing exercise of seaweed farmers in Unguja Island, it was found that people in Fukuchani village did not farm seaweed anymore, whilst the number of seaweed farmers at Nyamanzi village was reported to decrease drastically where fibre boats given to seaweed farmers as government support were found to be not in use in Nyamanzi village. These results confirm earlier study by Msuya (2012) who reported that in 1993 when *Cottonii* was also farmed in Paje, the village had 500 seaweed farmers (440 women and 60 men) where the number grew to 1,400 farmers (men and women) in 1998. By 2010, the number of seaweed farmers at Paje had dropped to 150 farmers, all of whom were women. Further, it was found that farmers at Bweleo village had decreased slightly from an initial of 152 farmers to 140 in 2010.

4.5 Time Use by Seaweed Farmers

On average, the majority of farmers spent about four to five hours per day, six days per week and two weeks per month in seaweed farming as shown in Table 4.9 up to Table 4.14.

Table 4. 9: Percentage distribution of time spent in seaweed farming by sex per day

Question	**Time (Hours)**	**Male**	**Female**	**Total**
On average, how many hours per day do you spend on seaweed farming activities?	3	8	11	10
	4	27	30	29
	5	41	44	43
	6	13	11	11
Total		89	**96**	**93**

Table 4. 10: Percentage distribution of time spent in seaweed farmingby locality per day

Question	**Time (Hours)**	**Unguja**	**Pemba**	**Total**
On average, how many hours per day do you spend on seaweed farming activities?	3	9	10	10
	4	29	29	29
	5	50	40	43
	6	9	12	11
	Total	**97**	**91**	**93**

Table 4. 11: Percentage distribution of time spent in seaweed farmingby sex per week

Question	**Time (Days)**	**Male**	**Female**	**Total**
On average, how many days per week do you spend on seaweed farming activities?	3	4	7	6
	4	14	18	17
	5	23	30	28
	6	44	35	37
	7	12	10	10
	Total	**97**	**100**	**98**

Table 4. 12: Percentage distribution of time spent in seaweed farming by locality per week

Question	**Hours**	**Unguja**	**Pemba**	**Total**
On average, how many hours per day do you spend on seaweed farming activities?	3	12	4	6
	4	19	16	17
	5	32	27	28
	6	28	40	37
	7	8	11	10
Total		**99**	**98**	**98**

Table 4. 13: Percentage distribution of time spent in seaweed farming by sex per month

Question	**Time (Week)**	**Male**	**Female**	**Total**
On average, how many weeks per month do you spend on seaweed farming activities?	2	93	92	92
	3	5	5	5
Total		**98**	**97**	**97**

Table 4. 14: Percentage distribution of time spent in seaweed farming by locality per month

Question	**Time - Week(s)**	**Unguja**	**Pemba**	**Total**
On average, how many weeks per month do you spend on seaweed farming activities?	2	97	91	92
	3	1	6	5
Total		**98**	**97**	**97**

The above times are times that are usually spent by farmers when doing seaweed activities at sea area, for example planting and harvesting of sea weeds. The researcher has noticed other activities being done by seaweed farmers at home such as preparing a 'tie tie' and put them across ropes, drying, cleaning, and packing seaweed in the bags.

4.6 Growing Period of Seaweed

70 percent of seaweed farmers reported that seaweed farming take place throughout the year, see Table 4.15 and Table 4.16, however, there are times when seaweed growth is at high peak and times where seaweed growth is low. Seaweed grows well from September up to April. In rainy seasons, seaweed can grow very well but may become rotten because drying of seaweed traditionally depends on sunlight. During stakeholder meeting, seaweed farmer from Shanake village said that seaweed in their village could grow well throughout

the year but could also die throughout the year depending on the area where it was planted. The research revealed that good growing period for seaweed might differ from one area to another and depends on weather of a particular year.

Table 4. 15: Percentage distribution of growing period of seaweed by sex

Question		**Male**	**Female**	**Total**
When does seaweed farming take place during the year?	*All through the year*	74	69	70
	All through the year but mainly in month of …	19	24	23
	Only during certain months of the year (please specify)	7	7	7
Total		**100**	**100**	**100**

Table 4. 16: Percentage Distribution of growing period of seaweed by locality

Question		**Unguja**	**Pemba**	**Total**
When does seaweed farming take place during the year?	*All through the year*	54	76	70
	All through the year but mainly in	39	17	23
	Only during certain months of the year (please specify)	7	7	7
Total		**100**	**100**	**100**

These results are in line with previous studies from Indonesia where it was found that the best farming season for seaweed varied from area to area, for example in Kupang, Onansila village experienced its best harvest season from June to August while Nakean village experienced

the best harvest season from March to May. Akle village could farm all year around, with high productivity from March to August. In Alor village the best harvest season was from January to May while in Daiama village, seaweed farmers were able to farm 3 times, between April and September (Fitriana, 2017). Previous studies from Bangladesh (Ahmed et al., 2022) revealed different timings for different species of seaweed such that Gracilaria was cultured from September to March, and Gelidium from October to March. January to March was suitable for farming of Enteromorpha while December to February was suitable for Halimeda farming. November to February offered suitable environmental conditions for Padina and Dictyota farming while December to February offered suitable condition for Caulerpa racemosa culture. Also, November to March was suitable for Sargassum and Kappaphycus alvarezii farming, while Porphyra was suitable for farming during December to March whereas Hypnea was cultured all the year round.

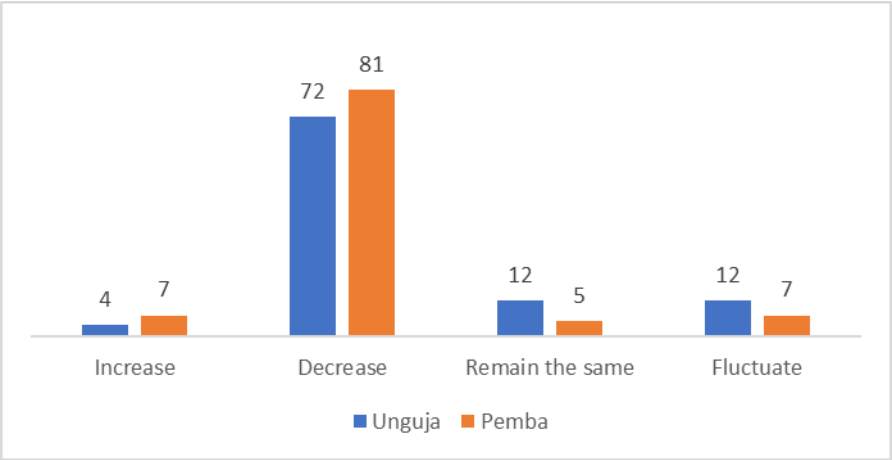
4.7 Demand for Seaweed

79 percent of seaweed farmers perceived that for the past five years, the demand for seaweed has decreased (Table 4.17 and Figure 4.1). With COVID 19 that has slowed down many business and economic activities across the globe, the demand for seaweed has decreased more.

Table 4. 17: Percentage distribution of perception on demand of seaweed by sex

Question		**Male**	**Female**	**Total**
For the past five years, has the demand for seaweed	*Increase*	6	6	6
	Decrease	82	77	79
	Remain the same	5	8	7
	Fluctuate	7	9	8
Total		**100**	**100**	**100**

Figure 4. 1: Percentage distribution of perception on demandof seaweed by locality



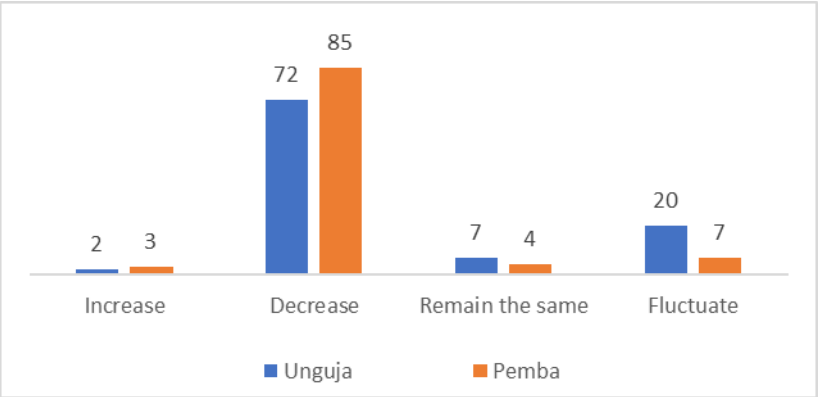
4.8 Price of Seaweed

Proportion of 82 percent of farmers reported that for the last five years, price of seaweed has decreased (Table 4.18 and Figure 4.2)

Table 4. 18: Percentage distribution of perception on price by sex

Question		**Male**	**Female**	**Total**
For the past five years, has the price of seaweed	*Increase*	3	3	3
	Decrease	87	80	82
	Remain the same	2	6	5
	Fluctuate	8	11	10
Total		**100**	**100**	**100**

Figure 4. 2: Percentage distribution of perception onprice by locality



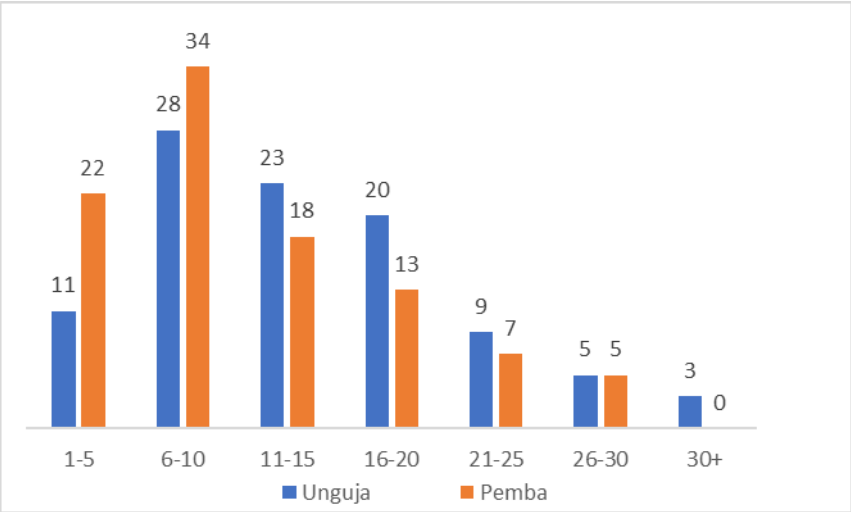
4.9 Experiences in Seaweed Farming

Being the old sub sector, about 80 percent of seaweed farmers have been in the industry for more than six years, see Table 4.19 and Figure 4.3, whereby majority have experiences between 6 to 10 years (33 percent). These results confirm an earlier study by Ronald B et al. (2015) who reported that the majority of the interviewed seaweed farmers in Zanzibar had a farming experience of 6 to 10 years.

Table 4. 19: Percentage distribution of experiences in seaweed farming by sex

Experiences in years	Male	Female	Total
01-5	19	19	19
06-10	32	33	33
11-15	22	19	19
16-20	14	15	15
21-25	7	8	7
26-30	4	5	5
30+	1	1	1
Total	**99**	**100**	**99**

Figure 4. 3: Percentage distribution of experiences in seaweedfarming by locality



4.10 Training

About 14 percent of the surveyed farmers reported to have received training (Table 4.20). For those who had training, they got it from government, seaweed cooperatives and seaweed companies (buyer).

Table 4. 20: Percentage distribution of training on seaweed farming by sex

Question		**Male**	**Female**	**Total**
Did you get any training on seaweed farming	*Yes*	14	13	13
	No	86	87	87
Total		**100**	**100**	**100**

Only 15 percent and 13 percent of the surveyed seaweed farmers in Unguja and Pemba Islands received training respectively as indicated in Table 4.21.

Table 4. 21: Percentage distribution of training on seaweed farming by locality

Question		**Unguja**	**Pemba**	**Total**
Did you get any training on seaweed farming?	*Yes*	15	13	14
	No	85	87	86
Total		**100**	**100**	**100**

Farmers used different methods to learn seaweed farming for the first time such as through observation, family, friends and training by government or seaweed company. 77 percent of seaweed farmers reported to have learned about seaweed farming for the first time by observing their fellows during seaweed farming activities. During FGDs at both Unguja and Pemba Islands, some farmers reported to receive training from different stakeholders such as Department of Fisheries from Ministry responsible for Agriculture, Zanzibar Seaweed Cluster Initiative, Institute of Marine Science of the University of Dar es Salaam and FAWE.

CHAPTER FIVE

QUALITY, SAFETY AND MARKETING OF SEAWEED

5.0 Overview

Quality and safety are very important issues in the seaweed industry. Quality always determines the price of the product. Quality and safe products for consumers' health sustain the practice of seaweed farming.

This chapter describes seaweed consumption, drying of seaweed, seaweed storage, seaweed health problems, usage of protective gear, standard quality of seaweed and technology use in seaweed.

5.1 Seaweed Own Consumption

Seaweed being widely used as food, production of hydrocolloids, as fertilizers and soil conditioners, animal feed, fish feed, biomass for fuel, cosmetics, wastewater treatment and integrated aquaculture (FAO, 2003), yet 87 percent of the surveyed seaweed farmers had not used seaweed for own consumption (Table 5.1).

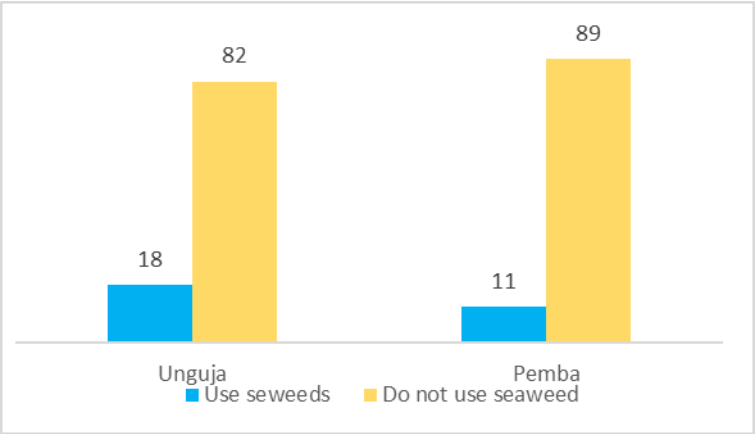
Table 5. 1: Percentage distribution of seaweed own consumption by sex

Question		**Male**	**Female**	**Total**
Have you ever taken seaweed for your own consumption?	*Yes*	10	14	13
	No	90	86	87
Total		**100**	**100**	**100**

The study indicates that 89 percent of seaweed farmers in Pemba had not used seaweed for own consumption and proportion of farmers with similar situation for Unguja was 82 percent, see Figure 5.1.

Similarly, results from introductory meetings, Key Informant Interviews and Focus Group Discussions indicated that the seaweed farmers lacked knowledge on the use and benefits of seaweed.

Figure 5. 1: Percentage distribution of farmers by using seaweed for own consumption by locality



Contrarily, seaweed is important in the traditional diet of the local people of Tawi-Tawi where a total of seven seaweed species are offered for sale in the local markets of Tawi-Tawi (Dumilag, 2019). The lower level of seaweed owns consumption in Zanzibar is the result of low value addition of the seaweed and lack of knowledge on the use and benefits of seaweed by farmers. Seaweed having many benefits and uses; little consumption of it means that seaweed farmers are also not benefited from health properties of seaweed, taking into account that they reported to get health related seaweed problems such as overall body pains and joint pains - thus leading to poor growth of seaweed sector in the long run. According to the study by Larson et al (2023), the main barrier to seaweed sectoral growth in Samoa islands was perceived lack of understanding of seaweed health and nutritional benefits by consumers. The study by Wendin and Undeland (2020) in Sweden revealed that one of the reasons to consider consuming seaweed by respondents was that seaweed was considered healthy.

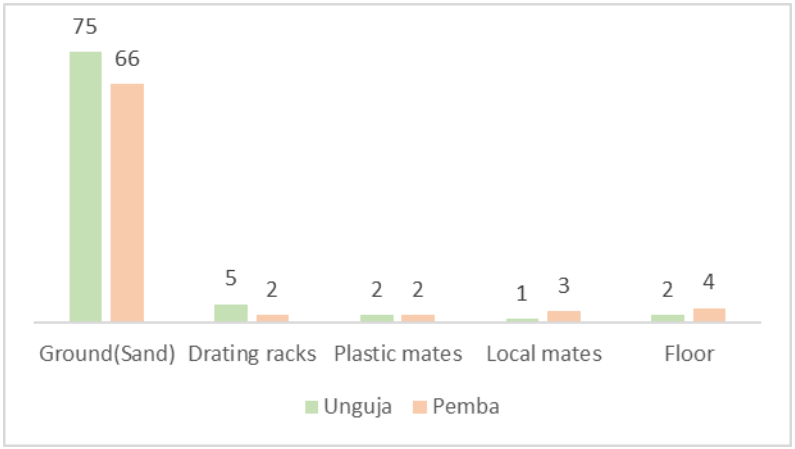
5.2 Drying of Seaweed

About 69 percent of seaweed farmers dried their seaweed on the ground (sand). Very few used local mates (2 percent), plastics mates (2 percent), drying racks (3 percent), floor (3 percent) and others use combination of these methods, Table 5.2 and Figure 5.2.

Table 5. 2: Percentage distribution of equipment used for drying seaweed by sex

Question		**Male**	**Female**	**Total**
Which equipment do you use for drying seaweed? (Multiple Answers Allowed)	*Local mates (jamvi/mkeka)*	1	3	2
	Plastic mates (turubali)	2	2	2
	Drying racks	2	3	3
	Ground (sand)	71	68	69
	floor	2	4	3

Figure 5. 2: Percentage distribution of equipment used for dryingseaweed by locality



According to various seaweed literatures, the most important quality factors for seaweed are moisture content, seaweed maturity and impurities. Through verbal conservation, the seaweed buying company stated that once harvested, seaweed in Zanzibar is of good

quality as compared to seaweed from other countries; however, the practices after harvesting put seaweed produced in Zanzibar at risk of losing its quality. Neish (2013) reported that the drying process determines the quality of seaweed.

ZPC (2018) revealed that lack of modern drying facilities (e.g., solar driers) have significantly affected the quality of seaweed produced in Zanzibar. Contrary to the drying process done in Zanzibar, previous study from Indonesia (Marino et al. 2019) reported that 64 percent of seaweed farmers used drying structures along the beach elevated from the ground while 18 percent placed their seaweed on the ground when their elevated drying structures are full. Despite the majority having dried seaweed on the ground, the seaweed farmers surveyed reported that seaweed needs to be dried on the grass or palm leaves for its better management. Besides, seaweed farmers in Jambiani village in Unguja Island reasoned that it is best to dry seaweed on palm leaves rather than the sand because the sand destroys the seaweed quality or the grass because the seaweed would destroy the grass (Erika, 2011).

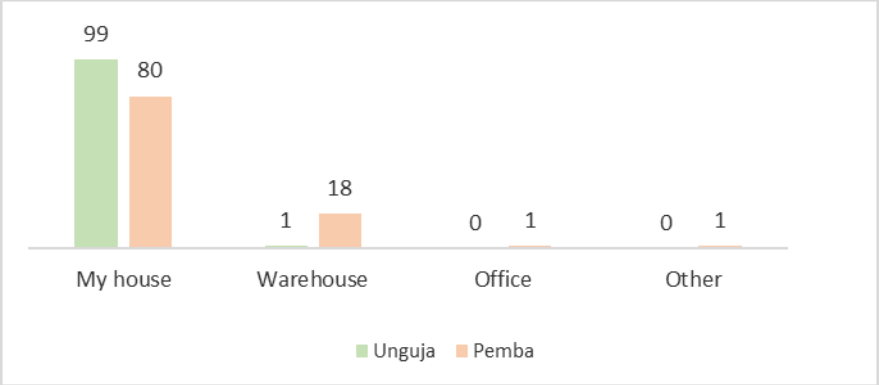
5.3 Storage of Seaweed

Table 5.3 and Figure 5.3 indicate that about 85 percent of seaweed farmers store their seaweed in their houses.

Table 5. 3: Percentage distribution of storage area by sex

Question		**Male**	**Female**	**Total**
After harvesting seaweed, where do you store them?	*My house*	78	87	85
	Warehouse	20	11	13
	Office	1	1	1
	Other (please specify)	1	1	1
Total		**100**	**100**	**100**

Figure 5. 3: Percentage distribution of storage area by locality



In some villages in Pemba, seaweed companies have built warehouses where seaweed farmers store their seaweed. The warehouses were found in Kiuyu Mbuyuni, Wingwi Mtemani, Maziwa Ng'ombe, Shumba Mjini, Micheweni na Mjini Wingwi. However, there were no warehouses in Fundo, Sizini and many of the surveyed villages in Unguja. Storing seaweed into warehouses may lead into good control of quality than storing them at homes. However, during the survey it was observed that seaweed stored at some warehouses were not very well handled to ensure no contamination with sands and other dirties.

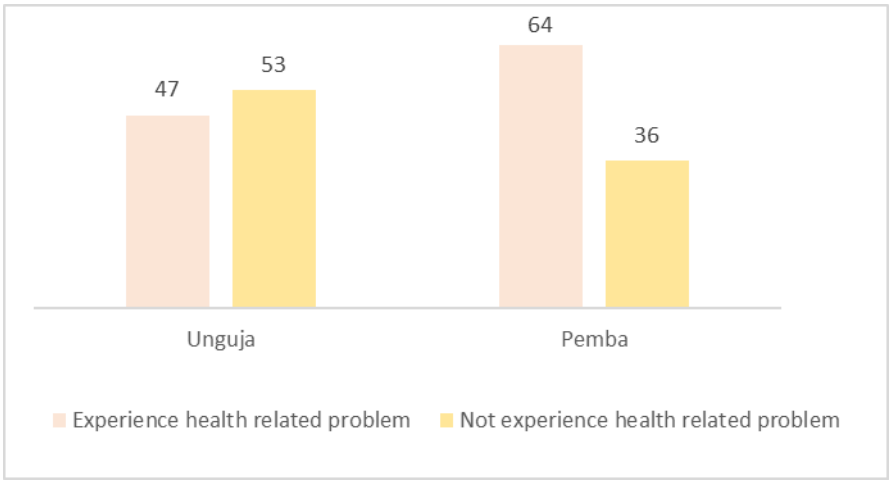
5.4 Seaweed Health Related Problems

Proportion of 59 percent of the seaweed farmers reported to get health problems due to seaweed activities as indicated in Table 5.4 and Figure 5.4. The difference in proportion of male and female who experienced seaweed health related problems was insignificant.

Table 5. 4: Percentage distribution of respondents with seaweed healthrelated problems by sex

Question		**Male**	**Female**	**Total**
Have you experienced seaweed health related problems?	*Yes*	61	58	59
	No	39	42	41
Total		**100**	**100**	**100**

Figure 5. 4: Percentage distribution of respondents with seaweed health related problems by locality



Health related problems reported by seaweed farmers were chest pain, pains in spinal cord, poor eyesight, waist pain, swelling of legs, skin diseases and overall body pain whilst majority reported to have combinations of these problems. Sometimes farmers get stings, bites, and cuts from sea organisms (e.g., 'bochu' and 'nyenga').

During Focus Groups Discussion meetings at Pemba Island, the discussants reported the presence of an unknown organism in the sea which they named it 'Kiwasho' which was said to be very harmful. Farmers reported that (Swahili Language);

"(Baharini) kuna vitu hatuvijuwi lakini vyawasha hivyo, sisi twaviita 'Kiwasho', ama hivyo vyawasha mpaka uende Hospitali ule madawa," (Anonymous, seaweed farmers at Tumbe Village during Focus Group Discussions on 28th March 2021). This is translated in English as "(In the ocean), there are things which we literally do not know but are extremely irritating, we call them 'irritants', they are really irritating until one goes to hospital and take in medicine."

Another farmer added, *"Mimi binafsi limenipata povu (la Kiwasho) na nikapelekwa hospitali, niliziba mkojo kwa masaa ishirini na nne." This is translated in English as "Myself I came into contact with foam 'irritant' and was sent to hospital, I could not urinate for 24 hours."*

According to the discussants, once the irritants 'Kiwasho' comes into contact with your skin, you get very severe irritation, your ribs become

squeezed, you get vomiting and coughing, and the body become very painful. As first aid, one needs to drink a lot of coconut water and milk before getting some proper hospital care. The discussants further explained that at hospital, the patient usually get syringe and drip as treatment and there was no particular treatment for 'Kiwasho' and people have been trying local medicine to treat 'Kiwasho' but with no success. As for the case of cuts from sea organisms such as stonefish 'nyenga', one may heal after three months. Previous studies (Msuya, 2012) stated that when farmers get stings from stonefish, they must inject against tetanus and sometimes had to go to neighbouring village for tetanus injection. Further, the discussants explained that one can get rid of 'Bochu' and 'nyenga' by wearing shoes but for 'Kiwasho', it is difficult to protect from it because it is not easily recognizable as it looks like dusty water or foam and come into contact with one's body in spite of wearing shoes. These results confirm previous studies by Msuya, (2011) that revealed that due to seaweed farming in Zanzibar, farmers were experiencing a number of undesirable skin conditions including itching, scarring and marking, darkening of colour, skin that shrinks and changes in its firmness or condition, bodily aches and pains including headaches, backaches, leg and joint pain and farmers' eyes were subject to negative effects including pain, blindness from prolonged exposure to strong sunlight, redness from salt water and intensified reflections, and itching from salt and sand particles.

5.5 Usage of Protective gear

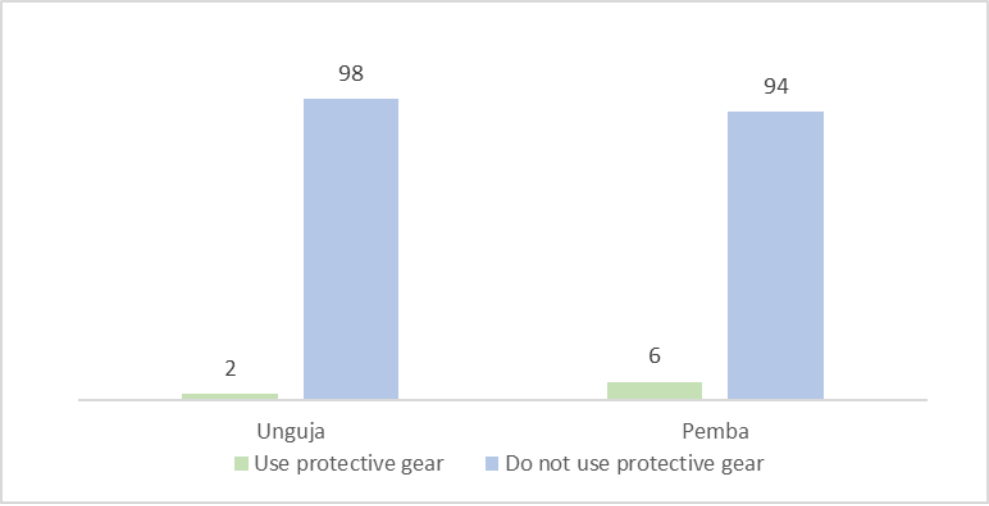
Seaweed farmers need to use specialised clothing or equipment to protect themselves from getting injured by harmful organisms present in the sea. However, about 95 percent of the surveyed seaweed farmers do not use any protective gear when doing seaweed farming activities (Table 5.5).

Table 5. 5: Percentage distribution of usage of protective gear by sex

Question		**Male**	**Female**	**Total**
Do you have any protective gear to protect you when doing activities of seaweed farming?	*Yes*	10	3	5
	No	90	97	95
Total		**100**	**100**	**100**

Across the two Islands, more farmers at Pemba (6 percent) use protective gear than those of Unguja (2 percent) as shown in Figure 5.5. For those few who use protective gear, they mainly use rain boots. The cuts and bites by sea organisms to farmers can be contributed by not using protective gear when doing seaweed activities.

Figure 5. 5: Percentage distribution of usage of protective gear by locality



5.6 Standards of Quality

Quality is the good determinant factor of price. Generally, good quality product fetches higher price. The study found that the entire processes within the seaweed value chain seem to ignore the issue of

quality. In terms of awareness on quality matters, nearly all farmers (99 percent) are unaware of the quality standards for seaweed (Table 5.6 and Table 5.7).

The seaweed was treated with no grades, and only those considered as good are bought from farmers by company agents. This is in line with previous studies from Sri Lanka where it was reported that the farmers and buyers equally do not consider much about the quality of dried seaweed and buyers pay a uniform price for dried seaweed regardless of quality. This contradicts the previous studies from Indonesia (Zamroni, 2021; Muthalib et al. 2017) where price of seaweed depends on its quality and those seaweed affected by diseases and wet seaweed were sold at lower normal price.

Table 5. 6: Percentage distribution of awareness of quality standards for seaweed by sex

Question		**Male**	**Female**	**Total**
Are you aware of quality standards for seaweed?	*Yes*	3	1	1
	No	97	99	99
Total		**100**	**100**	**100**

Table 5. 7: Percentage distribution of awareness of quality standards for seaweed by locality

Question		**Unguja**	**Pemba**	Total
Are you aware of quality standards for seaweed?	*Yes*	0	1	1
	No	100	99	99
Total		**100**	**100**	**100**

Further, nearly all farmers (99percent) reported that there were no set up quality standards that they were supposed to conform to during each stage of farming seaweed as shown in Table 5.8. Similarly, these farmers were not aware of quality aspects of seaweed however they seem to follow normal farming practices that also help them in preserving the quality of seaweed.

Table 5. 8: Percentage distribution of presence of quality standards for seaweed by locality

Question		**Unguja**	**Pemba**	**Total**
Are there set up quality standards that you are supposed to conform during each stage of farming seaweed?	*Yes*	0	1	1
	No	100	99	99
Total		**100**	**100**	**100**

5.7 Technology use in seaweed farming

Table 5.9 illustrates technology use by seaweed farmers such that an average of 95 percent of the farmers does not engage themselves in seaweed related activities – i.e., processing and value addition technologies.

Table 5. 9: Percentage distribution of technology use by sex

Question		**Male**	**Female**	**Total**
Are you engaging in any other seaweed related activities?	*Yes*	6	5	5
	No	94	95	95
Total		**100**	**100**	**100**

Generally, more than 99 percent of sea weeds currently produced in Zanzibar is exported in raw form with value addition less than 1percent thus making farmers not to realize the full potential of the seaweed industry. In Zanzibar, there are few entrepreneurs who make different products from seaweed such as cosmetics, body oils and soaps and used it as food whilst seaweed flower are used in making cakes, snacks, bread, and juice. During FGDs, it was found that seaweed farmers at Paje and Bweleo are producing and selling different seaweed products at premium price. By the time the research was conducted, the packed dried seaweed and seaweed flower at Bweleo and Paje were sold at TZS 2,000 per 250g and TZS 10,000 per kilogram respectively.

CHAPTER SIX

INCOME AND EXPENDITURE ON SEAWEED FARMING

6.0 Overview

The chapter describes sources and amount of startup capital, seaweed earned per season, quantities, and price of sold seaweed, income satisfaction, decision on the use of income, last time for selling seaweed, seaweed buyers, stocks of seaweed, records keepings, earnings from other economic activities and economic activities affecting seaweed farming.

6.1 Sources of startup capital

Seaweed farmers started seaweed farming using different sources of capital including assistance from seaweed company (buyer), own savings, assistance from friends and relatives. Table 6.1 and Table 6.2 show the main sources of startup capital where more than 70 percent of the farmers started seaweed farming with their own savings.

Table 6. 1: Percentage distribution of sources of startup capital by sex

Question		**Male**	**Female**	**Total**
What was the major source of your start-up capital for your seaweed business?	*Seaweed company*	18	20	20
	Own savings	76	71	72
	Assistance from relatives/friends	5	8	7
	Private loan agent	0	0	0
	Other specify	1	1	1
Total		**100**	**100**	**100**

This confirms an earlier study by Makame et al. (2021) that highlighted the various sources in which inputs were obtained by the seaweed farmers including company (buyer), friends and relatives.

Across the two Islands, the proportion of farmers with startup capital from seaweed company in Unguja was nearly twice (31 percent) than those of Pemba (15 percent). This could be attributed to the fact that commercial seaweed farming was first introduced in Unguja around 1989 before spreading to Pemba. In those initial days, seaweed companies used to give support to farmers to encourage the establishment of seaweed farms.

Table 6. 2: Percentage distribution of sources of startup capital by locality

Question		**Unguja**	**Pemba**	**Total**
What was the major source of your start-up capital for your seaweed business?	*Seaweed company*	31	15	20
	Own savings	63	76	72
	Assistance from relatives/friends	6	7	7
	Private loan agent	0	0	0
	Other (please specify)	0	2	1
Total		**99**	**100**	**100**

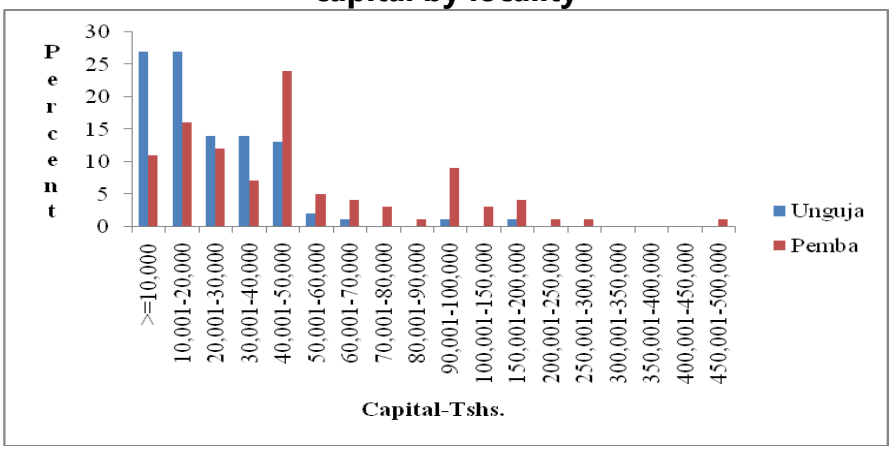
6.2 Amount of the startup capital

The amount of startup capital for a proportion of 21 percent of farmers ranged between TZS 40,000 to TZS 50,000 as shown in Table 6.3 and Figure 6.1 below.

Table 6. 3: Percentage distribution of the amount of startup capital by sex

Question	**Amount in TZS**	**Male**	**Female**	**Total**
What was the startup capital of your seaweed business? TZS	>=10,000	9	17	15
	10,001-20,000	12	21	19
	20,001-30,000	10	14	13
	30,001-40,000	7	9	9
	40,001-50,000	21	21	21
	50,001-60,000	4	4	4
	60,001-70,000	3	3	3
	70,001-80,000	3	2	2
	80,001-90,000	1	0	0
	90,001-100,000	13	5	7
	100,001-150,000	5	2	2
	150,001-200,000	6	2	3
	200,001-250,000	2	0	1
	250,001-300,000	1	0	1
	300,001-350,000	1	0	0
	350,001-400,000	0	0	0
	400,001-450,000	0	0	0
	450,001-500,000	1	0	0
Total		**99**	**100**	**100**

Figure 6. 1: Percentage distribution of the amount of startup capital by locality

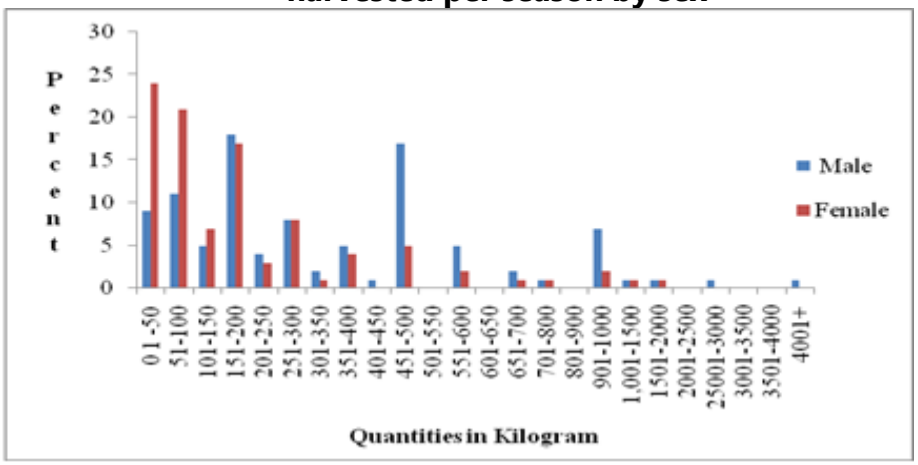


Farmers were also able to start the seaweed farming with capital below TZS 30,000 since seaweed farming involves related people living in the same community, hence making it easier for a new farmer to get raw materials freely from colleagues - for example seaweed seedlings.

6.3 Seaweed Harvested per Season

About 63percent of seaweed farmers harvested between 1kg to 200 kg of seaweed per season, Figure 6.2.

Figure 6. 2: Percentage distribution of quantities of seaweed harvested per season by sex



The results show that proportion of males harvesting/producing high quantities per season was higher than that of female despite the fact that female constitutes about 90 percent of the total seaweed farmers. This may imply that males are more advantageous than females in the industry which could be attributed to the access to equipment such as boats and bicycle for seaweed transportation during planting and harvesting. This situation also implies that if more men participate in the sector, production of seaweed could increase more. Previous studies from Indonesia revealed that the country has the highest seaweed production in the world due to balance participation of men and women in the sector (Kunjuraman, V et al. 2019). In Philippines and Wagina Islands, men carry 60 percent and 68 percent of the seaweed farming respectively (Bacaltosi et al. 2012 and Kronen et al. 2010).

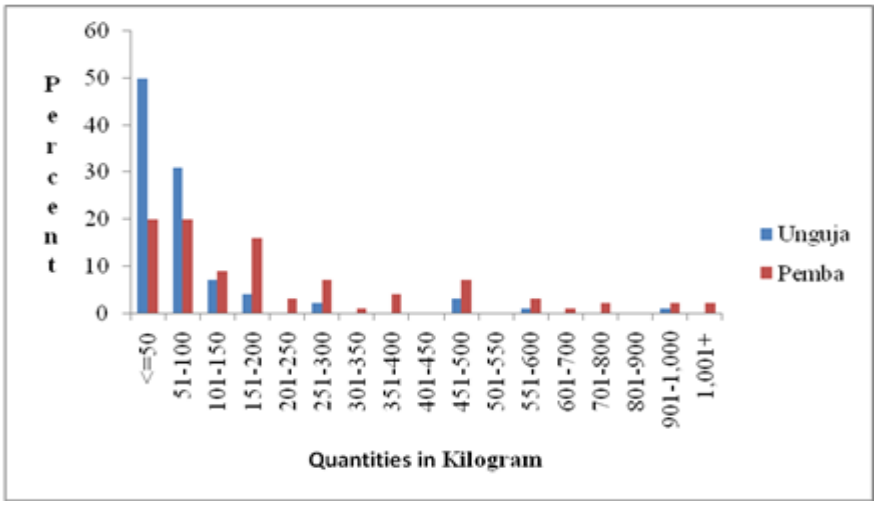
6.4 Quantities, Price and Income of Seaweed Sold

Table 6.4 shows the quantities of seaweed sold by farmers in their last sale. The trends show that as quantities of seaweed increase, proportion of male is high as compared to female.

Table 6. 4: Percentage distribution of Quantities of seaweed sold for last sale by sex

Question	**Seaweed (Kg)**	**Male**	**Female**	**Total**
What quantities of seaweed did you sell for the last time?	<50	12	33	28
	51-100	14	26	23
	101-150	11	8	8
	151-200	19	11	13
	201-250	3	2	3
	251-300	8	5	6
	301-350	2	1	1
	351-400	4	3	3
	401-450	1	0	0
	451-500	11	5	6
	501-550	1	0	0
	551-600	5	2	3
	601-700	1	1	1
	701-800	2	1	1
	801-900	1	0	0
	901-1,000	2	1	2
	1,001+	3	1	1

Figure 6. 3: Percentage distribution of Quantities of seaweed soldfor last sale by locality



The results show that the price of seaweed sold last time by farmers varied between farmers depending on the types of seaweed sold and location where seaweed selling was taking place.

Table 6.5 shows the price of seaweed sold in the last sale by seaweed farmers across the Islands.

Table 6. 5: Percentage distribution of Price of seaweed sold for last sale per kilogram by sex

Question	**Price TZS/ Kg**	**Male**	**Female**	**Total**
What was the price of seaweed per kilogramme when you sold seaweed for the last time	<=500	62	47	51
	600	28	24	25
	700	8	24	20
	800	1	1	1
	1,000	0	1	1
	1,200	0	0	0
	1,600	0	0	0
	1,700	0	0	0
	1,800	0	2	1
	1,900	1	1	1
	2,000	0	1	1
Total		**100**	**100**	**100**

Table 6. 6: Percentage distribution of price of seaweed sold for last sale per kilogram by locality

Price TZS/ Kg	**Unguja**	**Pemba**	**Total**
<=500	5	68	51
600	13	29	25
700	75	0	20
800	2	0	1
1,000	3	0	1
1,200	0	0	0
1,600	0	0	0
1,700	0	0	0
1,800	0.2	1.6	1
1,900	0	1	1
2,000	2	0	1
Total	**100**	**100**	**100**

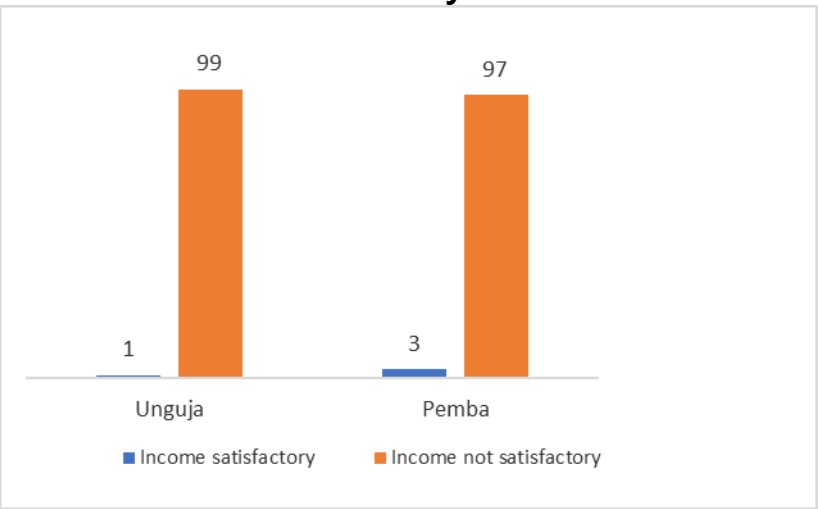
6.5 Income Satisfaction

By the time the research was conducted, the mean price of seaweed was TZS 597. About 97 percent of seaweed farmers confirmed that the income earned from seaweed was not satisfactory when compared to the many efforts put on seaweed until sold to the buyer, Table 6.7 and Figure 6.4. According to study by (ZPC, 2018), Zanzibar seaweed farmers were realizing between 30 percent to 40 percent of the export price compared to farmers in Philippines and Indonesia who earned between 60 percent to 70 percent of the export price.

Table 6.7: Percentage distribution of income satisfaction by sex

Question		**Male**	**Female**	**Total**
Is the income obtained from seaweed satisfactory according to your work?	*Yes*	3	3	3
	No	97	97	97
Total		**100**	**100**	**100**

Figure 6. 4: Percentage distribution of income satisfaction by locality



Farmers believe that they put a lot of energy into the farming, but they get minimum economic return compared to the effort. Studies by Makame et al. (2021) reported that the buyers argued that the price that they offer for buying seaweed is the only option for them to remain afloat since taxies surrounding the business and external

competition with other global producers of the seaweed also made them to remain with the price.

6.6 Decision on the Uses of Income

Table 6.8 and Table 6.9 indicate that more than 75 percent of the total farmers make own decisions on the uses of the income they earn from seaweed farming activities. However, close family members such as husband/wife do make decision on the income earned from their spouses.

Table 6. 8: Percentage distribution of decision on the uses of income by sex

Question		**Male**	**Female**	**Total**
Who make decision on the uses of the income obtained?	*Myself*	81	76	77
	Husband/Wife	18	22	21
	Son	0	0	0
	Daughter	0	0	0
	Other relatives	1	2	2
Total		**100**	**100**	**100**

Across the two Islands, the proportion of seaweed farmers in Unguja making own decision on the uses of income earned was higher than that of Pemba. This could be associated with the tendency of seaweed farmers in Unguja to prefer farming individually rather than a family.

Table 6. 9: Percentage distribution of decision on the uses of income by locality

Question		**Unguja**	**Pemba**	**Total**
Who make decision on the uses of the income obtained?	*Myself*	82	75	77
	Husband/Wife	18	22	21
	Son	0	0	0
	Daughter	0	0	0
	Other relatives	0	2	2
Total		**100**	**100**	**100**

6.7 Seaweed Buyers

About 73 percent of the seaweed farmers sell their seaweed to private company. Across the two Islands, the proportion of seaweed farmers selling to private company was higher (99 percent) in Unguja than that of Pemba (64 percent). The higher dependency of the seaweed farmers to one type of buyer implies the presence of market information gap (price dispersion) among seaweed value chain actors. Out of the total farmers surveyed, no one was selling seaweed outside Zanzibar. During FGDs in Unguja Island, it was found that some farmers were selling their seaweed to Tanzania mainland and Kenya.

6.8 Last Time to Sell Seaweed

By the time the survey was conducted, about 75 percent of the farmers sold their seaweed for the last time not more than three months (Table 6.10 and Table 6.11)

Table 6. 10: Percentage distribution of last time to sell seaweed by sex

Question		**Male**	**Female**	**Total**
When did you last sell your seaweed?	*less than one month ago*	38	36	37
	1 month to 3 months	41	38	39
	3 months to 6 months	15	15	15
	More than 6 months ago	6	11	9
Total		**100**	**100**	**100**

Across the two Islands, majority of seaweed farmers in Unguja (52 percent) sold seaweed for the last time less than one month ago while majority of seaweed farmers at Pemba (45 percent) sold seaweed for the last time between one month and three months.

Table 6. 11: Percentage distribution of last time to sell seaweed by locality

Question		**Unguja**	**Pemba**	**Total**
When did you last sell your seaweed?	*less than one month ago*	52	31	37
	1 month to 3 months	22	45	39
	3 months to 6 months	11	16	15
	More than 6 months ago	14	8	9
Total		**99**	**100**	**100**

6.9 Stocks of Seaweed

76 percent of seaweed farmers confirmed that they had no stocks of seaweed that they wished to sale, see Table6.12.

Table 6. 12: Percentage distribution of possession of stock of seaweed by sex

Question		**Male**	**Female**	**Total**
Do you have stock of seaweed that you wish to sell?	*Yes*	23	24	24
	No	77	76	76
Total		**100**	**100**	**100**

Across the two Islands, proportions of seaweed farmers with no stocks were higher in Unguja, 79 percent than those in Pemba, see Table 6.13.

Table 6. 13: Percentage distribution of possession of stock of seaweed by locality

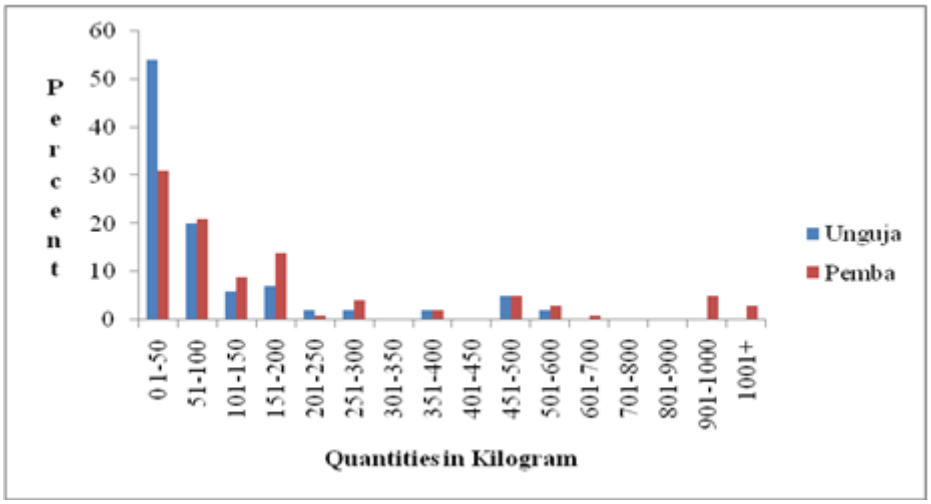
Question		**Unguja**	**Pemba**	**Total**
Do you have stock of seaweed that you wish to sell?	*Yes*	21	25	24
	No	79	75	76
Total		**100**	**100**	**100**

For those 24 percent farmers who had stocks of seaweed the amount of their stocks is indicated in the Table 6.14 below and Figure 6.5.

Table 6. 14: Percentage distribution of quantities of stocks of seaweed by sex

Stock of seaweed (Kg)	Male	Female	Total
0 1-50	24	41	37
51-100	18	21	21
101-150	14	7	8
151-200	17	11	12
201-250	1	1	1
251-300	4	4	4
301-350	2	0	0
351-400	2	2	2
401-450	0	0	0
451-500	2	6	5
501-600	2	3	3
601-700	0	1	1
701-800	0	0	0
801-900	1	0	0
901-1000	9	2	4
1001+	4	1	2
Total	**100**	**100**	**100**

Figure 6. 5: Percentage distribution of quantities of stocks of seaweed by locality



The reasons for having stocks were found to be low demand, low price, and stocks came from recent harvest and farmers were accumulating more seaweed to sell at large quantities.

6.10 Records Keeping

Documentation in the seaweed industry at grassroot level was very poor. About 90percent of the total farmers did not keep records of their sales and revenue as indicated in Table 6.15 and Table 6.16.

Table 6. 15: Percentage distribution of records keeping by sex.

Question		**Male**	**Female**	**Total**
Do you keep records of sales and revenue?	*Yes*	13	9	10
	No	87	91	90
Total		**100**	**100**	**100**

Table 6. 16: Percentage distribution of records keeping by locality

Question		**Unguja**	**Pemba**	**Total**
Do you keep records of sales and revenue?	*Yes*	2	13	10
	No	98	87	90
Total		**100**	**100**	**100**

The proportion of seaweed farmers who did not keep records of sales and revenue was higher (98 percent) in Unguja than those in Pemba (87 percent).

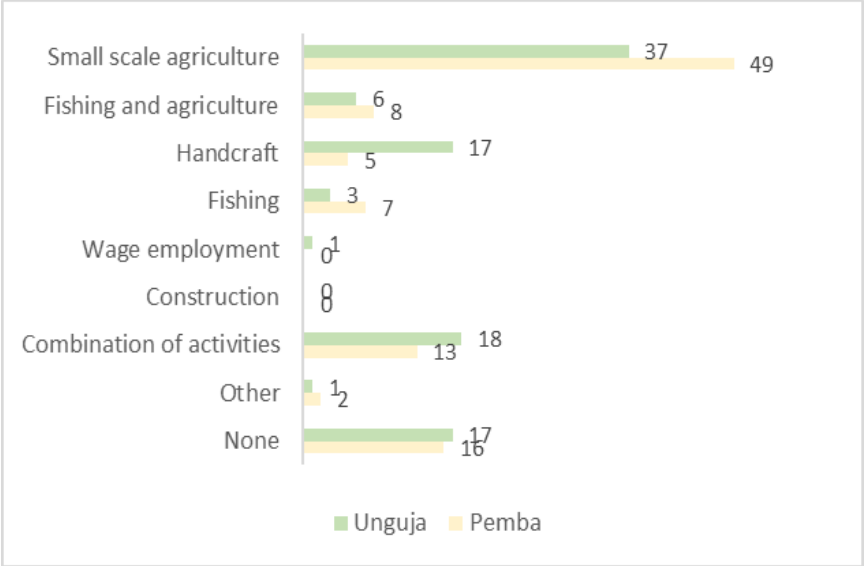
6.11. Engagement in Other Economic Activities

The study indicates that about 80 percent of the seaweed farmers were engaged in different types of economic activities apart from seaweed farming (Table 6.17 and Figure 6.6)

Table 6. 17: Percentage distribution of types of economic activities engaged by sex

Question		**Male**	**Female**	**Total**
Aside from farming seaweeds, what are the other economic activities you are engage in?	*Fishing*	17	2	6
	Small Scale Agriculture	34	49	46
	Wage employment	1	0	0
	Handcrafts	4	10	9
	Construction	1	0	0
	None	5	20	17
	Other	2	1	2
		0	0	0
	Fishing & Agriculture	22	3	7
	Combination of activities	15	13	14

Figure 6. 6: Percentage distribution of types of economic activities engaged by locality



At least 67 percent of seaweed farmers were engaged in small scale agriculture followed by fishing, such that female seaweed farmers dominate the small-scale agriculture while men dominate the fishing sector. Other economic activities that seaweed farmers reported to engage themselves in during the survey and FGDs were small business, waged employment, handicrafts, cookery, and construction of buildings.

Table 6.18 shows income earned by farmers from other economic activities per month besides seaweed farming. The trends of income show that there exists income inequality between male and female whereby male counterparts earned more income than females.

Table 6. 18: Percentage distribution of earnings from other economic activities per month by sex

Question	**Amount in TZS**	**Male**	**Female**
How much, you earn per month from your other activities	01-10,000	28	56
	10,001-20,000	12	11
	20,001-30,000	8	8
	30,001-40,000	2	3
	40,001-50,000	12	8
	50,001-60,000	3	2
	60,001-70,000	0	1
	70.001-80,000	2	2
	80,001-90,000	1	2
	90,001-100,000	7	3
	100,001-150,000	6	2
	150,001-200,000	6	1
	200,001-250,000	3	0
	250,001-300,000	6	0
	300,001-350,000	1	0
	350,001-400,000	1	0
	400,001+	2	0
	Total	**100**	**99**

Despite having engaged in other economic activities, however, an average of 95 percent of seaweed farmers across both Islands considered seaweed farming as their main activity whereby proportion of women was higher (97 percent) than that of man (89 percent), see Table 6.19 and Table 6.20. This is in contrast with previous studies from Sri Lanka and India where seaweed farming was considered the second highest perceived importance of the farmers preceded by fishing (Ginigaddara et al. 2018; Krishnan, M. & Narayanakumar, R. 2013).

Table 6. 19: Percentage distribution of seaweed as main activity by sex

stion		**Male**	**Female**	**Total**
Do you consider seaweed as your main activity?	*Yes*	89	97	95
	No	11	3	5
Total		**100**	**100**	**100**

Table 6. 20: Percentage distribution of seaweed as main activity by locality

Question		**Unguja**	**Pemba**	**Total**
Do you consider seaweed as your main activity?	*Yes*	93	95	95
	No	7	5	5
Total		**100**	**100**	**100**

6.12 Economic Activities Affecting Seaweed Farming

About 65 percent of seaweed farmers confirmed that fishing affected seaweed farming followed by fishing with tourism, small scale agriculture, tourism, and transportation by small boats (Table 6.21 and Figure 6.7). Seaweed farmers reported that fishermen do their fishing in the same areas where seaweed is planted, and their small boats destroy the seaweed farms. This situation has sometimes led to conflicts between seaweed farmers and fisherman.

The tourism sector was reported to affect seaweed farming specifically in Unguja Island. This has also been confirmed during FGDs at Paje where discussants said that investors use kites for tourist gaming which hit people and pegs, thus destroying their farms. They further explained that previously, people used to put local mates around 20 feet from seashore for sun drying seaweed, but due to construction of hotels near the sea, the owners of hotel do not want to see seaweed spread in the open space in front of their hotels - hence they have to carry heavy seaweed long way.

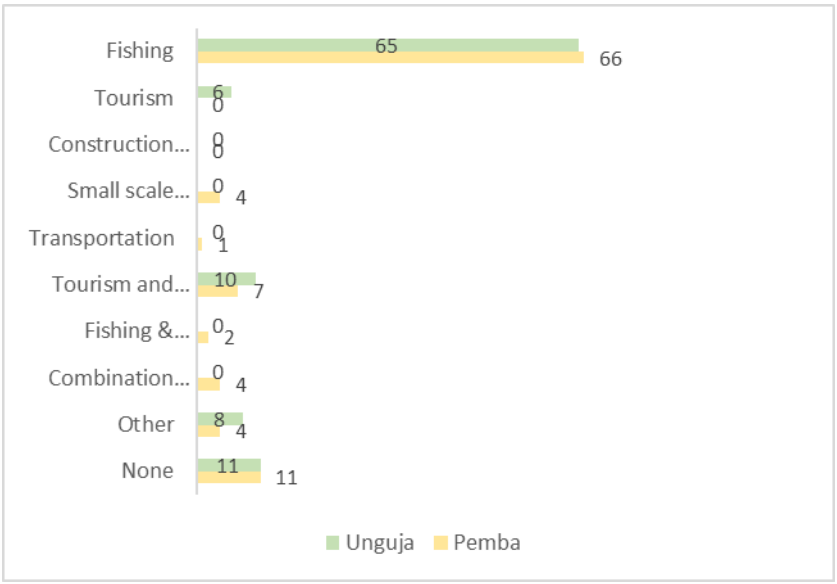
The discussants also reported that there were no spaces or thoroughfare in between hotels thus making them to walk long distance while transporting seaweed from sea to storage areas. These results confirm an earlier study by Msuya (2012) who reported that the growth of the tourism industry in Paje has impacted on farmers' access to the beaches since hotels have built seawalls, which force farmers to walk long distances to access the beaches. Hotel walls had also been built in areas which had previously been used for the drying of seaweed. Additionally, in Uroa and Pongwe villages, surveyed farmers reported that the swimming pool water coming from hotels to the sea have chemicals that cause their seaweed to decay. This agrees with the study by Makame et al. (2021) which reported that untreated water from hotels' swimming pools had an impact on seaweed farming.

Seaweed farmers at Kajengwa reported that due to construction of hotels, they were moved out of areas where they used to plant their seaweeds. The farmers further explained that there are no open spaces near the beaches where they could dry their seaweeds and areas where they could build a room or hut for exchanging clothes when they get wet in the sea. In rare cases, during rainy season, water from farms such as rice farms move to the sea and seaweed may get infected due to fertilizer that comes with water from those agricultural farms.

Table 6. 21: Percentage distribution of economic activities affecting seaweed industry by sex

Question		**Male**	**Female**	**Total**
Is there any economic activity that is affecting your seaweed farming? (Multiple Answers Allowed)	*Tourisms*	1	2	2
	Fishing	63	66	65
	Construction work	0	0	0
	Small scale agriculture	2	3	3
	Transportation	2	1	1
	Others	5	6	5
	None	12	10	11
	Tourism & Fishing	8	7	8
	Fishing & Agriculture	2	1	2
	combination of other activities	4	3	3
Total		**99**	**99**	**100**

Figure 6. 7: Percentage distribution of economic activities affecting seaweed industry by locality



CHAPTER SEVEN

FINANCE AND ORGANISATIONS

7.0 Overview

Seaweed farming needs support of various types such as finance to develop. Both public and private entities need to inject financial support to the seaweed industry. This chapter highlights community-based organisation, supporting organisations outside community, possession of saving account and credit services.

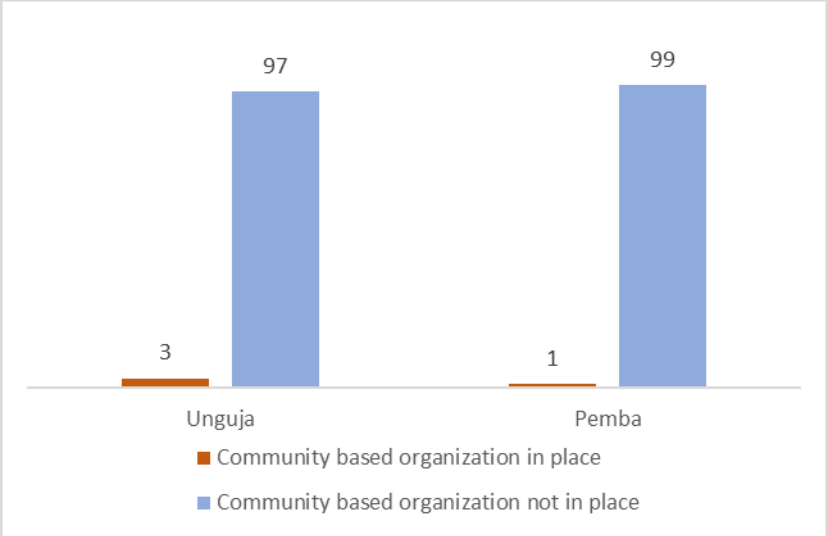
7.1 Community Based Organisations

A proportion of 99 percent of seaweed farmers reported that there was no community-based Organisation that focused on seaweed farming issues in their community (Table 7.1 and Figure 7.1).

Table 7. 1: Percentage distribution of presence of community-based organisation by sex

Question		**Male**	**Female**	**Total**
Are there any community-based organisations in the community that focus on seaweed farming issues and management?	*Yes*	2	1	1
	No	98	99	99
Total		**100**	**100**	**100**

Figure 7. 1: Percentage distribution of presence of community-based organisation by locality



Majority of farmers having reported the absence of community – based organisations that focused on seaweed farming issues in their community implies that the organisations are not present, or they are present, but seaweed farmers themselves are not aware of them. There were mixed results from the same village when farmers were asked about the existence of community-based organisations whilst some responded in affirmative form (yes) others responded that there were no organisations in their community to support seaweed activities. This agrees with the research by Makame et al. (2022) who reported that there was limited understanding of the existence of these associations by seaweed farmers. The author further explained that there were number of associations related to seaweed like Shehia seaweed committees (Formulated by the government through Department of Fisheries) and Association of Pemba Seaweed Farmers but farmers felt like that they were not part of those organisations and received no support from them.

The seaweed farmers who confirmed the presence of organisations in their society focusing on seaweed issues and management reported that the criteria for gaining access to those organisations were having

a minimum age of 18 years, being a seaweed farmer, and/ or have knowledge on seaweed farming sector.

Further, when asked about accessibility to those community-based organisations, all male farmers reported that the organisations are open to both male and female genders while female farmers, a proportion of 76 percent confirmed that the organisations are open to both genders as shown in Table 7.2.

Table 7. 2: Percentage distribution of accessibility of community-based organisations by sex

Question		**Male**	**Female**	**Total**
Are Organisations open to	*Women only*	0	24	16
	Both	100	76	84
Total		**100**	**100**	**100**

Across the two islands, all farmers at Pemba confirmed that the community-based organisations are open to both male and females while at Unguja Island, a proportion of 71 percent confirmed accessibility of community-based organisations to both males and females, see Table 7.3.

Table 7. 3: Percentage distribution of accessibility of community-based organisations by locality

Question		**Unguja**	**Pemba**	**Total**
Are organisations open to	Women only	29	0	16
	Both	71	100	84
Total		**100**	**100**	**100**

Farmers further reported that responsibilities of the community-based organisations are, among others, to encourage seaweed farming, to buy seaweed, to value-add seaweed, to coordinate list of seaweed farmers, supervise small regulations regarding seaweed sector and to provide loans to the members.

Table 7.4 and Table 7.5 indicate the extent to which farmers perceive the advantage or benefit in becoming a member of community-based organisations.

Table 7. 4: Percentage distribution of perceived benefits of community-based organisations by sex

Question		**Male**	**Female**	**Total**
Do you see any advantage or benefit in becoming a member?	*Yes*	50	67	61
	No	50	33	39
Total		**100**	**100**	**100**

Table 7. 5: Percentage distribution of perceived benefits of community-based organisations by locality

Question		**Unguja**	**Pemba**	**Total**
Do you see any advantage or benefit in becoming a member?	*Yes*	53	71	61
	No	47	29	39
Total		**100**	**100**	**100**

Advantages of becoming a member in community-based organisations were said to be encouraging farming of seaweed, keeping records on list of farmers, adopting value addition technologies, finding solutions to challenges of seaweed farmers, farming of seaweed, and supervising agreed seaweed bylaws.

Further, a proportion of farmers at 88 percent reported that there were no institutions outside the community that supported seaweed farmers operation and management (Table 7.6)

Table 7. 6: Percentage distribution of perceived organisations outside community supporting farmers by locality

Question		**Unguja**	**Pemba**	**% Total**
Are there other organisations or institutions outside the community that influence/ have an impact on/provide support to seaweed farmers operations and management in the community? (FAWE, Govt, University, Marine institute,)	*Yes*	13	12	12
	No	87	88	88
Total		**100**	**100**	**100**

Those who confirmed support from institutions outside their community mentioned that the main support was training and equipment and more than 90 percent of the support came from seaweed companies. However, for the last 12 months, more than 97 percent of farmers reported to receive no support from any organisations.

Table 7. 7: Percentage distribution of perceived support from organisations in the last 12 months by sex

Question		Male	Female	Total
Have you received any support in the last 12 months?	*Yes*	3	2	2
	No	97	98	98
Total		**100**	**100**	**100**

Table 7. 8: Percentage distribution of perceived support from organisations in the last 12 months by locality

Question		**Unguja**	**Pemba**	**Total**
Have you received any support in the last 12 months?	*Yes*	2	3	2
	No	98	97	98
Total		**100**	**100**	**100**

7.2 Possession of Saving Account

A proportion of 97 percent of the surveyed seaweed farmers do not have bank account or any account in other small micro finance groups (Table 7.9 and Table 7.10).

Table 7. 9: Percentage distribution of possession of saving account by sex

Question		**Male**	**Female**	**Total**
Do you have a saving account with financial institution?	*Yes (Bank)*	2	0	1
	Yes (SACCOS)	1	1	1
	Yes (Cooperative)	0	1	1
	Others	1	1	1
	No	96	97	97

Table 7. 10: Percentage distribution of possession of saving account by locality

Question		**Unguja**	**Pemba**	**Total**
Do you have a saving account with financial institution?	*Yes (Bank)*	0	1	1
	Yes (SACCOS)	1	1	1
	Yes (Cooperative)	1	0	1
	Others	1	1	1
	No	96	97	97

This situation implies that seaweed farmers were not benefiting from financial services from bank and other micro financial institutions thus becoming disadvantageous. Previous studies from Zanzibar by W. Hamad & G. Islam (2022) reported that access to various financial supports such as credits from formal and informal financial institutions, saving from various sources and grants increased source of income to the farmers which results into better livelihood condition.

7.3 Request for loan

Table 7.11 and Table 7.12 indicate that the majority of seaweed farmers (about 98 percent) had not requested for loan. Farmers confirmed that the main reasons for not requesting loans where they were not in need of loans, the income from seaweed was low to repay the loan, they had no information on where to obtain the loan, unaware of loan procedures, presence of interest rate and long procedure for getting loan.we

Table 7. 11: Percentage distribution of loan request by sex

Question		**Male**	**Female**	**Total**
Do you ever ask for and receive a loan from a financial institution?	*Ask and receive*	1	1	1
	Ask and not received	1	1	1
	Do not ask	98	98	98
Total		**100**	**100**	**100**

Since a proportion of 97 percent of seaweed farmers had no savings account from bank or any other microfinance institutions, this situation might deprive the seaweed farmers from getting access to loans.

Table 7. 12: Percentage distribution of loan request by locality

Question		**Unguja**	**Pemba**	**Total**
Do you ever ask for and receive a loan from a financial institution?	*Ask and receive*	2	1	1
	Ask and not received	0	1	1
	Do not ask	98	98	98
Total		**100**	**100**	**100**

A proportion of 70 percent receives money between TZS 100,000 and TZS 500,000 whereas the highest money received from financial institution/micro finance was TZS 5.5 million and was received by female seaweed farmer.

About 30 percent of seaweed farmers who requested loan perceived that getting credit was not simple (Table 7.13). The difficult part of

getting loan was said to be possession of collateral, long procedures, the need to have guarantor and waiting for the association to have capital. Collateral and stringent conditions were the main reasons reported to prevent other farmers from getting loan after requested.

Table 7. 13: Percentage distribution of Perception on getting credit by sex

Question		**Male**	**Female**	**Total**
Do you think getting credit is simple?	*Yes*	67	71	70
	No	33	29	30
Total		**100**	**100**	**100**

CHAPTER EIGHT

CONCLUSION AND RECOMMENDATION

8.0 Overview

This chapter presents further insights that were drawn during the study and provides conclusions and recommendations to help boost the seaweed industry in Zanzibar.

8.1 Further insights

The survey found that there exists mistrust between farmers and buyers (seaweed company agents). Farmers do not trust weighing and quality assurance processes employed by seaweed buyers. Almost in all surveyed villages e.g., Uzi, Ng'ambwa and Chukwani, farmers were claiming about the measuring process where they reported that the weight recorded for a bag of seaweed always come in whole number, there is no quarter or a half. When one agent in Pemba was asked about why he does not consider a half or a quarter during measuring process of seaweed, the reply was he was compensating for sands and dirties that were usually present in the seaweed. This agrees with the previous study by Ali (2014) which revealed that seaweed farmers at Uroa village in Unguja islands reported that measuring devices of buyers had faults because whenever they measured seaweed before selling to buyers, it had never happened for their weights to tally with weights provided by the buyer. This is in contrast with previous studies from Indonesia where it was reported that normally the village traders had the scales and farmers accepted their accuracy (Fitriana, 2017). Similarly, the company agents (the buyers) do not have trust in farmers as well. The agents reported that farmers sometimes do not dry their seaweed very well purposely to increase their weight when on scales. The agents further reported that farmers mix seaweed with dirties and put water on them thus increasing cost of cleaning the seaweed to the company. This is in line with the study by Ali (2014)

who revealed that buyers reported that seaweed farmers were not cleaning and drying their seaweed well enough.

The seaweed industry is being extremely impacted by climate change. According to the farmers, productivity of seaweed has severely reduced. The seaweed gets rotten and die in many villages pushing farmers to always move and go further in the sea in search of new plantation area. According to FAO (2020), seaweed die off in Zanzibar due to severe epiphyte infestation coupled with high incidence of ice-ice disease. This is in line with the previous studies from Indonesia by Muthalib et al. (2017) which revealed that seaweed was infected with the diseases thought to be due to extreme environmental changes such as currents and temperature. The previous studies from India found that there was poor growth of seaweed due to presence of 'ice-ice' diseases, however, there was disagreement about its causes, some people argued that the segments were indicative of a bacterial or viral infection while others attributed the disease to physical stress caused by changes in the farming environment (Krishnan, M. & Narayanakumar, R. 2013). Similarly, previous studies from Malaysia found that there was disagreement amongst both farmers and extension officers in the description of the ice-ice syndrome, as either an infectious disease or just a consequence of suboptimal environmental conditions (Kambey 2021).

Seaweed farmers in Zanzibar further reported that currently there were no treatments for seaweed diseases unlike in other agricultural produces. Either they reported that authorities from government visited their areas and took the infected seaweed for research, however they did not get any feedback thereafter. During FGDs at Bweleo the discussants said that in the past, they used to plant and harvest seaweed throughout the year, however, once after the big Tsunami that hit Indonesia, farmers started to notice environmental changes that have been affecting production of seaweed - hence they could no longer plant and harvest seaweed throughout the year as was before. According to them, there occur many dirties that cover both varieties of seaweed (*Spinosium* and *Cottonii*) causing them to

die. It was also reported that during sunny days (summer) there is so much heat that kills seaweed because most of them are planted at low water level. A proportion of 83 percent of the surveyed farmers confirmed to have noticed environmental changes over the past five to ten years mainly dirties, high temperature and strong waves.

This is in line with the study by Cleyndert et al. (2021) who reported that seaweed farmers in Zanzibar indicated that seaweed farming had been affected by changes in climatic factors over the last 20 years include increased sea temperatures, increased winds, and irregular rainfall. This also confirms the study by Shimba et al. (2021) which revealed that seaweed farmers in Zanzibar reported that some water channels have dried up, farms water levels had been declining and new beaches appeared to have formed. Interestingly, the discussants further explained that they had been told by seaweed consultant from Indonesia that those considered as 'dirties' in Zanzibar were type of seaweed known as *Glacilaria* that are normally grown, sold, and used for many purposes in other countries including Indonesia. Since the 'dirties' is not type of seaweed that is acceptable in the Zanzibar's market by the time the study was conducted, therefore farmers continued to consider it as 'dirties' and make no use of it.

Despite being affected by climate change, the practices of seaweed farming in Zanzibar might have environmental implications as well. For example, it is estimated that to produce 1.5 tons per season, one need to have 1000 nylon ropes and 600 wooden pegs, such that pegs usually lasts for 6 months up to 12 months. Therefore, thousands of people are replacing hundreds of pegs after every six months for decades! This situation translates into heavy deterioration of trees, most of them being mangrove trees as they are the most preferred plants for making pegs by seaweed farmers. Further, despite the seaweed sector being very old, still farmers have been using the same traditional way of planting seaweed.

The study observed the farmer's use of crowbar, iron bars and rods for creating a hole where peg is inserted, and this usually occurs along costal area of North district of Pemba where the sea ground is rocky

in nature. Also, the seaweed farmers carry with them buckets and drums filled with sands to be used as anchors for pegs in the sea area which might have environmental implication as well. To control the implication of seaweed farming to the environment, previous studies from Bangladesh revealed that seaweed farmers are also needed to submit a report on environmental impact assessment (EIA) which was generally conducted by local environment at free of cost (Ahmed et al. 2022) while in Tanzania the requirement for an environmental impact assessment (EIA) for village-level seaweed farming was abandoned (De San 2012).

There seems to be very low knowledge and information regarding the seaweed sector as well as a wide information gap across seaweed value chain actors. The study revealed that while some villages were active in value addition activities, yet many seaweed farmers in similar villages and different villages do not know the different uses of seaweed and its benefits. The study revealed that there is wide gap of knowledge between farmers living in the same village, while some are aware of the existing opportunities in and out of their communities favouring seaweed sectors such as seaweed support organisations and training programs, others in similar villages are not aware of them. Major challenges with respect to marketing of seaweed and its products are found to be limited market information, price instability and lack of awareness on seaweed products. This confirms the previous study by Douglas et al. (2021) which reported that seaweed farmers lacked knowledge on the competitive price of seaweed in the world market.

Nearly half (46 percent) of seaweed farmers confirmed that there are specific challenges to women. The seaweed farming is very labour intensive and seems to be heavy work to women, thus rendering them largely dependent on the support from men. In some area's farmers need to walk long distances from their village to the sea, e.g., about 5 km as observed in Kiuyu Mbuyuni and Shanake villages, while carrying loads such as hammer, crowbar, strings, and seaweed seedlings. This confirms the study by Victoria (2018) who reported that women

seaweed farmers could walk one to two hours when going to their seaweed farms. Also, women reported to feel irresponsible on family matters such as leaving children behind without proper care and late preparation of family meals.

The local market for seaweed was seasonal. Farmers do not have guarantee on the timing of selling their seaweed. Some farmers were paid once they sell their seaweed while others reported to stay up to three to four months before getting paid. The local seaweed exporters had no guarantee on selling seaweed to the international market, for example the local seaweed company that was exporting seaweed to China had no contract with the buyer. According to the company the Chinese importers did not want to enter a formal contract) thus giving them no guarantee or projection of selling their produce to that international market. According to Msuya et al. (2014), farming of red seaweed in Western Indian Oceans also faces the challenge of unreliable international markets. For example, the international processors buy seaweed material near their factories from Asia before coming to the WIO Region including the large producers in Tanzania.

Lack of working tools and equipment was also reported to be a major challenge facing seaweed farmers. Farmers could hardly afford to buy working tools due to low income generated from the seaweed farming activities. As seaweed farming also take place further in the sea, farmers require to use boats to reach their farms. However, many of them lack boats especially women, hence they have to hire from those who have them. Farmers reported that they have small peddle sailed boats which largely endanger their lives as they can easily capsize, making it even worse to farmers who have no basic swimming skills. Other working tools reported to be insufficient were "tie-tie", transport vehicle for transporting seaweed from the sea to storage area, solar driers, machines for processing seaweed etc. Besides, the farmers decried losing their harvests to unknown people when the latter get hold of their possessions unlawfully.

However, the main challenges posed by seaweed buyers were infrastructure (port congestion, roads, and power outages), high

taxation and slow handling of documentation and permits by relevant authorities in the government. The buyers reported that taxes were too high, and they sometime did not understand why they were required to pay for a particular tax. For example, a buyer was claiming that their company is being asked by relevant government authority from time to time to pay taxes (have a license) for a warehouse where the seaweed was stored. The company, for their part (i.e., one buying the seaweed), believe that they were already paying the relevant license to ZIPA and other taxes, hence it should have been the owner of the warehouse to pay for the storage license, and not them.

The buyer further explained that when transporting seaweed from Micheweni district to Mkoani district, they are paying charges to relevant government authority found in Micheweni, but, when the seaweed reaches Mkoani district, the company is also required to pay charges (TZS 5000 per ton of Seaweed) to relevant government authority found in Mkoani district. Previous studies (ZPC, 2018) revealed that seaweed sector was facing multiple taxes charged by multiple authorities such as Tanzania Revenue Authority (TRA), Zanzibar Revenue Authority (ZRA) and local authorities at different stages of seaweed value chain.

8.2 Conclusion and Recommendations

Respondents, among others, have recommended a number of issues, including: the rise in price of seaweed; provision of working tools such as boats, strings, drying racks and transport; education on different aspects of seaweed such as uses, benefits and value addition; sharing the results of researches to the farmers; provision of special areas for drying sea weeds; construction of warehouses, exchange rooms and construction of value addition plant; seaweed measuring process to be followed up; implementing measures to combat climate change and presence of conducive legal environment governing the seaweed sector.

Based on the findings and other insights, the research recommends the following:

1. **Strengthening policy and institutional framework:** This should involve reviewing regulatory environment governing seaweed subsector and formulating policies and regulations to promote the sector - such as regulations on quality and adopting good agricultural practices, reviving, and strengthening seaweed farmers committees and cooperatives.
2. **Investing in Education:** Introduce a Training of Trainers (TOT) program to selected seaweed stakeholders at Shehia (local area) level and staffs responsible for seaweed sector with detailed M & E framework for making follows up. The trainees will be responsible to train seaweed farmers from time to time with different aspects related to seaweed industry including quality issues, value addition and farming technologies, swimming, and dive skills. Special program to emphasize the seaweed society into sending their children to school and adult education should be promoted.
3. **Introduce Experimental Phase for Seaweed**: A two or three - year experiment aiming to generate information, among others, by understanding clearly best production period and site selection for seaweed, good farming methods and value addition technologies, production needs and world market demand and prices would seem relevant. The experiment preferably should involve different activities such as capacity building program, seaweed site selection, research, and application of research outcomes on the seaweed sectors with emphasis on knowledge and information sharing across the seaweed value chain actors.
4. **Investing in Quality Management:** Relevant quality bodies such as Zanzibar Bureau of Standards (ZBS), Government Chemist and Zanzibar Food and Drug Agency (ZFDA) should be strengthened through capacity building programs and acquisition of laboratory equipment so that they have parameters for grading seaweed to maintain good quality. The bodies and other relevant institutions should set up quality standards to be followed by seaweed stakeholders including farmers and company agents. The Ministry responsible for Agriculture needs to emphasize Sanitary and Phyto

Sanitary measures.

5. **Putting in Place Supporting Infrastructure:** Infrastructure such as power supply, water and roads' network should be more reliable. Other infrastructure such as seaport, rubble roads ending to seaweed farms, improving storage facilities - including the use of solar dryers, use of moisture regulators and testers, construction of seaweed warehouses, stairs and drying places such as stony floor, bakery and exchange rooms for women should be considered.
6. **Introduce Environmental programs**– The seaweed projects need to take into consideration and incorporate aspects from environment such as marine conservation and tree planting activities so that the seaweed sector is sustained.
7. **Strengthening collaboration among actors:** Seaweed sector is affected by other sectors including tourisms, agriculture, education, fishing, and health. There is a need to have very strong collaboration between all stakeholders that affect the seaweed sector directly or indirectly to make the development of the sector sustainable. Stakeholders who take and implement interventions geared to promote the seaweed sector need to work collaboratively to manage well resources for seaweed sector and curb effectively the many challenges affecting the seaweed sector. There should be regular meetings between different actors along the seaweed value chain including seaweed farmers, government officials and buyers to build trust among them and collaborate in good faith to promote the seaweed sector.

   i. **Education** – Investing education in the seaweed society for both children and adult so that it becomes easy for farmers to adopt good practices including the use of new farming technologies to make the seaweed farming more profitable.
   ii. **Health** – Proper health infrastructure and personnels to be available such that farmers can rely upon when getting injured or impacted by seaweed farming activities.

iii. **Tourism** – The sector needs to be socially responsible by operating without affecting environment and impact seaweed farming negatively, the seaweed and tourism should co-exist but not compete.
iv. **Agriculture and Fisheries**– The sector should encourage planting of trees to replace trees affected due to use of pegs for seaweed farming. Fishing activities should be done without affecting seaweed farms.
v. **Environment**– To fully supervise national plans on environment including conservation of marine areas.
vi. **Private Sector** – Collaborate fully with the government in implementation of national plans and interventions supporting seaweed.
vii. **Finance** – Adequate financial resources to be allocated to interventions and programs aiming at promoting seaweed industry in Zanzibar.

The research has limitation, due to limited resources. Some areas of high interest were not researched in this study, therefore it is recommended that in future research be undertaken to explore potentials and competitiveness of Zanzibar seaweed, to analyse critically the legal environment governing the seaweed sector and analysing impacts of the interventions taken to promote the seaweed industry in the Islands.

Conflict of interests

The author hereby declares that there is no conflict of interests.

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