

**ENVIRONMENTAL IMPACTS OF SEA WEED FARMING
AT PAJE VILLAGE ON THE EAST COAST OF
ZANZIBAR ISLAND.**

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In Partial Fulfillment of the Requirements for award of the Degree
Master of Science in Environmental Management
and Development.

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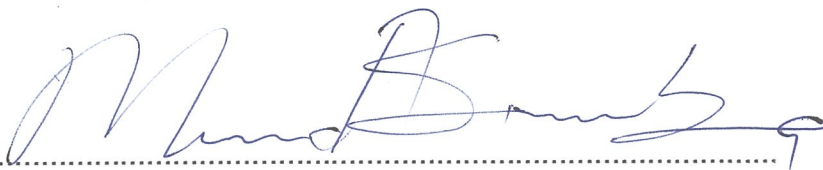
January, 2012



DECLARATION

I, Majid M. Suleiman, do hereby that, this thesis titled "Environmental Impacts of seaweed Farming at Paje Village on the East Coast of Zanzibar Island is my own original work and that is has never been submitted before to any other University or institution of learning for award of a degree or the equivalent.

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(Supervisor)

Date 11/05/2012

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LIST OF ABBREVIATION

FAO: Food and Agriculture Organization (of the UN)

ENEP: United Nations Environmental Program

EIA: Environmental Impact Assessment

JUMASPA: Jumuiya ya Maendeleo Shehia ya Paje

A B S T R A C T

Seaweed has many uses which including source of food, in agriculture is used as organic fertilizer and also has been used in medicinal products.

However, seaweed farming has side effects on environment and most coastal communities who involved in this farming do not well know.

The general objective of this study was to assess environmental impacts of seaweed farming.

The specific objectives of the study were including; to identify types of seaweed and activities related to seaweed farming and to find out environmental impacts of the activities involving in seaweed farming.

The study investigation was guided by questions that aimed to establish what activities carried out prior to establishing a seaweed farm and to what extent the activities lead to environmental degradation.

The methods of data collection were both quantitative and qualitative approach. The instruments used including questionnaires, interviews and discussions.

The major findings of the study revealed that seaweed farming has impacts on both marine and terrestrial environment. The study concluded that seaweed farming impacts most affecting marine ecology.

The study recommended number of strategies focusing in controlling and minimizing the environmental impacts of seaweed farming activities these including monitoring seaweed farming projects and providing environmental education to seaweed farmers.

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CHAPTER ONE

THE PROBLEM AND ITS SCOPE

Background of the study.

Globally, there are over 9000 species of sea weeds divided into three major types: green, brown, and red (Guiry, 2005). All seaweeds depend on light for growth and therefore they mostly occupy the intertidal areas or shallow light penetrating zone (need no arable land) for photosynthesis and pigment synthesis. Also need moderate water current and low wave action. Optimum temperature range between 27-30 °C, with salinity level of 30-35‰.

Seaweed has not only been used as a food source but also have a range of other uses. They are used in agriculture and in horticulture as an organic fertilizer, and in manufacturing of agrarian carrageenan products. Also they have been used as medicinal products.

Until about 1980, most of the sea weed production in many countries has been from the harvest of wild stocks. Species harvested include varieties of *Eucheuma*, *Gracilaria*, *Porphyra* and *Kappaphycus*.

Subsequently, it was recognized that the demand for sea weed and sea weed products were greater than supply (Naylor, 1976). Hence cultivation was viewed as the best means to increase production so as to meet the demand. Later, international development agencies started to assist some countries with seaweed potential sites, such as Philippines and Indonesia in the early 1980's with the development of seaweed farming with some guide for undertaking the farming (Trono and Ganzon-Fortes, 1989).

In 2002, world aquaculture production of seaweeds from both cultivated and wild reached over 11.5 million tons (FAO, 2007). However, the volume of production is differing among the continents and individual countries that produce the seaweed. In North America, seaweed is mostly produced from wild stocks. Cultivation is carried out at a very small-scale due to the lack of a conducive environment to support the growth of the seaweed. Thus, with the total production of 15,143 metric tons per year, USA becomes the leading producer of seaweed in North America,

followed by Canada and Mexico. In order to meet the increasing demand, most of the seaweed used in America, especially in the USA, is always imported.

Chile with the production of about 109, 308 metric tons per year has become the leading nation in seaweed production in both cultivation and wild harvesting in South America, and according to archeological evidence, utilization of the seaweed in Chile dates to 13,000 years ago at a late Pleistocene settlement (FAO, 2001).

Other countries in South America, producing seaweed, especially the wild ones, are Argentina, Brazil, and Peru. Thus, the seaweed production in the South America is higher as compared to North America.

In Europe, as in North America, seaweed cultivation occurs only on a small-scale. However, France produces about 600,000 tons annually; thus, production is higher compare to the North American (Guiry, 2005).

Other countries in Europe, apart from France, producing seaweed but in small quantities are UK, Ireland, Portugal, Spain, and Norway.

In Asia, seaweed is widely cultivated and harvested from wild stocks, and has been consumed for more than a millennium in China and Japan (FAO, 2003). Archaeological evidence indicate that seaweeds had been included in folk medicines for many thousands of years in Japan (13,000-300 BC), China (2700 BC) and India (300 BC), (Teas, 2005).

In Asia, China, Japan, Philippines, North and South Korea as well as Indonesia, are the largest producers. With the production of more than 9 million tons annually, China holds the first rank in the world in seaweed production (Suria, 2003).

Other countries in Asia with moderate production, are Malaysia, India, Vietnam, Thailand, Bangladesh, and Sri Lanka.

In Africa, seaweeds have also been used in medicinal activities by ancient Egypt as far back as 1550 BC (FAO, 2001).

Data indicate that African coasts have a biodiversity of seaweeds where production from a relatively pollution-free environment may be a key marketing advantage. In addition, these coasts also offer good accessibility and hence are conducive to mariculture.

With the exception of countries such as South Africa, Senegal, Namibia, Tanzania, Ghana, Egypt, Morocco, Togo and Cameroon, still there is limited exploitation, cultivation and utilization of sea weeds on the African continent (Hishamunda, 2007). Thus, most of the seaweeds production from Africa is exported.

East Africa, with the exception of Uganda, has some good sites along the coasts where mariculture is carried out. However, in Kenya most of the mariculture involves farming of marine fish and crustacea such as shrimps and lobsters. The sea weed farming is still in the infant stage.

In Tanzania, seaweed farming was first introduced in Unguja islands (commonly known as Zanzibar) and Pemba in 1989 and later on the mainland of Tanzania (Oliveira *et al.*, 2005) and has been viewed as a potential economic opportunity for coastal communities and a way of reducing pressure on marine resources (Msuya, 1998). The industry has become popular in some coastal areas as a means of income generation.

Small-scale farms on suitable sites, some of which are run by groups of women and youths, are scattered along the entire coastline of the country, from Tanga in the north to Mtwara in the south, and on the islands of Mafia and Zanzibar.

Tanzania produces about 9,000 tons of seaweeds annually from harvesting of both cultivated and wild stocks and in 2000 exports reached 13,000 tonnes, of which approximately 4,000-5,000 tonnes were produced in Zanzibar (Oliveira *et al.*, 2005).

In Zanzibar, seaweeds are cultivated in the eastern and southern coasts of the island in village such as Uroa, Paje, Bwejuu, and Jambiani. Lack of agricultural land, especially in coastal areas, where most of the female gender is engaged in agriculture, as their main socio-economic activity, has resulted into increased poverty. So, seaweed farming is an appropriate alternative socio-

economic activity to most females which are excluded in traditional activities of fishing (Kaladharan and Kaliaperunal, 1999).

Therefore, seaweed cultivation has rapidly emerged as one of the major cash crop, producing income to cover household costs. Women dominate the seaweed farming business and have used their cash incomes to acquire modern housing facilities. The seaweed industry also holds the key to economic empowerment of the female gender in coastal water communities.

Seaweeds export has been improved from 1,782- 4,773 tonnes (dry weight) in 1991 and 1996 respectively to over 6,000 tonnes in 2000 (Mtolera *et al.*, 2005). Thus, seaweed farming in Zanzibar has reportedly improved living standards in coastal villages.

Statement of the Problem

The environmental impacts of seaweed farming on the coastal regions of Zanzibar, where such farming is being carried out, is not well known by most coastal communities who are engaged in and benefited from the practice.

Data from similar studies carried out in Indonesia, indicate potential negative impacts of seaweed farming, during and after the farming had ceased, including clearance of forest, especially mangrove trees, removal of sea grasses, removal and shading of corals as well as destruction of sea urchins and seabed.

Experience shows that such destruction in the coastal regions, might lead to change of patterns of sedimentation on the sea bed (Ochieng, 1995).

Seaweed farming also associated with trampling on the seabed which result to various impacts including water turbidity and sediments disturbance, affecting feeding of marine animals, creating visual impacts, noise, decrease in light intensity, and affecting behaviors of various organisms, in addition, lead to seabed erosion and damage marine ecosystem <http://environment.gov.mu> .

Brad (2008) note that introduction of new species into an ecosystem might lead to upsets the existing order and could change the habitat of some species and lead to regime shift to marine ecosystems within an area to a few hundred miles.

Seaweed farming carried out on the intertidal area has a tendency of killing corals on the area, this happen as the seaweeds covering the corals and obstructing the sun light which is important for corals' life. This might have impact to marine ecosystem as corals form a part of marine ecosystems.

Mustelin (2007) note that seaweed farming has consequences for the intertidal ecosystem; often seaweed practice include uprooting of other species such as seagrasses and might leading to alteration of marine natural habitats, including marine resting and breeding areas especially on the intertidal areas.

Cultivation of seaweed farming require large amount of durable erratic sticks and propagated by vegetative cuttings (Mtolera *et al.*, 2005).

Study carried out in three coastal villages (Uroa, Pwanimchangani and Kiwengwa) in Zanzibar on the utilization of indigenous tree species sticks such as (*Macphersonia gracilis*, *Psychotria bibracteatum*, *Eugenia* spp. *Sideroxylon inermis* and *Euclaea racemosa*) in seaweed cultivation, indicate that seaweed cultivation increase pressure on natural forest and might lead to scarcity to forest resources (Kombo *et al.*, 1996).

Furthermore, fishermen, in some seaweed farming areas, have been experiencing reduction of fish species and fish catches.

In light of the above challenges, there is need to find out the environmental impacts of seaweed farming on the area where such activities are being carried out and propose an intervention to redeem the situation.

Purpose of the study

The purpose of the study is to assess environmental impacts of sea weed farming.

Objectives of the study

General objective

General objective of the study is to assess the environmental impacts of seaweed farming at Paje village on the east coast of Zanzibar Island.

Specific objectives

The specific objectives of the study;

- To identify the types of seaweed and activities related to seaweed farming,
- To find out the environmental impacts of the activities involved in seaweed farming,
- To evaluate the challenges of seaweed farming among the coastal communities in Tanzania.

Hypothesis

The study was based on the following null hypothesis;

- The methods and activities employed in seaweed farming have no significant impacts on the environment.

Scope

The study will be conducted in Paje village which is located at latitude 6° 15'S and longitude 39° 32' E. It is on the Coast of Zanzibar Island and about 40 kilometers from Zanzibar town.

Significance of the study

The study will contribute to the body of knowledge and raise awareness to the local community on the environmental impacts of sea weed farming.

The study will also provide information to the Zanzibar government institutions, non government organizations, community-based organizations, the educational sector, trade organizations and other stake holders that deal with environmental conservation and sustainable development.

The work will help to plan and employ some mitigation measures that can minimize or control further environmental destruction over the area and other areas in Zanzibar where such activities take place.

Definitions of key Terms

Seaweed: Is any of the larger, multicellular forms of algae living in fresh and salt water, especially along marine coastal lines. Globally there are over 9,000 species of seaweeds divided into three major types- Green, brown, and red. Red is the most species-rich group (6,000), followed by brown (2,000) and green (1,200) (Crawford, 2002).

Seaweeds are commonly found at low tide and all of them depend on light for growth.

Seaweed differs from plants in that they lack the true stem, leaves, roots, and vascular system found in higher plants. Instead they anchor themselves to solid objects and absorb nutrients directly from the water, manufacturing their food by photosynthesis. Some of them are got from wild while other are grown in farms. Seaweeds are edible and have many commercial and industrial uses (FAO, 2002).

Seaweed Farming: This is the practice of cultivation and harvesting seaweeds. The practice is carried out on the seaside or along intertidal zones at an optimum temperature range of 27-30°C with salinity levels of 30-35‰. The species cultivated include varieties of *eucheuma*, *glacilaria*, *porphyra*, *luminaria* and *kappaphycus alvarezii* (Mtolera *et al.*, 2005).

Materials needed in seaweed cultivation.

Pointed wooden stakes or sticks of 1 inch diameter and 1 metre long, nylon ropes, smaller plastic cords called "tie-ties" and bags.

Method of cultivation.

In Fixed off-bottom method which was used on the study area; ropes are cut about 3-5m long and bunches of seaweed placed about 10-20cm apart are secured on the rope using "tie-ties" (plastic cords). Each line of seaweed is then tied to wooden

stakes that have been firmly embedded in the sand (seabed). A typical of seaweed farm consist of about 25-50 such lines.

Best time for seaweed farming is during sunny days, low tides, and when there are no strong winds. Morning is the suitable time (Kombo *et al.*, 1996).

Seaweed farming sometimes also known as aquaculture or algaculture. Aquaculture is the farming of aquatic organisms such as fish, crustacean, mollusks, and aquatic plants (such as seaweeds) in both fresh water and salt water (FAO, 1998).

Mariculture: Is the branch of aquaculture involving cultivation of marine organisms for food and other products in the open ocean, an enclosed section of the ocean, or in tank, ponds or raceways which are filled with seawater. Mariculture also refers to aquaculture practiced in a marine environment and includes fish farming, shrimp farming, oyster farming, and algaculture (De Silver, 1992).

Environment: Is our surrounding which includes living and non-living things. The non-living components of the environment are land, water and air. The living components include germs, plants, animals and people.

All plants and animals adjust to the environment in which they are born and live. A change in any component of the environment may cause impacts and discomfort and affect normal life. Any unfavorable change or degradation in the environment disturbs interaction and threat the lives of organisms (Chapman and Mather, 1995).

Sea grass: Sea grasses are flowering plants from one of the four plant families (Posidoniaceae, Zosteraceae, Hydrocharitaceae or Cymodoceae) all in the order (Alismatales) in the class of monocotyledons, which grow in marine, photic zone and full-saline environments. There are about fifty eight species worldwide (Oliveira *et al.*, 2005).

Sea grass meadows provide coastal zones with a number of ecosystem services which include fishing grounds, and hundreds of associated species including all phyla, turtles, dugongs and sea urchins (Ochieng, 1995). In addition, the ability of sea grasses to absorb nutrients from the soil and to shelter nitrogen-fixing

organisms capable of fertilizing the water column with limiting nutrients make sea grass meadows a unique and productive environment (Mtolera *et al.*, 2005).

Sea urchin:

Is a common name for approximately 700 species of echinoderms within the class Echinoidea comprises sea urchins and heart urchins, having hard calcareous shells, made up of closely fitting bony plates. They move about by means of short to long, movable spines covering the shell.

The mouth is at one pole of the sphere with a complex chewing structure composed of five jaws and the anus is at opposite pole. Sea urchins are found in oceans all over the world. www.newworldencyclopedia.org/entry/sea_urchin

They play an important role in marine food chains, consuming algae, sea grasses, seaweed and various invertebrates such as mussels and sponges and being consumed by crabs, sea stars, fishes, mammals and birds (Follo and fautin, 2001).

Corals: Corals are colonies of tiny living animals found in marine water that contain few nutrients. Corals are most commonly found at shallow depths in tropical waters. Corals usually live together in groups, secreting calcium carbonate and form coral reefs. The coral reefs form some of the most diverse ecosystems on the planet earth.

The coral reefs provide a home of over twenty five percent of all marine species, including fish, mollusks, worms, crustacean and many others (Muhando *et al.*, 1998).

Ecosystem: Ecosystem refers to organisms living in a particular environment, such as a coral reef or a forest, and the physical part of the environment that affect them.

Marine Ecosystems: Marine ecosystems are part of the largest aquatic system on the planet, covering over 70% of the Earth's surface.

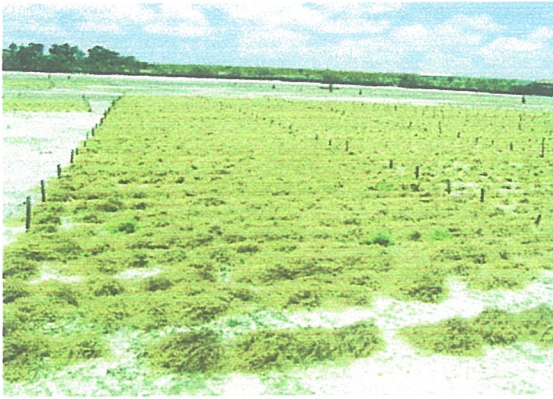
Some examples of important marine ecosystems are ocean, estuaries, coral reefs, mangrove forests, intertidal systems (rocky, sandy and muddy shores) and other tropical communities.

Marine ecosystems are home to a host of different species ranging from tiny planktonic organisms that comprise the base of a marine food web (ie phytoplanktons and zooplanktons) to large mammals such as the whale and seals. In addition, many fish and bird species reside in marine ecosystems. Many animals' species rely on marine ecosystems for food and shelter from predators.

<http://www.epa.gov/boiewb1/aquatic/marine.html>

Indigenous forest/thicket:

Is the forest that originating in and naturally growing or occurring in a region. A typical forest may consist of various kinds of tree species that are highly valued and serve different functions and services to the environment, community and economy of the region. [www.http://Indegenoustree gif.mht](http://Indegenoustree.gif.mht)



Seaweed farm on intertidal zone, at Uzi island, Zanzibar.

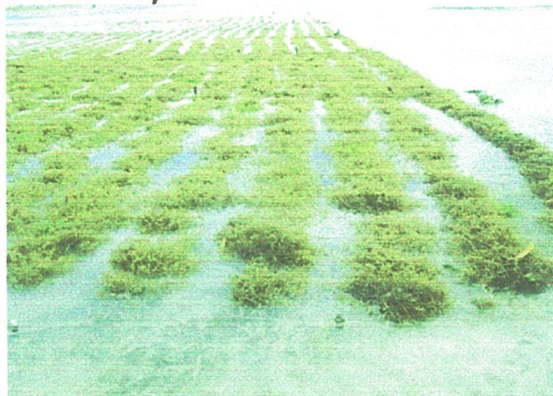


Plate 1: Seaweed farmer cultivating seaweed at Paje, East coast of Zanzibar.

Source: Department of Fisheries Zanzibar, 2011

CHAPTER TWO

LITERATURE REVIEW

Introduction

In this section, a review of literature related to the environmental impacts of seaweed farming on the east coast of Zanzibar was made.

Types of seaweed grown at Paje village.

Recently, seaweed farming has become popular in some coastal areas of Tanzania as a means of income generation. There are small-scale seaweed farms on suitably selected sites that are scattered along the entire coastline of the country, from Tanga in the north to Mtwara in the south, and on the island of Mafia and Zanzibar. The species grown here include *Kappaphycus* and *Eucheuma*. *Kappaphycus* is believed to be indigenous while *Eucheuma* was originally imported from the Philippines. *Eucheuma* has a high content of carrageenan, a polysaccharide from its cell wall which is used in foods, cosmetics and pharmaceutical products as a gel (FAO, 2005).

Kappaphycus and *Eucheuma* are the two species (types) of seaweed grown at Paje village. They grow best in warm (30° C), salty (35‰), sea water with adequate movement and clear water that allows for maximum light exposure (FAO, 2001).

Activities employed prior to establishing a seaweed farm.

The activities involved in establishing seaweed farms depend on the methods used in such farms. According to FAO (2005) there are two seaweed farming methods and these are the Floating and the Fixed off-bottom monoline methods.

The Floating method is the growing of seaweed in deeper areas of the sea using floating lines. A study done in Lamitan, Basilan (Indonesia) showed that the method does not have negative impacts on the environment (FAO, 2005). In the Fixed off-bottom method, the farm is cultivated along intertidal areas, on the sea grasses, and/or on top of corals and involves such activities as removal or raking of sea grasses, removal of corals, clearance of mangrove trees and removal of sea urchins prior to farm construction (Trono, 1990).

Kombo *et al.*, (1996) report that, most of seaweed growers (95%) women and young girls in Kiwengwa (east coast of Zanzibar island) cut sticks themselves for seaweed farming from the nearby forest with a variety of tree species. The seaweed growers leaves Kiwengwa with the impression that they remain little pressure on the forest.

Experience shows that a seaweed farmer may spends 2-3 hours for culling and 6-7 hours in cultivation seaweed on the seabed, this involves trampling on the seabed.

Environmental Impacts of activities carried out prior to establishing a seaweed farm.

The removal or raking of sea grasses, removal or shading of corals and sea urchins as well as clearance of mangrove trees along the sea or coast can lead to significant environmental impacts on the marine ecosystem and coastal area in the following ways:

Numerous studies have shown that sea grasses, sea urchins, corals and undamaged or undisturbed seabed play a major role in sustainability of marine ecosystem and coastal environments.

Ochieng and Eirfemeijer (2002) maintain that sea grasses and corals reduce erosion caused by swash and back wash processes. Thus, if they are removed, this can trigger erosion along the beach. Sea grass meadows is a nursery, breeding, and feeding ground for marine fish and crustacean and mollusc species such as crabs, lobster (*Panulims*) and shrimps (*Penaeus*) (Ochieng, 1996).

Several fish species graze on sea grasses, notably rabbit fishes (*Siganidae*) and surgeonfish (*Acanthuridae*), while parrot fishes (*Leptoscarcus*), graze the epiphytes on the sea grass. Adult fish such as snappers, groupers, grunts, and barracuda, feed on the fauna of sea grass beds, while the diet of their juveniles is mainly sea grass-derived detritus. So, removal of sea grasses disturbs the feeding environment for the fish.

Sea grass beds and corals in East Africa, as elsewhere, harbor a diverse collection of associate plant and animal species. Studies on sea grass and coral productivity in this region, have identified over 50 species of macro algae and 18 species of algal

epiphyte, at least 75 species of benthic invertebrates – especially gastropods and bivalves, several species of sea cucumbers and sea urchins species, various shrimp, lobster and crab species and thousands fish species in association with sea grass beds. This clearly underscores the importance of sea grass meadows and corals for biodiversity conservation (UNEP, 2001).

Seagrasses have dense root system comprises of rhizomes that not only help in nitrogen fixing but also helps bind the sea sediment and prevent sediment erosion.

Algaculture and mariculture are different types of cultivation of water organisms and animals under controlled conditions and is this case alteration of marine environment (Humeirah, 2008). This lead to creation of unnatural sea system in the coastal areas, where sea grasses are found and disrupt the nutrients supply and the balance environment wherein the seagrasses thrive.

Introduction of new species or decline of one species by removal, killing, or diseases into an ecosystem can upsets the existing order and might change or affect the habitant of some species within an area. Brad (2008) report that pathogen of the sea urchins caused the population of this creature to decline drastically in the Caribbean during the early 1980s. This led to proliferation of brown algae that the sea urchins feed on and created problem in the Caribbean coral reefs. Thus, introduction of seaweed farming (alga culture) and the removal of sea grasses, might affect the habitant of some marine species on the seabed.

Seaurchins consuming algae including sea grasses and various invertebrates and being consumed by crabs, sea stars, fishes, mammals and birds (Follo and Fautin, 2001). Hence their removal or killing might lead to their population decline and impacts on energy flow in marine food chains.

Photosynthetic studies carried out in Zanzibar have indicated that sea grasses may respond favorably to any future increases in marine carbon dioxide levels due to global climate change (Ochieng, 1996).

Seagrasses together with mangroves function as a trap reducing the influx of sediments, organic materials and nutrients from adjacent ecosystems to the ocean,

therefore keeping the water over the coral reefs clearer and in doing so, sustain life of the corals (Ochieng and Erftemeijer, 2002).

Trampling of the seabed during seaweed cultivation and harvesting result to water turbidity which lead to decrease in light intensity, create noise, affecting behavior of different organisms, in addition, may result to sediment disturbance, seabed erosion and damage to marine ecosystem.

Cutting of indigenous tree species from natural forest/thicket for seaweed cultivation may increase pressure on forest resources (Kombo *et al.*, 1996). In addition to that, some plastic materials (Tai tai) that are used for holding seaweed can remain on the seabed for many years, hence may have impacts to marine ecosystem.

Conceptual Framework

The conceptual framework (Figure1) depicts the environmental impacts of seaweed farming.

The environmental impacts include destruction of marine ecosystems, coastal erosion, loss of biodiversity, and change of water quality. These are the result of socio-economic activities around the coastal areas. It should be noted that seaweed farmers' activities which including removal of sea grasses and sea urchins, shading of corals, destruction of seabed through trampling and cutting of trees which may include mangroves contribute a lot to the environmental impacts. However, this relationship may be modified by land scarcity, unemployment and poverty.

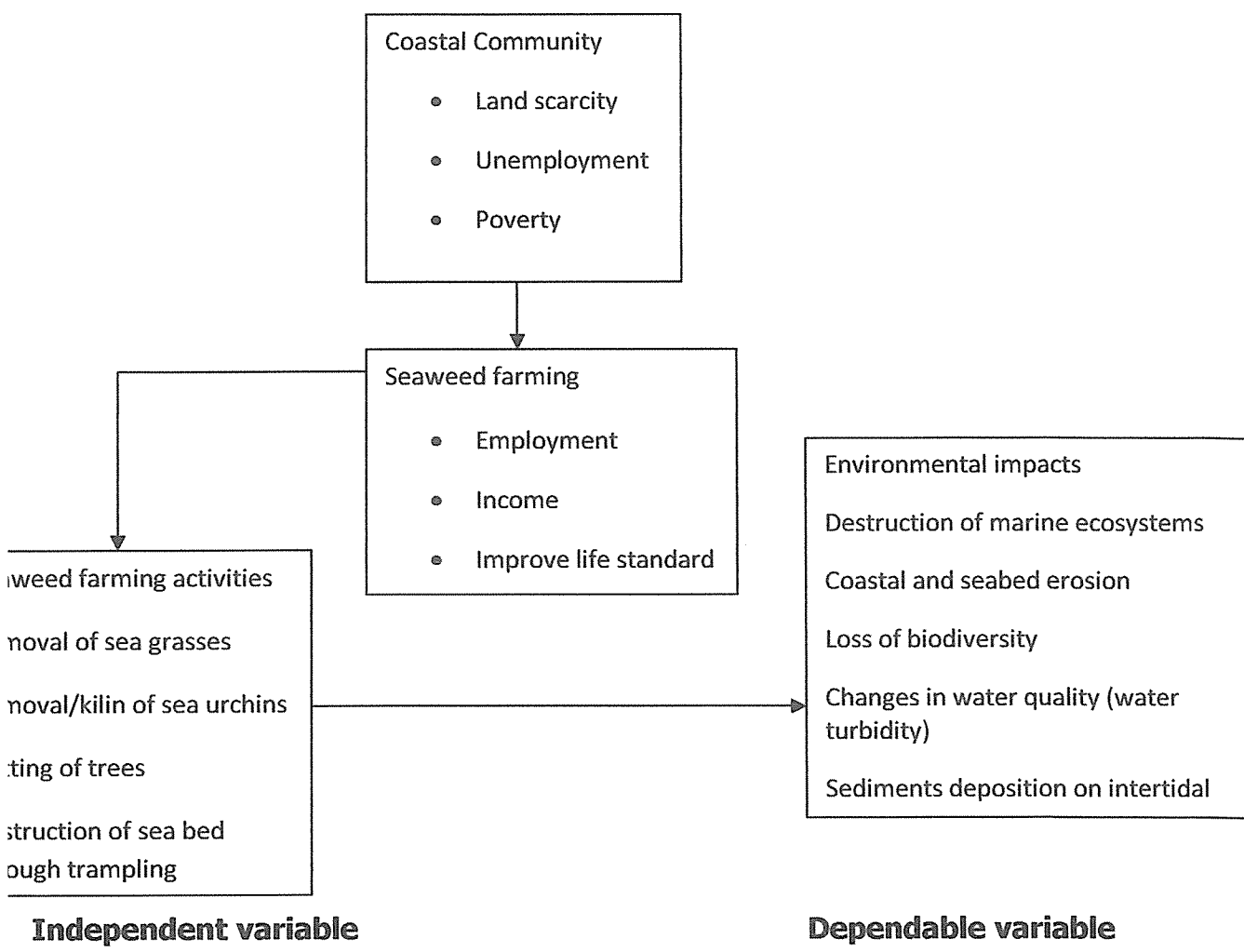


Figure 1: *Conceptual Framework on the impacts of seaweed growing on the environment.*

CHAPTER THREE

METHODOLOGY

Introduction

This section gives a detailed description of the study area, how data was collected and analyzed. It focuses on the general design of the study, research population, the sample size, instruments and limitations of data collection in the field.

Description of the study area.

Paje is located at latitude 6° 15'S and longitude 39° 32'E. It lies east coast of Zanzibar island about 40 kilometers (24.7 miles) from Zanzibar town. Paje experiences tropical climate with two rainy seasons (March-June and October-December) and temperature ranging between 27°-30°C throughout the year and are tempered by ocean breezes.

Research design

The study took the form of a descriptive survey to identify types of seaweeds grown and the different activities employed in establishing seaweed farms and how they cause environmental impacts at Paje village on the east coast of Zanzibar Island. It was also involve both qualitative and quantitative research approaches to collect data and determine the relationship between the variable seaweed farming and its impact on the environment.

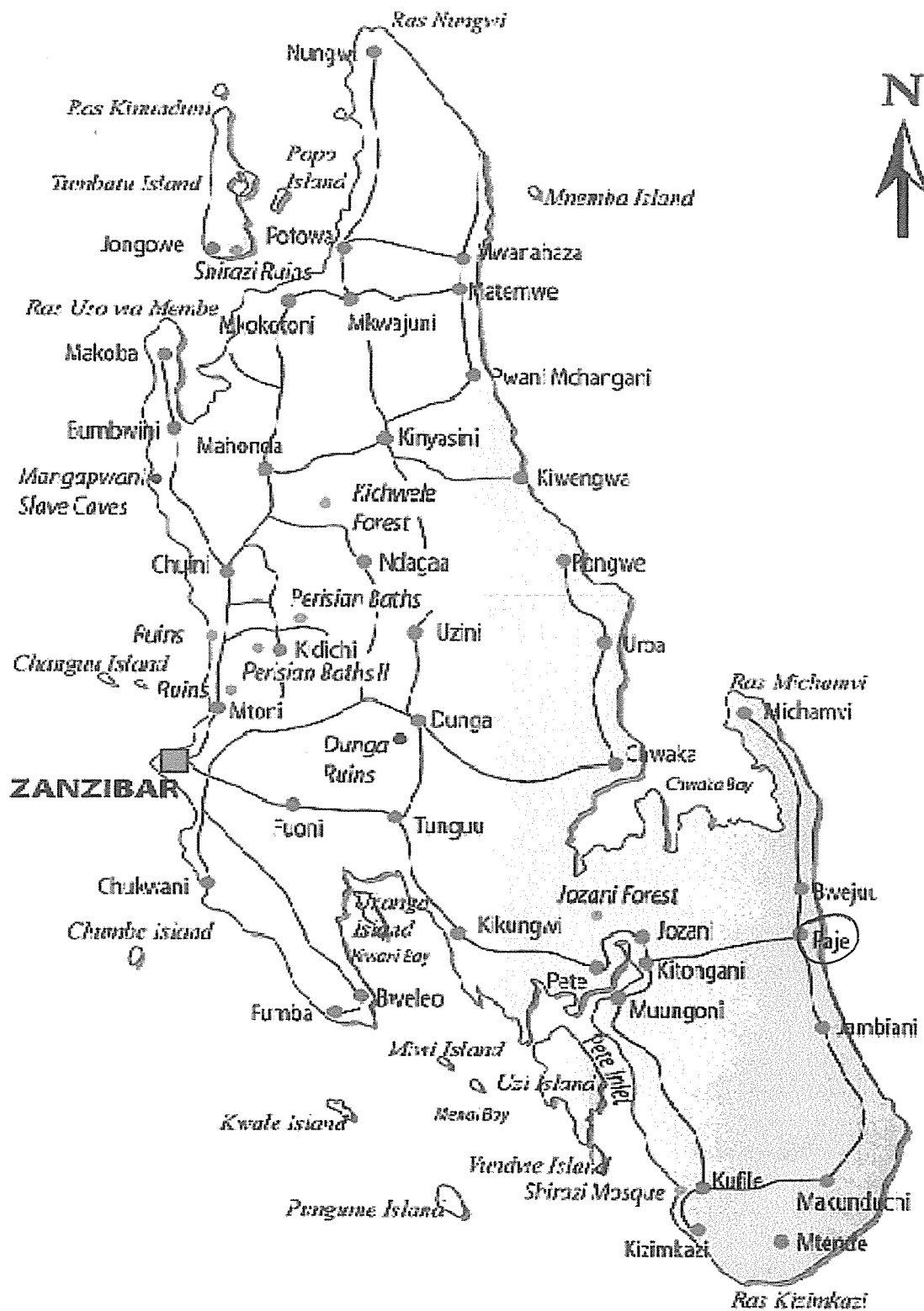
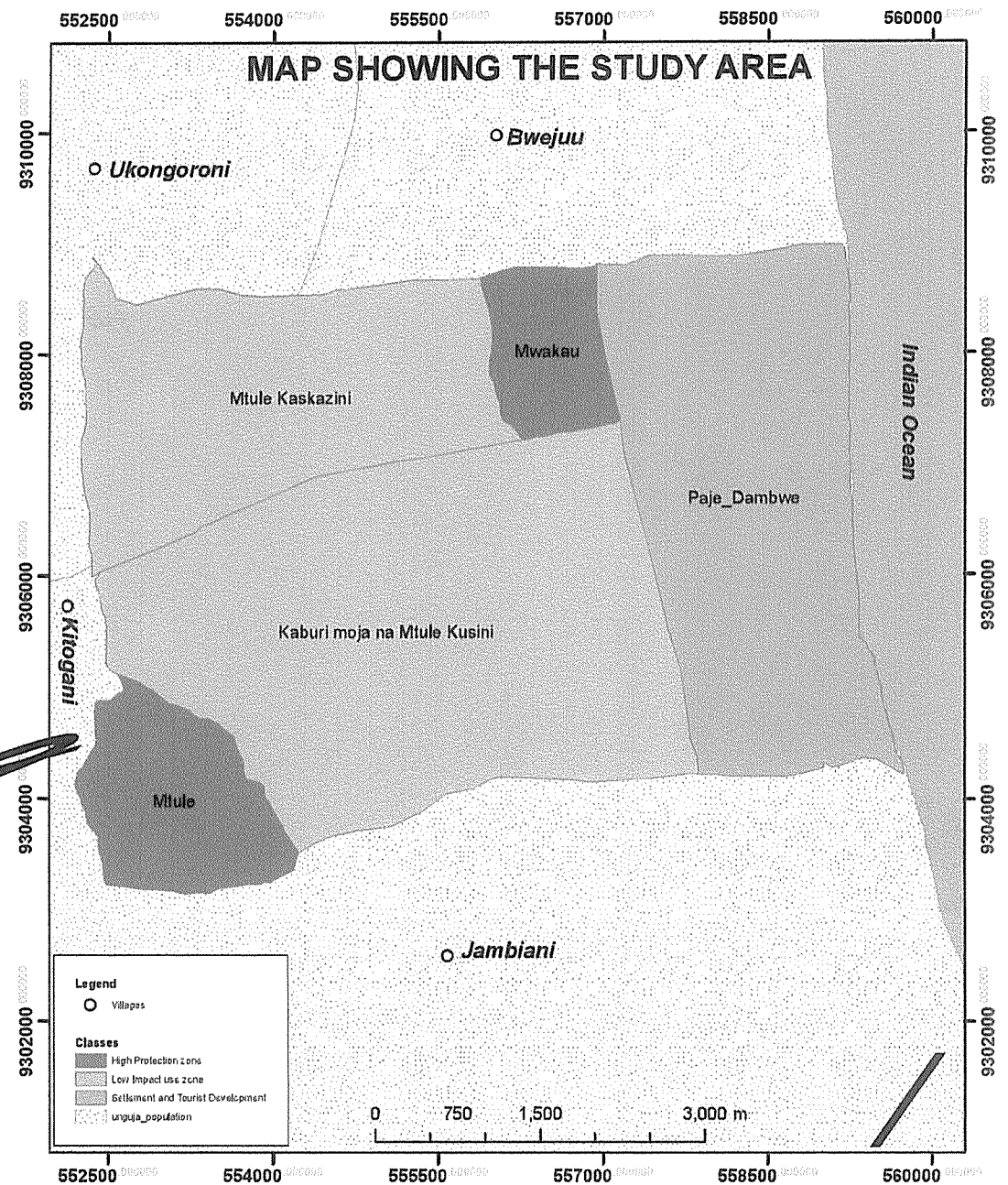
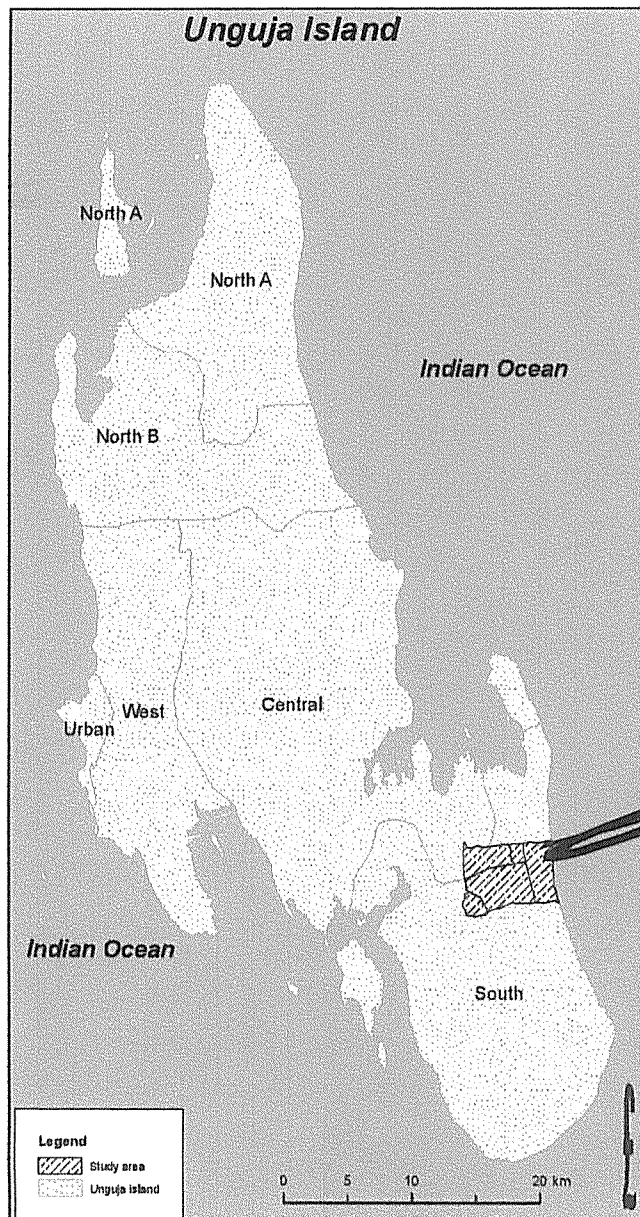


Figure 2: MAP OF ZANZIBAR SHOWING AREA OF STUDY

Source: Department of Marine resource-Zanzibar, 2010



Research population

This study included seaweed farmers and fishermen from Paje village, plus government officials from the Department of Forest, Department of Fisheries, Department of Environment, hoteliers, beach recorder, NGO (Environment) and leader of the village which make a total target population of 291.

The sample size used sample technique that ensured each respondent get a chance of participation in the study.

Sample size

In this the researcher used simple random sampling technique and Slovens formular will be used to obtain sample size from the target population in such a way that sample of same size have equal chance of being selected Amin (2005).

Where;

N=Population size

n=Sample size

n=

n=

n=

n=

n=

n=

N

—————

$1+N (0.05)^2$

291

$1+291(0.0025)$

$1+0.7275$

291

1.7275

168.45

Therefore, the sample size is 168 of respondents.

Table 1 : Sample size

Population (Respondents).	Population total (Target population)	Sample Units
Seaweed Farmers	150	100 (males & females) ((30) (70)
Fishermen	80	44
Forest Department officials	15	5
Department of Environment officials	15	5
Department of Fisheries Development officials	15	5
NGO (Environment)	10	5
Hoteliers	4	2
Beach recorder	1	1
Village's leader	1	1
Total	291	168

Source: Primary Data from sample size

Sampling Procedure

In order to obtain a representative sample, simple random sampling was employed where the respondents randomly picked on the study area. This gave respondents an equal chance of being selected. Random sampling was also used to get males and females respondents with different experiences (number of years) in seaweed farming while in fishing was used to get respondents (fishermen) with different experiences (number of years in fishing).

Research Instruments

This study intended to utilize secondary data (review of literatures) and primary data which was obtained from the study area. Methods such as interviews, questionnaires, focus group discussions, transect walk, direct observations and the use of photography were employed.

Data Gathering Procedures

Before the administration of the questionnaires

- i) An introduction letter was obtained from the School of Post Graduate Studies and research for the researcher to solicit approval to conduct the study in respectively areas.
- ii) When approved by authorities, the researcher assisted by authorities in charge secured qualified respondents selected through random sampling.
- iii) The respondents were explained about the study and before interviewed face to face they were informed or signing the Informed Consent Form.
- iv) In the selected government departments researcher left the questionnaires to assistants who selected by the authorities to administrating the data collection.

During the administration of the questionnaires

- i) The respondents were requested to answer completely within seven days and not to leave any part of the questionnaires unanswered.
- ii) All returned questionnaires were then checked if all were answered.

Data analysis.

The data was analyzed using statistical package for social science (SPSS) where variables were analyzed accordingly and the data was translated and presented using tables, graphs and pie charts. This means that, the data was analyzed and presented in form of figures that also be backed by frequency and percentage.

Ethical considerations.

The researcher sought permission and advice from the relevant authorities before the commencement of the study so as to win the

respondents consent and confidential for the purpose of research.

Limitation of the study.

The study will face some limitation such as inadequate of time, lack of scientific data describing ecological effects since the introduction of seaweed on the place of removed sea grasses as well as particular marine organisms or species that might affected as sea grasses and sea urchins removed and disappeared.

Lack of data describing marine species that have been disappeared since the introduction of seaweed farming. Lack of data describing hectares of forest consumed in seaweed farming annually.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND INTERPRETATION

Introduction

This chapter presents the research findings. It shows the data that was collected from the research instruments that were used in collection the data for the purpose of this study. It also indicates presentation of the findings. The findings are presented consonance with the research questions and objectives set earlier in chapter 1. That is Environmental impacts of seaweed farming. Activities carried out prior to establishing a seaweed farm. How do these activities lead to environmental degradation. Challenge of seaweed farming and possible solutions to the challenges.

This study engaged respondents of different categories in term of their gender, age, level of education. All of them are divided into nine groups that are seaweed farmers, fishermen, governments' officials from department of Forest, Environment and Marine resources, as well as Hoteliers, Beach recorder, NGO and village leader as represented on the table below with frequency and percentage of each category.

Table 2 Demographic of respondents and their percentage

Category	Frequency	Percent (%)
Seaweed farmers	100	59.5
Fishermen	44	26.1
Department of Forest officials	5	3.0
Department of Environment officials	5	3.0
Department of Marine Resources	5	3.0
NGO (Environment)	5	3.0
Hoteliers	2	1.1
Beach Recorder	1	0.6
Village's leader	1	0.6
Total	168	99.9%

Source: Field Data from category of all respondents of the study.

From the table 2 a large percentages of respondents were seaweed farmers (59.5%) and fishermen (26.1%) followed by government officials from Department of Forest, Environment and Marine resources and from NGO each represented 3.0%.

Questionnaires were designed from 1 to 8 questions for seaweed farmers. Questions 1 to 3 for fishermen. Questions 1-5 for government officials Department of Forest. Questions 1-5 for Department of Environment and questions 1- 6 for Department of Marine resources officials. Questions 1-3 for Hotelier. Questions 1-2 for Beach recorder Questions 1to 4 for NGO and two questions for village’s head.

Background information of respondents (seaweed farmers).

Gender of the respondents

Table 3 Gender of the respondent

Gender	Respondents	Percentages (%)
Female	90	90
Male	10	10
Total	100	100

Source: Primary data

In the table 3, 90 percent of the people interviewed were female and the remained were males. It was evident that, in the study area there were many female farmers engaged in and dominates seaweed farming compared to male.

The study has found that most males in the area prefer an industry that one getting income in a quick or short time, hence can meet daily family’s needs, thus, most males who were first engaged in seaweed farming gave up the industry saying that it takes times in cultivation (5-6 hours) and waiting for about three weeks before harvesting while the price in the market is low (TZ Sh. 150-200 hundred/kg) thus, it takes times to earn a farmer. Therefore, most of them abandoned it and back to fishing.

Age distribution of the Respondents.

The respondents were asked to give their age; this was particularly relevant to seaweed farmers. The answers were collected and sort out and represented in the Table 4 below.

Table 4 Age distribution of Respondents

Age group	Frequency	Percentages (%)
20-24	6	6
25-30	6	6
31-34	16	16
35-40	22	22
41-44	12	12
45-50	12	12
51-54	10	10
55-60	8	8
61-65	8	8
Total	100	100

Source: Primary data

From table number 4 the findings show that majority of the respondents (22%) were between the age group of 35-40. Another proportion of respondents were in the age group of 31-34, that were 16% of the respondents. Age group of 20-24 and 25-30 are the least proposition of respondents represented by 6% respectively. From those findings, it meant that majority of seaweed farmers who engaged in that industry were young between the age group of 31-40 compared to other age groups.

Marital status of the Respondents.

The respondents were also enquired to give their marital status. Table number 5 summarize their answers. The table show that the majority of the respondents (82%) especially women were married while there were only one male who were married. The remained were not married (12%) and widow (6%).

Table 5 Marital status of the Respondents.

	Married	Not married	Widow
Female	80 (80%)	4 (4%)	6 (6%)
Male	2 (2%)	8 (8%)	-
Percentages	82%	12%	6%

Source: Primary data

Educational level of the respondents (farmers).

The study sought information of the level of education of the respondent from illiterate to university level. The findings in the table 6 show that majority of the respondents (sea weed farmers) 54% had primary education, followed by secondary level 32%. The findings also reveals that 2% attended adult education (special education for those who were never been at school) and 6% had only attended madrassa (Qur'an class) and the last group 6% had never studied as indicated on the table number 6 below.

Table 6 Educational level of seaweed farmers

Level of Education	Frequency	Percentages (%)
None	6	6
Madrassa	6	6
Primary	54	54
Secondary	32	32
Adult	2	2
Diploma	0	0
University	0	0
Total	100	100

Source: Primary data

Question one was the name of village which respondents live in. The village was Paje, located east coast of Zanzibar Island.

Next question was seeking to know from respondents whether he/she was immigrant or native in the area. About 94% of the respondents (94) were native and the remaining 6 (6%) were immigrants who came and live on the area because of marriage.

Type of seaweeds grown on the area.

The study wanted a respondent to mention type of seaweed he/she grows on the area. All responses 100% confirmed that Eucheuma species which is common known as Spinosium was grown on the area.

Whether the seaweed cultivated in the deep water or intertidal zone.

Further the study asked respondents to mention whether he/she cultivates seaweed in the deep sea or along the intertidal zone. All the respondents (100%) in the study area answered that they cultivating seaweed along the intertidal zone, using Fixed off bottom method.

Activities involved to seaweed farming and their reasons.

When researcher asked respondents to mention activities done prior establishing seaweed farm and reasons for doing such activities. Table number 7 below summarizes their responses.

Table 7 Activities done prior to establishing a seaweed farm and reasons for doing such activities.

Activities	F	Percentages (%)	Reasons
Removal of sea urchins	52	52	Sea urchins eat seaweeds and lead to both poor production and low quality.
Killing of sea urchins	46	46	Sea urchins sting seaweed farmers with their sharp point spines and cause physical pain.
Removal of sea grasses	76	76	Seaweed plot should be free from sea grasses. They interfering sea weeds growth.
Cutting of trees for sticks/poles	90	90	The use of sticks/poles cannot be avoided in Fixed off-bottom seaweed farming method. Without sticks/poles seaweeds can easily be taken by sea waves and lost.
Removal of corals	4	4	Gave no reasons.

Source: Primary data.

The above table 7 representing total of frequencies and percentages of each activities done prior establishing a seaweed farm as mentioned by each respondent. This means that each respondent mentioned a number of activities and each respondent represented 1%. Thus, activities with 90% in the table mean that such activity was mentioned by 90 respondents. The findings as revealed above a large percent of responses acknowledged that there are different activities done prior establishing seaweed farm which including cutting of trees, removal of sea grasses and killing of sea urchins.

On above findings the researcher also observed that some activities such as removal and killing of sea urchins is usually done during plot preparation but also continual occurring on seaweed farming area since sea urchins frequently visiting seaweed plots, hence the study found that most sea weed farmers prefer to kill them to avoid their seaweeds being damaged rather than removal and relocate to another area.

The researcher from observing the seaweed cultivated area and in group interview with respondents also observed that removal of sea grasses occur during only plot preparation for the farming and once the grasses removed they do not regenerate as long as the area is covered by the seaweeds except when the farming is stopped.

However, some seaweed farmers confirmed that sometimes they do not remove the sea grasses but they disappeared once the seaweeds are cultivated on the area.

Plants species cutting for making sticks/poles used in seaweed farming.

Researcher sought to know species of plants that a respondent uses in seaweed farming for sticks/poles. The table number 8 below indicates the plant species that common cut for making sticks/poles by the seaweed farmers in the study area.

Table 8 Plant species used by the sea weed farmers.

Local name	Botanic name	F	Percentages (%)
Msiliza	Euclaea racemora	58	58
Mkongge	Psychotria bibracteatum and Sansariera kirkii	42	42
Mdaa	Euclaea schimperi	32	32
Mjoma	Macphersonia gracilis	50	50
Mgudi/Mlapaa	Polysphaera parvifolia	20	20
Mnusi	Maytenus mossambicensis	20	20
Ukaaga	Eugenia capensis	28	28
Mkoko	Mangroove	2	2

Source: Primary data

The above table representing total of frequencies and percentages of plant species used in seaweed farming as mentioned by each respondent. This means that each respondent mentioned more than one species of plants they use in seaweed and each respondent represented 1%. Thus, 58% in the table represented plant species that were mentioned by 58 respondents. The findings as shown above was revealed that some plants with a large percentage of 58, 50 and 42 such as *Euclaea racemora* and *Macphersonia gracilis* are more preferred compared with other plants.

In the above table 8 it was also evident that the seaweed farmers involving in trees cutting. Further about 70% of the respondents confirmed that they cut the trees from nearby indigenous forest and some plants species such as *Euclaea racemora* (Msiliza) 58%, *Macphersonia* (Mjoma) 50% and *Psychotria bibracteatum* (Mkongge) 42% are more preferred in seaweed farming for poles than other plants species. The study has revealed that the seaweed farmers prefer plants that produce straight sticks/poles and resistant to sea water. However, most of the sticks/poles are used

for at least 3-4 months before rotting, so far, no plants species used in seaweed farming in the area that is durable in salt water.

How often do the activities done

Next question was asked how often the activities conducted do; all respondents (100%) answered that usually the activities are done twice a month (after every two or three weeks) during neap tides (low tides). However, the activities are not done on all seaweed plots at a time only done on all plots that not yet cultivated.

Whether the activities involved in establishing seaweed farms have impacts on environment.

When the study asked respondents views on whether the activities prior to establishing seaweed farms have impacts on environment. Their responses shown on the figure number 3 below

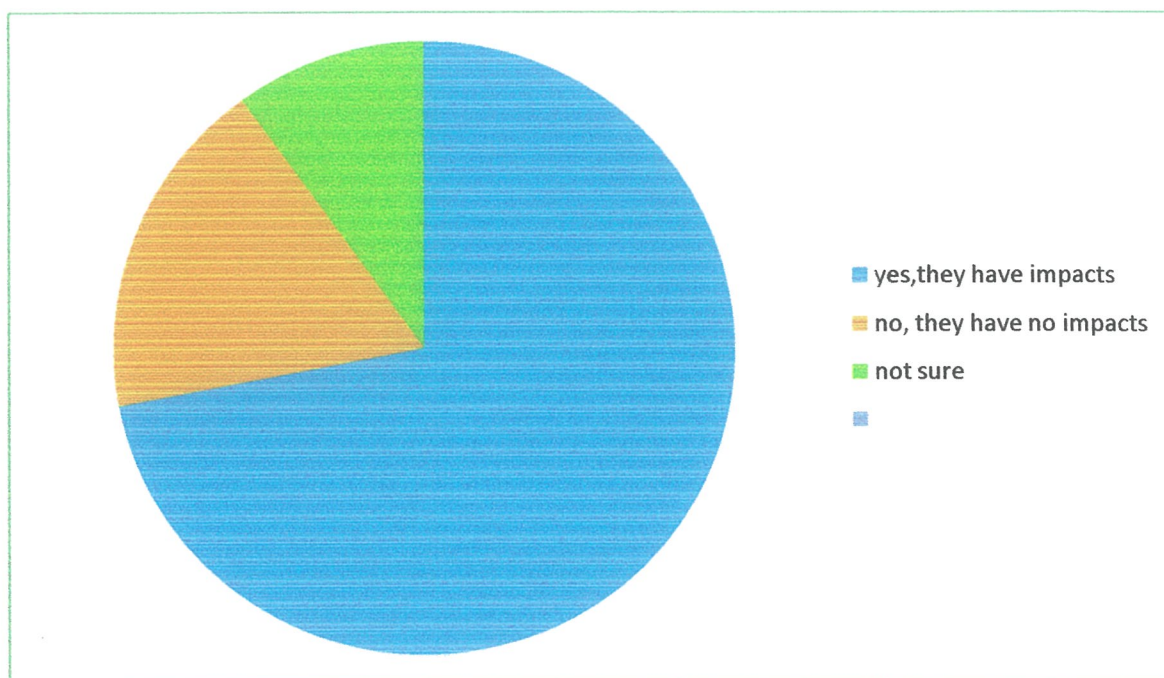


Figure 3 Respondents' views on activities prior to establishing a seaweed farm.

The above figure number 3 representing the respondents views on whether activities prior establishing seaweed farms have impacts on environment. The findings showed that a total of 72 respondents (72%) acknowledged that the activities have impacts on environment, 18 respondents which was equals to 18% believed that their activities have no impacts on environment while 10 which represented 10% were not sure whether the activities have impacts or have no.

From the above figure, it was evident that the views of seaweed farmers on environmental impacts in relation to their activities are differ, however, a bigger percentage 72% confirmed that the activities have impacts on environment.

From talks with some males' village elders of over 50 years most of them claimed that the area along the coast used to have a big thickets which now disappeared and added that all activities involving in seaweed farming have impacts to both environment and farmers' health status.

Activities and their impacts.

Researcher sought to find out respondents views on the impacts of the activities prior establishing a seaweed farm. Table number 9 summarizes their responses.

Table 9 Activities and their impacts.

Activities	F	Percentages (%)	Impacts
Sea grasses removal	60	60	Disappearance of some marine animals
Cutting of trees	30	30	Degrade environment
Corals removal	6	6	Destruct fish and other marine organisms' breeding area
Removal/killing of sea urchins	20	20	Might have effects (do not yet know)

Source: Primary data.

The above figures represent total frequency and percentage of impacts of each activity as mentioned by respondents. This mean that each respondent mentioned more than one activity and its impact, accept for killing of sea urchins and each respondent represented 1%.

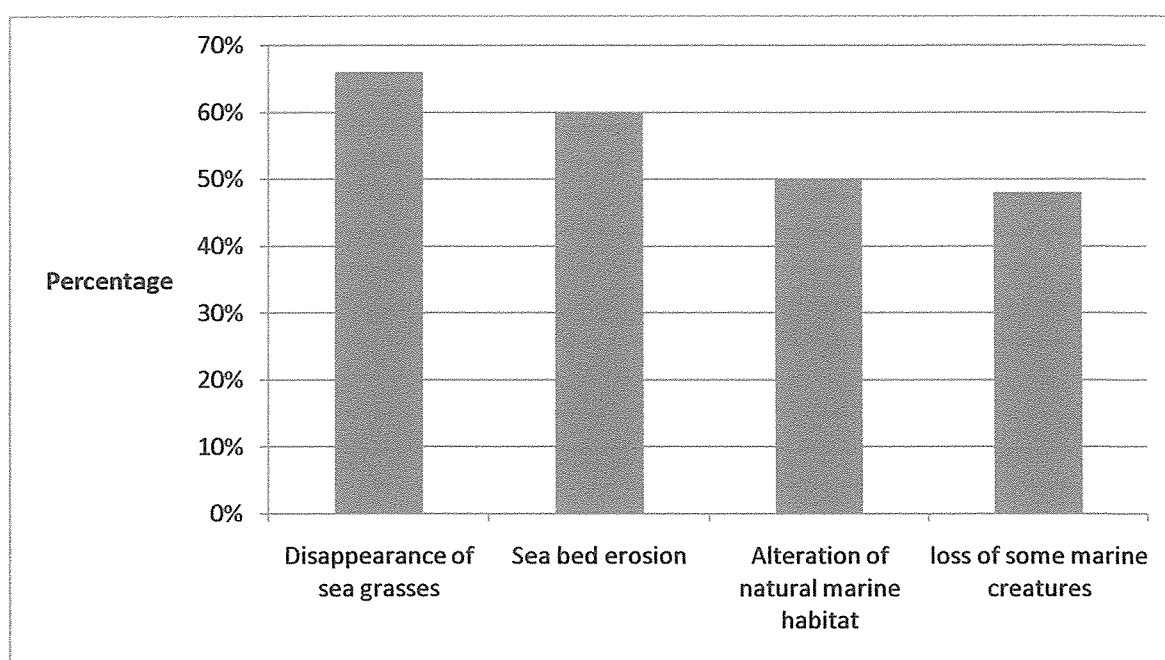
On this findings was evident that respondents acknowledged that activities such as removal of sea grasses, cutting of trees for poles/sticks, removal of corals and sea urchin as well as killing them have impacts. However, a big percentage 60% was indicated by sea grasses removal, following by trees cutting 30%. Some respondents argue that some activities such as killing of sea urchins might have effects but they said that they do not yet know exactly.

Information on impacts of seaweed farming.

The study asked a respondent to answer whether he/she have ever heard that seaweed farming have impacts on environment, 66 (66%) of responses answered "yes" and 34 (34%) of the responses answered "no".

The next question asked respondents (those who said "yes") to mention sources of that information in above. Two sources mentioned, that is JUMASPA-NGO (Jumuiya ya Maendeleo Shehia ya Paje-(Paje Developmental Organization)) and stories from friends.

Further the researcher required respondents to mention the impacts that he/she had ever heard. Figure 4 below indicates the responses.



Source: Primary Data

Figure 4. Seaweed farming impacts that were ever heard.

The above figure 4 represent total percentages of impacts of seaweed farming as mentioned by 66 respondents (66%) who had ever heard them. This mean that each respondent mentioned more than one impact that he/she had ever heard and each respondent represented 1%. Therefore, impact such as disappearance of sea grasses was mentioned by all respondents while of 60% seabed erosion was mentioned by 60 respondents.

The findings in figure 4 reveal evidence that about 66% of the respondents had ever heard some information on environmental impacts of seaweed farming.

Land ownership on seaweed farms.

The researcher was seeking to confirm whether the seaweed farmers own the area under seaweed cultivation. The respondents did not stop on saying "yes" or "no" but gave more opinions that was summarized as 48% of the opinions which believed that the area is belonged by government, while 30% believe that the area is owned by Paje village and 22% believe that the area is owned by no one. The study found that the seaweed farmers do not have property right of the area used for seaweed cultivation. However, they believe that they have the right to use it for their lives.

Whether there was a land ownership problem on seaweed farm area.

Further the researcher sought to understand from respondents on whether there was land ownership problem/dispute on seaweed farming area. All respondents (100%) answered "no". However, most interviewees mentioned that oftentimes they have been asked by hoteliers not to cultivate or drying seaweeds on the area in front of the hotels (intertidal and beach).

Whether there was any environmental conservation programs.

The respondents were asked whether there were any environmental conservation programs that taught in Paje village. All responses (100%) answered "yes".

Next question asked respondents to mention the tutors and the area that have been focusing. All responses (100%) mentioned JUMASPA (NGO) and it focuses on trees planting along the beach and garbage controlling at Paje village.

Whether the villagers understand the tutors.

Further the researcher wanted to confirm from respondents on whether the villagers understand the tutors. About 88% of the responses answered "yes" and 12% answered not sure.

Activities the villagers did on the environmental conservation programs.

The study also asked respondents to mention activities that the villagers did or engaged in to show evidence of their understanding on the environmental conservation programs that taught in the village. About 82% of responses mentioned that villagers do not haphazardly dumping garbage at the village and educating one another on sustainable use of forest resources.

Whether there was any challenge in seaweed farming.

The respondents were asked whether seaweed farming has challenges. All responses (100%) answered "yes".

Next question sought to find out the challenges in seaweed farming. The respondents mentioned the following challenges.

Physical challenges.

Most of the interviewees about 80% said that they often suffer from fatigue, chest pain, legs aches, sore eyes (from the glare of the sun and seawater reflection) and dry cracked lips. Injuries from stepping on sea urchins and painful strings from fish such as sting rays. They further added that, the price of seaweed in the market is still very low (150-200 Tsh/kg).

Challenges on changing the seaweed method (Fixed off bottom method).

Observation has shown that the fixed off-bottom seaweed cultivation method which is used by the seaweed farmers on the study area has impacts on marine ecology since it associated with destruction of seabed through frequently trampling and removal of sea grasses which in turn instigated seabed erosion.

Therefore, other method such as Floating and net methods were tried on the area as alternative to the Fixed off bottom method. However, interviewees (seaweed farmers) reported that neither of methods has been successes on the area due to strong waves of the sea on the area which often led to the loss of seaweeds and all the instruments used, hence led to loss of farmers' income and disappointed. In addition, they mentioned that the floating method is an expensive one since it involves the use of instruments such as boat and floating objects that most of the farmers cannot afford them. Thus, both of the methods had totally failed on the area. Therefore the farmers mentioned that still they use the Fixed off bottom method.

Loss of some marine creatures on the seaweed farming areas.

About 62% of the interviewees gave emphasis description that the following marine creatures (Mollusks and malacostraca) especially shells such as Humpbacked conch or strombus gibberulus (Chuale), Chicoreus ramosus (Komedole), Pleuroploca trapezium (Komefundwa), Sea cucumbers (Majongoo), triton shells, crabs and stone fish were frequently found on the area where (now) seaweed is cultivated but have been disappeared.

Whether there were Solutions or Strategies planned for solving the problems.

The study was seeking to find out solutions or strategies that have been planned for solving the problems or combating the challenges. About 70% of the responses answered that still there was plan on changing the seaweed method since the failure

of the other method (floating methods). Further pointed out that they asked for loans and experts for introducing other new methods and educating the farmers.

How far have been successes.

Next question was seeking to find out to what extent the plan had been successes. About 90% of the responses mentioned that still there was no success on the plan.

Reasons for not been successes.

The study was further seeking to find out reasons for not been successes on the plan. About 63% of the responses answered that there is a lack of experts on that industry and instability of seaweed prices also creates set back in getting a loan. While 37% of the respondents gave no reasons. The study found that some seaweed methods are used in deeper water (3-7 meters deep) hence it can be difficult in such deep water for women who are the majority on that farming to dive in such deep. Observation has shown that the Fixed off-bottom method of sea weed farming together with the activities associated with it was still practicing on the area.

Whether there was any other economic activity that the farmers engaged in.

The respondents were asked on whether there was any other economic activity that a respondent engaged in apart from the seaweed farming. Most of the seaweed farmers about (90%) answered that they had no other alternative economics activity and that depend on seaweed farming only.

Interviews for Fishermen.

The study interviewed 45 fishermen from the study area.

Researcher wanted to know from the fishermen, type of fishing, experiences in fishing, whether they experiencing fishing problem, whether they experiencing changes on coastal belt, whether the seaweed farming has impacts to fishing, solution to solve the problem and benefits of seaweed farming to fishing.

Question one wanted to confirm if the respondents practicing fishing. All the responses 100% answered "yes".

Next question the researcher sought to know type of fishing the respondents practicing. All the responses 100% answered small scale.

When researcher asked respondents to mention their experiences in fishing. Table number 10 below summarizes their responses.

Table 10 Respondents experiences in fishing.

Number of years in fishing	F	Percentages (%)
9	3	6.7
13	3	6.7
15	3	6.7
21	6	13.3
25	6	13.3
27	6	13.3
30	9	20.0
34	9	20.0
Total	45	100

Source: Primary data

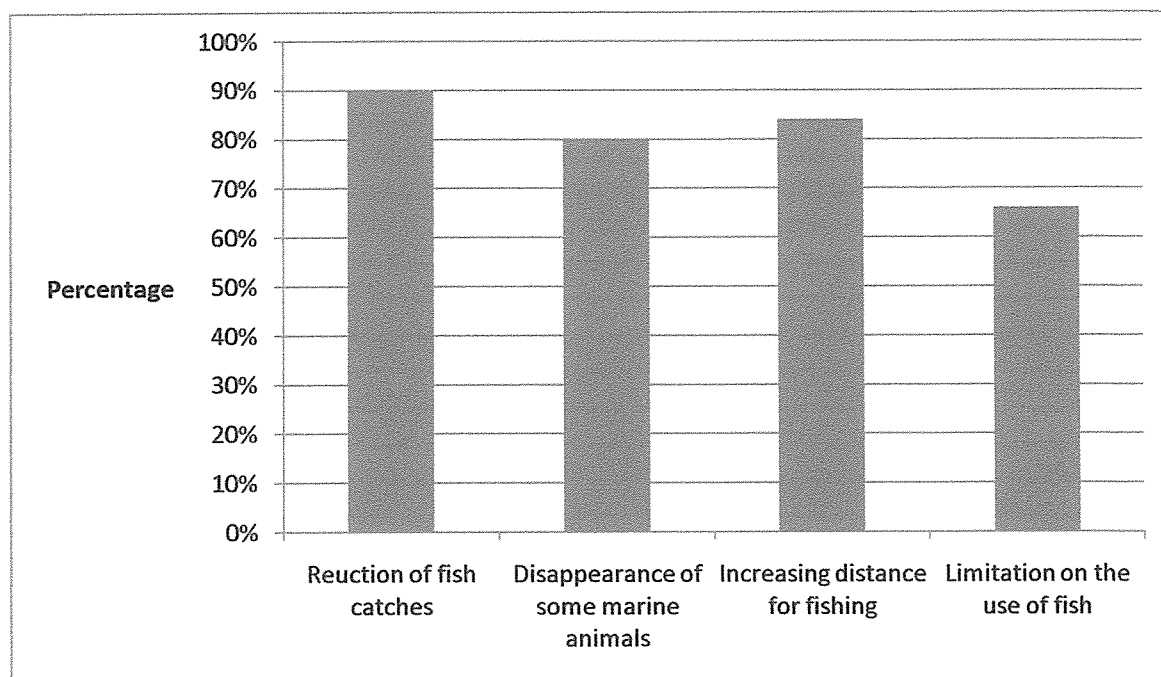
The above table 10 representing total frequency and percentage of number of years of respondents (experiences) in fishing as mentioned by respondents.

From the above data on the table number 10 was evident that majority of the respondents more than 50% have been in fishing before introduction of seaweed farming on the area (1985-86). Thus, it was important for this group of respondents to be included in the research since they have been working on that environment for more than twenty five years hence their knowledge and experience were important in understanding changing of the environmental condition before and after the introduction of the seaweeds farming on the area.

Whether there was fishing problems on the area.

The study wanted to know from respondents on whether they experiencing fishing problem on the area. All responses 100% answered "yes".

Next question wanted respondents to mention the problem experienced. Figure number 5 summarizes their responses.



Source: Primary Data

Figure 5. Fish problems experiencing on the area.

The above figures represent total percentage of each fishing problem as experienced on the study area and as mentioned by respondent. Each respondent mentioned more than one problem and each mentioned problem from one respondent represented 2.2%. Thus, a problem with 88.88% approximated (90%) which is reduction of fish catches on the above figure was mentioned by 40 respondents out of 45 respondents. While increasing distance for fishing 84% was mentioned by 38 respondents out of 45.

As revealed on the figure number 5 above a large percent of respondents confirmed that there was fishing problem experienced on the area, which were; reduction of fish catches 88.88%. Another percentage of 84.4 of the respondents confirmed increasing distance in fishing. 80% of them confirmed disappearance of marine animals such as mollusks and 66.7% of the respondents confirmed limitation on the use of traditional fish traps (Dema) along the intertidal zone as the area is covered by seaweeds.

On the above findings the researcher observed that the problems are influenced by destruction of marine ecology which is alteration of both physical and biological environment. The physical environment including light, water and nutrients due to frequently seabed trampling (seabed walking) that leads to water turbidity which also create visual impacts noise and decrease light intensity hence photosynthesis thus affect energy flow. The biological environment including removal of sea grasses and killing of the sea urchins might affect marine animals' habitat and energy flow (nutrients) since some creatures feed on sea grasses and sea urchins

and lead to abandoning (disappearance) on the area hence creating problem in fishing.

When do the problems started.

The respondents were asked to confirm whether the problems started before or after the introduction of seaweed farming on the area. About 33 of the responses (73.3%) confirmed that the problems had been started some years after the introduction of seaweed farming. While 12 of the responses (26.6%) answered not sure.

Whether seaweed farming has impacts on fishing.

The researcher was seeking to find out the views of the respondents on whether the seaweed farming has any impacts on fishing. About 30 of the responses that represented (66.6%) answered "yes" and 9 responses represented (20%) answered "no". While 6 of the responses (13.3%) answered not sure as shown on the table number 11 below.

Table 11 Whether seaweed farming has impacts of fishing.

Response	F	Percentage (%)
Yes, it has impacts	30	66.6
No, it has no impacts	9	20.0
Not sure	6	13.3
Total	45	99.9

Source : Primary data.

From the above findings it was evident that a large percent of the respondents' views 66.6% confirmed that the seaweed farming has impacts on fishing, while 20% disagreed that seaweed farming has impacts in fishing and 13.3% were not sure whether it has impacts or has no impacts in fishing.

Next question sought to confirm from respondents the impacts and the ways those impacts develop. Table number 12 below indicating their responses.

Table 12 Impacts of seaweed farming on fishing.

Impacts	F	Percentages (%)
Seabed erosion and increasing sedimentation along the intertidal area that reduce sea water level and causing fish to avoid or migrating the area.	30	66.6
The eroded sediments burying marine creatures such as corals and mollusks (shells) and affecting fish habitats.	24	53.3
The area where seaweed farming is carried out is no longer used for fishing.	30	66.6
Disappearance of sea grasses also affecting fish habitats hence impacts on fishing.	36	80.0

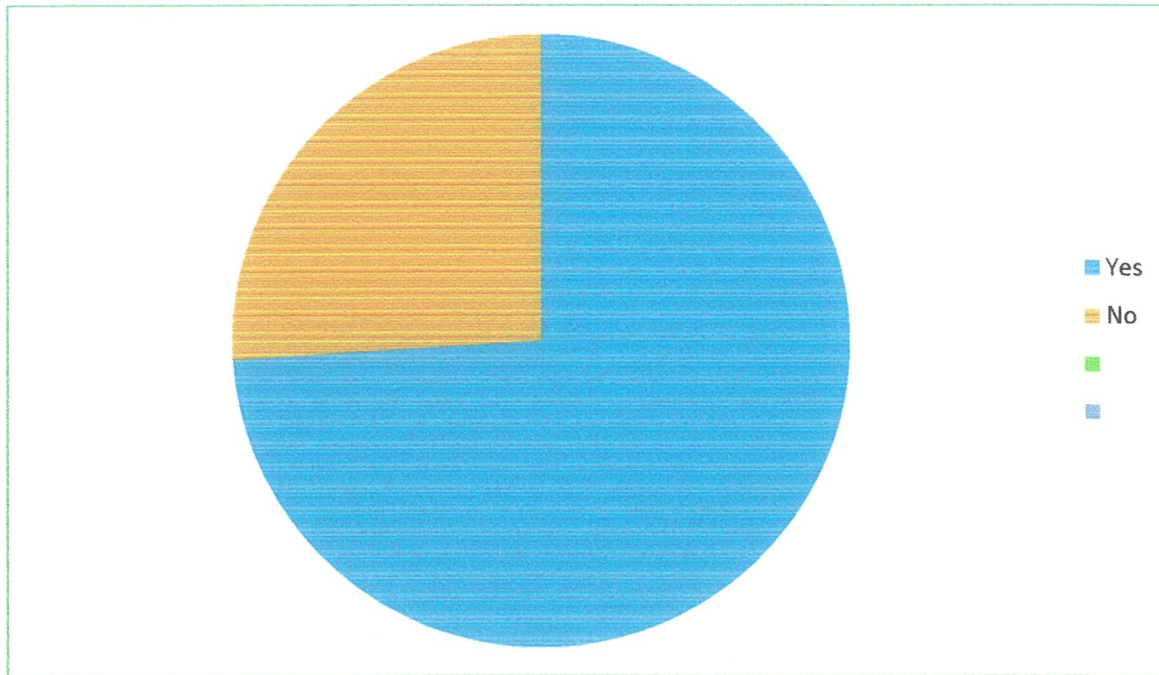
Source: Primary Data.

The above table number 12 represents total frequency and percentage of impacts of seaweed farming on fishing as mentioned by respondents. This mean that each respondent mentioned more than one impact and each mentioned impacts from one respondent represented 2.2%. Thus, 80% on the table representing impact which was mentioned by 36 respondents while 66% representing impact which was mentioned by 30 respondents.

The table number 12 gives evidence that seaweed farming in different ways causing impacts on fishing. The researcher observed that eroded sediments from the seabed on seaweed farming plots creating several small sandbars like features along the intertidal area and lead to minimizing of the sea water level hence have a potentiality of burying sea animals such as shells and corals.

Whether the respondents experiencing environmental changing on the coastal area.

When respondents were asked whether experiencing environmental changes on the coastal belt on the area, their responses were as represented on the figure 6 below.



Source: Primary Data **Figure 6. Whether respondents experiencing environmental changes on coastal belt.**

The above figure number 6 represent total percentage of views on whether the respondents experiencing environmental changes on coastal belt of the study area as mentioned by respondents. The figure indicating that 33 of the responses which were equal to 73.3% confirmed that there were environmental changes on coastal belt and 12 responses which were equal to 26.7% answered "no".

Environmental changing that have been experienced on the area.

Next question wanted respondents to mention the changes that one has been experienced on coastal zone of the area. Table number 13 below summarizes their responses.

Table 13 Environmental changes experienced along the coast on the area.

Changes experienced	F	Percentages (%)
Increasing accumulation of sediments along the intertidal area and the beach.	20	44.0
Disappearance of some marine animals on the beach such as crabs.	25	55.5
Dried of a river	17	37.7
Loss of forest resources	22	48.8

Source: Primary data

The above figures represent total frequency and percentage of environmental changes as experiencing on the coastal belt of the area as mentioned by 33 respondents 73.3% who confirmed that they experiencing environmental along the coast. This means that each respondent (33 out of 45) mentioned more than one experienced changing on the area. The percentage however was based on whole number of respondents (45).

The above findings in the table number 13 was evident that there were some environmental changes experienced along the coast on the study area which including, loss of forest resource, drying of a river and increasing accumulation of sediments along the intertidal zone and on the beach.

How do the changes started.

Researcher wanted to know from the respondents' views (from 33 above respondents)on how was the changes started on the area along the coast. The respondents' answers on how the changes started summarized on the table number 14 below.

Table 14 How do the environmental changes started.

Responses	F	Percentages (%)
Disappearance of sea grasses	22	48.0
Accumulation of sediments from seabed erosion.	17	37.7
Deforestation of coastal thickets	22	48.0
Cultivation of seaweeds in the sea	15	33.3
Not sure	18	40.0

Source: Primary data

The above table represents figures of total frequency and percentage of summarized views (reasons) explained how the changes started on the area as mentioned by of 33 respondents. This means that each respondent mentioned a number of reasons explained how the changes started. The percentage on the table based on the whole number of respondents (45-fishermen), thus, each mentioned reason by one respondent represented 2.2%.

From the above findings it was evident that the respondents believed that there are many reasons that they thought might led to the changes along the coastal area of the study area as mentioned above on the table. However, 18 of the respondents were not sure how did the changes start. The researcher observed that all of the above mentioned related to seaweed farming industry and found that loss of sea grasses on the seabed and creeping vegetation (grasses) along the beach as well as deforestation of coastal tickets are vividly changes and immediate effects of seaweed industry on the study area.

When do the environmental changes started.

The study further wanted to know from respondents when do the environmental changes started. Table number 15 indicating their responses.

Table 15 When do the environmental changes started.

Responses	F	Percentages (%)
Long time ago	5	11.11
Not long time	12	26.66
Nearly 10 years ago	15	33.33
Not sure	13	28.88
Total	45	100.00

Source : Primary data

The above table represents the findings of total frequencies and percentage of respondents that mentioned their views on when do the changes started. From this findings it evident that views of respondents on when did the changes started differ among them, however, a large percent of responses 33.33% confirmed that the changes started nearly 10 years ago. 28.88% were not sure when do the changes start.

Whether the changes affected the area and fishing.

The study was further seeking to confirm whether the changes affecting the area and in fishing breeding.

Effects on the area.

About 55.5% of the responses confirmed that off-shore fishing is ceased due to drying of river and reduction of sea level on the intertidal zone. While about 66.6% of responses confirmed that there was reduction of forest resources such as building materials for example poles.

Effect in fishing.

About 60% of the responses confirmed that most fish breeding areas have been destroyed and most fish have changed their habitant to deep water.

The responses have also confirmed that some fish species have been disappeared on the area but there was no any data yet confirmed this claim.

Solution to solve the problem.

The study sought to find out solution or ways from respondents to solve the problem. The findings are shown in the table number 16.

Table 16 Solution/ways for solving the problem.

Solution/ways	F	Percentages
Seaweed farmers should be educated.	33	73.3%
Seaweed farming method should be changed.	30	66.6%
Committee should be formulated to monitor seaweed farming.	22	48.8%
The government should intervene the issue.	15	33.3%
Seaweed farming should be abolished.	6	13.3%

Source: Primary Data.

The above figures represent total frequency and percentage of solution for solving the problem each as mentioned by respondents. This means that each respondent mentioned more than one solution in solving the problem, and each mentioned solution by one respondent represented about 2.2%.

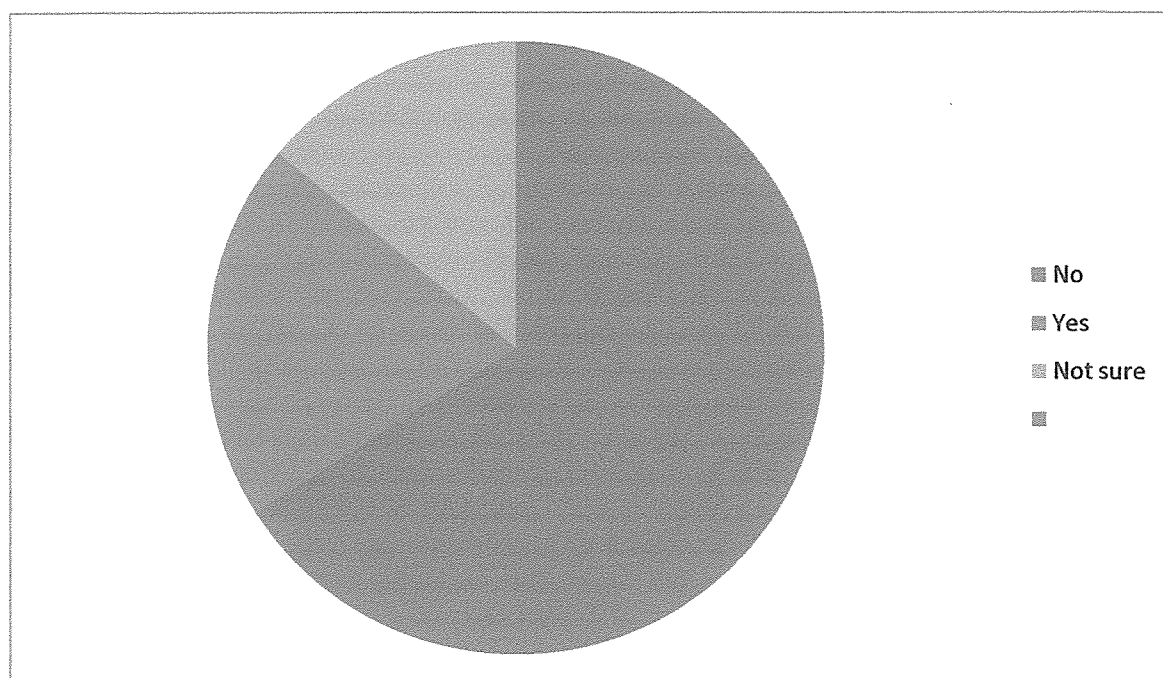
The above findings were evidences that the respondents had different views on the way of solving the problem. On the above findings the researcher has also observed that government intervention, providing education (Environmental education) to seaweed farmers and changing of seaweed farming method can lead to significant impact in solving the problem. This is because the government can control it through EIA process, formulating by-laws, regulations and policy.

If seaweed farmers given environmental education they will be aware and commitment on conserving environment and control their activities.

The fixed off bottom method has impacts on both marine and terrestrial plant species due to the removal of sea grasses and cutting of coastal thickets for making poles used in seaweed farming, thus, if the prevail method is changed such impacts can be minimized at large.

Whether seaweed farming has benefits to fishing.

The study also sought to find out respondents' views on whether the seaweed farming has benefits to fishing. Figure number 7 below indicates their responses.



Source: Primary Data **Figure 7. Whether seaweed farming has benefits to fishing.**

The above figures represent total percentage of views of respondents on whether seaweed farming has benefit to fishing as mentioned by respondents. The findings as shown that 66.7 % which represented 30 respondents answered "no" while 20% which represented 9 respondents answered "yes" and 13.3% which represented 6 respondents answered "not sure".

From the above findings were evidence that a large percentage of the responses 66.7% confirmed that the seaweed farming has no benefits to fishing.

Further the study wanted to know from those respondents (20%) who said that the seaweed farming has benefits to fishing. The searcher, however, observed that their responses, however, were not directly focus on benefit of seaweed farming to fishing rather focused on those fishermen who married with some seaweed farmers (females) that were benefited from the incomes of their wives getting from selling the seaweeds.

Interviews for Hoteliers.

The study has also included two respondents who were members of Crystal tourists' hotels management (a private hotel) which is located along the beach not far off from seaweed farming plots.

The study wanted to know the following from respondents: Whether there was seaweed farming activities around their hotels. What were those activities. How far

was from the hotels. Whether those activities have impacts on environment and what were the impacts. Whether those impacts affecting tourism industry. Whether they had any solution and Whether there was land ownership problem between the seaweed farmers and the hotels.

Question one asked respondents to name the hotel they work/own.

Whether there is seaweed farming activities taking place around the hotel.

Next question wanted the respondents to confirm whether there was seaweed farming activities taking place around their hotel. All their responses confirmed that there was seaweed farming activities taking place around the hotel.

The researcher asked the respondents to mention those activities. All the responses mentioned the activities that taking place was cultivation of seaweed farming. Next question sought to know distance of the seaweed farming plots from the hotel. All the responses answered about 100 meters left-hand side of the hotel's swimming site (in front of the hotel).

Respondents views on whether the seaweed farming has impacts.

The study also sought to find out the respondents' views on whether the seaweed farming has impacts on the environment. Their responses confirmed that to some extent it has impacts to the environment.

Impacts of seaweed farming.

Next question asked the respondents to mention those impacts. All responses point out that the seaweeds that lay down to dry on the beach sometimes become rotten as they become wet especially during long rains seasons and stinking the beach thus annoying beach users.

Remaining of rubbish of nylon ropes, plastic strings called "tie ties" and decayed poles that often left by seaweed farmers and scattering along the intertidal area and on the beach- degrading environment.

Creeping grasses such as *Ipomea pescapraea* (Milakasa) has been disappeared along the beach as a result of using the beach for seaweeds drying thus instigating beach erosion since the grasses act as resistant for beach erosion.

Whether seaweed farming affects tourism industry.

When further asked if those impacts affect tourism industry. Their responses were "no". However, they said that remnants of seaweeds and stinking from decaying seaweeds annoy the tourists when they rest on the beach. While remain of sharp pointed decayed poles, erecting poles and sticks on the seabed creating dangers

during swimming especial during high tides as the poles and sticks are hidden by sea water. Hence limiting tourists in kite surfing.

Solution to the situation.

The researcher further wanted to know whether there is any solution that being suggested on that situation. Their responses said no any solution on that situation so far.

Whether there is land ownership problems/land disputes.

Next question asked if there was any land ownership problem or land disputes between the seaweed farmers and hotel owners. The respondents said "no" added that there was no longer conflict since the seaweed farmers moved from the area in front of the hotel. However, from talks with some seaweed farmers, the researcher discovered that some seaweed farmers received some compensation from the hotel owners to leave and stop cultivating seaweeds in front of the hotel.

Interviews for Paje's Beach Recorder (from government).

The study was seeking to know the following from the respondent: His responsibilities and experiences as beach recorder. Whether he was familiar with seaweed farming activities. Whether those activities have impacts on environment and what were those impacts. Whether he has any solution to the problem.

Beach recorder responsibilities.

The first question was asked his responsibilities at beach. The response was to conserving Paje beach environment and ensuring no one destructing environment both in the sea and on the beach.

Experience at work.

Next question wanted to know the respondent's experience at work. The response was eleven years.

Whether the respondent was familiar with seaweed farming activities.

Another question asked respondent to confirm whether he was familiar with seaweed farming activities at Paje village. The answer was "yes".

Whether seaweed farming activities have impacts on the environment.

When the researcher sought respondent's opinions on whether the seaweed farming activities have impacts on environment the answer was "yes".

Environmental impacts of seaweed farming activities.

Next question required the respondent to mention the environmental impacts of the seaweed farming activities. The respondent mention that cutting of trees for sticks/poles, drying of seaweeds on the beach leads to disappearance/killing of beach grasses such as Milakasa (*Ipomea pescapraea*) which are important for beach erosion resistance, disappearance of sea grasses, remain of pieces of nylon ropes in the sea and on the beach and emission of bad smell from decayed seaweeds on the beach.

Solution to the problem.

The study was seeking to find out solution that suggested by the respondent. The respondent suggested that method of seaweed farming used at Paje village should be changed and educating the farmer on important of conserving environmental resources.

Interviews for JUMASPA (PAJE-NGO)

The researcher interviewed 5 members of JUMASPA and sought to know the following:

When and why was it established. Whether was it practicing environmental conservation and why. What were the focused areas and why were those areas. What were the activities on conservation. Whether were experienced any environmental degradation related to seaweed farming on the area. Measures that were taking to solve the problem. Whether there were challenges in environmental conservation in relation to seaweed farming. Ways of improving the situation.

JUMASPA (Jumuiya ya Maendeleo Shehia ya Paje—Paje village developmental organization) was established in 1997 with the intention of mobilizing and advocating development and promoting social welfares at Paje village. It delegating its responsibilities under four committees.

Whether JUMASPA practicing environmental conservation.

The researcher wanted to know whether the NGO practicing environmental conservation. All respondents confirmed that JUMASPA practicing environmental conservation under the Natural resources and Environmental conservation committee.

What do you do in conserving environment.

The study wanted to know activities that JUMASPA was done in conserving the environment. The respondents explained that they established trees planting complain and mobilizing villagers to participate and controlling poor disposal of garbage from tourist hotels.

Areas such conservation focusing and why such areas only.

Next question sought to confirm area which such conservation was focused and reasons. The respondents put out that JUMASPA conserving environment throughout Paje village including Paje beach and area along tourist hotels.

Reasons for establishing environmental conservation.

The decision of establishing environmental conservation was reached after the village witnessed environmental degradation along the beach which included beach erosion, loss of indigenous coastal thickets as a result of unsustainable cutting of trees and from poor disposal of tourist hotels and domestic garbage.

Environmental degradation relating to seaweed farming.

The researcher also wanted to know whether JUMASPA experiencing any environmental degradation related to seaweed farming in the area. All the responses answered "yes". Next question was to mention the environmental degradation related to seaweed farming. The respondents pointed out that disappearance of sea grasses, beach erosion, remain of smaller plastic cords called "tie-ties" in the sea and cutting of trees for sticks/poles. They added that seaweed farming affect both marine life and loss of forest.

Measures/Programs that had been taken to solve the problem.

The study was seeking to find out what measures has JUMASPA taken to solve the problem. The respondents mention that establishment of natural resources and environmental conservation committee which among other responsibilities it monitoring and controlling uses of the village's (Paje) natural resources including forest resources and it mobilizing villagers participating in trees planting along the beach campaign as well as educating the villagers on conservation of natural environment were measures that have been taken to combat the problem.

Challenges in environmental conservation in relation to seaweed farming.

When the respondents required mentioning challenges that JUMASPA facing in environmental conservation in relation to seaweed farming at Paje. The respondents mentioned that changing of method of seaweed farming from Fixed off-bottom method to Netting or Floating line methods which to somehow not bad to environment was still a big problem since all those methods had failed due to strong sea waves and lack of capital and financial support from stakeholders. They added that the seaweed farmers still cutting very young trees for sticks/poles thus affecting

regeneration. Nevertheless there is no alternative economic activity to women who majority of them engaged in seaweed farming industry.

Ways for improving the situation.

The study further seeking to find out respondents' views on improving the situation. Their responses suggested that there should be enforcement of environmental conservation rules/regulations, by-laws and formulating policy to govern seaweed farming and using of environmental resources.

Interviews for head of the village (Paje).

The study was sought to know the following from the head of the village: How long had been in the village. His responsibilities. When was seaweed farming established on the village. Whether there was any environmental problem reported from the village. How and when did they start. Whether seaweed farming had contributed on that problems. How was it contributed. What measures were taken to check up the problems. Whether there was challenge in controlling them.

How long has the respondent been in the village and on duty as village leader

The researcher wanted to know how long has the respondent (the village's head) been in the village. The respondent answered 41years. Next question the researcher wanted to know how long has the respondent been on the duty as a village's head. The respondent answered 12 years.

Responsibilities as a head of village.

The study was seeking to know the respondent's responsibilities as a head of village. The respondent point out that his responsibility is to deal with all development activities and problems concern with the village's prosperity.

When did seaweed farming start at Paje?

The respondent was required to mention the year in which seaweeds cultivation was established on the village (Paje). The respondent mentioned that the seaweed cultivation on the village started between 1979-1980s.

Whether there was any environmental problem that has ever been reported in the village.

The researcher sought to confirm whether there was any environmental problem that has ever reported in the village. The respondent said "yes". Further the respondent was asked to mention those problems. The respondent point out that

deforestation, haphazard disposal of garbage, and coastal environmental degradation were some of the environmental problems that have ever been reported in the village.

How and when did they start?

The study required the respondent to mention how and when did those environmental problems start. The respondent answered that the problems started when number of immigrants and unemployed people increased in the village, increasing human activities along the coast including on intertidal zone, and increasing cutting of trees for different purposes which including charcoal making. Further the respondent mentioned that the problems started between 2001-2002.

Whether seaweed farming has been contributing on the environmental problems or has any environmental impacts.

The study was seeking to find out the respondent's opinions on whether seaweed farming has been contributing to the problems or whether any environmental impacts have. The responses were "yes, it has".

How has seaweed farming contributed on the problems.

Next question asked the respondent in what ways (how) has the seaweed farming contributed on the problems. The respondent answered those seaweed farmers' activities such as haphazardly cutting of trees and seaweeds drying on the beach have contributed to forest loss and loss of beach grass cover which also instigating beach erosion.

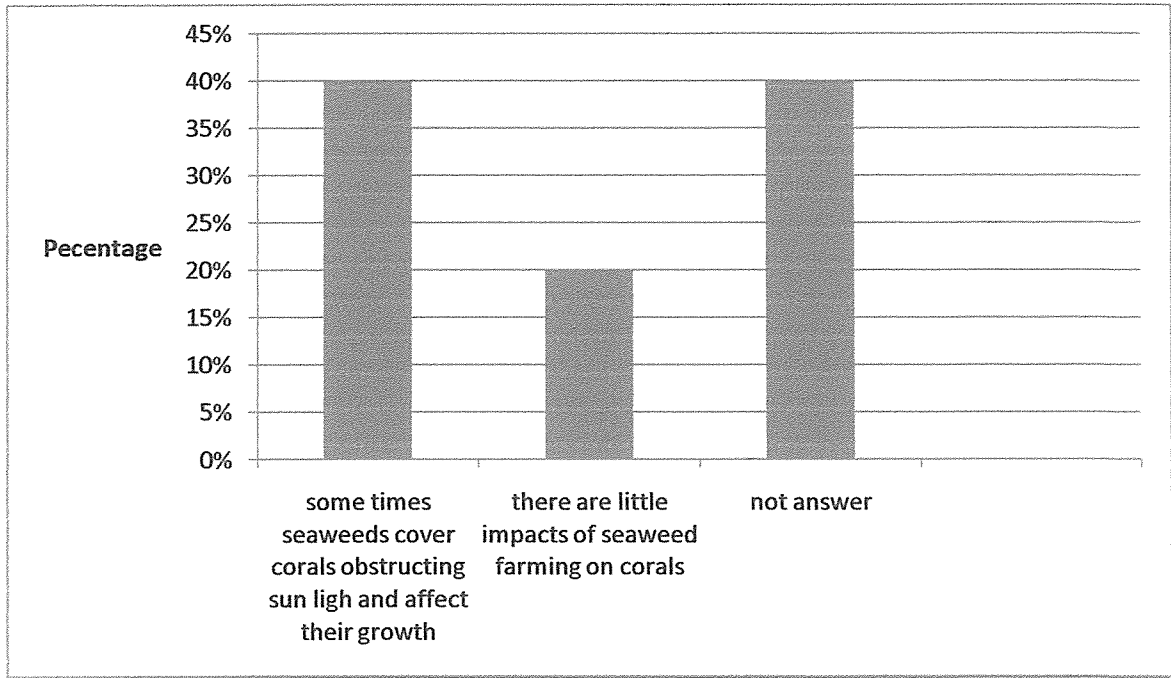
What measures had been taken to check up the problems.

The researcher sought to find out what measures have been taken in handling the problem. The respondent answered that the villagers have been educated on environmental conservation. However, the researcher further wanted to know if there were any particular measures that have been taken in controlling seaweed farming environmental problems. The respondent said that there was no any particular measure for controlling seaweed farming environmental problems.

Whether there was a challenge in controlling them.

The study asked whether there was a challenge in controlling them. The respondent answered "yes". Next question wanted to know those challenges. The respondent pointed out that the method that the seaweed farmers used in farming including instruments such as poles and sticks which the farmers have nowhere to get them

Question 3(ii) sought to know from respondents views whether seaweed farming has any impacts on corals. All respondents answered “yes”. When the researcher wanted to know those impacts from the respondents. Their responses whether seaweed farming has impacts on corals are presented in figure number 8.



Source: Primary Data. **Figure 8. Impacts of seaweed farming on corals.**

From the above figure number 8, two respondents (40%) did not mention the impacts of seaweed farming on corals but they agreed with the argument that whether the seaweed farming has impacts on coral. 40% of the responses confirmed that seaweed cover corals obstructing sun light and affecting their growth. While 20% of the responses confirmed that there were little impacts of seaweed farming on corals since the farmers avoid cultivating on areas covered by corals. However, on this finding, was also evident that the respondents confirmed that seaweed farming has impacts on corals.

Whether seaweed farming has impacts on mangrove/other plants.

Question 3 (iii) sought to confirm from respondents’ opinions whether the seaweed farming has impacts on mangroves or on other plant species. Table number 19 indicates their responses.

Table 19 Impacts of seaweed on mangrove/other plants

Impacts on mangrove/other plants	F	Percentages (%)
Mangrove and other plants species might affected because of the method used by seaweed farmers.	2	40
Seaweed farmers cut varieties of tree species that found nearby for sticks/poles.	2	40
Most seaweed farmers in Zanzibar do not use mangrove but they use other plants species.	1	20
Total	5	100

Source: Primary Data.

The figure above shows that there is no clear evidence on the impacts of seaweed farming on mangrove, however, on the above findings it was evident that there were other plants species that affected by seaweed farming.

Whether seaweed farming has impacts on Sea grasses.

Question 3(iv) was seeking to find out from respondents' views if seaweed farming has impacts on sea grasses. All respondents answered "yes". Further the study asked them to mention the impacts. Their responses summarized in the table number 20 below.

Table 20 impacts on sea grasses.

Impacts on sea grasses	F	Percentage(%)
Actions of seaweed farmers and seaweeds through sway movements remove sea grasses.	2	40
Seaweeds obstructing sea grasses from getting sun light (photosynthesis) and siltation leading to depletion of sea grasses.	2	40
Not answer	1	20
Total	5	100

Source: Primary Data.

As revealed above 80% of the respondents confirmed that seaweed farming has impacts on sea grasses in different ways. 20% of the responses also agreed that the seaweed farming has impacts on sea grasses but no impacts were mentioned.

Whether seaweed farming has impacts on sea Urchins.

In question 3(v) the researcher wanted to know from respondents whether the seaweeds farming have impacts on sea urchins. The findings showed that 60% confirmed that the sea urchins were either killed or removed by the seaweeds farmers during seaweed farms preparation and whenever they found them around their farms.

Whether seaweed farming has impacts on any other sea animals that not mentioned above.

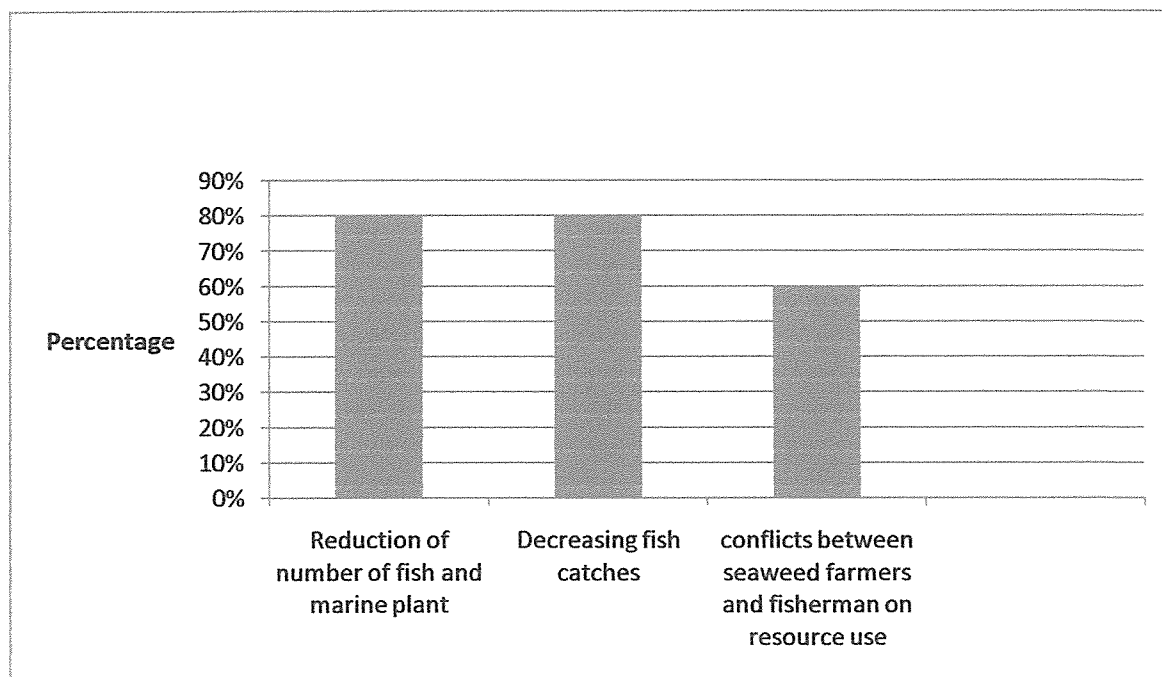
In question 3(vi) the study further wanted to know from respondents whether there was an impact to any other sea animals apart from those mentioned above. About 40% of the responses answered "yes" and mentioned that sea cucumbers that live near to the shore along intertidal zone (where seaweed cultivation is carried out) have been affected and disappeared.

Whether the disappearance or depletion of the above (affected) marine organisms have impacts on environment.

Question 3(vii) was seeking to find out from respondents whether the above mentioned affected marine organisms (corals, sea urchins, sea cucumbers and sea grasses) which either led to their disappearance or depletion as a result of seaweed farming activities whether have impacts on environment. The finding showed that 100% confirmed their disappearance or depletion has impacts on environment such as causing imbalance of marine ecosystem and affecting food web.

Whether seaweed farming has impacts on fishing.

Question 4(a) sought to confirm from the respondents' opinions whether seaweed farming has impacts on fishing. The responses of whether seaweed farming has impacts on fishing are indicated in figure number 9 below.



Source: Primary Data.

Figure 9. Impacts on fishing

The above figure number 9 representing total of (frequencies and) percentages of each impact as mentioned by each respondent. This means that the each respondent mentioned a number of impacts of seaweed farming on fishing and each respondent represented 20%. Thus, 80% in the table represented impacts that were mentioned by four respondents. The findings as revealed above 80% of responses acknowledged that seaweed farming causing reduction of number of fish and marine plants species (stock abundance), the same percentage 80% of responses confirmed that seaweed farming decreasing fish catches and 60% of the responses confirmed that seaweed farming causing conflicts on resource use.

Whether seaweed farming has impacts on coastal environment.

Question 4(b) was asked the respondents' views on whether seaweed farming has impacts on coastal environment. Their responses indicated in table number 21.

Table 21 Impacts on coastal environment.

Impacts on coastal environment	F	Percentages (%)
Pollution (disposal) of remnants of old nylon ropes and plastic cords (tie ties) along intertidal zone and on the beach.	4	80
Cutting of coastal thicket trees.	3	60
Coastal environment prone to erosion.	3	60

Source: Primary Data.

The above table number 21 representing total of frequencies and percentages of each impact as mentioned by each respondent. This means that each respondent mentioned more than one impacts of seaweed farming on coastal environment and each respondent represent 20%. As revealed above 80% of the responses confirmed that seaweed farming causing pollution from remnant of materials used in the seaweed industry, 60% of the responses confirmed that seaweed farming lead to cutting of coastal thicket trees and another 60% of the responses confirmed that seaweed farming lead to coastal erosion.

Whether there was need to control seaweed industry.

Question 5(a) was seeking to find out respondents' views on whether there was need to control seaweed industry. All responses of whether there is need to control seaweed industry 100% agreed that there was need to control seaweed industry.

Is there any program or plan (strategy) to control it.

In next question 5(b) the study further wanted to know from respondents if there was any program or plan targeting to control seaweed industry. All responses answered "yes". On confirmed this, the study further asked the respondents to mention them. Their responses are presented in table number 22.

Table 22 Program and plan (strategy) controlling seaweed industry.

Program and plan to control seaweed industry	F	Percentages(%)
Introduction of other new methods (Netting and long lining) instead of Fixed off bottom method.	3	60
Use the existing method but in deep water.	2	40
Establishing alternative livelihood activities.	3	40
Provision of environmental education.	4	80

Source: Primary Data.

The above table representing total of frequencies and percentages of each strategy as mentioned by respondents. This means that each respondent mentioned a number of strategies in controlling seaweed industry and each respondent represent 20% thus a strategy with 80% above represent four respondents. The findings as revealed above show that there were a number of strategies to be employed in controlling seaweed farming industry and a large percent of the strategy 80% was provision of environmental education both to seaweed farmers in particular and to community as a whole.

Challenges in controlling seaweed farming environmental impacts.

Question 6(a) was seeking to find out challenges in controlling seaweed farming impacts from the respondents. Table number 23 below shows their responses.

Table: 23 Challenges in controlling seaweed farming environmental impacts.

Challenges in controlling seaweed farming impacts.	F	Percentages(%)
Increasing number of seaweed farmers	4	80
Poverty	4	80
High price of tools of other seaweed farming methods	3	60
Lack of employment to rural community	2	40
Increasing seaweeds demands in the world market	2	40
Most seaweed farmers lack environmental education and have low level of education	2	40
Inefficient collaboration with stakeholders	2	40
Lack of guidelines and policy	1	20

Source: Primary Data.

The above table representing total of frequencies and percentages of each particular challenge as mentioned by respondents where each respondent represented 20%. Thus impact with 80% represented challenges that were mentioned by four respondents (out of five). On the above findings it revealed that in controlling seaweed farming environmental impacts there are lots of challenges.

Whether there was any solution in addressing the challenges

In question 6(b) the study wanted to know whether there is any solution to the challenges. Table number 24 summarizing their answers.

Table 24 Solution to the challenges

Solution to the challenges	F	Percentages(%)
Creation of other alternatives livelihood like bee keeping, livestock husbandry and vegetable farming.	3	60
Educating seaweed farmers on better use of marine and other environmental resources and support them with farming materials.	2	40
Preparation of comprehensive policy and guidelines that can include all seaweed farmers' stakeholders.	2	40
Encouraging establishing NGOs for environmental protection.	1	20

Source: Primary Data.

The above table representing total of frequencies and percentages of each solution as mentioned by each respondent and each respondent represented 20%. Thus 60% which was a larger percent on the table represented solution provided by three respondents (out of five). With the above findings, the researcher observed that in addressing seaweed farming environmental impacts there must be close cooperative among seaweed farmers and all seaweed farming stakeholders.

Whether there was any law governing mariculture in Zanzibar.

In discussion with a lawyer from Marine Department on whether there was any laws governing mariculture in Zanzibar. The respondent confirmed that so far there was no such law. However, the respondent confirmed that the Bill on such laws was still in process.

Questionnaires for Department of Forest and Renewable Resources

It was important to include this department in this study since it deals with conservation and monitoring of natural forest.

The study wanted to know from the government officials Department of Forest and Renewable Resources the following: Whether seaweed farmers use any vegetation in seaweed farming cultivation. Type or plants species they use. Number of hectares consumed annually by seaweed farmers in seaweed farming. Whether there was any environmental impact on the use of such plant species. Whether there was any other vegetation that not used by seaweed farmers but affected by seaweed industry. Whether there was any program or plan to control them. Whether there was any challenge in controlling them. Whether there was any solution to solve the challenges.

Question one asked respondent to mention the name of the institution.

Whether seaweed farmers use any vegetation on seaweed farming

Question 2(a) wanted the respondents to confirm whether the seaweed farmers use any vegetation in seaweed cultivation. All responses 100% answered "yes".

Next question 2(b) asked respondents to mention plants species that used by the seaweed farmers. The table number 25 summarized their responses.

Table: 25 Plants species used in seaweed farming.

Local name	Botanic name	F	Percentages (%)
Mjoma	Mascphersonia gracilis	5	100
Msiliza	Euclaea racemora	4	80
Mkonge	Psycotria spp.	3	60
Mdimumwitu	Polysphoeri suregoda Zanzibariensis	2	40
Mkoko	Mangroves	2	40

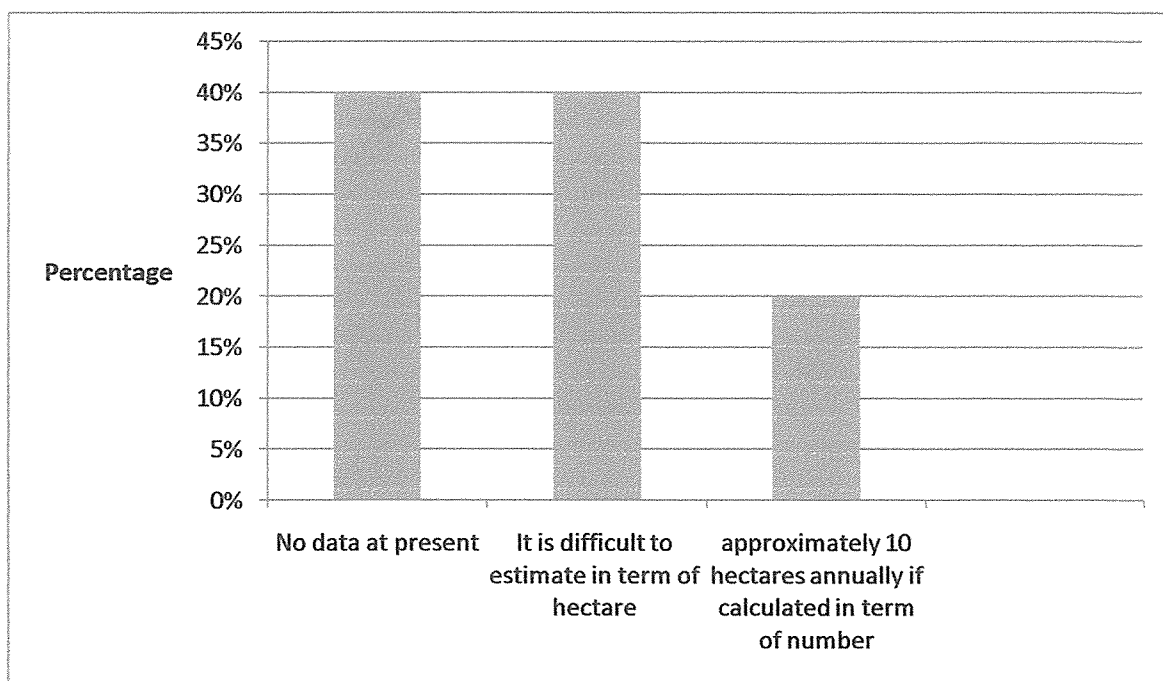
Source: Primary Data.

The above table representing total of frequencies and percentages of each plant species used by seaweed farmers in seaweed cultivation as mentioned by respondents and each respondent represented 20%.Therefore, plant species with 100% means that it was mentioned by all respondents. While 80% was mentioned

by four respondents and 60% mentioned by three respondents. This means that each respondent mentioned more than one plant species as used in seaweed cultivation. On the above findings the researcher observed that the seaweed farmers use varieties of plant species in seaweed cultivation, however, some of those species especially those with 100% and 80% such as *Maschersonia gracilis* and *Euclaea recemora* are more used or preferred compared with other plants species.

Number of hectares annually consumed by seaweed farmers in seaweed farming cultivation.

Question (2c) wanted to know from respondents number of hectares consumed annually by seaweed farmers in seaweed farming cultivation. Figure number 10 indicates their responses.



Source: Primary Data. **Figure 10. Number of hectres consumed annually in seaweed cultivation.**

The above findings in the figure number 10 shows, that 40% of the responses confirmed that there was no data indicating the number of hectares consumed. Another 40% of the responses confirmed that it was difficult to estimate in term of hectares due to the randomly method of the seaweed farmers used in cutting the trees while 20% of the responses approximated 10 hectares when calculated in term of number of species cut per area. On the above findings the study observed that there was no official record indicating the number of hectares consumed annually in seaweed cultivation

Whether there were any environmental impacts on the use of such plants species.

Question (3a) The researcher sought to confirm whether there are environmental impacts on the use of such plants species. All the responses answered "yes" 100%. Next question wanted to know the impacts. Table number 26 below indicating the impacts.

Table: 26 Environmental impacts on the use of such plants species.

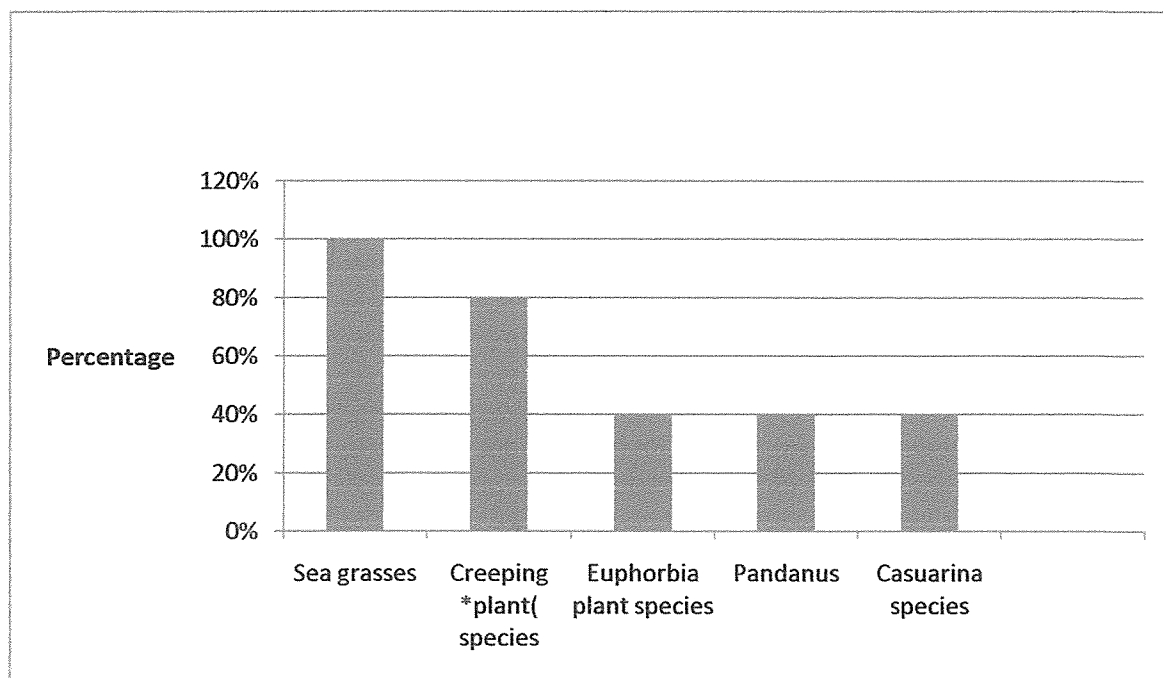
Impacts	F	Percentages(%)
Reducing regeneration capacity since they cut very young plants species.	4	80
Destruction of wild animals' habitats.	4	80
Declining traditional medicinal plants species.	3	60
Gradually inviting climatic and environmental changes	3	60
Reducing likelihood of having large trees in future	2	40
Disappearance of some plants species (no data yet)	1	20
If reducing number of wood stock in the forest.	1	20
Declining of grazing areas consuming by wild animals.	1	20

Source: Primary Data from Forest and Renewable Resources Department officials.

The above table representing total of frequencies and percentages of impact as mentioned by each respondent. This means that each respondent mentioned more than one impacts of seaweed farming and each respondent represent 20%. Thus, each impact with 80% above means that it was mentioned by four respondents. On the above findings large percent of the responses mentioned number of impacts on the use of the mentioned plants species in seaweed cultivation this confirmed that seaweed farming has impacts on environment.

Other vegetation affected by seaweed industry.

Question (4a) The researcher sought information whether there other vegetation in the sea or on coastal area that are not used by seaweed farmers but affected by seaweed industry. All responses 100% were "yes". Next question the researcher wanted to confirm such plants species. Figure 11 indicates their responses.



Source: Primary Data. **Figure 11. Other vegetation affected by seaweed industry.**

The above table indicating total of frequencies and percentages of different vegetation (plant) that are not used by seaweed farmers in seaweed cultivation but affected as mentioned by respondents. Each respondent represented 20% and each respondent mentioned more than one type of vegetation that affected.

On the figure vegetation with 100% such as sea grasses means that it was mentioned by all five respondents. As revealed in the above table larger percent of the responses confirmed that there different other vegetation that are not used in seaweed cultivation but affected by seaweed industry. The study observed that most of the vegetation which are not used in seaweed was affected during cultivation (sea grasses) and during dying of seaweeds especially on the beach (creeping, euphorbia, pandanus and casuarinas species).

Whether there was any environmental impact as other vegetation affected by seaweed industry.

The study further wanted to know from respondents' views whether there was any environmental impact as the above mentioned vegetation affected. The finding showed that 100% of the responses answered "yes" their reasons were discouraging plant degeneration such as casuarinas species, killing some young plants and reduces coastal stabilizing.

Whether there was any program and plan to control them.

Question 5(a) was seeking to find out from respondents whether there was any program or plan to control. All responses 100% answered "yes".

Further the study wanted the respondents to mention those program and plan. The respondents mentioned that provision of knowledge on better utilization of natural resources including forest resources; climate change projects and forest protection were the program and plan. On understanding this, researcher in discussion with some (two) respondents further asked whether there was any program for controlling impacts of seaweed on marine vegetation such as sea grasses. Their responses confirmed that there was no any such program from Forest Department and further clarified that even those mentioned above programs were not only specifically established for controlling seaweed impacts but for controlling any other industry that may have impacts on vegetation and environment as a whole.

Whether there were challenges in controlling them.

Question 5(b) wanted to confirm whether there were challenges in controlling the seaweed industry. The findings were as shown on the table number 27.

Table 27 Challenges in controlling them.

Challenges	F	Percentage
Trees are only source of materials for sticks and poles in Fixed off-bottom method.	5	100%
People do not follow rules and regulation (by-laws) in using forest resources.	4	80%
There is no alternative source for replacing using of wooden sticks/poles.	4	80%
Lack of materials to avoid using of beach for drying seaweed.	2	40%

Source: Primary Data.

The above table representing total of frequencies and percentages of number of challenges as mentioned by each respondent. Each respondent represented 20%. Thus a challenge with 100% means that was mentioned by all five respondents while those with 80% were each mentioned by four respondents (out of five). The findings above revealed that 100% of the responses confirmed that trees were the only source of materials used in fixed off-bottom seaweed farming method which is

the only method used on the study area while 80% of the responses confirmed that there was breaching of by-laws monitoring use of forest resources. Same 80% of the responses confirmed that there was no alternative source for replacing using wooden sticks or poles and 40% of the responses confirmed that there was lack of materials that can avoid using of beach for drying seaweeds sea weeds. On the above findings the study observed that if there is need of changing the current sea weed method on the study area as alternative to minimize haphazardly cutting of trees as done by seaweed farmers or done by other people for seaweed farmers. However, other seaweed farming methods are more costly and most of the seaweed farmers on the study area are poor. This creating a big challenge.

Whether there was any solution in solving the challenges.

Question (5c) was asked whether there was any solution to solve the challenges. The answers were “yes”. Next question sought to confirm the solution. Table number 28 summarizes their responses.

Table 28 Solution to the challenges.

Solution to the challenges	F	Percentages (%)
Educating seaweed farmers.	5	100
Establishment of trees planting organization	4	80
Educating communities on wood cut in sustainable way/use.	4	80
Encouraging finding alternative to seaweed farming cultivation.	3	60

Source: Primary Data.

The above table representing total of frequencies and percentages of each solution as mentioned by each respondent. Percentages of the solution show that ranging from 60% to 100% this because each respondents mentioned a number of solutions and each respondent represented 20%.This means that a solution with 100% in the table above was mentioned by all five respondents. As revealed above 100% of the responses point out that the solution of the challenges was to educating the seaweed farmers, while 80% point out that the solution was to establish trees planting organization, another 80% mentioned that solution was to educating the communities on wood cutting and 60% supposed that the solution was to seaweed farming. This means that the respondents had a number of solutions to the challenges. On the above findings the study observed that the best way was to educating the community as mentioned by all respondents.

Questionnaires for Department of Environment officials.

It was important to include this department since it deals with all matters related to environmental issues.

The study wanted to know from government officials Department of Environment in Zanzibar the following: Awareness of Environmental impacts of seaweed farming (in general). Impacts of seaweed farming on: corals, mangrove, sea grasses and other plants. Impacts on sea urchins and other marine animals. Whether their effects have impacts on environment. Whether seaweed farming need to be controlled. Whether there challenges in controlling seaweed environmental impacts.

Question one asked respondent to mention the name of the institution.

Awareness of environmental impacts of seaweed farming.

Question (2a) asked whether a respondent (official) aware of environmental impacts of seaweed farming. All the respondents 100% answered "yes".

Next question (2b) sought to know those impacts. Table number 29 below indicating their responses.

Table 29 Environmental impacts of seaweed farming.

Impacts	F	Percentages(%)
Environmental destruction associated with cutting of trees for sticks and uprooting of sea grasses.	5	100
Marine habitat destruction from sea grasses removal	4	80
It associated with changing of water quality (water turbidity) as a result of frequently seabed trampling.	3	60
Siltation to other areas that lead to kill other organisms.	3	60
Destruction and loss of biodiversity (grass and microorganisms) at seaweeds drying sites.	2	40
Ecological imbalance- some marine organisms do not like seaweeds thus disappear, the seaweeds dominates.	2	40
Potential clearance of mangroves where available on the area.	2	40
Seabed sweeping by seaweeds clusters on the field.	1	20
Removal of coral rag stones as anchored for seaweeds in Broadcasting seaweed farming method.	1	20
It associates with introduction of exotic species.	1	20

Source: Primary Data.

The above table representing total of frequencies and percentages of each particular impact as mentioned by each respondent. This means that each respondent mentioned more than one environmental impacts of seaweed farming and each mentioned impact by one respondent represented 20%.

As revealed above percentages of mentioned environmental impacts of seaweed farming ranges between 20%-100%. However there are two larger percentages one of 100% of the responses which confirmed that seaweed farming causing environmental degradation associated with cutting of trees for sticks and uprooting of sea grasses, while another large percent of about 80% of the responses

confirmed that seaweed farming lead destruction of marine habitat result from removal of sea grasses. Followed by 60% which acknowledged that seaweed farming causing water turbidity which results from frequency seabed walking by seaweed farmers and another 60% confirmed that seaweed farming lead to siltation to other areas such as on intertidal zone and that killing some other organisms such as mollusk and corals.

From the above findings the researcher found that there was no doubt that the environmental impacts of seaweed farming was well known by the respondents.

Whether there was impacts on corals, mangroves, sea grasses and sea urchins.

Question (3a) was asked whether seaweed farming has impacts on corals, mangroves, sea grasses, and sea urchins. Their answers were "yes" 100%.

Impacts of seaweed farming on corals.

Question (3a. i) was sought to know from respondents whether there was impacts of seaweed farming on corals. Their responses summarized in the table number 30.

Table 30 impacts on corals.

Impacts on corals.	F	Percentages(%)
Nearby corals can be affected through siltation and water turbidity.	4	80
Moving up and down of farmers breaks nearby corals.	3	60
Siltation deposition can cover corals and kill them	1	20
Some seaweed farming methods have impacts to corals.	1	20

Source: Primary Data.

The above table representing total of frequencies and percentages of each particular impact as mentioned by each respondent. This means that each respondent mentioned more than one environmental impacts of seaweed farming on corals and each mentioned impact by one respondent represented 20%.

As revealed above percentages of mentioned environmental impacts of seaweed farming on corals ranges between 20%-80%. However there are two larger percentages one of 80% of the responses which confirmed that seaweed farming affecting nearby corals through siltation and water turbidity. While 60% of the

responses confirmed that corals break through seaweed farmers' movement around the seaweed cultivating areas.

Impacts on mangroves and other plants.

When respondents were asked to mention whether seaweed farming has impacts on mangrove and other plants. Their responses as shown in the table number 31 below.

Table 31 impacts of seaweed on mangrove and other plants.

Impacts on mangrove/other plants	F	Percentages (%)
Mangrove and other plants species might affected because of the method used by seaweed farmers.	2	40
Seaweed farmers cut varieties of tree species that found nearby for sticks/poles.	2	40
Most seaweed farmers in Zanzibar do not use mangrove but they use other plants species.	1	20
Total	5	100

Source: Primary Data.

The above table representing total of frequencies and percentages of each impact of seaweed farming on mangrove and other plants as mentioned by each respondent. As revealed above 40% of responses pointed out that mangrove and other plants affected but this depend on methods used by the farmers, thus, method such as Fixed off-bottom which is common used on the study area associating with cutting of trees of sticks and poles hence affecting different plants species. The same 40% also acknowledged the impacts of seaweed farming on varieties of plants species and 20% confirmed that most seaweed farmers in Zanzibar do not use mangrove in seaweed farming.

From the above findings the study observed that there was no direct evidence on the use of mangroves plants species on seaweed farming but on the other hand it was evident that there was impacts of seaweed farming on other plants species.

Whether seaweed farming has impacts on sea grasses.

When the study in question 3a(iii)sought to know from respondents on whether seaweed farming has impacts on sea grasses. The findings shown that all five respondents (100%) agreed that such farming has impacts on sea grasses. When the study further wanted to know those impacts. 60% of the responses confirmed that the sea grasses are removed during seaweed plots preparation while 20% pointed out that the sea grasses are disappeared on the seaweed farming plots due

to obstruction of sun light which affecting their growth (photosynthesis) and also due to siltation. Further 20% of the responses did not mention any impacts, although agreed that the farming has impacts on sea grasses.

Whether seaweed farming has impacts on sea urchins.

In question 3a(v) the researcher wanted to know from respondents whether the seaweeds farming have impacts on sea urchins. The findings showed that 60% of the responses confirmed that the seaweed farming has impacts on sea urchins through their displacement from seaweed cultivation area or killing by seaweed farmers while 40% did not answered.

Whether there was impact on other marine organisms (apart from those mentioned above).

Question 3a (vi) was seeking to find out from respondents on whether there was impacts on any other marine animals apart from corals, sea grasses and sea urchins. The findings shown that only 20% of the responses confirmed that there is displacement of marine carnivorous species. While 80% of the responses did not answer.

Impacts on environment.

Question (3b) asked respondents views on whether the impacts of seaweed farming on corals, mangroves or other terrestrial plants, sea grasses, sea urchins and on other marine animals have impacts on environment. All responses 100% answered "yes". Next question sought to find out how and in what ways affects the environment. Table number 32 indicates their responses.

Table 32 Impacts of seaweed farming on Environment

Impacts on Environment	F	Percentages (%)
Ecological imbalance on both marine and terrestrial habitat.	3	60
Affecting food chain when one or some species are removed or displaced.	2	40
Changing of seabed on seaweed cultivating area from greenish to white sands as sea grasses disappeared.	2	40
Seabed erosion and siltation along the intertidal area.	2	40

Source: Primary Data.

The above table number 32 representing total of frequencies and percentages of each impact as mentioned by each respondent. This means that each respondent mentioned more than one impact of seaweed farming on environment and each mentioned impact by one respondent represented 20%.

As revealed on the above table percentages of mentioned impacts of seaweed farming on environment ranges between 40%-60%. However, a large percent of the responses which is 60% confirmed that seaweed farming causing ecological imbalance on both marine and terrestrial habitat. While other mentioned impacts represented by 40% each as shown above.

Need to control the seaweed industry.

Question (4a) asked respondents views on whether there was need to controlling the seaweed industry. All the responses 100% answered" yes". In next question (4b) the researcher further wanted to know ways for controlling such industry. Table number 33 below summarizes their responses.

Table 33 Ways for controlling seaweed industry impacts.

Ways	F	Percentages (%)
Carrying out comprehensive study to know exactly environmental consequences of seaweed farming.	3	60
Carrying out EIA on the existing seaweed farming areas.	3	60
Monitoring and accessing changing in species abundance and its ecological aspects.	2	40
Developing policy, regulation and guidelines.	2	40
Controlling exotic species.	1	20
Stopping new seaweeds farming projects.	1	20

Source: Primary Data.

The above table representing total of frequencies and percentages of each way for controlling seaweed industry impacts as mentioned by each respondent. This means that each respondent mentioned number of ways for controlling seaweed farming impacts and each mentioned impact by one respondent represented 20%.

As revealed above percentages of ways for controlling seaweed farming industry impacts ranges between 20%-60%. However there are two larger percentages of

60% each of the responses which each pointed out the need of carrying out comprehensive study to know exactly environmental consequences of seaweed farming and carrying out EIA on existing seaweed farming areas.

From the above findings it was evident that respondents had number of views in ways for controlling seaweed industry impacts.

Challenges in controlling seaweed farming environmental impacts.

Question (5a) asked if there was any challenge in controlling seaweed farming environmental impacts. All the respondents answered "yes" 100%. Further the study wanted to confirm those challenges. Table number 34 below indicating their responses.

Table 34 Challenges in controlling seaweed farming environmental impacts.

Challenges	F	Percentages (%)
Carrying out EIA and Environmental report is expensive.	3	60
Lack of guidelines in establishing seaweed farms.	2	40
Low level of knowledge of seaweed farmers on environment in relation to seaweeds farming.	2	40
Poverty.	2	40

Source: Primary Data.

The above table representing total of frequencies and percentages of each challenge in controlling seaweed farming environmental impact as mentioned by each respondent. Thus each respondent mentioned more than one challenge and each mentioned challenge by one respondent represented 20%.

As revealed above percentages of mentioned challenges in controlling environmental impacts of seaweed farming ranges between 40%-60%. However a large percent of the mentioned challenges was represented by 60% of the responses which confirmed that carrying out EIA and Environmental report was expensive, followed by lack of guidelines, low level of knowledge of seaweed farmers' on environment and poverty each represented by 40%.

The above findings was evident that there are number of challenges facing both the authority and farmers themselves in controlling seaweed farming environmental impacts.

Whether there was any solution to addressing the challenges.

Question (5b) sought to confirm from respondents views on whether there was any solution to addressing the challenges. Their responses summarized in the table number 35.

Table 35 Solution to the existing challenges.

Solution	F	Percentages (%)
All responsible institutions should strict ensure that EIA or Environmental study is carried out before establishing or allowed for the farming to take place	4	80
Setting of procedures/regulation and guidelines to those who want to establish seaweed farms.	3	60
Establishing socio-economic that is alternative and which is environmental friendly and tangible to that community.	2	40

Source: Field Data from Department of Environment officials.

The above table number 35 representing total of frequencies and percentages of each solution to the existing challenges as mentioned by each respondent. This means that each respondent mentioned more than one solution and each mentioned solution by one respondent represented 20%.

As revealed above percentages of mentioned solution for the challenges differ and range between 40%-80%. This means that two solutions with 80% and 60% which each emphasizing on conducting EIA or Environmental study before allowing seaweed farming to take place and setting of regulation and guidelines to those who supposed to establish seaweed farms were more prioritized compared with other solution which focused on establishing alternative socio-economic which supposed to be tangible to that community and environmental friendly. However the study found that conducting EIA and Environmental study as solution was among the mentioned challenges in controlling seaweed farming environmental impacts and was mentioned that carrying out such analysis or assessment was expensive hence there is still doubt in fulfilling this as prioritized and achievable solution.

CHAPTER FIVE

FINDING, CONCLUSIONS AND RECOMMENDATIONS.

Introduction.

This chapter presents the findings, conclusions and recommendation of the results presented in chapter 4 as related to the views of other scholars in the literature review and in the statement of the problem. The researcher also supplements them with personal views. The conclusions were reached basing on the discussion of findings of the study and the recommendations made arising from the conclusions reached. The areas for further research have been explored emanating from the questions raised by the entire study.

FINDINGS:

Based on the findings the study achieved the three specific objectives of the study that were; to identify the type of seaweed and activities related to seaweed farming, to find out the environmental impacts of the activities involved in the seaweed farming and to evaluate the challenges of seaweed farming among the coastal communities in Tanzania.

On the first and second objectives were, to identify the type of seaweed and activities related to seaweed farming the study findings revealed that there were two types of seaweed that grown on the study area and to find out the environmental impacts of the activities involved in the seaweed farming. The types of seaweed were Kappaphycus and Eucheuma which common known as Spinosium and Fixed off-bottom method was the only method used in cultivating the seaweed on the study area. While activities involving on such method the findings revealed that can be divided into three stages. These were activities prior cultivation, activities during cultivation and after harvesting of seaweeds.

The study findings in prior cultivation activities revealed that the seaweed farmers preparing plots for cultivating seaweed, thus, involving in number of activities which

including cutting of different young plants species which they believing durable for seawater and cleaning the plots (intertidal area) by removal of any materials which seem not needed on the farming, this including removal of sea grasses, removal or killing of sea urchins and so forth. These activities the findings had shown that associating with loss of varieties of terrestrial young plants species (loss of biodiversity) as different plants species cutting for sticks and poles. Disappearance of both sea grasses and marine animals such as mollusks which including oyster (chaza), Humpbacked conch or Strombus (chuale), Chicoreus ramosus (komwe), Sea cucumbers (majongoo) and sea urchins along intertidal zone as the area is cleaned by seaweed farmers for seaweed cultivation.

Activities involving during seaweed cultivation including erecting of wood sticks and poles on the seabed, plastic or nylon ropes later tied between the sticks and later bunches of seaweed placed on the ropes and tied using smaller plastic cords called "tie ties". The findings revealed that these activities during seaweed cultivation are responsible in destruction or depletion of some marine animals such as sea urchins as these animals are killed whenever they are found around the seaweed farming areas by seaweed farmers as seemed to be harmful to both seaweeds and farmers. Water turbidity, seabed erosion and siltation also developing as tied seaweed moving forth and backward due to seawater movement and as seaweed farmers making frequently walking on the seabed as planting the seaweeds, erecting sticks and poles latter leaving number of holes on the seabed. This creating noise, obstructing sun light and visual impairment to marine animals including fish and destructing marine animals' habitats.

After seaweed harvesting the erecting wooden sticks and poles creating danger during swimming especially high tide when they are hidden by sea water while remnant of most undegradable plastic cords called "tie ties" remaining in the sea. Most of the seaweed farmers put their harvested seaweed in sacks and pooling these heavy sacks of wet seaweeds on the seabed and by so doing increasing seabed trampling and erosion and destroying benthos life. When seaweed farmers drying seaweed on the beach creeping vegetation affecting and disappeared and instigating beach erosion.

PHYSICAL IMPACTS

Nearly 40% of the respondents said in interviews that they experienced health problems because of nature of the work of seaweed farming. In the general statement they said that it was so a difficult job that led to chest pain, legs aching, sore eyes (from glaring of the sun), injuries from stepping on sea urchins and general body fatigue.

The last objective was to evaluate the challenges of seaweed farming among coastal communities in Tanzania. The study findings revealed the following challenges; roughness of the sea waves which very often led to the loss of seaweed farming equipments and seaweed. Poverty which acts as a setback and hinder the farmers in changing the current method (Fixed off-bottom method) since other methods associated with the use of equipments that are expensive such as boat which most of the farmers do not afford. Poor price of seaweed in the market (250 TZ shillings) thus, most of the seaweed farmers complained on this poor price of the crop as compared with the labour lost in farming and physical health deterioration experienced. Poor growth of other types of seaweed which have high quality and heavier compared with the current two grown types (*Kappaphycus* and *Eucheuma*). Based on those findings it is difficult to some challenges to get immediate solution such as roughness of the sea waves which often leading to loss of seaweed crop to poor harvest and thus, poor income to the farmers.

Changing of the current method of seaweed farming is also not easy since most of those methods need and using expensive equipments such as boats and some of the methods need deep water more than 3 meters deep while most of seaweed farmers are women who are poorer and lack financial support from stakeholders and cannot reach such deep water.

It was found that some types of seaweed have higher demand in the world market because of their quality compared with other types grown on coastal communities in Tanzania; however, they do not well flourish on these coasts. Hence it inviting research or seaweed experts in solving such challenge. How long will this take to accomplish is not known.

The seaweed business so far is controlled by private companies which setting price on their own interest, thus, seaweed farmers have low ability on changing this situation or improving the price.

Conclusion.

As rising from the discussion held on findings, the researcher concludes the following: In generally the seaweed farming impacts most affecting marine ecology and increasing pressure on coastal indigenous trees species. Thus, based on findings seaweed farming method (Fixed off-bottom method) used by the farmers and their activities employed in seaweed farming (prior cultivation, during and after harvesting of seaweeds) have significant impacts on environment.

This opposes and rejects the stated null hypothesis.

Recommendation.

The recommendations in this study were made in accordance with the conclusion reached.

Thus, based on findings seaweed farming method (Fixed off-bottom method) used by the farmers and their activities employed in seaweed farming (prior cultivation, during and after harvesting of seaweeds) have significant impacts on environment.

The researcher recommended the following;

- All responsible sectors related to natural forest reserve, environment conservation and marine resources development should work together in controlling seaweed farming activities.

- There is need of conducting EIA or Environmental analysis and monitoring to all seaweed farming plots and the result should be exposed to all seaweed farmers, stakeholders and communities.
- The government also has to create systems of monitoring and evolution for the existing seaweed projects, especially those that have been currently established. This would help to understand the magnitude of the environmental impacts related to seaweed farming and make necessary adjustments or setting regulation governing such farming.
- The government has to work with all seaweed stakeholders to enable changing of all seaweed farming methods that seemed harmful to environment this including providing loans to the farmers.
- There is need of providing environmental education relating to seaweed farming impacts to all seaweed farmers and coastal communities this will help them in appreciating, safeguarding and using environmental resources in sustainable ways.
- Creation of various alternative socio-economic that are viable to coastal communities especially to women who majority of them do not own land, cannot participating in fishing, have low level of education or uneducated, poorer and have family to take care.

Area for Further Research:

Through this study, the research discovered loopholes in the field of research which ought to be researched on improving or controlling the farming. Therefore, this research finds the following areas ripe for research:-

- Impacts of utilization of indigenous trees species in seaweed cultivation in Zanzibar.
- Impacts on disappearance of marine organisms along intertidal zone where seaweed cultivation is carried out.
- Environmental impacts of seaweed farming on marine ecology.

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APPENDIX 1 A

TRANSMITTAL LETTER

OFFICE OF THE DEPUTY VICE CHANCELLOR (DVC)

SCHOOL OF POSTGRADUATE STUDIES AND RESEARCH (SPGSR)

Dear Sir/Madam,

**RE: INTRODUCTION LETTER FOR MAJID M. SULEIMAN
REG.NO.MEM/42767/92/DF TO CONDUCT RESEARCH IN
YOUR ORGANIZATION.**

The above mentioned candidate is a bonafide student of Kampala International University pursuing a Master of Science in Environmental Management and Development.

He is currently conducting a field research for his dissertation entitled,
**Environmental Impacts of Seaweed Farming at Paje Village on the East
Coast of Zanzibar Island.**

Your institution has been identified as a valuable source of information pertaining to his research project. The purpose of this letter is to request you to avail him with the relevant information he may need.

Any data shared with him will be used for academic purposes only and shall be kept with utmost confidentiality.

Any assistance rendered to him will be highly appreciated.

Yours truly,

Novembrieta R. Sumil,Ph.D

.Deputy Vice Chancellor, SPGSR

APPENDIX 1B
TRANSMITTAL LETTER FOR THE RESPONDENTS.

Dear Sir/ Madam,

I am a Master in Environmental Management and Development candidate of Kampala International University. Part of the requirements for the award is a dissertation. My study topic is entitled

Environmental Impacts of Seaweed Farming at Paje Village on the East Coast of Zanzibar Island.

Within this context, therefore, kindly I request you to participate in this study by answering the questionnaires. Any data you will provide shall be for academic purposes only and no information of such kind shall be treated for no any other than academics.

I promise to observe the principle of utmost confidentiality in handling the information I shall receive from you.

Thank you in advance.

Yours faithfully,

MAJID M. SULEIMAN.

**OFFICE OF THE ASSOCIATE DEAN, SOCIAL SCIENCES
SCHOOL OF POSTGRADUATE STUDIES AND RESEARCH (SPGSR)**

May 11, 2011

Dear Sir/Madam,

**RE: REQUEST FOR MAJID M.SULEIMAN MEM/42767/92/DF
TO CONDUCT RESEARCH IN YOUR ORGANIZATION**

The above mentioned is a bonafide student of Kampala International University pursuing a Masters of Science in Environmental Management and Development.


He is currently conducting a field research of which the title is "**Environmental impacts of Sea Weed Farming at Paje Village on the East Coast of Zanzibar Island.**".

Your organization has been identified as a valuable source of information pertaining to his research project. The purpose of this letter is to request you to avail him with the pertinent information he may need.

Any information shared with him from your organization shall be treated with utmost confidentiality.

Any assistance rendered to him will be highly appreciated.

Yours truly,



**Dr. Roseann Mwaniki
Associate Dean social Sciences, SPGSR)**



REVOLUTIONARY GOVERNMENT OF ZANZIBAR
MINISTRY OF AGRICULTURE AND NATURAL RESOURCES

Tel. Nam: +255 (0) 24 2238628
Fax: +255 (0) 24 2232782
E-mail: dccff@redcolobus.org
Website: www.dccff.com

Department of Forestry and Non-
renewable Natural Resources,
P. O. Box 3526,
Zanzibar - Tanzania

Our ref/IMMZ/7/17/46

Date: 18th November, 2011

Associate Dean Social Sciences,
School of Postgraduate Studies and Research (SPGSR),
Kampala International University,
Kampala - UGANDA.

**RE: CONFIRMATION FOR MR. MAJID M. SULEIMAN MEM/42767/92/DF TO CONDUCT
RESEARCH IN OUR DEPARTMENT**

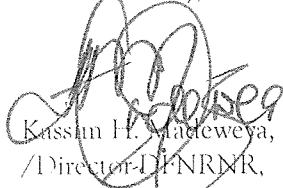
Please refer your letter of May 11, 2011 and that from Institute of Marine Science, University of Dar Es Salaam of 24th June, 2011 with reference AO1/VoXVJI/58, all are concerned with the above captioned heading.

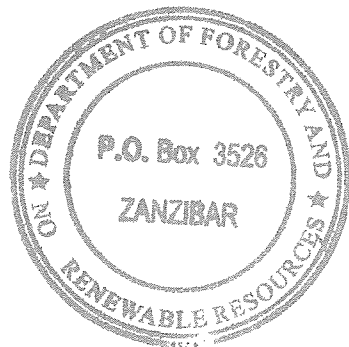
Department of Forestry and Non-renewable Natural Resources would like to confirm that Mr. Majid M. Suleiman has approached this department in July, 2011 requesting permission to conduct his field research titled 'Environmental Impacts of Sea weed Farming at Paje Village on the East Coast Zanzibar'. Three staff were allocated to assist him in his field work, namely Mr. Tamrin A. Said, Mr. Ally A. Mwinyi and Mr. Said A. Fakihi. They helped him to collect as much information as he needed.

So we are proud to inform you that he has completed his field work without any problem.

Thank you,

Yours sincerely,


Kassim H. Mawewe,
/Director-DINRNR,
Zanzibar.



Cc: Director of Institute of Marine Sciences,
University of Dar Es Dar Salaam,
Zanzibar. TANZANIA



REVOLUTIONARY GOVERNMENT OF ZANZIBAR
MINISTRY OF LIVESTOCK AND FISHERIES

P. O. Box 295
MARUHUBI, ZANZIBAR
Email:wmifugouvuviznz@yahoo.com

Tel : 024 – 2233320
Fax: 024 – 2238512

Our Ref: WMU/20/2/21/151.

Date: 27rd December, 2011

Associate DEAN Social Sciences (SPGSR),
Kampala International University,
Kampala – UGANDA.

**REF: REQUEST FOR MAJID M. SULEIMAN TO CONDUCT RESEARCH
IN OUR ORGANISATION**

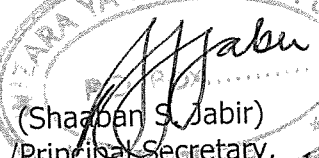
Please refer your letter No. MEM/42767/92/DF dated 11 May, 2011

This is to certify that the above mentioned student has been conducting his research with the Department of Marine Resources for a period of two months, The title of Research is Environmental Impacts of Sea Weed Farming at Paje East Coast of Zanzibar Island.

Mr. Suleiman has been very cooperative and exhibited good attitudes during the whole period of the exercise.

Since the questionnaire included areas of interest, we hope the analysis will expose relevant information needed by this Ministry

Yours Faithfully,


(Shaaban S. Jabir)
Principal Secretary,
Ministry of Livestock and Fisheries,
ZANZIBAR.

Direct lines to:

Minister 024 2238513, Principal Secretary 024 2233320, Deputy Principal Secretary 024 2238507.



THE REVOLUTIONARY GOVERNMENT OF ZANZIBAR
THE FIRST VICE PRESIDENT OFFICE

Tel: +255 - 24-2239007

FAX: +255 - 24 - 2237008

E-Mail: mazingiraznz@yahoo.com

Ref No.: IM/29/1/9 VOL IV/92

Department of Environment

P. O. Box 2808

Zanzibar

Date: 02 January 2012

TO WHO IT MAY CONCERNS

RE: TESTIMONIAL

Dear Sir/Madam

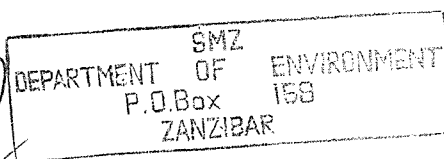
This is to certify that Mr. Majid M. Suleiman approached the Department of Environment, Zanzibar, vide MEM/42767/92/DF of Kampala International University, Uganda, for research support and assistance pertaining to his work titled *'Environmental Impacts of Sea Weed Farming at Paje Village on the East Coast of Zanzibar.'* The candidate was referred to the Policy, Planning, and Research Unit of the Department of Environment for literature review, documentation, questionnaire feedback, and discussion. Afterwards, the candidate designed and ran his own questionnaires and research work which forms the basis of his own research outcome under Kampala International University.

Regards

(Sheha M Juma)

Director,

Department of Environment
The First Vice President Office
Zanzibar



APPENDIX II
CLEARANCE FROM ETHICS COMMITTEE

Date _____

Candidate's Data

Name _____

Reg.# _____

Course _____

Title of Study _____

Ethical Review Checklist

The study reviewed considered the following:

- ___ Physical Safety of Human Subjects
- ___ Psychological Safety
- ___ Emotional Security
- ___ Privacy
- ___ Written Request for Author of Standardized Instrument
- ___ Coding of Questionnaires/Anonymity/Confidentiality
- ___ Permission to Conduct the Study
- ___ Informed Consent
- ___ Citations/Authors Recognized

Results of Ethical Review

- ___ Approved
- ___ Conditional (to provide the Ethics Committee with corrections)
- ___ Disapproved/ Resubmit Proposal

Ethics Committee (Name and Signature)

Chairperson _____

Members _____

APPENDIX III
INFORMED CONSENT

I am giving my consent to be part of the research study of Mr. Majid M. Suleiman that will focus on Environmental Impacts of Seaweed Farming.

I shall be assured of privacy, anonymity and confidentiality and that I will be given the option to refuse participation and right to withdraw my participation anytime.

I have been informed that the research is voluntary and that the results will be given to me if I ask for it.

Initials: _____

Date _____

APPENDIX IV A RESEARCH INSTRUMENT

QUESTIONNAIRE GUIDELINE FOR THE LOCAL COMMUNITY TOWARDS ENVIROMENTAL IMPACTS OF SEAWEED FARMING AT PAJE VILLAGE EAST COAST OF ZANZIBAR ISLAND .

Section A Personnel Information

(Individual or group information)

Tick where applicable

Sex of respondent

Male ☐ Female ☐

Marital status

Married ☐ Not married ☐

Divorced ☐ Widowed ☐

Education level

Primary ☐ Secondary ☐

Diploma ☐ University ☐

Madrasa ☐ None ☐

Age of the respondent

18 – 20 ☐ 21 – 24 ☐

25 – 30 ☐ 31 – 34 ☐

35 – 40 ☐ 41 – 44 ☐

45 – 50 ☐ 51 – 54 ☐

55-- 60		61-- 65	
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APPENDIX IV B

Section B Questionnaire to Seaweed Farmers

1a) Name of village you live.....

b) Immigrant, born (native)?

2a) What type of seaweed you grow, since when?

.....

b) Do you cultivate the sea weeds in the deep sea or along the intertidal zone ?

Other

.....

3a) What activities do you do prior establishing the seaweed? Removal of sea grass/

Removal of corals/seaurchins/ cutting of mangrove forest/others

.....

b) What species/types of plants you use/cut.

c) How often are these activities conducted? Spring tide / Neap tide/Seasonal ties/
others.

.....

d) Do you think that these activities have any effect to environment? Yes/No

If yes, what are they.....

4a) Have you ever heard that seaweed farming have impacts on the environment?
Yes/No.

(b)If yes how did you get the information? Through the media/government public
awareness programs / through books /through the private sector/seminars, radio,
stories, others.

.....

c) If yes, what are they?

.....

5a) Do the seaweed farmers own the seaweed farming area? Yes/No

b) Is there any land ownership problem on seaweed farming areas.? Yes /No

c) If yes, what are they?

6a) Is environmental conservation programmes being taught at Paje village? Yes/No.

(b) If yes, who is taught? In which area do they focus?

(c) Do the villagers able to understand them. Yes /No?

(d) If no, why do you think so?

e) If yes what do they do?

.....

7a) Are there challenges/problems in seaweed industry? Yes/No

b) If yes, what are they?

c) What solutions or strategies you plan to solve them?

d) To what extent have you succeeded?

e) Give reasons if you not have been succeeded

8) What other economic activities you engaged apart from seaweed farming?

.

APPENDIX IV C

Questionnaires to Hoteliers, Beach recorder,

NGO-Environment and Head of village (Sheha).

To Hoteliers.

1a) Name of hotel you own/work.....

b) Are there seaweed farming activities around your hotel ? Yes/No

c) If yes, what are they?

d) How far from your hotel?

2a) Do they have impacts on environment? Yes/No

b) If yes what are they?

c) Do they affect tourism industry? Yes/No

d) If yes, how?

e) What Solution do you suggest?

3a) Are there land ownership problems between hotel owners and seaweed farmers?
Yes/No.

b) If yes, what are they?

To Beach Recorder.

1a) What are your responsibilities at beach?

b) How long have you been at work?

c) Are you familiar with seaweed farming activities? Yes/No

d) Do they have impacts on environment? Yes/No

e) If yes, what are they?

2) What solution do you suggest?

To NGO-Environmental.

1a) Name of NGO.....

b) When and why was it established?

2a) Do you practice any environmental conservation? Yes / No .

b) If yes, which area do you focus? Why such area?

c) What do you do?

(b) If no, what do you think is the reason?

3a) Do you ever experience any environmental degradation related to seaweed farming in the area ? Yes /No.

b) If yes, what are they? erosion / floods/high temperatures/reduction of fish species ,and catch /reduction of mangrove vegetation or cutting of trees/ destruction of corals, others?

c) What challenges do you facing in environmental conservation in relation to seaweed farming?

4) What do you think can be done to improve the situation? Train the farmers / local communities and the general public with environmental conservation/increase public awareness, training and education about natural environment/ enforce the environmental conservation rules, regulation, policies, and laws.

.....

To village's head.

1a) How long have you been in the village and in your responsibility as a village's head?

b) What is your responsibility?

c) When do seaweed cultivation started on the village?

d) How many seaweed farmers are there in the village?

e) Are there any environmental problems reported in the village? Yes/No

If yes, what are they?

f) How and when did they start?

2a) Do you think that seaweed farming has contributed on the problems? Yes/No

b) If yes, how?

c) What measures had been taken in checking up them?

d) Do you face any challenge in controlling them? Yes/No

If yes, what are they?

APPENDIX IV D

Questionnaire to Fishermen

1(a) Do you practice fishing? Yes /No.

b) If yes what type of fishing is? Small scale / large scale? others/
.....

c) How long have you been in fishing?

d) Do you experience fishing problem? Yes / No.

If yes, what are they?

e) Did they started before or after introduction of seaweed farming?

2a) Do you think that seaweed farming activities has any impact on fishing? Yes /No

If yes, how and what are they?

b) Is there any conflict between fishermen and seaweed farmers? Yes/No

If yes, what is it?

c) Do you experience environmental changes in the coastal belt at your village (Paje)? Yes/No.

d) If yes, what are the changes?
.....

e) How and when did they start?

f) How do these changes affect?

(i) In the area?
.....

(ii) In fish breeding
.....

3) What solution do you think to solve these problems?

4a) Do you think seaweed industry has any benefit to fishing? Yes/No

b) If yes, what are they?

APPENDIX IV E

Questionnaire for Government officials Department of Environment.

1) Name of Institution.....

2a) Are you aware of environmental impacts of the seaweed? Yes/ No.

b) If yes what are they?

.....
.....
.....

(3a) Do you think seaweed s have impacts on :

(I) Coral reefs ? Yes/No.

If yes, what are they?

.....
.....
.....

(ii) Mangrove/ other plant species? Yes / No.

If yes, what are they?

.....
.....

(iii) Sea grasses? Yes /No.

If yes, what are they?

.....
.....

iv) Any other grasses? Yes /No

If yes, what are they and what impacts?

.....

v) Sea urchins Yes /No

If yes, what are they?

.....

vi) Any other marine animals Yes /No

If yes, what are they?

.....

.....

3b) Do you think their (disappearance, destruction) affect environment? Yes/No

If yes, how?

.....

.....

.....

4a) Do you think seaweed industry need to be controlled? Yes/No

b) If yes, what should be done?

.....

.....

.....

5a) Do you think are there challenges in controlling seaweed environmental impacts?
Yes/No

if yes, what are they?.....

.....

5b) What are the solution do you think to address such challenges?

.....

.....

.....

Thank for your cooperation.

**APPENDIX IV F Questionnaire for Government officials Department of
Marine Resources.**

1) Name of Institution.....

2a) Are you aware of environmental impacts of the seaweed? Yes/ No.

b) If yes what are they?

.....

(3a) Do you think seaweed s have impacts on :

(I) Marine ecosystem Yes/No

If yes, what are they?

(ii) Coral reefs ? Yes/No.

If yes, what are they?

(iii) Mangrove/ other plant species? Yes / No.

If yes, what are they?

.....

.....

(iv) Sea grasses? Yes /No.

If yes, what are they?

.....

v) Any other grasses? Yes /No

If yes, what are they and what impacts?

.....

vi) Sea urchins Yes /No

If yes, what are they?

.....

.....

.....

vii) Any other sea animals Yes /No

If yes, what are they?

.....

.....

viii) Do you think their (disappearance, destruction) affect environment? Yes/No

If yes, how?

4 (a) Do you think that seaweed farming has impacts on fishing? Yes/No

If yes, what are they?

(b) Do you think seaweed farming has impact on coastal environment? Yes/No

If yes, what are they?

.....

5a) Do you think seaweed industry need to be controlled? Yes/No

b) If yes, what should be done?

.....

.....

.....

b) Do you think are there challenges in controlling seaweed environmental impacts?
Yes/No

if yes, what are they?.....

.....

.....

.....

c) What are the solution do you think to address such challenges?

.....

.....

Thank for your cooperation.

APPENDIX IV G

Section F: Questionnaire for Department of Forest and Non Renewable Natural Resources officials.

1) Name of the Department.....

2a) Do seaweed farmers use any vegetation on seaweed cultivation? Yes/No

b) If yes, what type or species of plants they use?

.....

.....

c) How many hectare have been used annually?

.....

.....

3a) Is there any environmental impacts on the use of such plant species? Yes/No

b) If yes, what are they?

.....

.....

c) If no, why?

.....

.....

4a) Is there any other vegetation in the sea or coastal areas (not used by seaweed farmers) but affected by seaweed industry? Yes / No.

b) If yes, what are they?

.....

.....

c) Is there any environmental impacts from such effects? Yes /No

d) If yes, what are they?

.....

5a) Is there any program, mitigation or plan to control them? Yes /No

If yes, what are they?

.....

b) Are there challenges in controlling them? Yes/ No

If yes, what are they?

.....
.....

5c) Is there any solution to solve such challenges? Yes /No

If yes, what era they?

.....
.....

Thank for your cooperation

RESEARCHER'S CURRICULUM VITAE

Personal Profile

Able to work efficiently and carefully, hard worker and organized, responsible and honest friendly and cheerful, hospitality and I strive to always keep a positive attitude and have the ability to learn quickly.

Educational Background

B.A.Education, State University of Zanzibar, 2003-2006.

Research Project: Challenges of Conserving Red colobus in Jozani Forest, Zanzibar.

Diploma: Education, Nkrumah Teacher Training College, 1999-200, Zanzibar.

Work Experience

Instructor, 2006-2009, Lumumba High School, Zanzibar.

Subject: Geography

Head of Geography subject, 2007-2009, Lumumba High School.

Head of the Panel of Environment, 2007-2008, Lumumba High School.

Member of Disciplinary Panel, 2006-2009, Lumumba High School.

