How Seaweed Farming Improve the Livelihoods of Women's in the East Coastal area of Zanzibar Archipelago- Tanzania

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***Abstract*: The paper presents threefold objective set out in the east coastal area of Zanzibar particularly at Paje and Bwejuu villages. It investigates how seaweed farming improves the livelihoods of women, their families and communities, it determines the methods used in seaweed farming; and the common uses of seaweed. Data were collected through literature review, interviews and questionnaire survey. Sixty women were randomly selected from both villages. Analysis consisted descriptive statistics and content analysis. Results revealed that, women conducting seaweed farming were improving their livelihoods which had positive impacts to their families and communities. Women produced 412 tons of seaweed in the year 2016/17 which is equivalent to 80% of the total seaweed production whereas men produced only 103 tons equivalent to 20% of the total production. About 65% of women reported to earn more than 900,000 TZS from seaweed farming and 76% of them were able to pay school fees for their children in the year 2016/17. Between the years of 2012-15, eleven (11) houses were constructed by women while two (2) houses were bought and forty-nine (49) houses were repaired. On top of that, women were able to self-finance their basic needs simply because they earned enough money from seaweed farming activities. Further results identified methods of seaweed farming such as line or off bottom and deep water floating. Results reported the common uses of seaweed are; food, agar, cosmetics, medicines, minerals and fertilizers. It is recommended that integration and considerations of seaweed farming and processing systems in both state and non-state development partners is necessary for women empowerment and for the country's sustainable development especially in Zanzibar archipelago and Tanzania at large.**

***Keywords*: Seaweed farming, Women, Livelihoods, East-coastal, Zanzibar**

1.0 Background

Tanzania depends on agriculture as the main contributor of foreign exchange, (UNDP, 2015; RGoZ, 2015). About 80 percent of the people are employed in the agricultural sector, and women are the ones mostly involved in farm activities (Kahan, 2013; Kalumanga et al., 2014; FAO, 2014). Seaweed farming is mostly practiced on Zanzibar Archipelago; the farming contributes greatly to the economy of Zanzibar whereby more than 80% of the seaweed farmers are women (Buriyo et al., 2001; Lange, 2009; Msuya, 2006a; RGoZ, 2011; Semesi, 2002; Mmochi et al., 2005; RGoZ, 2012; Msuya et al., 2012). Seaweed in Zanzibar is a well entrenched activity that generates money from foreign countries and gives coastal people, especially women, an opportunity to earn income for themselves and their families (Msuya, 2012; Murphy, 2002; Buriyo, 2001; Crawford, 2007; Msuya et al., 2010; Valderrama, 2013). Seaweed farming in Tanzania began in the 1930s when seaweed was harvested from the wild and exported to European and U.S. markets. By the 1950s, 4,000 tons of dry seaweed was mainly exported to France, U.S. and Denmark (Buriyo, 2001; Mshigeni, 1983). The trade, however, collapsed during the late 1970s when the wild stocks were depleted. It was then Tanzania started searching for possibilities of farming seaweed; the first experiments on farming seaweed were conducted during the mid-1980s (Buriyo et al., 2001; Msuya et al., 2007). In 1989, commercial cultivation of two species Kappaphycus alvarezii commercially known as cottonii, and Eucheuma denticulatum commercially known as spinosum, began, (Msuya et al., 2012; FAO, 2014). The two species were imported from Philippines when the local variety of Eucheuma was not able to survive under cultivation. See Plate 1 below (A and B).

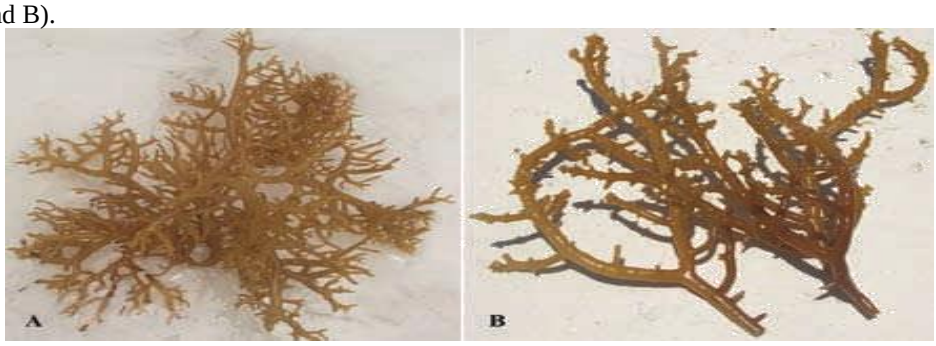
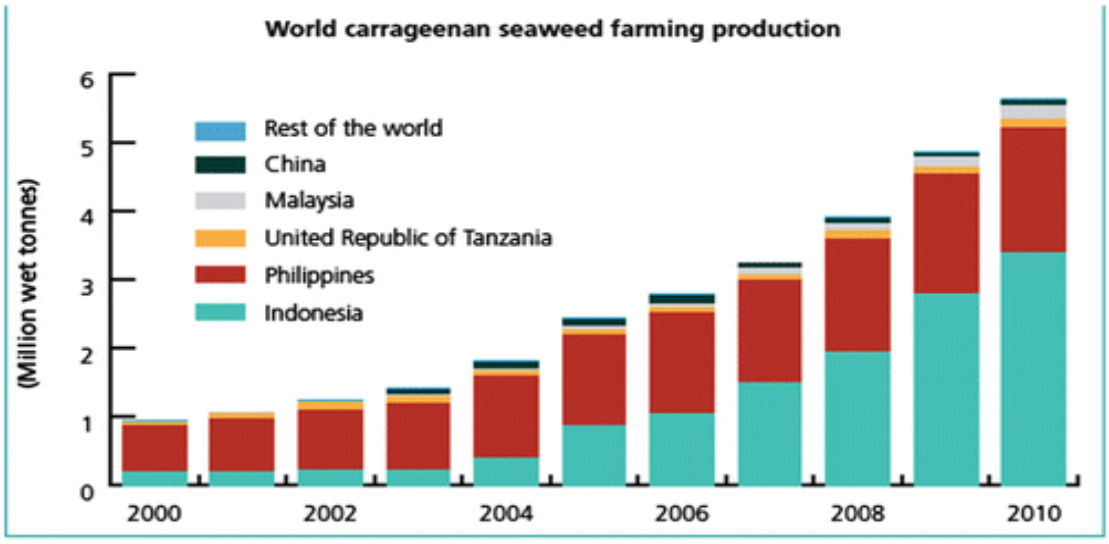


Plate 1: Two common types of seaweeds in Zanzibar: Cottonii and Spinosum

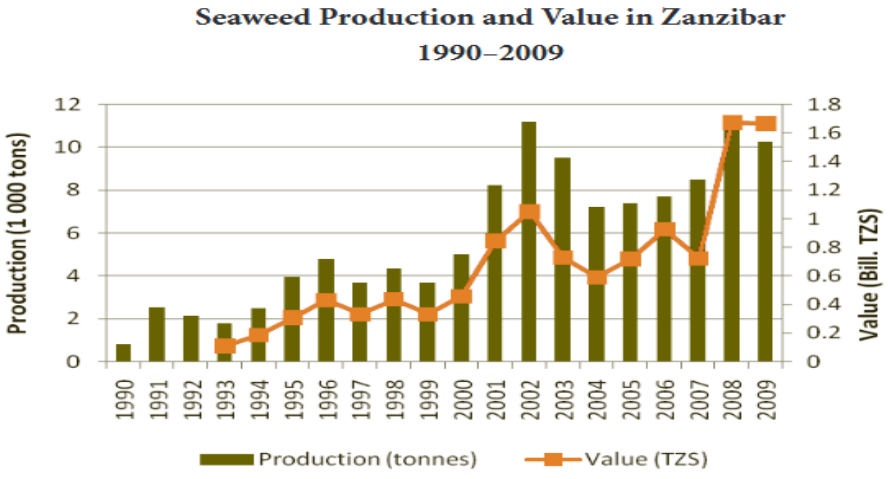
The commercial cultivation of seaweed in Zanzibar Island started in 1989 and then spread to mainland of Tanzania around 1991. Between 1992 and 1996, seaweed farming expanded to the mainland's regions Tanga (Zuberi et al. 2007), Bagamoyo and Mafia Island (Msuya 2010a), and in 1995–6 continued expanding to Mtwara, Lindi and Kilwa (Msuya 1995, 1996). Zanzibar, which is part of Tanzania, has two main islands called Pemba and Unguja (Swahili for Zanzibar Island) and about 51 other surrounding small islets. The first commercial farms were positioned in two villages, Paje and Jambiani, on the East Coast of Zanzibar (Mmochi et al., 2005; Msuya, 2012). Seaweed farming is now an important industry contributing significantly to the economy of the Zanzibar Islands (RGoZ, 2015). Comparatively, Zanzibar was reported the third biggest exporter of seaweed after the Philippines and Indonesia in the year of 2012 (FAO, 2012). See Figure one below



Note: Carrageenan seaweeds under cultivation are *Kappaphycus* and *Eucheuma* seaweeds (Solieriaceae)
Source: FAO FishStat

Seaweed farms are generally located in shallow, calm and constantly warm waters, but only where the bottom part of water is sandy, the temperature should be between 25 and 30 degrees centigrade (Murphy, 2002). In Unguja island of Zanzibar the areas where seaweed mostly grows are: Paje, Shungi, Jambiani, Pwani, Bwejuu, Michamvi, Kidoti, Pwani Mchangani, Matemwe, Fukuchani, Kiwengwa etc. in Unguja and many villages in Pemba (Msuya et al., 2012).

There is great potential for seaweed farming if few factors are well addressed at the start of any farming initiative such as potential buyers, culture methods, and who particularly participates in the farming (Kahan, 2013). Integration of seaweed farming with other income generating activities (IGA's) also seems to yield more benefits. Communities can also undertake pearl farming, eco-tourism and production of seaweed-based products such as soaps, cosmetics, lotion, medicines and food (Valderrama, 2013). Despite the previous trend of seaweed farming in Zanzibar, the industry is still the largest marine export product, contributing over 90 per cent of Zanzibar's marine exports (RGoZ, 2015). The Department of Fisheries Marine and Resources of Zanzibar (in 2012), reported the previous production performance trend of the seaweed, in the three years between 1990 and 1993, to increase from 808 to 1,768 metric tons, valued at 106 million Tanzanian shillings (TZS) (US$ 67,840.00). By 2009, seaweed production had increased to 11,000 metric tons, valued at 1.6 billion TZS (US$10.24 million), see Figure 2 below.



Source: RGoZ, 2011.

Women in the east coastal of Zanzibar have been conducting seaweed farming for decades; the activity has made them advance their livelihoods. This paper investigate how seaweed farming improve the livelihoods of women in the east coastal area of Zanzibar specifically at Bwejuu and Paje villages, determining the methods used in seaweed farming and the common uses of seaweed.

2.0 Study Area and Methodology

Zanzibar is comprised of two main islands-Unguja and Pemba. The islands lie between latitude 04° 50" and 06° 30" South, and between longitude 39° 10" and 39° 50" East. Unguja is the main island and covers an area of 1,666 km^2, while Pemba covers an area of 988 km^2 giving a total land area of 2,654 km^2 (Francis and Bryceson, 2001). The study was conducted at Bwejuu and Paje villages in Unguja-Zanzibar. These villages are located in the southeast of the island, in the east coastal. A research implemented cross sectional research designs which collect data at single point in time and at once (Saunders et al., 2007). Multistage sampling process was done to select an area for the study. The east coastline of Zanzibar was selected as the study area. From the East coastline, the East-South region was selected purposively based on the fact that the region has villages with good records of seaweed farming. From this region two villages Paje and Bwejuu were selected because they have major seaweed producers in the east coastal of Zanzibar. Both primary and secondary data were collected. Primary data were gathered from the selected women through the following methods:

Key informants such as; Village Executive Officers, Community Development Officers, and Agriculture Officers were included in discussing issues pertaining seaweed farming activities among women at the study area. A well-structured checklist was used as a guide during the interview. The participants' observations enabled the collection of information by researcher's own observation without interviewing the respondent. This method helped to obtain information relates to what was happening and not complicated by either the past behaviour or altitudes of respondents. Participants involved in focus group discussion were randomly selected. Various actors with different age, education, marital status and occupation were attended. Data were also collected through using a structured questionnaire which composed of both closed and open-ended questions. Apart from the above information household characteristics, gender roles access and control were considered as important information among interviewed women. By considering the types of data collected, two methods of analysis were utilized. Data collected through the questionnaire administered to women who are seaweed farmers were summarized, coded, and entered in computer using SPSS software (version of 2016). For analysis, descriptive statistics were applied; the quantitative data that were obtained through key informant, participant observation and focus group discussion were analysed using content analysis. This involved verb discussion held with professional Agriculture Officers, Village Executive Officers and women who are seaweed farmers. In this way the recorded dialogue with respondents was broken down into smallest meaningful units of information or topics.

3.0 Results and Discussion

3.1 Characteristics of Respondents

Characteristics of respondents were analysed based on age, education and farming working experiences. Data in table 1 shows that, the biggest age group of women were the ones aged between 28-37 years, making 38% of all participants. This implies that most of the respondents were the middle age. Data reported that, 79% of respondents had primary school level education and 77% of women were reported to have an experience of more than four years dealing with seaweed farming activities. Due to that, majorities of respondents were considered to have a lot of experiences on seaweed farming activities in the east coast area of Zanzibar.

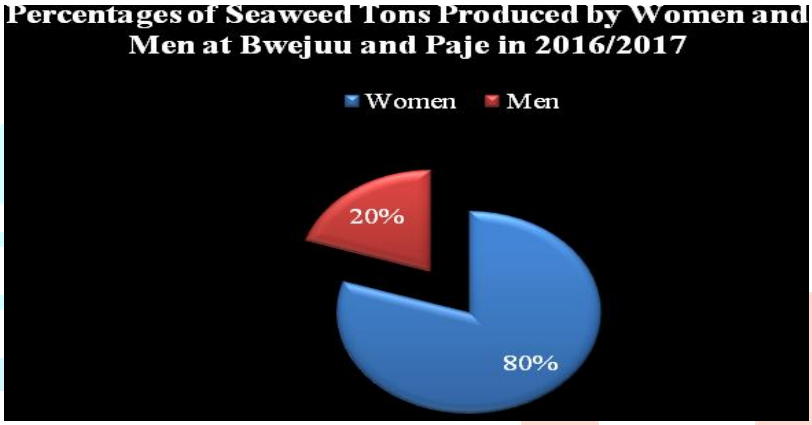
Table 1: Characteristics of respondent

Parameter	Characteristics	Response (%)
Age (Years)	18 - 27	23
	28 - 37	38
	38 - 47	30
	48+	9
Education	None	12
	Primary	79
	Secondary	7
	Others	2
Farming experiences	0 – 3 years	23
	4 – 7 years	32
	8+	45

3.2 Seaweed Tons Produced by Women at Bwejuu and Paje in the Year of 2016/2017

When the sun rises to begin a new day, women at Bwejuu and Paje villages in the east coast of Zanzibar dot the beaches in their colourful kangas (traditional Swahili dress) to start their work. They are the seaweed farmers, taking advantage of the low tide to collect seaweed that washes ashore throughout the night, plant seedlings and harvest the crop. Women in these areas seem to be committed with seaweed farming activities. Most of them have realized that, seaweed farming activities is the only way to make them economically independent. Seaweed farming activities has become a tool for liberation by enabling women to run their families without depending more on their husbands.

On accounting the number of seaweed tons produced, a total of 515 tons were reported to be produced at Bwejuu and Paje in the year of 2016/2017 (RGoZ, 2015). Bwejuu produced 280 tons while Paje produced 235 tons. The percentage analysis shows that 54% and 46% of total production were produced at Bwejuu and Paje respectively. Research reports claim that 80% of the total seaweed production was tendered by women (Msuya, 2012; RGoZ, 2015). Thus, women at Bwejuu and Paje produced 412 tons equivalent to (80%) while men produced only 103 tons equivalent to 20% of the total seaweed. These findings are implying that women play a vital role in production of seaweed, in the study area. The role of women especially in agriculture is witnessed everywhere in Tanzania, according to Kalumanga (2015) argued that, women are the pivotal in agricultural production in Tanzania. Thus, more attention should be given to women for the sustainability of seaweed production in the east coastal of Zanzibar and other areas producing seaweed. Refer Figure 1 below.



3.3 Income Earned by Women from Seaweed Farming in the Year of 2016/2017

The Revolutionary Government of Zanzibar report of (2015), reported that, about 80% of the seaweed farmers are women. As one of the top exports for the island, seaweed provides a livelihood for them. Currently, there are more than twenty products that women produce from seaweed, these includes liquid soaps, shampoos, and foods such as seaweed juice, cakes, cookies, salad and jam, all these products have made women to improve their livelihoods. Women sell these products at higher prices than the raw unprocessed seaweed. Value addition has indeed increased the income of women and improved their livelihoods.

Most of the women interviewed have experience of more than four years doing seaweed farming activities. On assessing their financial income obtained from seaweed in the year of 2016/2017. The study revealed that, 65% of women earned more than 900,000 TZS. The amount was reasonable for them to improve their livelihoods and curb their basic needs. Further analysis reported that, 21% of women earn more than 100,000 TZS per month equivalent to 1,200,000/=TZS per year. Refer Table 1 below.

Income Earned by Women of Bwejuu and Paje through Sea Weed Farming Activities in 2016/2017

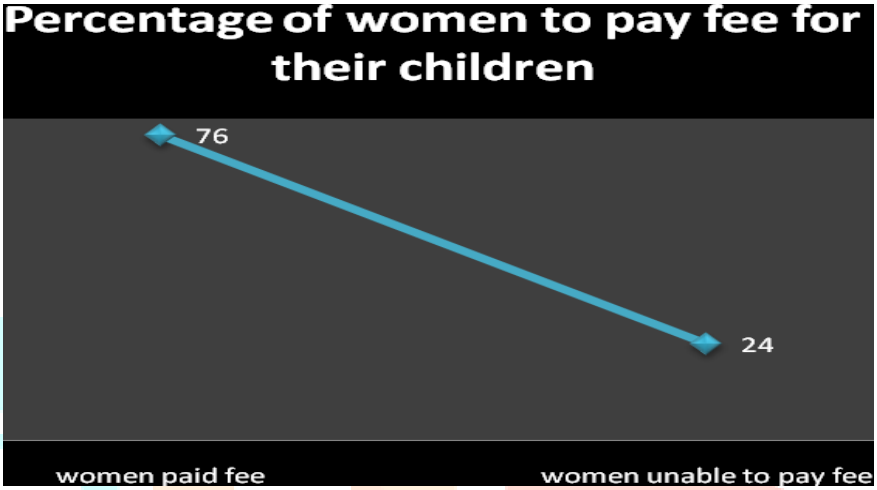
Income earned in TZS.	Number of Women	Percentages
0 - 300,000	0	0
30001- 600,000	7	11.67
600,001- 900,000	14	23.33
900,001 – 1,200,000	18	30
1,200,000 and above	21	35
Total	**60**	**100**

3.4 How Women Managed to Pay School Fees for their Children

On examining the eligibility for women to pay fees for their children, 76% of women were reported to pay school fee for their children in the year of 2016/2017, which means that, only 24% were not able to pay. Seaweed farming activities have made women at Bwejuu and Paje villages to earn enough money which helped them to fulfil their basic requirements including paying

school fee, uniforms and excises books, buying food and other basic needs for their children and families in totality. Due to domination of the patriarchy system in Zanzibar, few women especially those who are engaged in seaweed farming, can be able to ascribe their basic needs without depending on their male counter parts. Seaweed farming has made women in Zanzibar to participate in some decision-making activities at household level and increase the level of equality. Empowerment of women in agri-business activities especially in seaweed farming can make the country to improve its economic status and move out of the challenges facing it and become easier to attain sustainable development (Davice, 2017). Women at Bwejuu and Paje have created their entrepreneurship systems resulted from seaweed farming activities which has helped them to get money and pay schools fees, buy uniforms and books for their children. Refer Figure 2 below.

Figure 2: Percentages of Women who were Able to Pay School Fees for their Children at Bwejuu and Paje villages in the year of 2015/2016



3.5 Women and Shelter Improvement at Bwejuu and Paje Villages

Seaweed farming activities have helped women to improve their family houses which they live in. During focus group interview one woman from Bwejuu villages who does not wanted her name to be mentioned said:
"I managed to build a good house and also to take my children to school. I've also bought a motorcycle that my sons use to supply my customers with seaweed products and helping me to carry seaweed from sea to home. In general, seaweed farming has changed life at my family".

Women have been working hard to improve their basic needs including shelter. Different studies acknowledge the contributions of women who are seaweed farmers in improving their houses. Women are reported to construct their own houses, while others reported to buy and repair their houses as well. During research interviews with women who are experienced in seaweed farming it was noted that, in four years consecutively from the year of 2013 to 2016 eleven (11) houses were constructed by women at Bwejuu and Paje villages. In the same duration two (2) houses were bought by women and forty-nine (49) houses were also repaired. The role of women in east coastal of Zanzibar in improving their livelihoods has been of great potential to their families and the whole surrounding communities. Other women have reported to purchase clothes and food to meet their daily needs. Great contributions of women who are seaweed framers in Zanzibar have been witnessed by different researchers who have documented their role in improving the economic status of Zanzibar (Crona et al., 2010). Studies have reported the role of seaweed farming activities as vehicle for women to achieve their basic needs (Eklund and Pettersson 1992; Mshigeni 1992; Pettersson-Lofquist 1995; Shechambo et al. 1996; Msuya 2000; Semesi 2002; Msuya 2006a and Shechambo et al. (1996). These researches reported that, seaweed farming activities helped the coastal communities of Zanzibar to own some items such as radios, clothes (mostly khanga) the traditional cloths worn by women), kitchenware, bicycles, motorcycles, furniture and so on. Generally, Seaweed farming has greatly improved the life of many families in the east coastal of Zanzibar. Refer Table 2 below.

Table 2: Number of Houses Constructed, Bought and Repaired at Bwejuu and Paje Villages in the 2013-2016

	Year				
Shelter Improvement	**2013**	**2014**	**2015**	**2016**	**Total**
New house constructed	2	4	3	2	**11**
House bought	0	1	1	0	**2**
House repaired	9	15	19	6	**49**

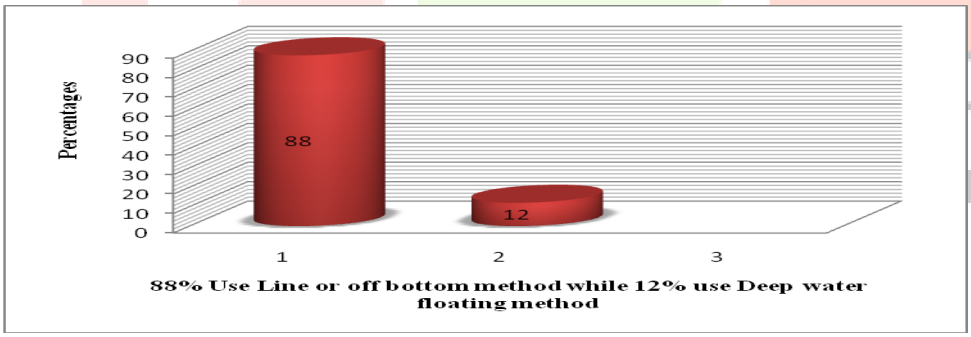
3.6 Seaweed Cultivation Methods

During research study, the seaweed cultivation method was also investigated. The research findings reported that, there are two common seaweed cultivation methods which are; line or off-bottom method and deep water floating method. In the villages of

Bwejuu and Paje research revealed that 88% of women do use line or off bottom method. This is a common method which is always carried out in shallow intertidal areas. In this method, the nylon ropes with seaweed are tied between two wooden pegs. The pegs come from mangroves or land-based plants. The seaweed branches, usually about 100 to 200gms, are tied to the lines and allowed to grow for three to four weeks before they are harvested. When harvesting, farmers remove the lines and the seaweed and then tie-in new seaweed branches (Refer Plate 2 below). In other way around, the research reported only 12% of women use deep-water floating method as a technique of seaweed farming. This is the new method (Technique) where the seaweeds are planted in water of 2-5 m, depending on the tidal range and the cast method where the seaweeds are bound to rocks using rubber bands and allowed to attach and grow through. This method is not common in the villages of Bwejuu and Paje (Refer Plate 2 and Figure 3 below).

Plate 2: Researchers and women at Bwejuu village work together to make seaweed farms by tying seedlings to ropes, which are then held together between sticks while another supporting a woman to carry the harvested seaweed.

Percentages of Women who Use Line or off Bottom and Deep Floating Farming Methods



3.6 Common Uses of Seaweed

During research study, the common uses of seaweed were also accounted. Research revealed that all over the world seaweed is most used as food, agar, cosmetics, medicines, minerals and fertilizers.

a) As Source of Food

In the east costal of Zanzibar and all over the world, seaweeds are commonly used as food. Some countries which consume a lot of seaweeds are Australia, Chile, China and Japan. To date, some of these countries especially China still buy seaweed from Zanzibar, this enabling women in Zanzibar to produce seaweed for exportation. Once women produce seaweed which is exported they earn money for improving livelihoods. There are many common foods mixed with seaweed in Zanzibar.

Plate 3 below shows how seaweed is used and consumed as source of food in Zanzibar.

b) As Source of Agar

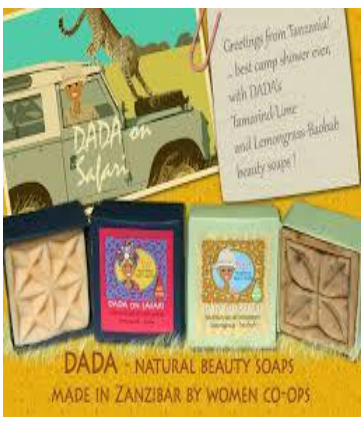
The agar is used in several ways. It is common used in preparation of ice cream, jellies, desserts etc., in sizing the textiles and clearing many liquids. It is also used in preparing shaving creams, cosmetics and shoe polishes. The agar has constantly been used in biological laboratories for media preparation. The best agar is manufactured from Gelidium of Rhodophyceae, which is also called vegetative agar. Japan produces the largest quantity of agar around the world (Rathsman, 2014). Agar is also obtained from several other marine algae, the yield of agar, setting temperature and gel strength of the product.

c) As Source of Soap, Cosmetics, Medicines and Minerals

Recently, the usage of seaweed in cosmetics and soap making is becoming a sounding business in the east coastal of Zanzibar. The majority of women in the villages of Bwejuu and Paje use seaweed extract in soap making and other cosmetics which is also becoming a major international trade at present. The elements contained in seaweeds act in harmony with the human body, helping to achieve beauty and relaxation. In cosmetology, it is important to know the biochemical composition and potential use of cosmetics. The extract can be used in two ways: either as an agent in preparation of products or as therapeutic agent itself. Alginates of different viscosity serves as thickening and dispersing agents and cream, jellies, liquid emulsions, lotions, compact powders, toothpaste, soaps etc. Manufacturing of soaps and alums is also of important. By burning sea weeds on the sea coast, the alkalis are prepared from sea weed ashes. These alkalis are employed in the manufacture of soaps and alums as well.

On the other hand, there are several medicinal properties of seaweeds. Algae rich in iodine such as Asparagopsis taxiformis, Sarconema spp. can be used for controlling goiter disease caused by enlargement of thyroid glands. Many bioactive compounds can be obtained from seaweeds. Several diseases caused by vitamin deficiency such as vitex, asthma, tooth decay etc., may be eradicated if flour of the sea weeds is added to the food. Iodine is the most important element to enable the thyroid glands to secrete the thyrosin which contains 60% iodine. It controls the general development of the animal. Seaweeds are the best source of iodine for human beings. Furthermore, some countries have even industries to process seaweed into suitable cattle feed. The manufacture of cattle feed from seaweed is made principally from brown algae and the processed food is fed to cattle, poultry and even pigs to enrich supply of minerals to the cattle. It has been recorded that dried sea weeds served as cattle food have enhanced the milk-yielding and egg-laying capacity of cattle and poultry respectively.

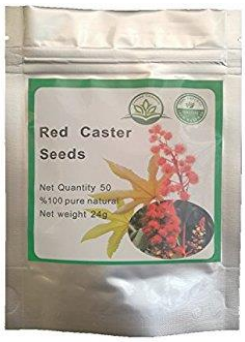
Plate 4 below show different soaps and cosmetics made from seaweed in Zanzibar.



d) **As Source of Fertilizers**

Seaweeds are a store-house of the important potash, ionic sulphate, trace elements and growth substances, besides having every other element and radical required by plants. Seaweed manure seems to increase resistance to disease. Most of the nutrients including nitrogen compounds are in ionic form and a quick absorption by crops takes place and relatively little is left to be broken down by soil micro flora thus, preventing acid conditions of the soil arising from the fermentation. In general, the minerals diffuse out from the seaweed thallus rapidly. Seaweeds are used in different parts of the world as fertilizer for various land crops. Freshly collected and cast ashore seaweeds are used as manure for coconut plantation either directly or in the form of compost in majority of coastal areas. Seaweed manure has been found superior to farm yard manure. Yet, another feature is that seaweed manure holds water and air at the same time and improves the soil in both respects. Like other manures, seaweed has a similar role but also contributes the required potassium, sulphur, phosphorus and calcium. The liquid seaweed fertilizer obtained from seaweed extract is used as foliar spray for inducing faster growth and yield in leafy and fleshy vegetables, fruits, orchards and horticultural plants.

Plate 5 below show different crop fertilizers made from seaweed.

4. Conclusion and Recommendations

4.1 Conclusions

Although seaweed farming activity is the vehicle for the country to reach the intended sustainable development goals (SDGs) as set by the United Nations by 2030, yet, the industry is still facing a lot of challenges. Tanzania, however, could possibly become the world's largest exporter of seaweed and could provide work for more people if the farming is addressed rightly. Changes in environmental conditions led to climate change, and the world market preference for one seaweed species means that, farmers are working for decreasing returns. The majority of the farmers especially women find themselves exacerbated as it is difficult for them to negotiate better prices for seaweed crop. Although officially the selling of seaweed by farmers to the buying companies is supposed to operate under a free trade system, unfortunately in Zanzibar seaweed farming operates under a monopsony system. The system which gives the buying companies greater power to set seaweed prices and control a large proportion of the market and drivers seaweed prices down. Large buyers and brokers own the market and price of seaweed in Zanzibar. There is no clear institutionalized platform for farmers to know and negotiate the market price. Also women have to work with the tides when farming, so their working times are not flexible. By inevitability, then, this has an impact on their ability to undertake their household duties in the mornings and evenings. However, assistance with childcare and other supportive policies to empower women could build into ethical trade agreements.

4.2 Recommendations

In order to guarantee the growing of the seaweed farming sector, it is advisable that, the government and other stakeholders should realize all the challenges pointed out. They have to identify the production, pricing and risk costs, examine both internal and external markets, assessing the process of value additions and costs of the required modern facilities hence empower the seaweed farming sector. It is also advisable to empower women especially who are dealing with seaweed farming activities by enabling them to get cheap loans which will enable them to buy some facilities required in farming activities. Cheap loan will enable them to buy materials required during value additions process. It is advisable to facilitate women so that they can be able to access market both inside and outside of Zanzibar. Women should be trained on how to run micro credit enterprises systems, so they can know how to run businesses without depending on brokers, and whole sellers who most treat them like labours. Seaweed information market centres should be established in Zanzibar for customers and other stakeholders from inside and outside Zanzibar to easily determine the price information which is relevance worldwide. This will avoid the price fluctuations and undetermined price which is very common in Zanzibar. Awareness especially on the usages of seaweed products among communities outside and inside Zanzibar should be advocated, this will attract investors to look for important opportunities on seaweed products. Awareness on the role of seaweed farming should be emphasized among men who always believe that, seaweed farming as an activity for women. The situation will definitely increase seaweed productions and income among communities' living in Zanzibar and Tanzania at large.

Acknowledgement

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