Technological Development to Help Women Seaweed Farmers Cope with the Effects of Climate Change in Zanzibar, Tanzania

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Rural women in Zanzibar cultivate seaweed in shallow-water lagoons and sell it as a cash crop. Seaweed is exported to Denmark, USA, France, China and Spain. The women use the traditional peg and line off-bottom method. By this method, seaweed is tied to nylon ropes using thinner ropes called tie-tie and the ropes with seaweed are stretched between two wooden pegs or stones previously fixed on the bottom depending on the nature of the intertidal substrate. If the substrate is sandy, ropes are stretched between wooden pegs and, if it is rocky, they are stretched between two stones (Fig. 1). The seaweed is then allowed to grow for six weeks and then it is harvested, dried and sold for export.



FIGURE 1. *Typical off-bottom seaweed farm in Zanzibar, Tanzania.*

To address the challenge faced by women seaweed farmers, research in Zanzibar has focused on developing innovative seaweed farming and value addition technologies that women can use to improve their seaweed business and enhance their livelihoods.

The women cultivate two types of seaweed, *Kappaphycus* (*K. striatum* and *K. alvarezii*) and *Eucheuma denticulatum*. From these seaweeds carrageenan is extracted and used in industrial processes such as in food, cosmetics and pharmaceutical industries as a stabilizer and emulsifier. Examples of such industrial products are body lotions, shampoos, and toothpastes from the cosmetic industry, which remain soft during use. The two types of seaweed are valued for the type of gel produced from them. *Kappaphycus* fetches a price that is double that of *Eucheuma* because its gel (kappa carrageenan) is thicker and has more industrial applications than that from *Eucheuma* (iota carrageenan). The price of *Kappaphycus* is US$ 0.50/kg dry seaweed while that of *Eucheuma* is US$ 0.25/kg.

Both seaweed types have been cultivated for 26 years. However, in the past seven years the higher valued *Kappaphycus* has failed to grow in shallow water areas where it has traditionally been cultivated because of impact of the climate change, including increased surface seawater temperatures, epiphytes, and "ice-ice" disease (Hayashi *et al.* 2010, Eklof *et al*. 2012).

Innovative Farming Technologies

To address the challenge faced by women seaweed farmers, research in Zanzibar has focused on developing innovative seaweed farming and value addition technologies that women can use to improve their seaweed business and enhance their livelihoods. Unlike the shallow-water off-bottom method, the innovative farming methods are used in waters of 2-5 m depth.

Research on developing innovative farming technologies started in 2005 when researchers from the Institute of Marine Sciences, working with Coastal Resources Center of the University of Rhode Island and the Western Indian Ocean Marine Science Association (WIOMSA), developed the first innovative technology. In their project, called Sustainable Coastal Communities and Ecosystems (SUCCESS), a floating raft made only of nylon ropes (Fig. 2a) was developed. Good growth rates obtained from this study (Msuya et al. 2007) led to more studies in Zanzibar working with farmers in four villages (Msuya 2006, Msuya *et al*. 2014). More innovative ideas resulted in the development of floating rafts made of bamboo (Fig. 2b), which were also used in the deeper waters of Zanzibar and Pemba under the Zanzibar

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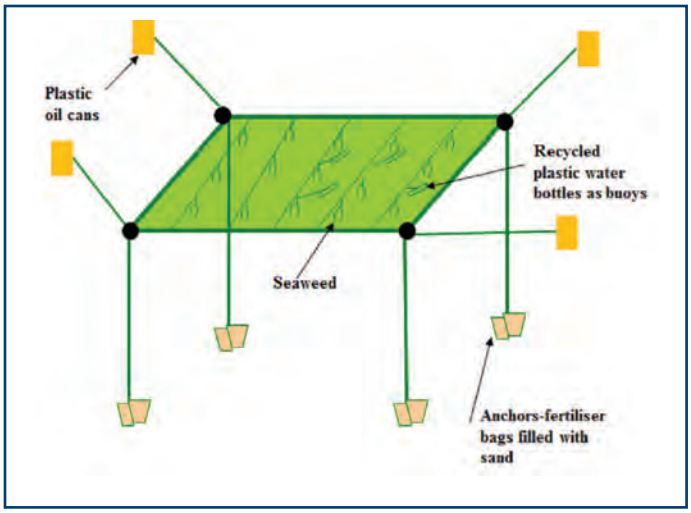


FIGURE 2a. *Components of a deepwater floating raft used for seaweed culture.*



FIGURE 2b. *Bamboo raft used for seaweed culture.*

Seaweed Cluster Initiative (ZaSCI-www.zasci.webs.com) (Msuya 2011c). Unfortunately the dissemination and upscaling of these two technologies has not been fully realized because of rough seas during grow-out, leading to breakage of the seaweed and causing loss of the crop.

To address the problem of rough seas, another technology called tubular nets (Fig. 3) was developed last year 2015 under a WIOMSA Marine Research Grant (Msuya 2015). In the tubular nets technology, the seaweed is placed inside the nets, minimizing breakage. Specific growth rates (SGR) of 2.1 ± 0.1 percent per day were recorded in the cold season in July. The highest SGR was 12.6 ± 4.7 percent per day recorded during the short rains in September. These results were similar to those obtained in Pemba, where the SGR of *Kappaphycus* ranged from 6 to 14 percent per day (Msuya 2011).

This new technology has high potential to help improve the livelihoods of women seaweed farmers. Considering that these results were from one study, it is important to ascertain the consistency of these results and then disseminate the technology to farmers. Also, to effectively use the technology, women need boats to travel to deeper waters. The women must work together with men in the deep waters, dividing their work accordingly, e.g. women working in the boats and men diving to anchor the nets.

Value-Added Technologies

Technologies for making value-added products from lower value seaweed were developed during 2006-2009. Women and men farmers in more than 30 villages were trained on how to make value-added products such as seaweed powder, soap, body creams and foods such as juice, jam, cakes, and cookies. The women are selling these products at higher prices. For example, whereas one kilogram of dry seaweed is sold for US$ 0.25, one kilogram of seaweed powder can be sold for US$ 6.

Another technology for value addition is extracting the water (sap) from the lower-value seaweed before it is dried (Neish and Msuya 2013). The sap is a good plant growth stimulator and women can use this sap to enhance growth of food crops for increased food production. The sap can also be sold as a commercial product to bring more cash income.

Conclusion

Women in Zanzibar can use the technology of farming in deeper waters to produce higher-value seaweed while coping with the impact of climate change. It is important to solve the challenges of rough seas and develop more farming technologies to help the farmers, especially women. In addition, in countries like the Philippines and Indonesia, there are many more products that are made from seaweed. If the women of Zanzibar are trained about these, they can produce and market many more products, but site visits and exchange programs are necessary. There is a need to consolidate and disseminate the technology of extracting the sap from lower value seaweed for women to use and market. These technologies have a high potential of improving the livelihoods of women seaweed farmers and those of their family members.

Notes

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References

Eklöf, J.S., F.E. Msuya, T.J. Lyimo and A.S. Buriyo. 2012. Seaweed Farming in Chwaka Bay: A Sustainable Alternative in Aquaculture? Pages 213-233 *In*: M. de la Torre-Castro and T.J. Lyimo, editors. People, Nature and Research in Chwaka Bay, Zanzibar, Tanzania, Zanzibar Town: WIOMSA.

Hayashi, L., A.Q. Hurtado, F.E. Msuya, G. Bleicher-Lhonneur and A.T. Critchley. 2010. A review of *Kappaphycus farming*: Prospects and constraints. Pages 251-283 *In:* A. Israel, R. Einav and J. Seckbach. Editors. Seaweeds and their Role in Globally Changing Environments, Cellular Origin, Life in Extreme Habitats and Astrobiology 15. Springer Science, London, England.

Msuya, F.E. 2015. Deep water device for farming seaweed: a way of producing the higher valued *Kappaphycus* for coastal communities in Tanzania. Report Submitted to Western Indian Ocean Marine Science Association, under MARG I.

Msuya, F.E. 2011. Experimental Farming of the Seaweed *Kappaphycus* in Floating Rafts in Pemba Island, Zanzibar, Tanzania BIRR-MACEMP Project Phase II. Consultancy Report



FIGURE 3a. *Tubular net technology for Gracilaria culture just after seeding.*



FIGURE 3b. *Tubular net technology for Gracilaria culture at harvest.*

Submitted to BIRR Seaweed Company.

Msuya, F.E. 2006. The Seaweed Cluster Initiative in Zanzibar, Tanzania. Pages 246-260 *In:* B.L.M. Mwamila and A.K. Temu, editors. Proceedings of the 3rd Regional Conference on Innovation Systems and Innovative Clusters in Africa, Dar es Salaam, Tanzania.

Msuya, F.E., A. Buriyo, I. Omar, B. Pascal, K. Narrain, J.J.M. Ravina, E. Mrabu, and J.G. Wakibia. 2014. Cultivation and utilisation of red seaweeds in the Western Indian Ocean (WIO) Region. Journal of Applied Phycology 26:699-705.

Msuya, F.E., M.S. Shalli, K. Sullivan, B. Crawford, J. Tobey and A.J. Mmochi. 2007. A Comparative Economic Analysis of Two Seaweed Farming Methods in Tanzania. The Sustainable Coastal Communities and Ecosystems Program. Coastal Resources Center, University of Rhode Island and the Western Indian Ocean Marine Science Association. www.crc.uri.edu, www.wiomsa.org

Neish, I.C. and F.E. Msuya. 2013. Seaweed Value Chain Assessment of Zanzibar. Report submitted for UNIDO Project no 13083 Building Seaweed Processing Capacities in Zanzibar and Pemba: Creating value for the poor.

