

Environmental changes and their impact on seaweed farming in Tanzania

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When seaweed farming started in Tanzania in 1989, the two species that are farmed commercially, *Eucheuma denticulatum* (spinosum) and *Kappaphycus alvarezii* (cottonii), were thriving with no differences in growth (Msuya in press). Recently, however, there differences in the growth of the two species have been observed, with one species, cottonii, being severely affected by changes in environmental conditions, leading to die-offs. The possible causes of the die-offs are stated in Msuya (this issue of World Aquaculture). The other species, spinosum, is not much affected though some seasonal reduction in growth has been observed. The impact and effects of the die-offs are shown by changes in production of the species, change in number of farmers, use of cultivation sites, fouling and effect on community services. In this article, effects of the changes in environmental conditions on the above mentioned issues as well as efforts to curb (or cope with) those conditions are discussed.

Effects on Seaweed Production

The effect of environmental changes on the production of cottonii is shown by the severe decline in seaweed production in areas where much of that species was previously produced. One such area is Songo-songo island² in southern Tanzania (Figure 1), an island that had a village that produced large volumes of cottonii. In addition, seaweed farming in Songo-songo, just like in other parts of Tanzania, had proved to be an important for the livelihoods of the people. However, the village severely hit by die-offs of cottonii has seen its seaweed production decreasing dras-



Fig. 1. Map of Tanzania coast showing the seaweed farming areas.

tically since 2004. Production varied from an annual tonnage of 420 t dry seaweed worth about US\$60,000 during the peak in 2003 to 26 t in 2008 worth only US\$3,000. This has had disastrous effect on the farmers who were depending for much of their income from farming seaweed.

A similar situation was observed in Zanzibar where farming of the species has failed in many areas where it used to grow. Combining the failure of cottonii and low price obtained from spinosum (Msuya in press), production of cottonii has severely decreased over the years; for example from 1,048 t in 2001 to 16.5 t in 2008. In mainland Tanzania, production of cottonii in all the cultivation sites has

also decreased in recent years. According to the Department of Aquaculture statistics, production of cottonii decreased from 1,500 t in 2003 to 887 t in 2008/2009.

Effects on Seaweed Farmers

Use of cultivation sites. The farmers have been practicing “shift cultivation,” in which they move from one farming site to the next trying to see if the seaweed will grow. In Songo-songo, for example, farmers have been changing the cultivation sites when they observed that production is failing (Msuya and Porter 2009). Whereas, seaweed was previously planted throughout the island, the cultivation sites are now concentrated on the southern part of the

island. Many large sites that were formerly productive are now abandoned (Figure 2).

Likewise, farmers in Bagamoyo on mainland Tanzania (Figure 1) have also changed their cultivation sites over time in response to die-offs. Farmers are able to tell the sites that they can use at a certain season of the year though those sites have been decreasing in number over the years. Farmers have changed cultivation sites according to the seasons or cultivation period and when that didn't work some of them stopped farming while others reverted to the lower paying spinosum.

Number of farmers. Although the change in the number of farmers has not been documented throughout the country, a study by Msuya and Porter (2009) showed that the number of seaweed farmers on Songosongo island has decreased over the years, from 809 during the production peak in 2003 to less than 400 in 2009. In Paje village on the east coast of Zanzibar, there were 1,400 farmers (both men and women) during the seaweed



Fig. 2. An abandoned seaweed farming site in Songosongo Island, Southern Tanzania (note the pegs used for farming are still fixed in the sediment). (Photo by Flower E. Msuya)

production peak (1990-1998) when cottonii was also farmed in the village, but in 2010, there were less than 200 farmers, all women. This is the case in many areas in Zanzibar as well as on the mainland.

According to a study by Msuya and Porter (2009), the variation in the num-

ber of farmers by sex showed the “opportunistic nature” of farmers when it comes to farming seaweed. When seaweed farming started in 1999, the number of farmers increased sharply supposedly because the seaweed was growing well. There were fewer men than women as is the case in all farming

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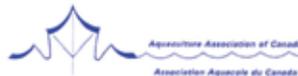
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Fig. 3. Seaweed farms and the intertidal area covered by the fouling *Cladophora* in Songosongo Island, Tanzania.

areas in Tanzania. When production peaked, the number of male farmers was similar to that of women in 2003, only to drop the following year when seaweed production declined. Some authors have described women farmers as being “more patient” than men. However, one year later, the number of men farmers increased and surpassed that of women. This may indicate that men tried to go back to fishing, which is the main occupation of the Songosongo people, but found they could not catch enough fish to sustain their lives. Whether this was an effect of decreasing fish catches, lack of proper fishing gear or money to purchase the gear has yet to be determined.

Fouling. Environmental changes have led to fouling on farmed seaweed (Figure 3). While in some cases fouling is seasonal, increased pollution or a rise in temperature may favor blooms of fouling organisms, such as the green alga *Cladophora* sp. In some areas the seaweed in entire shallow lagoons has been covered by fouling organisms.

Continuous Shifting of Cultivation Sites

It has been observed in Zanzibar that whereas cottonii was cultivated

in almost every village when seaweed farming started, the trend has been that crops are failing from the north toward the south of Zanzibar island. For example in 2005, cottonii and *K. striatum*, an alternative variety of cottonii, were farmed in the village of Uroa on the east coast of the island and Jambiani on the southeast coast. By 2008, none of either variety was farmed in Jambiani. In Uroa only one part of the village still farmed cottonii and farming was concentrated on one site, whereas at another site where a study by Msuya and Kyewalyanga (2006) was conducted, the seaweed could no longer be grown. The cottonii farm shown in Figure 4 was thriving well at the time of the study, but not now. Spinosum is now cultivated on the farm instead of cottonii (Msuya and Kyewalyanga 2010). In two other villages located north of Jambiani where cottonii was thriving well during the 1990s, the seaweed has completely failed and the farmers have resorted to farming spinosum. Currently, on the east coast of Zanzibar, except for the small site in Uroa, cottonii is farmed only in the far south in the village of Makunduchi (Figure 1). In Bweleo on the southwest coast of Zanzibar, *K. striatum* was introduced

and farmed for about five years but failed. By 2009 there was no *K. striatum* being farmed; the villagers are now farming spinosum.

Effect of Cottonii Die-off on Farmers' Livelihoods

Changes in environmental conditions caused die-offs of cottonii, which meant there was less product to sell. Coupled with this is the lower price of spinosum. Thus, those farmers who cannot farm cottonii either have no seaweed to sell or get less money by growing and selling spinosum.

During the mid-1990s, studies showed that seaweed farmers were able to buy more clothing after they started farming seaweed than before. Msuya (2006) reported that women farmers purchased more pairs of khanga, a colorful cloth used by East African women to wrap over their dresses (Figure 5). The author reported that whereas the women in Zanzibar owned less than five such pairs before starting seaweed farming, they were able to own more than 30 pairs after. With the current situation of seaweed die-offs, women do not own as many pairs as they used to; some only own 15 pairs now. This, coupled with increasing inflation, causes the value of money from seaweed farming to decline over time.

Throughout Tanzania, farmers feel that the price of seaweed does not match the amount of work that needs to be invested in its production. The minimum price farmers would like to see for spinosum is US\$0.2 to 0.3/kg of dry seaweed. Some farmers also state that while the prices of day-to-day items have drastically increased while the price of seaweed has barely gone up. That is not the case with other commodities. For example, in 1986, the price of seaweed was US\$0.04/kg (using the current exchange rate) and that of rice was US\$0.06/kg. Currently, the price of one kg of rice is US\$1.0, while that of seaweed is US\$0.13.

Men farmers explain that they farm seaweed only when they are in need of some quick cash, such as in Zanzibar, but the price does not match the labor they put in. In Tanga on the mainland, one young man stopped

operating his farm allegedly because the price of seaweed was “a female price,” meaning that it can be tolerated by women but not by men who need more cash. The man was a very active farmer, having built his own house with money obtained from seaweed farming. When he was ready to marry he used the money obtained from seaweed sales as a dowry and for wedding celebrations.

While very few men farm seaweed on Zanzibar island, more men still farm seaweed in Pemba island and mainland Tanzania, especially in the southern regions. People may have more alternatives in Zanzibar, owing to thriving tourism compared with other coastal regions on Pemba and mainland Tanzania.

In areas where the seaweed die-offs are severe, such as Songosongo island, farmers do not have enough food and they definitely cannot have a balanced diet. It is not unusual to stay in Songosongo for three or four days and not be able to have vegetables in your meals. Whereas farmers used to earn cash from seaweed sales, they are now earning nothing and they are getting poorer everyday. Most families cannot afford three meals a day. Those people who are considered well-off, such as government officials or employees of the seaweed buying companies, who can afford to have three meals a day, eat the food to have something in their bellies but not to be satisfied as should be the case. Although these can afford to have three meals a day, their meals, however, just like the rest of the community, hardly contain any vegetables and fruits, these being very scarce in the village.

Effect on Community Services

Percent of money given for community development. Usually exporters allocate a certain percentage of their seaweed business funds for community development or provide direct services. An example of this is a 5 percent incentive offered in one village in Zan-



Fig. 4. A *Cottonii* farm in Uroa, Zanzibar in the year 2006. The species has failed and *Spinosum* is now cultivated on this farm.

zibar by C-weed Company, one of the six buying companies. Because of the failure of *cottonii* cultivation, such service has been terminated in some areas, such as in the Songosongo island, southern Tanzania. On this island, the seaweed exporting companies were contributing US\$ 267 per month for community development but because of the die-offs followed by drastic decrease in seaweed production, nothing was paid by 2009 (Msuya and Porter 2009). This could be similar situation in other areas where production has decreased, at least the amount paid or the frequency of payment could be greatly affected.

Temperature Increase

Water temperature at seaweed farms have been increasing over the years. It has been reported that water temperature on seaweed farms recorded in 2007-2009 were higher than those recorded in the 1990s. Highs increased from below 30°C in the 1990s to 38°C in 2008 (Msuya and Porter 2009). In other tropical countries, temperatures on seaweed farms have been below 32°C (Qian *et al.* 1996, Hurtado *et al.* 2008).

What Are Stakeholders Doing?

Various stakeholders are trying to help the seaweed farmers. Exporters of seaweed, for example, are bringing in new varieties of *cottonii* as alternatives to the failing variety. Likewise, the gov-

ernments of Tanzania (GoT) and Zanzibar (SMZ) are boosting production through formation of an Aquaculture Department within the Ministry of Agriculture (GoT) and funding alternative activities through different donor-funded projects (GoT and SMZ). Initiatives, such as the Seaweed Cluster Initiative in Zanzibar (ZaSCI, www.zasci.co.tz), are engaged in innovation of the farming method by using the deep-water farming technique and adding value to the low priced *spinosum*. Other efforts being taken by seaweed buying companies include promoting higher production of *spinosum* by giving gifts to the best farmers and increasing the price of both species as a motivation to farmers.

Conclusion

Changes in environmental conditions have greatly affected the production of one species of seaweed in Tanzania leading to shifting cultivation sites and farmers getting less money than they used to. The die-off of the higher valued seaweed species *cottonii*, coupled with the price differential in Tanzania, is greatly affecting the farmers. There are farmers on Songosongo island, for instance, getting poorer every day. Men are leaving seaweed farming and women are getting discouraged, although they are holding on because of lack of alternatives. The various efforts to help the farmers should be encouraged and, where possible, other stakeholders should be encouraged to help. An integrated, united effort where one party builds on what another has done should be encouraged.

Notes

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²Songosongo is an island that has no arable land (the land is dry and rocky) so no
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row crop farming is done. There are no industries, no large businesses and the island is small; the population is 5,600 people. Thus, the farmers have very few alternatives and thus readily took up seaweed farming when it was introduced to the island in 1996.

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