A Comparative Analysis of the Socio-Economics of Seaweed Farming in Two Villages along the Mainland Coast of Tanzania



By:

Brian R. Crawford and Mwanahija S. Shalli

2007

The Sustainable Coastal Communities and Ecosystems (SUCCESS) Program

In Cooperation with
The Tanzania Coastal Management Partnership (TCMP)
The Sustainable Environmental Management through Mariculture Activities (SEMMA) Program

This publication is available electronically on the Coastal Resources Center's website: www.crc.uri.edu. It is also available on the Western Indian Ocean Marine Science Association's website: www.wiomsa.org. For more information contact: Coastal Resources Center, University of Rhode Island, Narragansett Bay Campus, South Ferry Road, Narragansett, RI 02882, USA. Email: info@crc.uri.edu

Citation: Crawford, B.R. and M.S. Shalli. 2007. A Comparative Analysis of the Socio-Economics of Seaweed Farming in Two Villages along the Mainland Coast of Tanzania The Sustainable Coastal Communities and Ecosystems Program. Coastal Resources Center, University of Rhode Island and the Western Indian Ocean Marine Science Association. 9p.

Disclaimer: This report was made possible by the generous support of the American people through the United States Agency for International Development (USAID). The contents are the responsibility of the authors and do not necessarily reflect the views of USAID or the United States Government.
Cooperative agreement # EPP-A-00-04-00014-00

Cover Photos:
Left, Women seaweed farmers harvesting seaweed
Right, a peg-and-line off-bottom farm at low tide

Photo Credits: Flower Msuya

Table of Contents

Page

Introduction 1

Village Locations 1

Methodology 1

Comparison of Seaweed Farming Households in Mlingotini and Ushongo Villages 2

Comparison of Seaweed and Non-Seaweed Farming Households 4

Summary and Conclusions 7

References 9

List of Tables

Page

Table 1. Mlingotini seaweed farming households 2
Table 2. Ushongo seaweed farming households 3
Table 3. A comparison of income statistics between seaweed farmers 4
Table 4. Comparison of means of income (log10) between seaweed farmers 4
Table 5. Demographics of Mlingotini and Ushongo seaweed farmers 4
Table 6. Mlingotini non-seaweed farming households 5
Table 7. Ushongo non-seaweed farming households 5
Table 8. Demographics of Mlingotini and Ushongo non-seaweed farmers 6
Table 9. Comparison of means of income (log10) 6
Table 10. Comparison of mean age between seaweed and non-seaweed farmers 6
Table 11. Pearson correlation matrix of demographic variables and household income 7

Introduction

Seaweed farming has become a well developed industry in Tanzania over the last decade. It is a significant export earner as well as an income and employment generator in coastal communities where it is practiced. The Tanzanian government has called for the aggressive expansion of seaweed farming in the recently adopted national Seaweed Development Strategic Plan (SDSP 2005). It targets the expansion of the "*cottonni*" variety of seaweed which commands a higher farm gate price than the "*spinosum*" variety. However, *spinosum* is more widely grown within the country at present than cottonnii which faces the die-off problems, The die off cycle of the cottonnii variety typically occurs after the heavy rainy season (March to May) and most likely due to water salinity, sedimentation from run-off and/or temperature differentials during this period (Mmochi *et al*. 2005). In order to help promote the expansion of the seaweed sector, a better understanding of how coastal communities adapt and incorporate seaweed farming into the mix of household livelihood activities is needed along with assessments of the relative advantages and disadvantages of the two varieties of farmed seaweed. In addition, seaweed farming is often promoted as an "alternative" livelihood that can help reduce pressure on overexploited nearshore and small-scale fisheries. However, few empirical studies have been conducted to assess the degree that seaweed farming actually functions as an alternative. This paper attempts to shed light on these issues. It compares two communities, one which exclusively grows the *cottonni* variety of seaweed and another that grows only the *spinosum* variety of seaweed.

Village Locations

The study is based on a survey of rural coastal households that was conducted in March, 2007. The two villages that are the focus of this analysis are located along the coast of the Tanzanian mainland where seaweed farming is expanding beyond its initial roots in Zanzibar. Mlingotini village with a population of 1,974 persons in 2002 is located approximately 10 km south of Bagamoyo town in Bagamoyo District and about 56 km north of the capital city Dar-es-salaam. It borders a large shallow coastal lagoon where seaweed is farmed. Ushongo village, with a population of 760 persons in 2002, is approximately 30 km south of Pangani town in the District of Pangani. It faces the open Indian Ocean where seaweed is farmed on shallow seagrass flats adjacent to the shoreline. In Mlingotini, seaweed farmers grow the higher value cottonni variety of seaweed whereas in Ushongo they exclusively grow the lower value spinosum seaweed.

Methodology

A systematic random sample of 30 seaweed farming adult individuals were surveyed in March, 2007 in Mlingotini and Ushongo villages along with a smaller sample of 22 non-seaweed farming respondents. This sample is a subset of a much larger survey of coastal households undertaken for an applied research project on assessing factors influencing successful promotion of coastal livelihood initiatives. Therefore, the sampling strategy was not initially intended for this particular analysis but the data is being used opportunistically for this study. The sub-sample analyzed here is due to interest in seaweed farming as a supplemental or alternative livelihood activity and since it provides an opportunity to compare two different community adaptations, each farming a different variety of seaweed. While much of the data presented here is from a relatively small sample size, making statistically significant analysis difficult, it nevertheless provides an important empirical view into seaweed farming communities. The detailed survey instrument and methodology used to collect this information is not elaborated in detail here but can be found in a companion report on the larger household survey (in preparation). In addition to the household questionnaire, direct observation within the two communities and key informant interviews were undertaken for this analysis.

We used two measures here of how seaweed is incorporated into household activities. The first is a ranking of all household productive activities in terms of their perceived importance by respondents and the second is the overall income generated of all productive activities conducted by adult members of the household. Inherent difficulties were encountered in trying to collect income data among coastal households. While a recall method is used, respondents in such poor rural settings have difficulty in estimating income generated from all their household productive activities. This is especially challenging for fishing, where catch and earnings demonstrate high daily, seasonal and annual variability. In addition, much of the farming production is used for direct household consumption or bartered, so this creates another challenge of translating the value of non-sold goods into the income variable. It should be noted that perceived rankings of the relative importance of household productive activities did not always correspond to the actual income figures provided by respondents. This was particularly true for farming, which tended to be higher in the perceived ordinal rank compared to the actual income figures provided. This was pointed out to several respondents after surveys were completed, but who still insisted that farming was more important. This is an interesting methodological footnote, but perhaps more importantly, provides a window into the perceptions of rural households. Farming often brings in a large infusion of money at one or two times a year after a harvest. A small dry goods shop by comparison generates a small amount of income daily but continuously and which over a year may generate more income, but it is not perceived as more important. The large scale infusion at one point in time by farming allows households to make major purchases as few if any people in these communities deposit earnings into bank accounts as a means of savings. In addition, farming is also linked to land tenure rights, one of the few major assets of households in these communities. These factors likely explain the difference in perceived ranking versus reported income.

Comparison of Seaweed Farming Households in Mlingotini and Ushongo Villages

Tables 1 and 2 below show that Ushongo seaweed farmers are much more dependent on seaweed farming in terms of importance towards household income compared to Mlingotini. In Ushongo, seaweed was ranked by all households as either first or second in importance whereas in Mlingotini, slightly more than half ranked seaweed as first or second in importance. Ushongo seaweed farmers tend to be less diversified in terms of household productive activities, dependent primarily on seaweed farming, fishing or trading as first or second ranked activities. Mlingotini shows a more even distribution of primary household activities in seaweed, farming, trading, and fishing among the first and second ranked activities. Mlingotini seaweed farmers also tend to show a larger number of productive activities per household with 26 percent having five or more productive activities compared to Ushongo with only 9 percent.

Table 1. Mlingotini seaweed farming households percent rank distribution of productive activities

Activity	*Rank*						*Total*
	1	**2**	**3**	**4**	**5**	**6**	
Seaweed	26.3	26.3	26.3	10.5	10.5		**100.0**
Farming	36.8	31.6	21.0	5.2	0		**94.6**
Trading	15.8	15.8	10.5	10.5	0		**52.6**
Livestock	0	5.2	15.8	15.8	10.5		**47.3**
Fishing	15.8	15.8	5.2	0	0		**36.8**
Government Officer	5.2	0	0	0	0		**5.2**
Other	0	0	0	0	0	5.2	**5.2**
Total	**100**	**94.7**	**78.8**	**42.0**	**21.0**	**5.2**	

N=19

Table 2. Ushongo seaweed farming households percent rank distribution of productive activities

Activity	*Rank*						*Total*
	1	**2**	**3**	**4**	**5**	**6**	
Seaweed	54.5	45.6					**100.0**
Trading	9.1	27.3	9.1	9.1			**54.6**
Fishing	36.4	9.1		9.1			**54.6**
Livestock			36.4		9.1		**45.5**
Restaurant	0	9.1	27.3				**36.4**
Farming	0	9.1	0	18.2			**27.3**
Tourism				9.1			**9.1**
Total	**100**	**100**	**72.8**	**45.5**	**9.1**	**-**	

N=11

Key informant interviews conducted in Ushongo and Mlingotini villages indicate that Ushongo seaweed farmers tend to use substantially more lines than Mlingotini seaweed farmers which in part accounts for the difference in rank of importance of seaweed farming between the two villages. Since *cottonni* seaweed produces more revenue per line (Seaweed Development Strategic Plan, 2005), we would expect that Mlingotini seaweed farmers would grow more seaweed if it is indeed more profitable than *spinosum*, but they do not. This is likely due to the fact that Mlingotini residents have more livelihood options than Ushongo village. Seaweed farming tends to be a physically demanding and very low wage earning activity, so substitutability by other better paying opportunities would tend to be higher in areas where there are more livelihood choices. This seems to be the case in Mlingotini due to proximity to Bagamoyo town and as illustrated in greater diversity of productive activities among seaweed farmers (Table 1). There is also limited space for seaweed farming in the lagoon and this may also be a contributing factor to why Mlingotini farmers do not grow more seaweed. Less farming space is needed in Mlingotini to produce a similar amount of income from seaweed as they produce the higher value *cottonni* variety compared to Ushongo, which needs more lines and space to earn a similar amount of income from the *spinosum* variety.

Total household income of seaweed farming households is compared between the two villages in Table 3. Mlingotini has a lower median income of seaweed farmers. However, comparison of the log10 of income[1] (Table 4) shows that there is no statistically significant difference between the two. Therefore, the difference in rank of importance of seaweed between the two villages does not seem to provide any advantages in overall household income generated. While seaweed farming is an important income earner to seaweed farming households in both villages, Mlingotini *cottonni* farmers tend to farm less, and rely on seaweed less for overall household earnings compared to the *spinosum* farmers in Ushongo, but earn about the same in terms of overall household income.

[1] A log 10 transformation of income was done to normalize the data before statistical analysis. The small sample size may have contributed to no statistically significant difference.

Table 3. A comparison of income statistics between seaweed farmers in Ushongo and Mlingotini villages

Statistic	*Ushongo*	*Mlingotini*
N of cases	11	19
Minimum	240000	100000
Maximum	6258500	3180300
Range	6018500	3080300
Median	1106500	766000
Mean	1806709	1164661
Standard Dev	2027591	897535

Table 4. Comparison of means of income (log10) between seaweed farmers in Ushongo and Mlingotini villages

Village	*N*	*Mean*	*SD*
Mlingotini	19	5.929	0.386
Ushongo	11	6.036	0.461

(t = -0.648 df = 18.1 p-value > .05)

Table 5 compares demographic characteristics between Mlingotini and Ushongo seaweed farmers. Mlingotini seaweed farmers are more likely to be female (68%), have smaller household sizes, are older and less educated than their Ushongo counterparts.

Table 5. Demographics of Mlingotini and Ushongo seaweed farmers

	Household Size	*Age*	*Years of Formal Education*	*Percent Male*	*Percent Female*
Mlingotini					
Mean	4.9	49.6	4.6	31.6	68.4
Standard Dev	2.4	17.5	3.0		
N= 19					
Ushongo					
Mean	5.6	33.9	7.2	45.5	54.5
Standard Dev	2.0	6.0	1.5		
N=11					

Comparison of Seaweed and Non-Seaweed Farming Households

Non-seaweed farming households in Mlingotini (Table 6) tend to be more involved in trading as the most important livelihood activity compared to seaweed farming households. While this sample size is small, it also suggests that seaweed farming households tend to be more diversified. Non-seaweed farming households tend to rely on fishing more as a primary activity. Therefore, seaweed farming does seem to have an impact as an alternative livelihood to fishing in this village.

Table 6. Mlingotini non-seaweed farming households percent rank distribution of productive activities

Activity	*Rank*						*Total*
	1	**2**	**3**	**4**	**5**	**6**	
Trading	41.7	16.7	8.3	8.3			**75.0**
Farming	16.7	33.3	25.0				**75.0**
Fishing	33.3	8.3	8.3				**49.9**
Restaurant	8.3						**8.3**
Livestock		8.3					**8.3**
Total	**100**	**66.6**	**41.6**	**8.3**	**-**	**-**	

N=12

In non-seaweed farming households in Ushongo (Table 7), fishing and farming tend to be more important productive household activities compared to seaweed farming households. While the sample size is very small, it tends to suggest that seaweed farming may be providing an alternative livelihood that displaces fishing (especially of primary livelihood importance) and possibly farming. Seaweed farming may also perhaps be taken up by individuals that have no access or rights to terrestrial farming lands. In either case, seaweed farming seems to have been a way for this community to diversify livelihoods as well. It should be pointed out however, that seaweed farming households in this village were clustered in one sub-settlement area where virtually all households were engaged in seaweed farming and where space for farming was limited. The non-seaweed farming sample was drawn from a different sub-settlement a few kilometers away from the seaweed farming sub-settlement, and adjacent to a cluster of beach hotels where very little seaweed farming took place. Hotel owners tend to discourage seaweed farming in front of their properties, so use conflict disincentives for seaweed farming come into play. The employment opportunities surrounding tourism, such as labor, trading, and restaurants may also be more lucrative than seaweed farming, tending to discourage seaweed farming in this sub-settlement as well.

Table 7. Ushongo non-seaweed farming households percent rank distribution of productive activities

Activity	*Rank*						*Total*
	1	**2**	**3**	**4**	**5**	**6**	
Fishing	60	30					**90**
Farming	10	30	30				**70**
Trading	20	10	10				**40**
Restaurant	10	10	20				**40**
Livestock			10	10			**30**
Labor		20					**20**
Tourism			10				**10**
Total	**100**	**100**	**80**	**10**	**-**	**-**	

N=10

Table 8 compares demographic characteristics between non-seaweed farmers in Mlingotini and Ushongo villages. Mlingotini non-seaweed farmers have lower median incomes, smaller households, and a bit more years of education as well as being slightly older than Ushongo non-seaweed farmers. Non-seaweed farmers are more likely to be male compared to seaweed farmers. Within Mlingotini village, non-seaweed farmers have smaller households, are younger, more educated, more likely to be male and have higher median incomes compared to seaweed farmers (see Tables 3, 5 and 8). Within Ushongo village, non-seaweed farmers also tend to

have higher median incomes, but less years of formal education (see Tables 3, 5 and 8). While gross inspection of median incomes tends to suggest differences between seaweed and non-seaweed farmers and between villages, we tested this difference statistically and found no significant differences (Table 9) between these groups. In grouping the entire sample into seaweed and non-seaweed farmers, we found no statistically significant differences between these groups in terms of years of education, income or household size. However, we did find a significant difference in age (Table 10), with seaweed farmers tending to be older than non-seaweed farmers.

Table 8. Demographics of Mlingotini and Ushongo non-seaweed farmers

	Household Income	*Age*	*Household Size*	*Years of Formal Education*	*Percent Male*	*Percent Female*
Mlingotini						
Minimum	90000	21.0	1.0	0.0	50.0	50.0
Maximum	2675400	71.0	13.0	7.0		
Median	1208000	35.5	3.0	7.0		
Mean	1299783	36.2	4.1	6.0		
Standard Dev	765386	13.5	3.4	2.4		
N= 12						
Ushongo						
Minimum	790000	19.0	2.0	0.0	70.0	30.0
Maximum	3831000	53.0	7.0	7.0		
Median	1527000	35.0	6.0	7.0		
Mean	1912346	34.7	5.4	4.9		
Standard Dev	1032007	11.1	1.6	3.4		
N=10						

Table 9. Comparison of means of income (log10)

	N	*Mean*	*SD*
Between non-seaweed farmers in the two villages			
Mlingotini	12	6.000	0.398
Ushongo	10	6.227	0.229
(t = -1.672	df = 18.0	p-value = 0.112)	
Between seaweed and non-seaweed farmers			
Seaweed	30	5.968	0.411
Non-seaweed	22	6.103	0.345
(t = 1.285	df = 49.0	p-value = 0.205)	

Table 10. Comparison of mean age between seaweed and non-seaweed farmers

Group	*N*	*Mean*	*SD*
Non-seaweed	22	35.500	12.208
Seaweed	30	43.867	16.162
(t = -2.126	df = 49.9	p-value < 0.05)	

Since demographic characteristics vary considerably between and among seaweed framers and non-seaweed farming survey respondents, these factors may also contribute to the differences in household earnings and could play a larger role than whether individuals are engaged in seaweed farming or not. Table 11 compares correlations of individual demographic variables

with household income for those variables that showed statistically significant relationships. For this analysis, the full data set of households in 18 coastal communities was used for better statistical power. Years of education is weakly correlated (positively) with household income. Age was not significantly correlated with household income. Years of education is also inversely correlated with age, with younger individuals tending to be more educated. This demonstrates encouraging trends on the education front whereby younger individuals seem to be obtaining more education than was possible for their older cohorts. This also seems to have some payoff in terms of increased household income for those more educated. Seaweed farming or variety farmed does not seem to be an important determinant of household income. Educational attainment tends to play a more important role.

Table 11. Pearson correlation matrix of demographic variables and household income

	Household Income	***Age***
Years of Formal Education	0.183**	-0.284***

N=338 ** p< 0.01 *** p<0.001

Summary and Conclusions

Seaweed farming has been demonstrated to be an important employment opportunity and income earner for households in Mlingotini and Ushongo villages. In both cases it also tends to diversify household productive activities. This is important if we are concerned about making communities more resilient and adaptable to various environmental or economic shocks and changes to any one type of productive activity that may occur from time to time. There is less evidence to suggest that seaweed farming of either variety provides an advantage in terms of greater overall household earnings when this is added to the productive household mix. In Mlingotini and Ushongo, seaweed farmers have lower median incomes than non-seaweed farmers. However, we found no statistically significant differences, although a larger sample size would have given us more confidence in this statistical result. Even in Ushongo where seaweed farmers grow more seaweed and where its' rank of importance to the household is higher, they to do not seem to do better economically either. In Mlingotini, if seaweed farmers grew more seaweed, it is reasonable to conclude that they might also improve overall household income. However, they do not rely more on seaweed and it does not seem to improve overall household income as well. Mlingotini therefore seems to provide more alternative livelihood opportunities which compete with seaweed for attention, and farming space also provides another constraint.

While we would have hoped to confirm the development hypothesis that seaweed farming increases income of coastal households, we cannot do so based on this analysis. It fact, it seems that seaweed farming does not improve overall household income compared to non-seaweed farmers and seaweed farmers may actually do worse. It is possible that seaweed farming households were poorer than non-seaweed farming households before they started farming and now show parity. To test that hypothesis individual households would have to be tracked before they started growing (most have been involved for many years already) to some point in time after they were growing seaweed, with a control group also sampled. This would be very difficult to do in practice, as villages where seaweed farming has not been started would need to be found, and then seaweed successfully introduced, or we would need to find individuals talking up seaweed farming for the first time and track them over a period of years.

We also see that community context matters in how seaweed is incorporated into the household productive activity mix. Where there are fewer alternatives, particularly in more rural and isolated villages, seaweed may provide more of an advantage compared to other potential

livelihood alternatives. In areas close to urban centers, or where seaweed farming space is limited, other alternatives may be more advantageous than seaweed. Lastly, demographic characteristics of seaweed farmers may also come into play. Older farmers and women may not have the physical stamina and strength to farm as much area as younger men and therefore not be capable of relying more fully on seaweed as a main source of livelihood. On the other hand, as *cottonni* provides higher value per unit of line farmed compared to *spinosum*, the less physically firm could farm less *cottonni* with less effort to earn an equivalent amount compared to *spinosum*.

Diversification of livelihood activities within a household may be equally or more important than increasing income in terms of project objectives. Livelihood diversification is a common strategy and frequent characteristic of poor rural societies. This strategy reduces risk and over-reliance on any one income source. With people as poor as they are in these coastal communities, they constantly live on the edge, where a major illness in the family from AIDS or TB, drought, or a drastic drop in the price of an international commodity could send them over the precipice, impacting their ability to survive or move economically ahead. Reducing risk therefore may be a more rational objective from the perspective of poor households, than trying to achieve modest increases in household income at greater risk.

The seaweed political economy is a contract growing system that actually reduces risks for growers. Some seaweed farmers interviewed stated that they are happy with the arrangement whereby buyers provide all the farming inputs to growers they then are required to sell back all harvest only to that buyer at a price dictated by the buyer, a system that can be exploitative Growers are more or less contract laborers on seaweed farms where all the inputs are owned by the buyer but where earnings are based on the total amount of seaweed they grow. In this situation, the buyer must use their own capital and assume most of the risks of this business. The grower does not risk any personal capital, just the value of their labor. There are very few seaweed buyers in Tanzania, and therefore few suppliers of seaweed inputs, so a monopsony situation tends to occur, theoretically repressing prices paid to growers. In this regard, it is interesting to note that Mlingotini does not follow this model. Mlingotini seaweed growers are independent and purchase their own inputs. Key informants have stated that they believe the Mlingotini seaweed group to be more entrepreneurial than others along the coast. A recent economic analysis in Mlingotini suggests that they actually receive a price premium above and beyond the costs of their inputs, and do better economically in this more competitive framework. However, they also assume more risk should the *cottonni* variety fail from disease and die offs. As *cottonni* is the more sensitive variety, their risks are higher. The risks of independent growing of *cottonni* therefore may also partially explain the reason Mlingotini tends not to grow more seaweed (compared to Ushongo), where they tolerate only a certain level of risk to their overall household earnings potential.

It is unclear from this study whether there are any advantages of farming *cottonni* seaweed versus *spinosum*. In areas where environmental conditions allow *cottonni* to thrive, and where space may be limited, the higher value crop would seem a more rational choice, such as in Mlingotini. In places where *cottonni* has failed and *spinosum* seems more environmentally appropriate, such as in Ushongo, there is little choice but to farm the only seaweed variety that grows in those local conditions. Context factors such as environmental conditions and geography may trump pure economics in the choice of variety of seaweed farmed. However, one potential advantage to *cottonni* over *spinosum* is that less effort is needed (less length of lines per unit of earnings) to produce an equivalent amount of earnings, so less physically firm individuals or those with less time available to farm due to involvement in other productive or non-productive activities (e.g. child rearing, fuel wood gathering) may find *cottonni* a more

advantageous crop if given a choice. This is particularly important for HIV/AIDS affected households where caring for sick household members, or being sick oneself is a burden. Women tend to bear a larger share of the burden in HIV/AIDS affected households. For these vulnerable groups, less labor intensive or less physically demanding activities are promoted as coping strategies (Torell et al. 2007). The cottonni seaweed therefore, where there is a choice, may be less physically demanding (for the same level of income) and a preferred crop of choice. However, since it is environmentally more sensitive, farming risks tend to be greater.

Lastly, this study also suggests that seaweed farming as an alternative livelihood can reduce dependence on fishing, and at least temporarily, relieve pressure on overfished stocks. However, unless alternative livelihoods are coupled with stronger resource management and effort restrictions on the fishery, and with expanding populations, any short term fishery benefits are likely to dissipate over the long term as the fishery returns to an open access yield. Gender differentials in occupational activities must also be more closely examined. For instance, since seaweed farming tends to be dominated by a large number of female farmers, who tend not to fish (although many women glean organisms from mangroves and reef flat areas – a form of wild harvest), and since capture fishing activities are predominately male activities, these gender role differences tend to reduce the likelihood of exit from or reductions in fishing resulting from seaweed farming. For alternative livelihood strategies aimed at fishing effort reduction to work, seaweed farming may help somewhat, but more substantial alternatives need to be offered that are attractive enough to male fishers to convince them to permanently take time away from fishing. In this regard, more attention to job satisfaction characteristics among fishers is needed as well as more attention given to gender differentiation in labor among the productive activity choices that are promoted.

References

SDSP. 2005. Seaweed Development Strategic Plan. Ministry of Natural Resources and Tourism. Dar es Salaam, Tanzania. 47p.

Torell, E., B. Kalangahe, M. Thaxton, A. Issa, V. Pieroth, O. Fahmy and J, Tobey. 2007. Guidelines for mitigating the impacts of HIV/AIDS on coastal biodiversity and natural resources management. Population Reference Bureau, Washington D.C. 26p.

Mmochi A.J., Shaghude Y.W., and Msuya F.E. 2005. Comparative Study of Seaweed Farms in Tanga, Tanzania. Submitted to SEEGAAD Project, August 2005, 37 pp.