

*Full length Research Paper*

# Climate change and household food insecurity among fishing communities in the eastern coast of Zanzibar

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**This paper examines the local vulnerability of households in two study communities in the east coast of Zanzibar focusing on food security, which is negatively impacted by climate variability and change. Findings have indicated that overall the local people in eastern coast of Zanzibar are insecure with respect to most major sources of food. Households solely dependent on natural resources through farming, fishing, livestock and poultry farming, have been found to be more vulnerable to food insecurity as these activities are facing considerable uncertainties associated with climate change and variability as well as other stress factors. Agricultural failure resulting from various factors, including local climate variability, coupled with uncertainty of fishing has many pushed households towards increasing dependence on market for their staple food supplies. Therefore, this enhances the household's vulnerability to food insecurity especially among households with low purchasing power. With increasing demand of fisheries resources in urban areas associated with the expanding tourism industry in the study area the price for fisheries resources has increased, causing the poor, including the fishers, to consume less fish and other seafood, and thereby limiting their dietary protein intakes.**

**Key words:** Agriculture, climate change, coastal communities, fisheries based livelihoods, food insecurity, food accessibility, vulnerability, Zanzibar.

## INTRODUCTION

The Fourth Assessment Report of the IPCC confidently contends that the observed climate variability and predicted changes in climate will potentially impact food and water security in Africa (Boko et al., 2007). Evidence in support of this argument include the considerable incidents of famine, food insecurity and water stress across Africa, which are partly associated with the variability of climate and the domination of El Niño Southern Oscillation (ENSO) events on the regional climatic patterns (Dai, 2011; Droogers, 2004). Similarly, more than 40% of people in Africa go to bed without

enough nourishing food (Cordell et al., 2009). The east coasts of both islands of Zanzibar are frequently affected by localised food shortages and, are sensitive to even moderate abnormalities of rainfall. For instance, in 2010-2011 more than 7,000 people in Micheweni district, in north-east Pemba, where Kiuyu Mbuyuni (one of the study site) is located, did not have enough food (Said, 2011). This was caused by high fluctuations in rainfall which started around 2006 and which affected crop production. Indeed, even without climate variability, access to food for the majority of the households along

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the drier east coasts of both islands is problematic and is one of the major food security problems of Zanzibar (Boetekees and Immink, 2008). Rose (1994), cited in Walsh (2009) argues that even during the best years, malnutrition along the east coasts is widespread. This study therefore provides the data needed to inform future interventions to reduce poverty and vulnerability and to help to accomplish future sustainable development goals set to take off after 2015 when the current millennium development goals (MDGs) expire.

The definition of food security provided by FAO during the World Food Summit in 1996, and applauded by many, recognises food security as “when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life” (Ericksen, 2008). Unlike previous definitions, this one highlights the role of food availability in connection to the accessibility of food for understanding food security at all levels (Ericksen, 2008). Since the 1970s, food security as a concept has evolved and has been defined extensively across disciplines because of its multi-disciplinary nature and complexity. However, it is now widely recognised that food security comprises four components: food availability, accessibility, stability and utilisation (Ziervogel and Ericksen, 2010; Balaghi et al., 2010; Ericksen, 2008).

Food availability is determined by the ability of households to produce, distribute and exchange food, while access to food is determined by affordability (purchasing power), allocation and preferences (social and cultural determinants influencing consumers). Utilisation is influenced by the nutritional value of the food, its social value and by food safety (Ziervogel and Ericksen, 2010; Ericksen, 2008). Indeed, all components of food security are tightly connected to various global and local determinants and thus they are sensitive to a number of stressors that may include environment, politics, ethics, employment, choices, land alienation and/or land grabbing, land degradation and climate variability and change (Chakrabortya and Newton, 2011; Ziervogel and Ericksen, 2010; Merino et al., 2012; Barnett, 2011; Wang, 2010). This highlights the fact that food insecurity is unevenly distributed both between and within social systems, as interactions between these determinants vary both between and within social systems or decision units, such as the household. For example at the household level, food insecurity may also be triggered by household choices and preferences influenced by livelihood security. A household may choose to go hungry to preserve assets and future livelihoods (Ericksen, 2008; Maxwell, 1996).

Climate variability and change is an additional pressure on food security and affects all four components of food security in many ways. Erratic rainfall, floods, increasingly warm conditions, increasing intensity and frequency of drought and storms and sea level rise (estimated at 1-2 mm/year) are likely to increase the problem of coastal

and ocean problems in Zanzibar (Zanzibar Revolutionary Government, 2009) and affect livelihoods, purchasing power, distribution systems, health, freshwater availability for farming and domestic use, important agricultural areas and marine resources, and ultimately affect the stability of food resources (Hanjra and Qureshi, 2010; Ziervogel and Ericksen, 2010; Ericksen, 2008). Therefore, the poor, who have low coping strategies and those who are dependent on climate sensitive ecosystems, are highly vulnerable to food insecurity.

## METHODOLOGY

### Study areas

This study was conducted in Kiuyu Mbuyuni, in the north-eastern parts of Pemba Island, and Matemwe, in the north-eastern parts of Unguja Island (Figure 1). Pemba and Unguja islands together form the island nation of Zanzibar which is part of the United Republic of Tanzania and located offshore Tanzania mainland coast. Zanzibar experiences two rainy seasons, the long rainy season locally known as *masika* is usually received in March, April and May and short rainy season locally known as *Vuli* in October, November and December. In between these two seasons the islands experience summer season (dry period) locally known as *kiangazi* in January, February and March and winter seasons locally known as *pupwe* in Unguja and *mchoo* in Pemba in June, July and August. The annual average rainfall along the east of both islands where the study sites are located is around 1400 mm, while the central and western parts receive up to 2000 mm per annum. The rainfall of 1400 mm cannot be considered low, however, recent studies (Walsh, 2009; Mustelin et al., 2010) revealed that east coasts are experiencing variations in the distribution of rainfall, onset of the rainy seasons and general decline of rainfall received particularly during short rainy seasons. Figure 2 for example shows that a total of 11 out of 19 years experienced rainfall below average during short rainy seasons between 1992 and 2010. The average annual rainfall is 1678 and 1623 mm/year in Unguja and Pemba islands respectively. Both study sites fall in the coral rag agroecological zone, which is less fertile than other agroecological zones and get exhausted easily in terms of soil fertility under minimum pressure and erratic water supply (Walsh, 2009). Shifting cultivation has been the main methods of farming in these areas (Walsh, 2009). The combination of poor soils and variability in rainfall along the east coasts have long been considered as major factors for the frequent localised food shortage in these areas including the study sites (Walsh, 2009).

Zanzibar is endowed with coastal and marine resources such as beaches, coral reefs, crop and grazing land, mangroves and other forests, sea grass, seaweed farms, fishery resources, salt marshes and collectable seafood that form the foundation of livelihood activities and which are important for the coastal well-being and the nation at large (Zanzibar Revolutionary Government, 2009). Fishing and agriculture are traditional livelihood activities in these areas, but people's livelihood portfolios have changed over the last two decades. Livelihood activities such as seaweed farming and those related to tourism (for example, handcrafts) have started to play a considerable role in the rural economy (Lange and Jiddawi, 2009).

### Data collection and sampling procedure

To understand the current situation of food security in the households, this study employed a household survey, where 200 households were randomly selected, 100 from each site. With

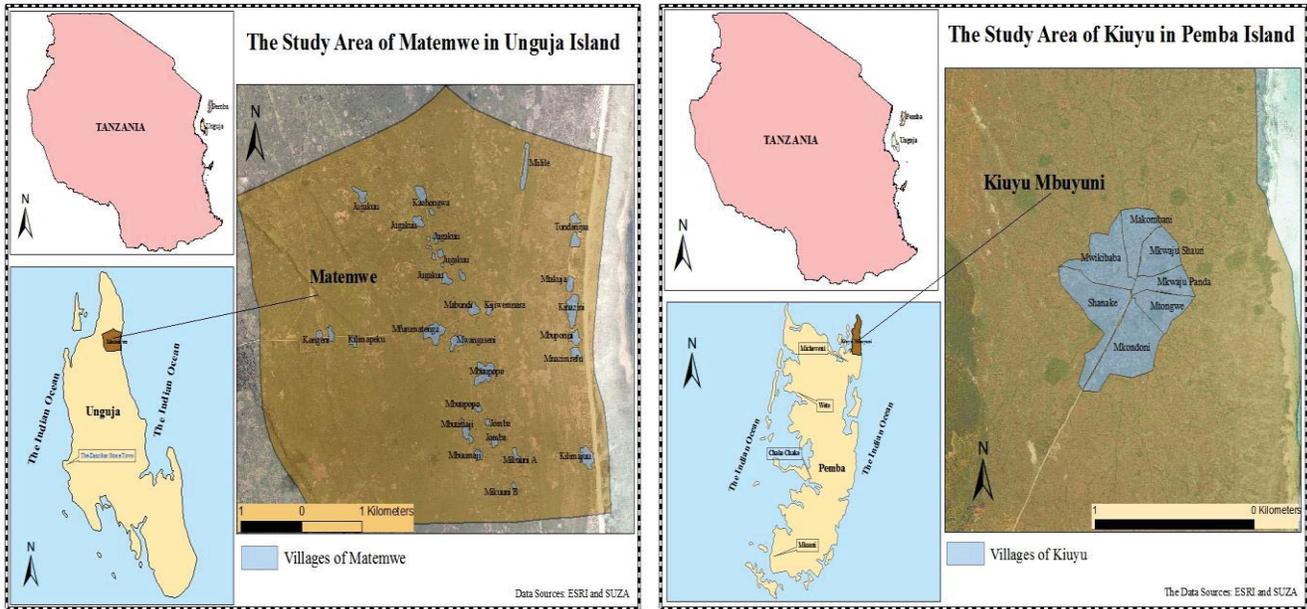


Figure 1. Map showing the locations of the study sites.

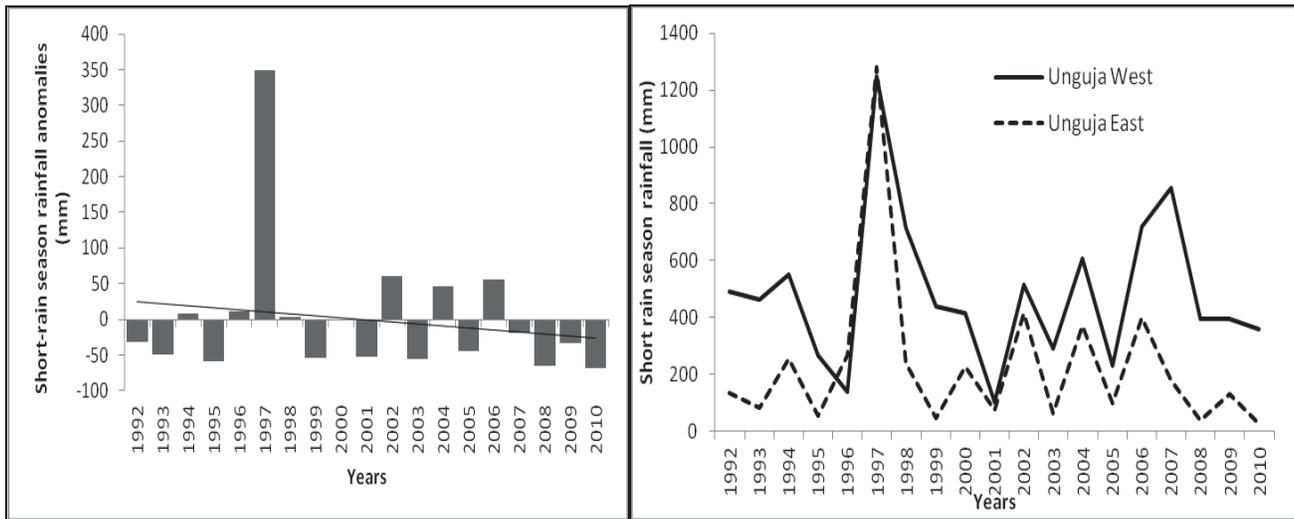


Figure 2. Left: Inter-annual variability of rainfall in the short-rain season/Vuli (October-December) on the east coast of Unguja from 1992-2010. Right: inter-annual variability of rainfall in short-rain season between Unguja West and East from 1992-2010 (Source: Makame 2013: pg 126-128). Note: The study did not compare rainfall received in Pemba West and East coasts as weather stations along the Pemba east coast were not operating reliably.

regard to availability and accessibility of main sources of food, the survey was designed to gather data on variables such as sources of major types of food, access to staple food, fish, and vegetables; the costs incurred by a household for staple food and fish per month; and accessibility of other types of food such as seafood, meat and chicken. The information collected provides insights into the current status of food security situation amongst households in the study sites. With regards to stability of staple foods, the survey was designed to capture data on consistency of food supply in the

households and seasonality. Lastly the survey aimed at understanding the various coping strategies employed by the households during the time of localised food shortages.

Data from the survey were analysed using the Statistical Package of the Social Science (SPSS) where descriptive statistics, including frequencies and percentages of respondents were determined across the four major themes of the study, namely availability, accessibility, stability and coping strategies during the time of crisis. The analytical results were disaggregated by study

**Table 1.** Percentage responses on availability of staple foods, fish and vegetables.

Adequate availability of food	Staple food		Fish		Vegetables	
	Kiuyu Mbuyuni (n=92)	Matemwe (n=97)	Kiuyu Mbuyuni (n=93)	Matemwe (n=92)	Kiuyu Mbuyuni (n=85)	Matemwe (N=96)
Yes	7 (8%)	17(18%)	26 (28%)	22 (24%)	9 (11%)	15 (16%)
No	85 (92%)	80 (82%)	67 (72%)	70 (76%)	76 (89%)	81 (81%)

**Table 2.** Pearson correlation results between inadequate availability of food and fish and livelihood diversification and family size.

Kiuyu Mbuyuni, Pemba			Matemwe, Unguja		
Types of food	Pearson Correlation	Livelihood diversification	Types of food	Pearson Correlation	Livelihood diversification
Food (N=94)	Correlation	-0.002	Food (N=97)	Correlation	-0.022
	P value	0.982*		P value	0.834*
Fish (N=93)	Correlation	0.015	Fish (N=92)	Correlation	0.121
	P value	0.886*		P value	0.249*

\* Pearson correlation was not significant ( $p > 0.05$  level, 2 tailed).

sites to facilitate comparisons between the two sites.

## RESULTS AND DISCUSSION

### Availability and accessibility of food in the households

The major staple foods in the study area are cassava, sweet potatoes, rice, sorghum and maize meal. Respondents across the study sites were asked if they had enough staple foods, fish and vegetables throughout the year and the results showed that 85 out of 92 (92%) households in Kiuyu Mbuyuni and 80 out of 97 households (82%) in Matemwe experienced periods of inadequate availability (Table 1). With regards to fishery products the results also showed that majority of the respondents 72% (67 households) in Kiuyu Mbuyuni and 76% (70 households) in Matemwe experienced inadequate availability of fisheries products throughout the year. The proportion of households that experienced inadequate availability of fish is slightly higher in Matemwe than in Kiuyu Mbuyuni. This is probably influenced by the high demand triggered by tourism and the urban market in Zanzibar town. This is an issue for concern as both sites are considered as fishing villages and fisheries products are the major sources of cheap animal protein preferred and accessible by most people.

A large percentage of the households who perceived inconsistency in the accessibility and availability of staple food and vegetables (Table 1) may be influenced by the

fact that the surveys were undertaken in the aftermath of the 2007-2010 periods which was characterised by prolonged dry conditions and declining rainfall (Figure 2) which impacted local farming and production. Vegetables, both wild and locally grown are sensitive to erratic rainfall, especially where the soil is poor. This is captured in the following quote from a respondent in Matemwe: "If rainfall becomes erratic we get a small amount of wild spinach in the bush, but these days even if we receive good rainfall and thus more wild spinach, we may not enjoy it because after a short while the plants are affected by pests. I remember in those early days we used to have massive coverage of wild spinach in the bush, to the extent of inviting people from the neighbouring villages to come and harvest". It is clear from this quotation that conditions have changed to the extent that local production of foodstuffs is being increasingly challenged by the changing climate.

A Pearson correlation was performed to understand whether there was a relationship between inadequate availability of food and fish, as observed and livelihood diversification and family size. The results revealed no relationship between these variables across the sites ( $p > 0.05$ ) (Table 2), suggesting that livelihood diversification and family size within the household do not necessarily reduce the risk of food insecurity.

The observed food insecurity mirrors the findings in the study by Walsh (2009) which showed that localised food shortages along the east coast of both major islands including the study sites, is attributed to poverty, unreliable rainfall, and poor soils. Unlike the 1971/72 famine, which

**Table 3.** Percentage responses on sources of major food types.

Source	Staple Food		Fisheries products		Vegetables	
	Kiuyu Mbuyuni (n=99)	Matemwe (n=96)	Kiuyu Mbuyuni (n= 100)	Matemwe (n= 91)	Kiuyu Mbuyuni (n=99)	Matemwe (n=99)
Buying	17	40	36	34	29	29
Own farm/fish	-	-	42	39	19	11
Buying+ own/ fish/ gardens	83	60	22	22	52	50
Relatives/neighbours	-	-	-	5	-	-
Wild	-	-	-	-	-	10

was influenced by both drought and the banning of food imports, recent food shortages may be linked to the low capacity of people to purchase or produce own food as even during good years, food insecurity and malnutrition are prevalent (Walsh, 2009). Furthermore, while local climate variability, affects locally grown crops, global climate change affects rice production in Asia, the major supplier of rice to Zanzibar (Peng et al., 2004). In terms of fish, households that were solely dependent on buying fish are more vulnerable compared to those who practice fishing as they cannot afford to consume fish on a daily basis because of competing prices offered by urban markets, particularly during the fishing off-seasons.

With regards to the relationship between households food insecurity and diversity of livelihood portfolio, the results from the present differ from a study conducted in northern Ghana which highlighted the positive and statistically significant impact of livelihood diversity particularly off-farm activities on household food security (Owusu et al., 2011). Although livelihood diversification in known as a coping strategy to food security (Barrett et al., 2001a,b), the observed low availability of food throughout the year is probably indicative of the failure of livelihood diversification to ensure food security in the study areas. This is mainly due to the fact that diversification of livelihoods was based on activities that are sensitive to normal seasonal variations in climate and to global market such as seaweed farming. Stress factors other than climate could have a role to play in influencing food insecurity in the area, especially since food shortage has traditionally been experienced even in years with good weather conditions. However, this was outside the scope of this study. Insights on other stress factors influencing food security in other parts of Tanzania are provided by Kangalawe et al. (2011) and Kangalawe (2012) from studies in the southern highlands, and Lyimo and Kangalawe (2010) in the semiarid zone of Tanzania.

### Understanding sources of major food types in connection with availability and accessibility of food in the households

Respondents were asked 'where the household gets most of its food, fish and vegetables'. The results in Table

3 show that none of the households interviewed depended solely on the farm to meet their staple food demands throughout the year. The majority of the households (85%) in Kiuyu Mbuyuni, and more than half of the households in Matemwe were both buying and producing their staple food stuffs. The results indicated that more people still do some farming in Kiuyu Mbuyuni, probably due to the fact that the village is experiencing less competition on the land use compared with Matemwe. In Matemwe 40% of the respondents reported to solely depend on buying food stuffs from shops. This is probably associated with land scarcity due to increasing land value in the area caused by the expansion of the tourism industry. The reasons cited for the high dependence on food from shops included poor soils, seasonality of rainfall, land scarcity, lack of water for irrigation, pests and diseases, and the absence of suitable land for rice cultivation (Valipour, 2014a,b,c,d; Valipour et al., 2014). This dependence on purchased food is highlighted below in a comment from a respondent in Matemwe. "For five years now, a large part of my food comes from shops. Farming is like our religion - one must do it but truly speaking, we are getting nothing out of it. The soil is very poor and the short rainy seasons have disappeared lately" (Figure 2). While it is acknowledged in the above quote that there are other stress factors influencing agricultural production, such as soil fertility, the variations in the seasonality of rainfall has a considerable influence in altering the cropping calendar that farmer used to follow, hence affecting food availability and/or security during some seasons. Figure 3 that in both Unguja and Pemba islands the monthly rainfall is relatively low during some months of the year (particularly June, July and August), which may influence seasonal production of crops like vegetables, especially where no irrigation facility is available.

With regard to fish, a large proportion of the respondents across the study sites reported to catch their own fish for domestic consumption (Table 3). About 36 and 34% respondents in Kiuyu Mbuyuni and Matemwe, respectively, were buying most of their fish, whereas 22% in both sites were both buying and fishing for themselves. Reasons such as engagement in other works, old age and health, and seasonality of wind seasons were cited as barriers that prevented them from self-reliance in fishing.

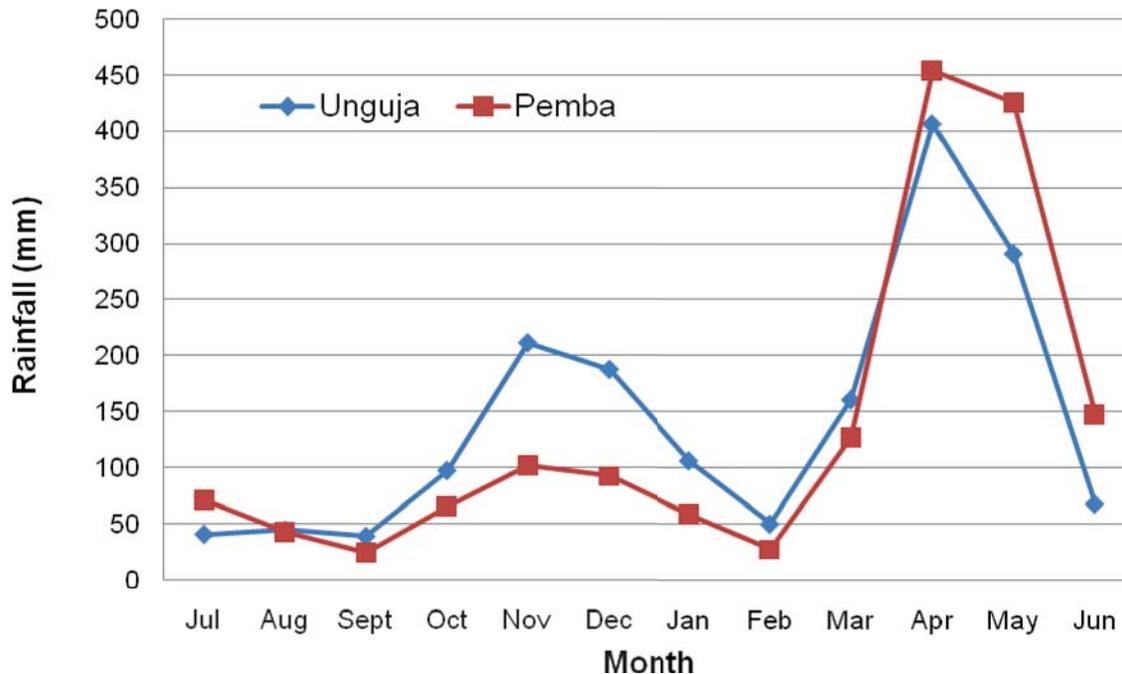


Figure 3. Monthly rainfall in Unguja and Pemba Islands.

fishing. The above observations further confirm the existence of multiple stress factors influencing food insecurity in the area. Interestingly however, 5% of the households in Matemwe were mostly dependent on remittances of fish and/or fish products from relatives and neighbours who practice fishing.

Perhaps the most striking results relate to the sources of vegetables. Unexpectedly, only 19 and 11% of the households in Kiuyu Mbuyuni and Matemwe, respectively, were largely dependent on their gardens for vegetables. About 29% in both sites bought most of their vegetables, while 53% in Kiuyu Mbuyuni and 50% in Matemwe bought and produced their vegetables (Table 3). The fact that a considerable proportion of respondents from both study sites were engaged in producing their own vegetables indicates that it has become important to diversify the sources of livelihoods in these predominantly fishing villages, especially given the various factors above that cause some of them not to engage in fishing. Nevertheless, most of these farmers/fishers have not been self-sufficient in vegetables because of the locally perceived poor soils, variations of rainfall, scarcity of land, diseases and pests and insufficient water for irrigation. Interestingly, however, 10% of the households in Matemwe draw many of their vegetables from the wild (Table 3), which indicates the need for continued protections and conservation of the source areas.

The results demonstrate that the majority of the households across the sites were using a combination of buying and producing their staple food, vegetables and fish. These results are inconsistent with other parts of

Africa, particularly with regard to staple food; for instance, in the rural district of Moma and Mabote in Mozambique more than 80% of households draw their food solely from their own farm plots (Hahn et al., 2009). Given the high levels of poverty within the households across the sites (Wash, 2009), concentrating on buying most food requirements, including vegetables, could be a major source of vulnerability to climate variability, food insecurity and social insecurity. Although over-dependence on small-scale farming for household food is always considered a source of vulnerability (Hahn et al., 2009; McDowell and Hess, 2012), the observed trend toward solely buying, diminishes the purchasing power, savings and access to assets for future adaptation to climate variability and change in the long run. For example, the reported localised food shortages in 2006-2007 (Walsh, 2009) and 2009-2011 (Said, 2011), especially in Kiuyu Mbuyuni were probably influenced by low purchasing power in the households as imported food was readily available in the food stores unlike during 1972 famine. This calls for a critical analysis of possible coping strategies and long-term adaptation options that these communities are using.

The findings from this study also suggest that a household's self-sufficiency with regard to the main types of food is challenged by a number of factors both climatic and non-climatic. Some of the explanations cited, such as scarcity of land for farming, poor soils and infrastructure for irrigation, are more powerful than the observed variability of rainfall for the last decade (Figure 2).

However, climate change has the potential to interact

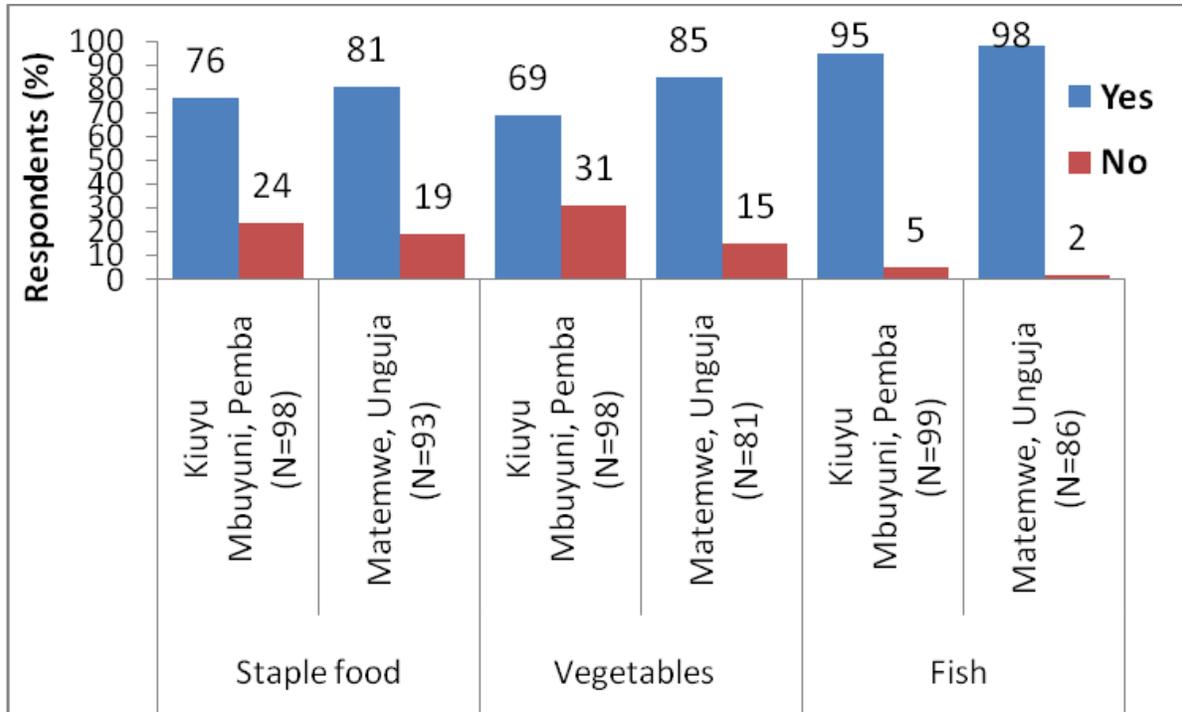


Figure 4. Responses on whether households ever experienced food/ fish/ vegetable instability over last five years.

adversely with these natural and developmental challenges, increasing vulnerability to food insecurity. Even in countries with massive land resources, these challenges threaten rural livelihoods and food security all over the developing world (Droogers, 2004; McDowell and Hess, 2012; Aggarwal et al., 2010; Ellis and Mdoe, 2003). Thus, reducing the severity of localised food shortages in small islands like Zanzibar requires a strict land use plan and increased access to irrigation facilities, better soil management through provision of farming inputs and enhanced access to assets related to fisheries.

### Stability of food in the households

In order to understand the nature of food stability in the study areas, all respondents, including those producing fish for themselves, those buying, and those who combine buying and self-producing, were asked whether they had ever experienced an inconsistent supply of food/ fish/ vegetables in their household over the last five years. The results in Figure 4 show that the majority of the respondents across the study sites had experienced such inconsistencies and instability in the supply of fish, staple food and vegetables, which negatively influence their food security.

An inquiry to identify years or seasons when households were severely affected by supply inconsistency over the last five years showed similar responses to

those on staple food and vegetables (Table 4). Most of the respondents mentioned the 2009-2010 period in which they faced both food and vegetable instability. During this particular period, both islands particularly along the eastern coast, experienced low rainfall (Figure 2), this resulted in localised food shortages in the study sites. Other periods identified in which households experienced difficulties in obtaining food and vegetables included the period in between 2007-2008 which experienced extended dry seasons, particularly along the east coast, that affected both staple crops and vegetables. Similar difficulties were reported to be experienced during the dry seasons of each year (Figure 3), during the south-easterly winds season locally known as *kusi*.

Since the majority of the households depend on fishing for their income to buy food, a considerable number of the households face food and vegetables instability during the fishing off-season (season of south-easterly winds). Therefore, the reported difficulties in obtaining food during this period can be translated as a lack of savings obtained during the fishing seasons. This again highlights the danger of over-dependence on purchased food stuff, as commented by one of the respondents in Kiuyu Mbuyuni: "Although we now obtain more money for selling just a small amount of fish catch, whatever we earn ends up in buying food, so we are facing difficulties of obtaining money for food during the off-season".

The majority of the households across the study sites believe that the insufficient availability of fish is most

**Table 4.** Years or seasons of difficulty in obtaining enough food.

Variable	Year/season	Kiuyu Mbuyuni	Matemwe	Total
	<b>Staple food</b>	<b>n=72</b>	<b>n=67</b>	<b>N=139</b>
Year or season shortage of food experienced	Dry season of each year	4	10	7.0
	South-easterly wind season each year	10	13	11.5
	2009-2010	83	75	79.0
	2007-2008	3	2	2.5
	<b>Vegetables</b>	<b>n=66</b>	<b>n=67</b>	<b>N=133</b>
Year or season shortage of vegetables experienced	Dry season of each year	17	36	26.5
	South-easterly wind season each year	-	2	2.0
	2009-2010	80	60	70.0
	2007-2008	3	3	3.0
	<b>Fisheries products</b>	<b>n= 93</b>	<b>n=86</b>	<b>N=179</b>
Season shortage of fish products experienced	South-easterly wind season of each year	97	94	95.5
	Rainy season of each year	3	4	3.5
	North-easterly wind season of each year	-	2	2

pronounced during the south-easterly wind season which normally lasts approximately four months in June, July, August and September. This windy season, is a period in which the winds blows from south-easterly direction to the north away from the Zanzibar coast and believed to drives fish away from the coast. More importantly, the wind hampers small vessels, the most common fishing vessels, from making fishing trips, mainly because these vessels cannot sail against the south-easterly wind on their way back from fishing trips. Thus many fishers remain at home during this season to minimise risk. During this period therefore very few boats operate (mostly motorised boats), and thus as a result of diminished supply, the demand increases and the price of fish products becomes too high for most people to afford. Even those households who were solely buying fish from the market face instability of fish consumption as they cannot compete with the prices paid in urban and tourism markets during this time of the year. Incidentally, this south-easterly wind season is also a period when the monthly rainfall is at the lowest (Figure 3), thus not being able to support significant crop production, especially of seasonal crops like vegetables. Consequently, the above two conditions together aggravate the food insecurity situation of the study sites during the respective months of June, July, August and September.

Even during normal fishing seasons (calm periods in April-May and October-November and some days of the north-easterly wind seasons in December-March), most of the fishers only operate during spring tides (approximately 17 or 20 days in each month); A similar example is given by Hill (2005) from his study in Vamizi island. Local experience indicated that a spring tide occur when the moon is either new or full and the difference

between high and low tide is the greatest. During the spring tides in the dry season the water is usually saline during with influx of brackish water. During this season the coastal areas are highly prone to cyclone-induced storm surges that may bring about the catastrophic damage (Chowdhury, 2010). In Zanzibar, the knowledge about the tidal cycles is crucial for fish vendors coming to buy fish. Tide may also affect inter tidal activities carried out during low water at spring tides such as collection of octopus, seashells, and sea cucumber (Zanzibar Revolutionary Government, 2009). Given the perceived decline in fish catch per fisher and the high demand for cash amongst fishers to buy food, many households experience food instability on monthly basis as far as the availability and accessibility of fish is concerned. This is demonstrated in the following remarks by one of the respondents in Matemwe: "the amount of fish supplied at home depends on the amount of fish caught; if we land more fish we will consume more fish, but if we land less we will consume less".

The foregoing analysis demonstrates that seasonality, coupled with variability of rainfall, lack of savings and of course, lack of off-farming and off-fishing activities affects the constant availability and accessibility of food. For example, although food instability and widespread malnutrition are common along the east coast, even in good years (Walsh, 2009) seasonal variation in rainfall intensifies the severity of food insecurity and nutritional status of the coastal communities (Makame, 2013). In Dinajpur, Bangladesh, food instability is far higher during the monsoon season than other seasons in the year (Hillbruner and Egan, 2008). Similarly, poor rural families in India are forced to cope with food insecurity mainly attributed to seasonal agricultural production caused by

**Table 5.** Percentage responses on the consumption of other sources of protein.

Variable	Seafood		Meat		Chickens	
	Kiuyu (n=100)	Matemwe (n=88)	Kiuyu (n=98)	Matemwe (n=88)	Kiuyu (n=99)	Matemwe (n=94)
Often	5	4	-	1	1	1
Sometime	42	38	14	32	86	65
Rarely	53	58	86	67	13	34

erratic rainfall (Agarwal, 1990). In assessing the risk of climate variability and change in two Mozambican communities, Hahn et al. (2009) also found that apart from other stress factors, climate variability and change, disasters such as floods and droughts have caused food instability for between three and eight months per year.

### Availability and accessibility of other food types

In a situation where the consumption of fish in coastal villages is perceived to be declining because of seasonality, lack of technology, increasing demand and low access to storage facilities such as electricity and refrigeration, make the communities more vulnerable as they are not able to preserve the food stuffs for long. Respondents in this study were asked on how often their households consumed other foods, such as seafood, meat and chicken. Here, seafood comprised of crustaceans (crabs, prawns, shrimps, and lobsters), molluscs (various types of shellfish), cuttlefish and octopus. Meat comprised both beef and meat from goats and other small animals. Strikingly, the results in Table 5 show that more than half of the households in both the study sites rarely consumed seafood, while 42 and 38% of the households in Kiuyu Mbuyuni and Matemwe, respectively only consumed seafood sometimes. Seafood consumption, which was once regarded as an important source of additional protein in coastal villages has diminished considerably and become rare for the majority, because of its value to both tourists and urban dwellers. Consequently once caught these crustaceans and molluscs are sold to earn cash incomes. While the sales contribute to household ability to buy food staples, these seafood become inaccessible in regular diets of the household.

Although Pemba site has no tourism hotels, seafood is traded as far as Zanzibar town and Mombasa, Kenya. For instance, it was observed that in Pemba, octopuses are informally traded in Mombasa, Kenya. Despite the local belief that eating octopus increases male potency, fishers themselves cannot afford to eat them; they prefer to sell them in order to provide for household needs, including food and iron roofing materials for their homes. Local testimonies highlighted that “Currently one octopus can fetch up to USD 10, thus no one would dare to consume an octopus; after all, octopus is not a staple

food. Everyone would rather sell it in order to obtain money to meet other demands. Truly speaking, octopus has become a food for tourists and not for the poor”. As similar testimony was given regarding other types of fish. It was narrated in Matemwe for instance, that “fish are available in Matemwe but people who are eating good fish are not natives. Most of them are tourists. People of this village cannot afford to buy fish. Villagers eat vegetable mostly. The only type of fish we afford to buy is dry anchovy (dagaa kavu). Octopus and squids are very expensive and none of the villagers can afford to buy them”.

Table 5 shows also that most households in the study sites rarely consumed meat. Interestingly, the consumption of chicken has also inclined towards the rare category. As such meat or chicken have become part of the diet only during celebrations such as Eid celebrations (two Eid celebrations per year in the Islamic calendar) and during a wedding ceremonies. Although livestock and poultry keeping are common, especially in Kiuyu Mbuyuni, both cattle and chicken are used as a source of manure to improve the soil and as assets to sell when needed.

In this instance, it can be argued that Zanzibar coastal communities experience low accessibility, not only of primary sources of food (staple food, fish and vegetables) but also of other types of foods such as seafood, meat and chickens and are thus vulnerable to food insecurity. However, the observed low consumption of meat and chicken may be associated with household choices in order to increase assets (Erickson, 2008; Maxwell, 1996). For instance, a household may opt not to sell their cattle in order to solve an immediate but small problem (for example, a food shortage in the household) so that they can increase stock for future adaptations. With regard to other seafood, the observed low consumption is clearly linked to increasing demand both within and outside the country, especially in the tourism industry (Garcia and Rosenberg, 2010), and these food stuffs are no longer an important part of the diet for the majority of coastal communities. Globally, these commodities represent the most valuable fisheries exports (Bondad-Reantaso et al., 2012). In examining the role of crustaceans and aquaculture in global food security, Bondad-Reantaso et al. (2012) postulated that the high income obtained from selling crustaceans would enable producers to buy lower

**Table 6.** Percentage responses on coping strategies for food insecurity at the household level.

<b>Coping Strategy</b>	<b>Kiuyu Mbuyuni (n=67)</b>	<b>Matemwe (n=60)</b>	<b>Total (N=127)</b>
<b>Coping with staple food insecurity</b>			
Food loan	51	52	51.5
Food aid	3	-	3.0
Eating wild food	5	-	5.0
Sleeping without eating	20	8	14.0
Reducing volume per meal	19	38	28.5
Reducing number of meals	3	2	2.5
<b>Coping with vegetables insecurity</b>			
	<b>Kiuyu Mbuyuni (n=73)</b>	<b>Matemwe (n=71)</b>	<b>Total (N=144)</b>
Consuming fish	27	25	26.0
Buying from market or other village	22	17	19.5
Eating staple food without vegetables	48	42	45.0
Eating food with beans bought from shops	3	6	4.5
Eating dried wild spinach obtained during rain seasons	0	10	5.0
<b>Coping with fisheries product insecurity</b>			
	<b>Kiuyu Mbuyuni (n=82)</b>	<b>Matemwe (n=84)</b>	<b>Total (N=166)</b>
Eating fish stored in fridge	1	2	1.5
Eating beans, pigeon peas and vegetables	37	31	34.0
Buying from outside	1	-	1.0
Eating fresh sardine and mackerels	-	10	10.0
Eating dried small anchovies	30	38	34.0
Eating staple food only	32	19	25.5

value products and thus contribute to food security. However, changes in food patterns as observed in the study areas may have a negative impact on the nutritional status and health of coastal communities (Receveur et al., 1997; Kuhnlein et al., 2004). For example, Kuhnlein et al. (2004) found a significant correlation between obesity and changes in dietary patterns all over the world. One may argue that sacrificing consumption of various seafood, including octopus, to generate income, without replacing it with foods of equal nutritional value, may have negative consequences for the dietary patterns of the coastal communities.

#### **Coping strategies for food instability at the household level**

Periodic food shortages and famine are not new phenomena in the study areas. For example, in the 1971-1972 famine, local people used various strategies to cope (Walsh, 2009). The most frequently cited strategies for coping with staple food instability were loans from shops or neighbours, reducing the volume of the meal, sleeping without eating and reducing the number of meals (Table 6). Other coping strategies, only cited in Pemba, were eating wild food and accruing food aid. With regards to

vegetables, which in most cases are considered as optional, respondents also cited a wide range of coping strategies. These included consuming staple foods without vegetables, eating more beans bought from the market and consuming dried wild spinach. Eating dried wild spinach locally known as *mchungu* is more common in Unguja than in Pemba.

The findings mirror those in urban Uganda (Maxwell, 1996), in urban Accra, Ghana (Maxwell et al., 1999) and in an informal settlement in the Vaal Triangle, South Africa (Oldewage-Theron et al., 2006). In urban Uganda, for instance, people are reported to eat foods that were previously less preferred, limited portion size, borrowed food or money and skipped meals (Maxwell, 1996). Similar experiences are reported in some parts of North-western Tanzania where many people decline to eat other foods (such as maize and rice), except in periods of absolute food (banana) shortage (Mwisongo and Borg, 2002).

Unlike the 1971-1972 famine, during recent localised food shortages, the consumption of cultivated plants and wild food such as poisonous wild yam (*Dioscore sansibarensis Pax*), locally known as *chochoni* as a response to famine (Walsh, 2009) was marginal, probably due to the availability of imported foods in the shops, and because it was not difficult to obtain a food loan from

local shops because of the high social bonding capital. Although food insecurity is widespread along the eastern parts of Pemba and Unguja (Boetekees and Immink, 2008), strong social capital, and willingness to help each other and strong neighbourhoods, coupled with the availability of imported food in the shops, has probably helped reduce the severity of food insecurity, especially during droughts (Makame, 2013).

With regard to fisheries products, respondents also identified a range of strategies that helped them cope with insufficient fish products in their meals. The most cited coping mechanism was consuming dry anchovy and vegetables. About 10% of households in Matemwe replaced high-value fish species with low-value (based on the local perception of the consumers), cheaper species such as sardines and Indian mackerel. The prices for these species are generally affordable and thus they are a common food for the poor and needy all over the developing world (Albert and Marc-Metian, 2009). Interestingly, some households in both study sites were doing nothing to cope with insufficient fisheries products; they simply ate plain meals without either vegetables or dried anchovies. Given the observed low intake of other sources of protein, these households could become more sensitive to dietary problems. The "do nothing" segment of the population demonstrates the variance in vulnerability across social groupings.

For many, eating dried anchovies (*dagaa kavu*), particularly amongst the fishermen, is less preferred by the affluent population. However, the increasing price of fresh fish due to high demand in both urban and tourism markets, and the need for hard cash on the part of the fishers have forced households to rely heavily on dried anchovies as a replacement for fresh fish, even during fishing seasons. Kent (1998) concluded for example that "when fish decline and the price go up, poor people are forced to shift into inferior food, putting them at risk of missing important micronutrients". A dry anchovy probably contains as many important micronutrients for human health as fresh fish but competition between non-food uses and direct human consumption and global climate change (Albert and Marc-Metian, 2009) is threatening this small pelagic fish all over the globe. Indeed, increasing demand for dried anchovies in urban areas and in mainland Tanzania and neighbouring countries will, sooner rather than later, put dry anchovies out of the reach for the majority of the poor in Zanzibar. This will further intensify vulnerability to food insecurity for the majority because vegetables, peas and beans, both cultivated and wild, are sensitive to periodic drought.

## Conclusions

Food security requires that all members in the household, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary

needs and food preferences for an active and healthy life. The overall picture emerging across the study sites is that local people are insecure with respect to major sources of food. Agricultural failure resulting from various factors, including local climate variability, coupled with uncertainty of fishing has pushed households towards buying most of their staple foods. This trend has affected food security tremendously due to low purchasing power, attributed to poverty. Increased demand in urban areas and the expansion of tourism industries within the study area and in neighbouring countries have increased the price for the limited fisheries resources, causing the poor, including the fishers, to consume less fish and seafood, thereby limiting their dietary protein intakes. Furthermore, the relationship between climate and coastal activities for both food and income is likely to affect all four components of food security, making the coastal communities even more vulnerable.

Food availability, accessibility and stability are threatened not only by climate variability but also by a number of development challenges, such as limited land and a small economy, and lack of irrigation facilities. Thus while addressing the community vulnerabilities associated with climate change and variability it is paramount to also manage other non-climatic factors that compound vulnerability to climate change-related food insecurity.

## Conflict of Interest

The authors have not declared any conflict of interest.

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