

Livelihood Assets and Activities in Two East Coast Communities of Zanzibar and Implications for Vulnerability to Climate Change and Non-Climate Risks

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Abstract

Climate variability related events such as drought and associated food shortages are not new along the coast of Zanzibar, but are projected to increase with the impacts of global climate change. This paper examines the 'internal' characteristics that make Zanzibar's coastal communities vulnerable to these and other changes, focusing on the factors that affect adaptive capacity (i.e. household and community assets) and sensitivity (i.e. livelihood activities and diversification). The sustainable livelihood approach and framework, especially the five capitals or assets, provided a lens to examine households' capital stocks and the factors influencing access to these, as well as the outcomes for livelihood activities. Access to different capitals and assets were found to affect the range and choices of livelihood activities available to households as well as their ability to cope and adapt to existing and new risk. Our analysis shows how households on the drier and harsher east coast of the Zanzibar islands are particularly sensitive to climate variability and change in concert with other livelihoods challenges. This is primarily due to their high dependence on natural-resource based livelihood activities, which are already facing pressures. Moreover, low levels of most livelihood capitals limit the choices households have and undermine their adaptive capacity and ability to bounce back from climate and other shocks and stressors.

Keywords: climate change, livelihood assets, coastal communities, multiple stressors, adaptive capacity, Zanzibar

1. Introduction

Small island states constitute some of the most sensitive, uncertain and fragile environments on our planet, and consequently are especially vulnerable to risks associated with climate change (Mimura et al., 2007). Declining rainfall, increasing temperatures, extreme weather events including storms and cyclones, sea level rise, changes in marine conditions and biodiversity, coastal floods and salt water intrusion are just some examples of the biophysical risks threatening the economy and livelihoods of people on these small island states (Badjeck et al., 2010; Mimura et al., 2007). Such risks are superimposed on a suite of other characteristics typical of small island states such as limited space and natural resources, high population densities, relative isolation and distance from markets, extreme openness of small economies to shocks, insufficient technical institutional and financial capacities, and highly natural-resources dependent livelihoods contribute to intensifying their vulnerability (UNFCCC, 2005). Also, developing regions, of which Zanzibar forms part, face an adaptation deficit and a multitude of other stressors that interact with and/or exacerbate the impacts of climate change (Niang et al., 2014). Structural issues such as high levels of poverty, low levels of development, high unemployment and limited livelihood options, and a lack of basic services are some of the factors that undermine the ability of people in Small Island developing states to adapt to climate change. Examples of current stressors on livelihoods include a decline in natural resources such as fisheries, agricultural challenges including competition with other land uses, health concerns such as HIV/AIDS, and water and food insecurity (Boko et al., 2007; Ghina, 2003).

Zanzibar is typical of other small island states in the developing world whose economy is based on activities that are sensitive to changes in climate such as agriculture, seaweed farming, fisheries, and tourism (Allison et al., 2009; Allison et al., 2005; Boko et al., 2007; Mimura et al., 2007; Gössling and Hall, 2006; Spinage, 2012). For

instance, in the past two decades, Zanzibar has experienced a high frequency of dry spells and localised food shortages (Said, 2011; Walsh, 2009), stronger winds and more heat waves than previously recorded (Watkiss et al., 2012) and coral reef bleaching attributed to the El Niño event of 1997/1998 (Payet and Obura, 2004). Other events have included coastal floods in urban Unguja in 2007 (Mustelin et al., 2010) and coastal floods in arable lands in Pemba in 2010-2011 (Sultan, 2011). Additionally, rainfall has shown declining trends particularly along the east coast of both islands, Unguja and Pemba (Salum, 2009; Kombo, 2011; Watkiss et al., 2012). Consequently these examples climate-related events are threatening the livelihoods of coastal communities in Zanzibar (Makame, 2013).

The changes in climate and sea level have various impacts on different sectors of the economy. For instance, rain-fed agriculture and livestock production, which, along with fishing, form the basis of food security in Zanzibar, have been affected by an increasing frequency of dry spells and by coastal floods on arable land (Sultan, 2011). The east coasts of both islands, where the study sites are located, traditionally receive unreliable rainfall compared to the central corridors and west coasts (Walsh, 2009) and are thus more vulnerable. Coupled with poor soil quality and low access to assets the dry spells have caused increased frequency of localised food shortages along the east coasts (Said, 2011; Walsh, 2009).

Despite the evident climate change risk and existing impacts, few in-depth, place-based studies have been conducted in Zanzibar that unpack the livelihood and vulnerability characteristics of rural, natural-resources dependent households and their coping and adaptation strategies now and in future (Makame, 2013). Only few studies have considered societal vulnerability in terms of the social characteristics and institutions that make individuals, households or societies sensitive to the impacts of climate change and other stressors (Adger and Kelly, 1999; Blaikie et al., 1994). It is within this context that we explore the vulnerability and adaptive capacity of rural communities living on the dry east coasts of the two main Zanzibar islands, namely Pemba and Unguja Islands. This paper is part of a larger study (Makame, 2013) that sought to address this knowledge gap. Our assumption is that “internal” household livelihood characteristics partly define the vulnerability and adaptive capacity of coastal communities in Zanzibar. Specifically, we examine the current status of and access to various livelihood capitals/assets and the type and portfolio of livelihood activities households engage in, as indicators of households’ adaptive capacity and sensitivity to climate change. Understanding these two aspects of livelihoods and the dynamic interactions between them contributes towards building a holistic approach to addressing vulnerability.

2. Methodology

2.1 Study Sites

The study was carried out in two shehia/wards in Zanzibar, namely Kiuyu Mbuyuni on Pemba Island and Matemwe on Unguja Island (Figure 1). Both are located in the north-eastern corners of the two islands that constitute Zanzibar and are considered particularly vulnerable to climate change. Socio-economic differences between the sites provided an opportunity to understand how they shape household assets and livelihood activities.

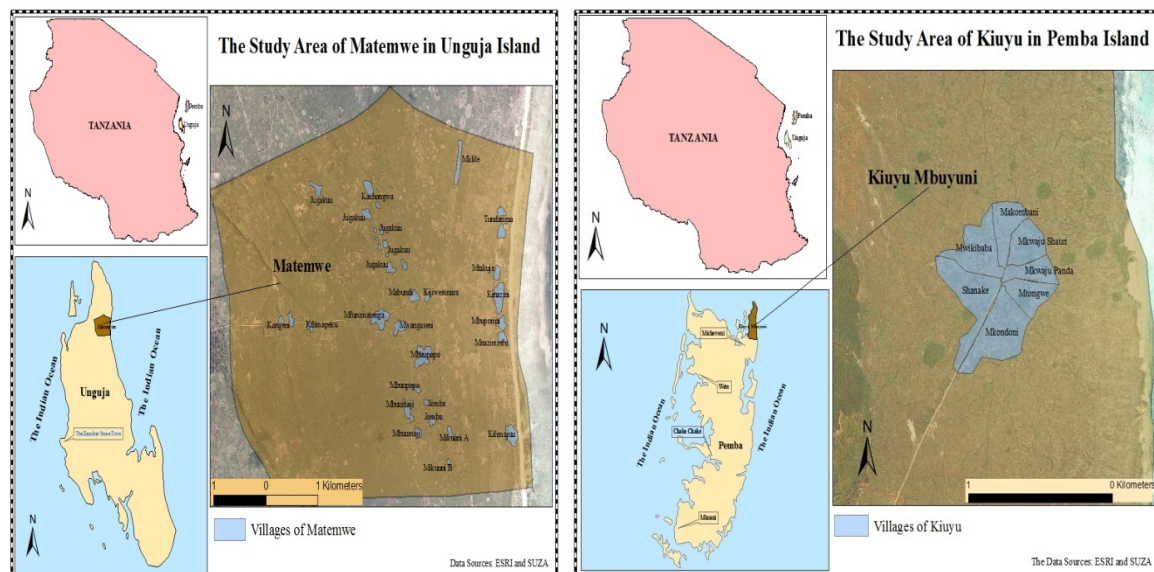


Figure 1. Location of study sites

In terms of biophysical conditions, both sites are situated on nutrient poor soils with poor agricultural potential derived from corals, and known as coral rags soils (Owen, 1993). Regarding climate, Zanzibar is tropical and humid, although the east-coasts where the study areas are located tend to be the driest and most prone to droughts (Walsh, 2009; Makame, 2013). Zanzibar experiences four main seasons in a year, namely: summer, locally known as *kiangazi* (January-March); the long rainy season or *masika* (March-May); winter, locally known as *mchoo* in Pemba and *pupwe* in Unguja (June-August/September), and the short rainy season or *vuli* (October-December) (Owen, 1993). Rainfall occurs in all four seasons, but is mostly received in the long rainy and short rainy seasons respectively, and then winter and summer. In both sites perceived changes in this seasonality have been recorded (Makame, 2013), with both the long rainy and short rainy seasons having being highly variable in both Pemba and Unguja. Changes in both seasons affect crop production, and agriculture in both sites is risky due to frequent droughts and dry spells, resulting in high dependence on fisheries. The main crops grown are maize, millet, sorghum and vegetables (Walsh, 2009).

While fishing and agriculture are the traditional livelihood activities in Zanzibar, people's livelihood portfolios have diversified over the last two decades. Livelihood activities such as seaweed farming and activities related to tourism (for example, handcraft production) have started to play an important role in the rural economy (Msuya, 2011). However, communities in both sites are extremely poor and primarily natural resource dependent.

2.2 Data Collection and Analysis

Data collection was mainly done using a household interview where a structured questionnaire was administered to one hundred households in each site that were randomly selected using lists obtained from local leaders. Key informant interviews were also conducted with two local leaders from each area, four NGOs representatives and two beneficiaries of the "Presidential Fund"¹. The household survey was designed to obtain information on the nature and role of livelihood activities and to gain insights regarding household asset/capital stocks of four major capital assets, namely human, physical, financial and social capital. The study involved respondents engaged in farming, fishing and seaweed farming. Differences between the two study sites were tested statistically using chi-square and t-tests for the selected continuous variables. Secondary information related to perceived changes in access to natural resources and other livelihood assets was also used (Makame, 2013).

2.2.1 Livelihood Capitals

Social capital was measured by assessing voluntary participation in a wide range of cooperative and savings groups as well as agreement with a set of indicators of social cohesion within the community. Firstly, with regard to voluntary participation in groups, respondents were asked if anyone in the household was a member of such

¹ The objectives of the President's Fund are to promote small businesses and entrepreneurship through sustainable empowerment of local entrepreneurs.

groups. The percentage of households that had members who participated in each group was determined. This was complemented by data obtained from local leaders on the number and nature of groups present and number of members by gender. Secondly, regarding social cohesion, variables measured included willingness to support each other, degree of tightness of neighbourhoods, whether borrowing and lending of money happened between neighbours, how well people get along with and trust one another, and to what extent they shared beliefs, norms and culture. Respondents answered using a four-point Likert scale (that is, 1=strongly disagree, 2=disagree, 3=agree and 4=strongly agree). The responses were combined to give a mean score as a measure of social cohesion.

Financial capital was assessed by asking respondents if they had access to credit and grants, savings in banks or savings clubs/groups, savings in non-productive assets, outstanding debts and lastly if they had faced an income shortfall in the previous 12 months. The percentage of respondents who answered 'Yes' or 'No' to each of these questions was determined.

For the *human capital* the measures used included education level of adults, skills, and health. With regard to education, respondents were asked to identify their level of education, after which the proportion of respondents in each education category was determined. The data from the household survey were complemented by secondary data on the current status of literacy to provide a picture for both household and district levels. In terms of skills, respondents were asked to identify the various skills available in their households that could be used to increase household income. The percentage of households with each type of skill was then determined. With regard to health, an inquiry was made on whether members of respondents' households were regularly affected by various illnesses and whether the illness affected household welfare.

Physical capital, apart from being a livelihood asset, also symbolises wealth and the ability to recover from the risks and shocks related to climate change and variability and other linked stressors. Physical capital can be sold to recover from damage or can be used as collateral to access loans and credit from banks and other sources of funds. Proxies for physical capital included land ownership, the quality of the house, ownership of livestock, and ownership of equipment (such as fishing vessels, boat engines, refrigerators, motor cycles, bicycles, radio, television, mobile phones, sewing machines, solar panels, and electricity). The respondents were asked about the nature of house ownership, types of construction materials used for the most of the walls and roofs of their homes and if they keep livestock. The respondents were also asked if their household owned stocks of assets or had access to the above-mentioned assets or services. The percentage of households stating "Yes" to the above assets was then calculated.

2.2.2 Livelihood Activities

The analysis of livelihood activities was undertaken to provide insights into the proportion of households that rely on livelihood activities that are sensitive to climate variability and change. Under the livelihood section of the interview schedule, respondents were asked to identify the livelihood activities practised by members of households to obtain food and cash income. The percentage of households engaged in each activity was then calculated.

3. Results and Discussion

This section presents and discusses the results from the study in terms of the access to the five livelihood assets. We argue that the way households respond to the risks and impacts of climate change mentioned earlier depends largely on their adaptive capacity. The adaptive capacity, in turn, depends on the amount and diversity of different capitals/assets (Table 1) and on the social networks, institutions and entitlements that influence how this capital is distributed and used (Blaikie et al., 1994). The assets households have and their ability to access these assets thus play a central role in explaining the vulnerability of rural communities to climate change (McDowell et al., 2010; McDowell and Hess, 2012).

Table 1. Capitals and assets available to and used by coastal communities

Description of Capital assets	Description
Natural capital	The natural resource stocks (soil, water, fisheries, forest) and ecosystems services from which livelihood strategies derive. Natural capital is crucial for current and future adaptation options, especially for small island states.
Financial capital	The capital base (cash, credit/debt, saving and other economic assets) which is essential for diversification, intensification and extensification of rural livelihood activities.
Human capital	The skills, knowledge, health, physical capabilities important to pursue different livelihood strategies successfully.
Social capital	Informal norms that promote cooperation between two or more people (social relations), networks, associations and affiliations. Social relations provide safety nets that can be immediately drawn on from friends, neighbours and family members during times of crisis. Social capital can also be framed within decision-making processes, participation in local institutions and organisation
Physical capital	Basic infrastructure (houses) which act as a guarantor in order to access financial capital. Production equipment and technologies (fishing vessels, boat engines, refrigeration, tractors, motorbikes, cell phones), which help to modernise livelihood activities for a better outcome; livestock and poultry.

Sources: Scoones (1998), Fukuyama (2000), Woolcock and Narayan (2000)

Given this centrality of assets, the well-known sustainable livelihood approach (SLA) which emphasises the dynamics of the stocks and flows of the five livelihood capitals and how these link to livelihood activities and outcomes (DFID, 1999) provides a useful analytical framework, and forms the basis of the so-called asset-based approach to vulnerability and adaptation adopted here (Frayne et al., 2012). The SLA underscores how the various capitals are linked such that access to one may facilitate access to another. For example, access to schooling (human capital) may not only facilitate access to financial capital, but it can also help to raise trust (social capital) levels within communities (Lanzi, 2007; Dinda, 2008). Further, schooling enhances the ability of people to discuss, debate, negotiate and add their voices in planning issues that directly affect the well-being of the household and community (Sen, 1997). This dynamic perspective on capitals and assets and their links to the range and type of livelihood activities employed by households was important in this study. In the next sections, the study results are provided and discussed by providing comparative information on assets and livelihood activities, and hence the adaptive capacity and sensitivity of households to climate variability and change in the two east coast sites.

3.1 Access to Social Capital through Participation in Cooperatives and Savings Groups/Clubs

Thirty eight percent of households interviewed in Matemwe found to have participated in community groups, whereas in Kiuyu Mbuyuni only 18% did so, with this difference being significant ($\chi^2 = 9.9$; $df = 1$, $p = 0.002$). The observed low participation in Kiuyu Mbuyuni corroborates with the data obtained from local leaders which showed that this site had only five community groups, while Matemwe had 22 groups. This indicates the communities in Matemwe are more exposed to cooperative groups, which may facilitate their easy access to social capital. About 438 individuals from Matemwe participated in these groups, of which 61% were female and 39% were male. The 438 individuals make up only 7% of the total population in Matemwe (based on the local leader registry, the total population of Matemwe was 6,381). In Kiuyu Mbuyuni the five groups available accommodated only 107 individuals of which 68% were female and 32% male. The total population for Kiuyu Mbuyuni was 6,416 (URT, 2013).

Like elsewhere, the community groups were largely dominated by women participants. Women's participation is widely associated with positive developments and better survival rate of cooperatives (Molinas, 1998; Mayoux, 2001; Westernmann et al., 2005). A study by Molinas (1998) reported a positive relationship between women's participation and increasing cooperation and social capital in Paraguay. However, the participation of women,

particularly in savings groups, may exert pressure on them as they may be forced by husbands to contribute cash to households' needs, in addition to their customary duties of producing and processing food (Mayoux, 2001). It is reported from elsewhere that participation in groups provides a link to various other capitals (Adger, 2003; Islam et al., 2011) and a means of increasing well-being and reducing vulnerability (Narayan and Pritchett, 1999; Fukuyama, 2000; Putnam, 2000; Cook, 2002; Cleaver, 2005).

Various factors were reported to have prevented the participation of greater numbers of individuals and households in the groups. An interview with local leaders revealed that some individuals had not joined the groups because of poor economic conditions and lack of time, a perception of few tangible and intangible benefits from these groups, disagreement and lack of trust regarding financial management, and low skills and education. For instance, to be a member in a savings group, one needs to buy a minimum of five shares at Tsh.10,000 (USD 9) per share, giving a total of Tsh.50,000 (USD 35). After that, the member can deposit whatever amount of money she/he wishes and after a while can borrow more than the amount of money deposited. Thus, the demand for initial capital and continuous contributions has probably precluded poorer households from participating in such groups. Cleaver (2005) reports from Usangu in mainland Tanzania that membership of groups depends on regular contributions, but not all people can contribute regularly because their income from livestock and crop farming is seasonal and sensitive to variations of climate.

Despite the stated challenges, several studies in developing countries have revealed a positive relationship between social capital and household well-being. For instance, Narayan and Pritchett (1999) found a significant relationship between membership in groups and an increase in household income in rural Tanzania. Since securing loans from formal sources is out of reach for most people (Mohamed, 2003), the membership in these groups can be a plausible way of overcoming financial constraints for Zanzibar's coastal communities.

3.2 Social Cohesion as a Means for Accessing Important Social Capital

Social cohesion is one of the most important social capitals as it draws informally on neighbours and relatives and offers immediate support during times of crisis. The mean score for the six measures of social cohesion was high, falling between 3 (agree) and 4 (strongly agree). However, the t-test showed a significant difference between the two sites regarding households' willingness to help each other, degree of tightness of their neighbourhood, how well they get along with each other, and on sharing beliefs, norms and culture (Table 2). For the entire set of variables, Matemwe obtained a slightly higher mean score than Kiuyu Mbuyuni. Kiuyu Mbuyuni was expected to score higher since it is a highly isolated area with low immigration compared with Matemwe, where tourism has caused high in-migration both from within Zanzibar and outside. However, previous political tensions and a history of life hardship in Kiuyu Mbuyuni could have possibly caused rifts between people. Overall, however, the findings demonstrate the connectedness within coastal communities, which is probably attributable to shared beliefs, culture and traditions, which can help people cope with shocks. For example, a study by Walsh (2009) in Pemba Island indicated that neighbours helped each other during times of drought and famine. Moreover, social cohesion is not only a resource to call upon during a crisis, but may be used to improve well-being, democracy and health (Grootaert, 1999; Putnam, 2000; Rose, 2000; Helliwell and Putnam, 2004).

Table 2. Mean scores and independent sample t-tests of social cohesion measures between sites

Variables	Shehia/ward	Mean±SE	SD	t-test
People around here are willing to help their neighbours	Kiuyu Mbuyuni	3.01±.064	0.643	(t=-4.366, df=197.72, p=<.001)*
	Matemwe	3.40±.062	0.620	
This is a close-knit or tight neighbourhood; people know one another	Kiuyu Mbuyuni	3.03±.046	0.460	(t=-5.705, df=188.9, p=<.001)*
	Matemwe	3.45±.058	0.575	
If I had to borrow TShs. 10,000 in an emergency, I could borrow it from a neighbour	Kiuyu Mbuyuni	3.03±.079	0.788	(t=1.441, df=197, p= >.05)
	Matemwe	2.86±.088	0.876	
People in this neighbourhood generally get along with each other	Kiuyu Mbuyuni	3.05±.044	0.435	(t= -5.522, df=187.2, p=<.001)*
	Matemwe	3.44±.056	0.556	
People in this neighbourhood can be trusted	Kiuyu Mbuyuni	3.37±.054	0.544	(t=-2.4, df=198, p=>.05)
	Matemwe	3.55±.052	0.520	
People in this neighbourhood share the same beliefs, culture and values	Kiuyu Mbuyuni	3.48±.052	0.522	(t=-5.801, df=176, p=<.001)*
	Matemwe	3.85±.036	0.360	

Note: The responses were 1 (strongly disagree), 2 (disagree), 3 (agree) and 4 (strongly agree)

*Significant difference between the study sites

Various forms of social capital can therefore be argued as important for adaptive capacity, and as demonstrated in the results may be particularly important for women who are often perceived as more vulnerable. However, the value and impact of social cohesion in coping and adaptation depends on the strength and weakness of links with other capitals (Sobel, 2002). For example, despite the relatively high social cohesion observed across the sites, there were still a considerable number of households that faced food shortages during previous erratic rainfall periods, for instance, in 2009-2011 (Said, 2011). It is clear then, that tight neighbourhoods alone cannot adequately reduce the severity of food insecurity and other shocks, especially when the whole community experiences agricultural failure. Thus, other forms of social capital are needed as complementary measures especially in the event of covariate risks such as climate extremes.

3.3 Access to Financial Capital

The majority of households across the sites had no access to any type of grants and/or pensions² (Table 3). Households in Matemwe received significantly more pension grants than those in Kiuyu Mbuyuni. The low number of households that received pensions is associated with the fact that many people in these villages were unemployed due to high illiteracy (see section 3.4.1). With regard to savings in formal banks or savings groups, it was found that 94% of respondents in Kiuyu Mbuyuni and 91% in Matemwe had no savings at all. This again may be linked to the low returns from their livelihood activities due to the small-scale nature of these activities. Low savings may also be influenced by a relatively low participation in cooperative and savings groups as discussed earlier. Furthermore, most households in both study sites had no savings of non-productive assets such as gold jewellery.

² Unlike a few others countries in the region there are no public welfare grants in Tanzania.

Table 3. Responses of households (%) regarding access to different types of financial capital

Variables	Kiuyu Mbuyuni (N=100)	Matemwe (N=98)	Chi-square
Households without any type of grants	95	82	$\chi^2=8.457$, $df=1$, $p=.004^*$
	Kiuyu Mbuyuni (N=100)	Matemwe (N=95)	
Households without savings in a bank or saving groups	94	91	$\chi^2=.828$, $df=1$, $p=.363$
	Kiuyu Mbuyuni (N=100)	Matemwe (N=95)	
Households without savings of non-productive assets such as gold	93	89	$\chi^2=1.069$, $df=1$, $p=.301$
	Kiuyu Mbuyuni (N=100)	Matemwe (N=95)	
Households with outstanding debts	59	59	$\chi^2=.000$, $df=1$, $p=.994$
	Kiuyu Mbuyuni (N=100)	Matemwe (N=100)	
Households without access to credit	97	79	$\chi^2=15.341$, $df=1$, $p=.000^*$
	Kiuyu Mbuyuni (N=100)	Matemwe (N=100)	
Households that faced income shortfalls in the last 12 months	49	60	$\chi^2=2.440$, $df=1$, $p=.118$

* Significant difference between sites

In terms of debt, more than half of the households across the sites have an outstanding debt (Table 3). Most of these debts came from food loans or from borrowing money to buy food, especially during critical periods such as drought and off-fishing seasons. The existence of small food stocks and the availability of food in the local stores have made food loans a common coping mechanism during food shortages (Makame et al., 2015). About 49% of households in Kiuyu Mbuyuni and 60% in Matemwe reported having faced income shortfalls in the last 12 months. The cause of these shortfalls included the unreliability of fishing activities; declining seaweed output due to increasing temperature and declining of crop output due to unreliable rainfall (Makame, 2013); reduced family labour due to illness and sometimes loss of productive household members through death; loss of livestock and poultry due to theft; and weddings and other costly social events. This suggests that the little cash obtained through various sources of income is used to solve a large number of problems, making people unable to save money for future risks. Such a situation is likely to perpetuate poverty and intensify vulnerability to climate change.

Regarding access to credit, 97% and 79% of the households in Kiuyu Mbuyuni and Matemwe respectively did not have access to credit to invest in primary or alternative livelihood activities. The difference between the two sites is significant (Table 3). More respondents in Matemwe received credit in various forms compared to Kiuyu Mbuyuni, mainly attributed to the higher participation in cooperatives and savings groups observed in Matemwe. To enable communities in these areas to improve their farming or fishing activities, and diversify their livelihoods, it is highly recommended that efforts need to be made to enhance local access to financial capital.

Considering the different capitals and their linkages, it has been argued that financial capital is perhaps one of the most important types, as greater financial capacity facilitates access to other assets such as land; increased investment in physical capital, for example, fishing gears; and increased savings (Mayoux, 2001; Nkopyen and Eteng, 2012; Kazi and Leonard, 2012). Several authors have shown the benefits of access to credit. Mayoux (2001) narrated many success stories among women in Cameroon who obtained credit from saving groups/clubs and which helped them obtain land for farming. Nkopyen and Eteng (2012) also reported in a case from Nigeria that there was a significant relationship between micro-lending and increased household savings and reduced

poverty. Low access to financial capital and savings as observed across the sites, therefore prohibits households building other capitals and from acquiring important assets for improving their livelihood portfolios and production activities, thus intensifying vulnerability to climate change. For example, households across the study sites reported that low ownership of fishing vessels, boat engines and gears tremendously reduced their fishing income. An interview with one of the few beneficiaries of the Presidential Fund in Matemwe revealed tremendous achievements over time. The beneficiary’s savings increased through new investment in small businesses including a small food store and supplying seafood to the nearby hotels. He also managed to cope with salt-laden on-shore winds by roofing his house with locally-made tiles. In order to build resilience to the expected changes in climate, the foregoing story highlights the need to increase the access of coastal communities to financial capital.

3.4 Human Capital and Implications for Vulnerability to Climate Change

3.4.1 Education and Skills

Levels of education were low amongst adults. Half of household heads had not attended school at all, whereas 23% in Kiuyu Mbuyuni and 20% in Matemwe had attained secondary education (Figure 3). The results concur with the Micheweni District Statistics in Pemba, where Kiuyu Mbuyuni is located. About 60% of Micheweni district population (total population estimated at about 88,000) are reported to be illiterate. Within this, 41% of the rural population have never attended school. Parents’ ambivalent attitudes towards education and high levels of school dropouts is attributable to labour needs especially for fishing have probably contributed to the observed illiteracy. Over time, education facilities have improved across the sites. For instance, Kiuyu Mbuyuni now has two schools and one teacher training college, and Matemwe has three schools. However, the extent to which illiteracy will be reduced will strongly depend on changing attitudes towards education among parents, and improving socio-economic conditions as well the quality of the teaching and learning environment in the schools.

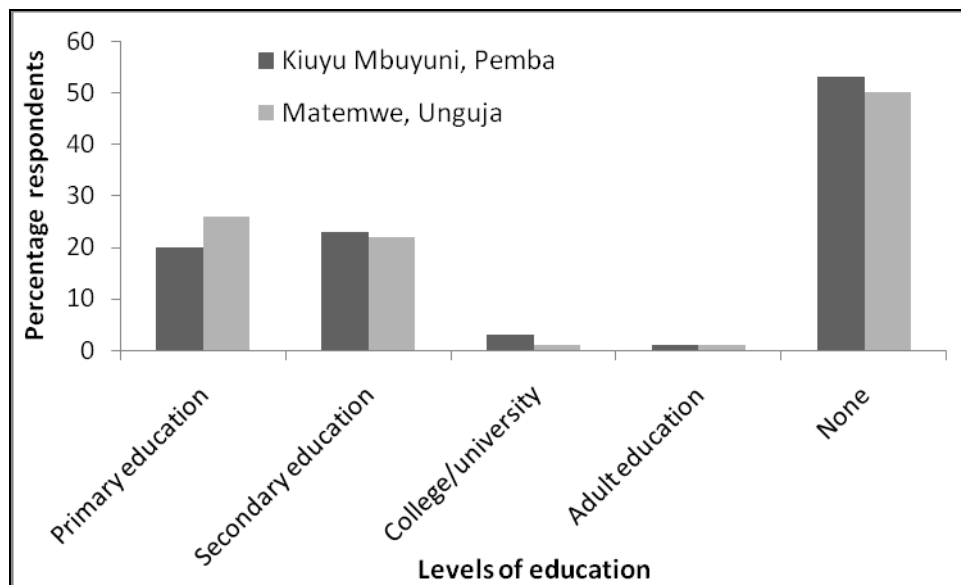


Figure 2. Education levels of respondents (mainly household heads)

The low level of literacy means local people do not have the opportunity of being employed in the formal and emerging sectors such as tourism. This argument is also supported by the results which show that only a few households have access to income from formal employment or tourism related jobs (Figure 2). With more than 15 hotels along the northeast coast of Unguja, one would expect a large number of locals to be employed. An interview with local NGOs revealed that very few people from Matemwe were employed in this sector, and most of those who were, in low earning positions such as watchmen and gardeners. Illiteracy, negative perceptions of the locals regarding tourism, perceptions of the hotel owners about the abilities of local coastal people, and poor legislation were cited as the major obstacles to employing local people in tourism. As a result, most of the workers come from mainland Tanzania. This situation limits the ability of local communities to diversify their livelihood activities, thereby perpetuating their vulnerability to risks associated with climate change.

Human capital is linked to other capitals in several ways. McDowell and Hess (2012) found that illiteracy, which

was driven by poor quality rural schools and culturally inadequate curricula, was itself a limit to successful adaptation. Education not only provides opportunities for employment and competency, it also provides life skills, confidence and innovation and increases trust among people (Lanzi, 2007; Dinda, 2008). In examining social capital in the creation of human capital and economic growth, Dinda (2008) found a significant relationship between education and levels of trust on the one hand, and income both at individual and national levels on the other. Schooling has the potential to create both social and financial capital (Lanzi, 2007; Dinda, 2008).

Regarding skills, the study found various skills other than those related to farming, fishing and seaweed farming. These included tailoring and making craft items such as handbags, mats, traditional headgear, pots and embroidery. In Matemwe, for example, there were women's groups specifically engaged in craft and artwork. By contrast, there were no such women's groups in Kiuyu Mbuyuni. This is probably influenced by the fact that Kiuyu Mbuyuni has no tourism activities to provide a market for locally-made craft goods as the local market is very small (Issa, 2012). Indeed, the observed richness of skills across the sites could, if carefully promoted, increase households' income and reduce vulnerability to climate change as well as to other stressors.

3.5 Physical Capital

3.5.1 Ownership of House and Land

The study found that the majority of the respondents interviewed lived in their own houses. However, most of them did not have title deeds for their house or the land on which it is built. This was mainly due to the lack of financial capital to process the application which requires a survey of the site and legal fees. This precludes the majority of the people using the title of their land and houses as a guarantee to access credit from banks, which often provides an alternative to formal employment as a guarantee. Similar findings were reported by McDowell and Hess (2012) from their study in Bolivian. These authors also found that the absence of title deeds for land prohibited local people from accessing financial capital, especially from formal sources. With the increasing value of land in Matemwe, particularly due to the expanding tourism sector, the provision of title deeds for local home and land owners would be a step towards building strong financial capacity and security for many. It could increase accessibility to financial capital and thus reduce the sensitivity to impacts of climate variability and tourism expansion.

3.5.2 Equipment, Household Goods and Infrastructure

The majority of households interviewed lacked crucial equipment and assets for fishing such as fishing vessels, boat engines, gears and refrigeration (Table 4). This situation results in fishing remaining artisanal, small-scale, and inefficient such that it may not sufficiently support the fishers' livelihoods. The results concur with findings from a fisheries survey in 2010, which indicated that there were only 45 boat engines in the district of Micheweni in which Kiuyu Mbuyuni is located (DFMR, 2012). A similar situation is also facing fishing communities in mainland Tanzania (Kangalawe and Lyimo, 2010). Similarly, a study by Badjeck (2008) in rural Peru found that more than 94% of the fishers do not own vessels and other fishing equipment. Most of the equipment is owned by middlemen or wealthy local people. Thus, the observed low ownership makes fishers easy prey for oppressive social ties with middlemen, who in most cases do influence the price of the fish catch in their favour. The reciprocal agreement between fishers and vessels and gear owners (middlemen) may restrict fishers' attempts to build strong financial capital, and thus makes them more vulnerable to variability in fish catch.

Table 4. Responses of households (5) regarding ownership of a range of physical assets

Variables	Kiuyu Mbuyuni (N=100)	Matemwe (N=100)	Chi-square
Household without fishing vessels	81	76	$\chi^2= .741$, $df=1$, $p=.389$
Household without boat engine	99	99	$\chi^2=.000$, $df=1$, $p=1.000$
Household without gear (traps)	89	79	$\chi^2=3.720$, $df=1$, $p=.054$
Household without refrigeration	99	98	$\chi^2=.338$, $df=1$, $p=.561$
Household without scooter	93	95	$\chi^2=.355$, $df=1$, $p=.552$
Household with bicycle	64	71	$\chi^2=1.117$, $df=1$, $p=.291$

Household without electricity	98	95	$\chi^2=1.332$, $df=1$, $p=.248$
Household with mobile	50	63	$\chi^2=3.438$, $df=1$, $p=.064$
Household without TV	96	96	$\chi^2=.000$, $df=1$, $p= 1.000$
Household with radio	71	88	$\chi^2=8.866$, $df=1$, $p=.003^*$
Household without furniture (e.g. lounge suite, dinning set etc)	97	86	$\chi^2=7.779$, $df=1$, $p=.005^*$
Household without solar panel	100	100	NA
Household without a sewing machine	92	88	$\chi^2=.889$, $df=1$, $p=.346$

*Significant difference between the sites

Apart from the equipment related to fisheries, most households across the study sites also lacked home-based equipment and appliances such as a scooter, television, furniture, and sewing machines and infrastructure such as electricity and solar panels. Comparatively, more households in Matemwe had radios and furniture than those in Kiuyu Mbuyuni (Table 4), which could be attributed to the better economic position in the former site compared to the latter. Since these assets and services have financial implications (Badjeck 2008), their absence in homes demonstrated, yet again, a low return from livelihood activities, low savings and a high level of poverty across the study sites. Ownership of such items may be helpful gaining access to information on various aspects including climate warnings.

3.5.3 Livestock and Poultry

Livestock and poultry are common animals kept across the study sites. However, the national sample census of agriculture 2007/2008 showed that Micheweni district where Kiuyu Mbuyuni is located had more cattle compared with North 'A' district in which Matemwe is located (RGZ, 2012). The increasing value of land as well as competition between traditional uses of land and expansion of tourism has probably reduced the number of livestock keepers and cattle in Matemwe in favour of other land use activities.

In most developing countries, livestock is treated as a 'living bank' and an important safety net that can be called upon during major financial shocks to the household. In many societies, livestock (mainly cattle, sheep and goats) play an important role as insurance against crop failures, as a source of manure and milk, and for building up economic and social relationships (Kangalawe et al., 2008). Crop diversification and livestock keeping are described as risk-averse strategies adopted by farmers especially in semi-arid environments (Scott, 1994; Kangalawe et al., 2001). In the study areas, apart from being sources of manure to cope with poor soil, livestock are treated as a safety net. Even poultry were not kept for consumption, but rather as a living bank for those shocks requiring immediate responses. Indeed, livestock in these areas are the life-line for the local community's survival. In the study sites the use of cow dung is the only way to replenish the coral rag soils. Cattle accumulation was also used to acquire other assets such as fishing vessels and houses. However, the survival of these animals is consistently challenged by increased frequency of dry spells that influence pasture availability, coastal flooding and sea water intrusion into freshwater sources triggered by sea level rise associated with climate change (Mustelin et al., 2010; Watkiss et al., 2012).

3.6 Natural Capital

Key informant interviews provided insight regarding ownership of and access to land for farming, fishing grounds for fishing and intertidal zones for sea weed farming. With regards to land for farming, according to Singer (1996), clearing is the most common means of land acquisition in most parts of the east coasts of both major islands. This was attributed to the fact that land along the east coast was not considered in land redistribution after the 1964 revolution because of the poor coral rag soils. Most farmers in Matemwe, for example, used to shift from one place to another as they usually had more than one plot. Shifting cultivation is no longer a common practice in both sites as pressures like population increase, and quarrying and tourism activities in the case of Matemwe has reduced farming land considerably.

While fishers can freely access fishing grounds, except those within marine protected areas, seaweed farmers in Matemwe where tourism is practiced along the beach front faced competition for intertidal zones. Legally, intertidal zones are a common resource, but interviews showed that in Matemwe conflict between seaweed farmers and hotels owners is common. Hotel owners want a clear and safe zone in front of the hotels for tourists to swim and play, whilst seaweed farmers want to plant seaweed for their survival. It was noted during an

interview with seaweed farmers that hotel owners used to pay seaweed farmers small amounts of money to encourage them to remove their seaweed plots from in front of the tourism hotels. In Kiuyu Mbuyuni, Pemba, despite having a wide and excellent beach, so far the inhabitants have managed to resist tourism in their area. Seaweed is planted in under-water blocks of no distinct length and width in the intertidal zone (Lange and Jiddawi, 2009). Pressure exerted by tourism in Matemwe has pushed seaweed farmers into a smaller area and thus has reduced their production and income (Makame, 2013). In addition to competition with the tourism sector, seaweed farming zones are affected by other stressors. These include falling water level due to sand deposition and variability in winds and temperature. Similarly, there is increasing evidence that climate change and associated impacts, together with high levels of use, are affecting fisheries as described in the introduction to this article and below.

3.7 Household Livelihood Activities

Closely related to the capitals above, a range of livelihood activities were reported within respondent households (Figure 3). The majority of households engaged primarily in natural resource-based activities such as crop farming, fishing, seaweed farming and animal husbandry. Crop farming is a source of food for the majority of the households, assisted by off-farm activities, particularly fishing, to ensure that food is consistently available and supply is stable. High levels of education reported in only 19% and 3% of the households interviewed in Kiuyu Mbuyuni and Matemwe respectively, having a member or members engaged in formal employment. Most of these people were employed, especially in Kiuyu Mbuyuni, as teachers. Only 10% of the households interviewed in Matemwe had members working in the tourism industry on temporary basis. An interview with the leaders of an NGO revealed that lack of education and tourism-related skills prevented local people from being employed in the tourism industry. No one was working in the tourism industry in Kiuyu Mbuyuni. As is increasingly typical of rural areas, the majority of households engaged in more than one activity to sustain their well-being.

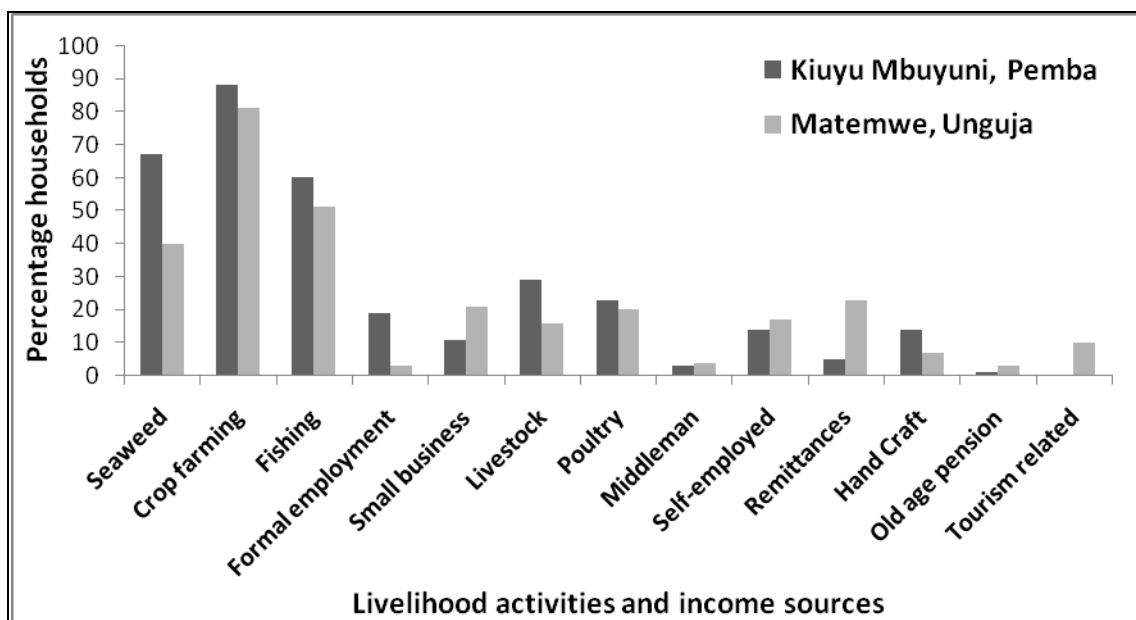


Figure 3. Livelihood activities and income sources across the sites

The findings show how highly dependent coastal communities are on natural capital and ecosystem services. Fishing is a key sector and mainly practiced by household heads and provides both food and cash income. However, these resources are increasingly being depleted through growing population pressure and greater numbers of artisanal fishermen and fishing boats. This has resulted in a general decline in fish catch and revenue per fisherman and per fishing boat (URT, 1994; Kangalawe and Lyimo, 2010). Thus, the livelihoods of fishing communities can only be assured through more sustainable exploitation of fishery resources in the midst of growing populations and a changing climate. Crop farming is mainly a source of food, but its contribution to the households' food needs is affected by seasonality. Due to a lack of irrigation systems, farming output in both sites declines during the dry seasons and prolonged drought events (Makame et al., 2015). Seaweed farming has emerged as an alternative source of income on both islands. However, it is also prone to variability in sea surface

temperature (Sheikh et al., 2012; Makame, 2013) and an unstable world market (Lange and Jiddawi, 2009). Participation in other off-farming and off-fishing activities is marginal.

Despite long-term attempts to increase livelihood opportunities among Zanzibar coastal communities in order to reduce poverty and pressure on dwindling resources, it appears that a move away from traditional activities is not an easy path for most people. Livelihood diversification in rural Africa and Asia is seen as an effective means towards poverty eradication and coping with shocks (Ellis, 2000; Bird and Shepherd, 2003; Niehof, 2004; Salayo et al., 2012). However, if that diversification is based mainly on using natural resources that are sensitive to climate change, the majority of households will struggle to cope and/or adapt to such changes, and are likely to remain vulnerable.

Across the sites, local communities indicated their wish to diversify into less sensitive activities ranging from modern vessel ownership to small businesses in order to escape from poverty, but they are restricted by the low level of assets as described above, especially poor skills, low savings and lack of access to credit. Undeniably, both seaweed farming and fishing on the one hand, and farming on the other, play a crucial role in livelihoods across the sites (Makame et al., 2015). However, the reported poverty and food insecurity makes it clear that these activities, as they are currently practised, cannot effectively help households to deal with future changes in both climate and sea levels (Barrett et al., 2001; Walsh, 2009; Makame, 2013).

4. Conclusions

Despite the range of livelihood activities that households undertake, the findings show that a large number of households are still largely dependent on natural capital for their survival. People's attempts to improve existing activities such as fishing or to turn to more lucrative livelihood activities outside farming and fishing are challenged by poverty, low levels of education and poor access to multiple assets mainly as a result of the absence of credit systems for the poor and those without land titles. As the majority of Zanzibar livelihood activities are controlled by climate, overdependence on natural resources makes these communities particularly sensitive to the impacts of climate change and variability, sea level rise, and other stressors on natural resources. This is exacerbated by limited access to other types of capital/assets, which prevents diversification. Consequently, it can be argued that adaptive capacity amongst Zanzibar's east coast communities is low.

One of the strongest capitals in both sites is the relationships between people, particularly relatives, friends and neighbours, as it provides a safety net in hard times. It has been established by this study that the severity of localised food shortages caused by the increasing frequency of dry spells, particularly in the last decade, has been mitigated by systems of mutual support. Building trust and collective agency by encouraging wider participation in cooperative and savings groups could be used to increase savings, improve financial capital and improve community well-being, thus building the generic adaptive capacity necessary to cope with impacts of climate change. In addition, in a situation where few people have formal employment, and none have titles to their land or houses to act as collateral for accessing loans from banks, membership in micro-finance clubs or new systems of micro-finance support is an important option. Such services need to be improved in Zanzibar in order to minimise the sensitivity of the local livelihood systems and to build the necessary capacity to adapt rather than just cope as households are presently doing.

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