“Climate change, impacts and adaptations in the coastal communities in Bagamoyo District, Tanzania”

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Climate change, impacts and adaptations in the coastal communities in Bagamoyo District, Tanzania

Abstract

Climate change is posing a serious risk to poverty reduction strategies and threatens to undermine decades of development efforts to attain the Millennium Development Goals. The adverse impacts of climate change are now wide spread among many communities worldwide including coastal communities in Tanzania. This study assessed the impact of climate change/variability on rural livelihoods, including vulnerability and existing adaptive capacities to climate change and variability. Different methods namely documentary search, structured questionnaire interviews, field observations and focus group discussion were used to complement each other. Finding from the study has shown that Bagamoyo community is experiencing impact of climate change and variability. They experienced it through factors which greatly affect their livelihood including variability in rainfall patterns and amount, increased incidences of drought, saltwater intrusion into estuaries and freshwater aquifers. Such impacts have greatly affected people's livelihood. Consequently, there has been increased pressure on forest resources for wood and charcoal to compensate for the affected livelihood sources such as crop production. The extent of vulnerability and the adaptive capacity to the impact of climate change and variability is variable from one household to another depending on their livelihood assets. Communities have multiple adaptation strategies including growing of drought tolerant crops, increased frequency of fishing, cultivation of wetlands, as well as keeping small stocks. These adaptation strategies could lead to long-term sustainability if enhanced and promoted.

Keywords: climate change, vulnerability, adaptive strategies, livelihood, coastal areas.
JEL Classification: Q23, Q24, Q 25, Q 54.

Introduction

Globally the climate has been changing over time with variable environmental and socio-economic impacts. Africa is one of the regions where the effects of climate change are being felt particularly hard. African countries, including Tanzania, are among the most vulnerable to the impacts of climate change due to lack of inadequate adaptation capacities, slow economic development, and low institutional capacity (IPCC, 2007). Climate change impacts have the potential to undermine and even undo progress made in improving the socio-economic well-being of communities in these countries. The negative impacts associated with climate change are also exacerbated by many other factors, including widespread poverty, human diseases, and high population density, which is estimated to double the demand for food, water, and livestock forage within the next 30 years (IPCC, 2007).

Increased droughts could seriously affect food production within the horn of Africa, East Africa and South Africa (IPCC, 2001). Food insecurity embedded to rainfall shortages is likely to be manifested in arid and semi-arid areas partly to their feebleness in terms of poor soil productivity, shortage and unreliability of rainfall and poor economic base. Furthermore, it was reported that increased variation and changes in mean temperature and precipitation are expected to affect crop productivity (Porter & Semenov, 2005; IPCC, 2007). The projected impacts are likely to be significant in the Eastern part of Africa where the majority of people depends on agriculture for their survival (Challinor, 2007). Since agriculture in Tanzania is predominantly rainfed, it is anticipated that where the frequency and intensity of droughts are predicted to increase, this will affect agricultural production, severely reduce the supply of different crops. It is also anticipated that a decrease in amounts of rainfall, increased evapo-transpiration and seasonal unpredictability will have serious consequences on crop yields, shifts in agro-biodiversity, and increase in outbreaks of pests and diseases (URT, 2008; Mongi et al., 2010). A decrease in agro-diversity compounded by climate change will have severe consequences on food security as it is an important insurance in events of drought and pest attacks (IPCC, 2007).

The coastal zone of East Africa, including coastal parts such as Pangani, Bagamoyo, Rufiji, Dar es Salaam, and Mtwara are not spared from the impact of climate change. According to some sources sea level rise impacts are increasingly manifesting themselves through fast beach erosion, particularly in Dar es Salaam, Bagamoyo, and Pangani, abandonment of spring wells that are the source of fresh water for coastal communities due to seawater intrusion into fresh groundwater in Bagamoyo is a clear indication of the effect of rising sea levels (URT, 2007; URT, 2008, Kabede et al., 2010; Pallewatta, 2010). In Pangani the 3 metres wall

protecting the Pangani Township from strong waves is collapsing due to stronger and higher tides (URT, 2008). The submergence of Masisiwe Island in Pangani is also attributed to sea level rise. It has been projected that coastal zones will experience loss of coastal and marine habitats and resources such as mangroves, sea grass-beds, fishes and corals (IPCC, 2007; URT, 2007). Sea level rise is the most challenging issue since it threatens the very survival and livelihood of the islands and coastal communities (URT, 2008).

While the impacts of climate change have been more evident (Mwandosya et al., 1998; IPCC, 2007; Mongi et al., 2010) there is limited understanding on the extent of vulnerability and adaptive capacities of different communities such as those of the coastal areas. Although substantial research has been undertaken to improve our understanding of complex and interwoven spheres of climate change, there are significant knowledge gaps regarding our understanding of impacts and adaptations likely to result from climate change. This paper examines the patterns and trends of climate change and community perception and responses to impact of climate change in Bagamoyo District. It also provides an assessment of adaptation strategies to climate change impacts in the coastal communities of the district and makes not only a contribution to the already existing literature on climate change impacts and adaptations, but also facilitates mainstreaming of climate issues into development strategies at various levels.

1. Description of the study area

The study was initially conducted in two villages namely Pande and Kidomole villages. Pande village is located in Zinga Ward, Yombo Division in the south east of Bagamoyo town. Kidomole village on the other hand is located in the north west of Bagamoyo District in Msata Division in Kiwangwa Ward. The study was further extended to Saadani and Matipwili villages to get more insights of climate change issues along the coastal strip of Bagamoyo district. The district is one of the six districts in Coastal Region. It is located between 370 and 390 east; and between 60 and 70 south of the Equator. The district covers an area of 9,842 km^2, of which 855 km^2 are covered by water bodies, while the remaining part which is 8,987 km^2 is occupied by dry lands. The district has six divisions, 16 wards, 82 villages and 645 hamlets. The district borders with Morogoro District in the west; Mvomero, Kilindi, and Handeni districts in the north; Pangani District in the north east; Indian Ocean in the east; Kinondoni District in the south east and Kibaha District in the south (Figure 1).

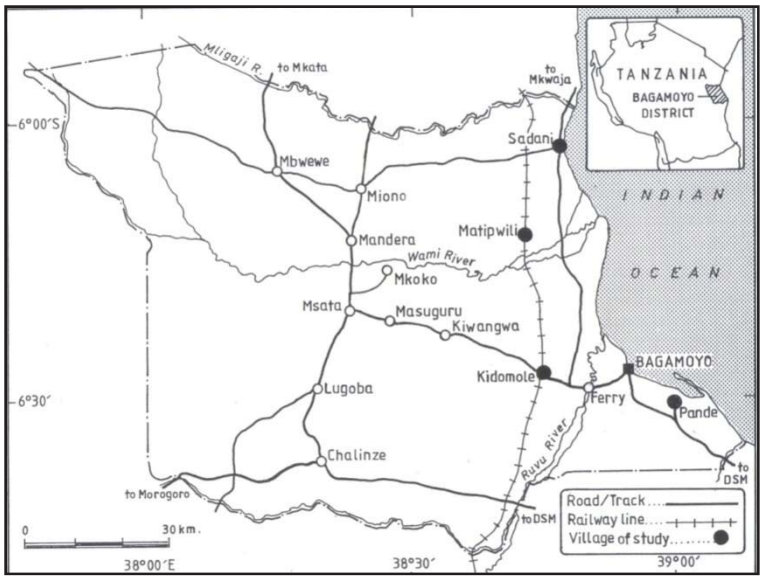


Fig. 1. Location of Bagamoyo District and the study area

Bagamoyo District has a humid tropical climate with seasonal average temperature ranging from 130C-300C. It is divided into 2 ecological zones, namely, the coastal strip which is characterized by savannah and bushy; and the up country which is covered with dense forest. The coastal strip receives relatively more precipitation than the upcountry part. Rainfall ranges between 800-1200 mm per annum. The short rain (vuli) season start from October to December while the long rain (masika) season starts from March to May (Bagamoyo District Profile, 2006). According to URT (2002), Bagamoyo district had a population of 228,967 people of whom 113,991 were males and 114,976 females. The district population density is estimated to be 24.6 people per km^2. Pande village comprises 300 households with a population of 1,724 inhabitants; while Kidomole village has 250 households with a popula-

tion of 833 inhabitants. The study villages comprise a diverse ethnicity due to in-migration of people from various parts of Tanzania. However, it was noted that in Pande village the Kwere and Doe are the most dominant ethnic groups while in Kidomole the Zaramo are predominant followed by the Ndengereko.

In the study villages agriculture and small business (petty trading) are the main livelihood activities (Table 1). Although there were more people keeping livestock in Kidomole compared to Pande and Matipwili villages, it was observed that in Pande and Matipwili villages livestock production was undertaken to a very limited extent and it involved mainly keeping of chicken (poultry) and goats while in Kidomole village people especially the barbaig maintain large stock of cattle and goats.

Table 1. Socio economic activities in the study area

Activity	Household participation (%)		
	Kidomole village	Pande village	Matipwili village
Agriculture (crop production)	72.0	90.0	80
Petty business (kiosks, food vending)	24.0	23.3	15
Livestock keeping	8.0	13.3	10
Fishing	0	16.7	20
Arts and craft work	4.0	3.3	2
Casual labor	4	3.3	8

Source: Field survey 2008.

In Kidomole village the household also mentioned charcoal burning, timber exploitation and livestock keeping as other economic activities though do not involve many people as compared to farming. During the discussions it was apparent that forest products play a crucial role in the livelihoods of Kidomole villagers. It was established that farming activities were negatively affected by climatic changes/variability; attacks by vermin like baboons; monkeys and wild pigs; the use of poor seeds and agricultural implements and water shortage. One of the informants made a direct correlation between uncertainty in agricultural production and the expansion of charcoal burning and petty trading as alternative livelihood strategies.

2. Methodology

In this study different methods and techniques were used to complement each other and to generate data from both primary and secondary data sources.

2.1. Literature review. Secondary data on socio-economic and physical aspects relevant to the study were obtained through literature review from various records, both published and unpublished literature, including reports obtained within and outside the relevant district headquarters, and the Tanzania Meteorological Agency (TMA).

2.2. Participatory methods. Participatory methods, including focus group discussion (FGD), key informants interview at village level, guided by checklist were used. Each village government was requested to identify 10-12 village members for FGD comprising of men and women of old age as well as people with long experience regarding the village background. Key informant interviews using standard checklists were used to capture local experience on climate change and its impact on community livelihoods. Also vulnerabilities and adaptive capacities of communities were captured through these methods. Narratives from both villages were summarized and presented in subsequent sections of the discussions'.

2.3. Household interview. A sample size of 5% (95 households) of the total households in the study villages were randomly selected for household questionnaire interviews. Due to financial and time constraints the sample size of 5% from each village was considered to be adequate since different sets of methods were used to complement each other in capturing the required information. With the assistance of village governments, respective households were randomly selected using village registers for interview among the information collected from households included perceptions of climate change and its influence on various livelihood activities, household vulnerability and existing adaptive strategies to impact of climate change and variability.

3. Results and discussion

3.1. Climate change and variability in Bagamoyo District. 3.1.1. *Local perceptions and indicators of climate change and variability.* Discussions with key informants regarding local perceptions of climate change established that the key aspects that were related to the climate were elements which directly influence their livelihood activities, farming and fishing (Table 2). It was noted that most of the interviewed households perceive climate as rainfall. Other climatic elements mentioned as indicators of climate were temperature, drought and wind. With regards to wind as indicator of climate it was noted that there were more response in Kidomole, Pande and Matipwili villages. This is because it is a coastal fishing villages which to a certain extent is influenced by strong sea winds. With the regards to floods there was high response in Matipwili due to frequent occurrence of floods causing destruction of crops.

Table 2. Households' perceptions of climate in Pande, Kidomole and Matipwili villages

Understanding of climate change	Villages		
	Kidomole N = 25	Pande N = 30	Matipwili N = 40
Climate as: rainfall	100	76.7	84
Climate as temperature	32	53.3	76
Understand climate as: drought	48	43.3	44
Climate as wind	8	23.3	38
Understand climate as floods	0	0	38
Understand climate as humidity	4	3.3	3.6

Source: Field survey 2008.

The study revealed that there is a growing feeling and perception among the villagers that climate change and variability is already occurring. Most of the respondents in the study villages (see for example Pande, 94%, Kidomole 87% and Matipwili 100%) acknowledged that there has been a change in climatic conditions. The study noted that villagers perceived changes in climate by focusing on the major climatic variables which have big impacts on their livelihood such as rainfall inconsistency and unpredictability over years, increased incidence of droughts, and increased temperature. Table 3 shows examples of indicators of climate change in Kidomole and Pande villages.

Table 3. Percent response on local indicators of climate change in Bagamoyo

Local indicators	Kidomole	Pande	Matipwili
Rainfall coming late in the seasons	72.0	70	78
Decreased amount of rainfall	52.0	60	64
Increasing temperatures	32.0	37	66
Increased incidences of drought	12.0	40	30
Shortened growing seasons	4.0	40	35
Decreasing crop productivity	16.0	27	50
Recurrent food shortage	12.0	10.0	20
Outbreak of plant diseases	4.0	13.30	46

Source: Field survey 2008.

Focus group discussions in the study villages reveals that climate is continuously changing and it is getting worse over time. Bad years are becoming more frequent than before. Such changes have been associated with changes in rainfall patterns with rainfall coming late in the season or not adequate (see Table 3). Other events which were associated with change in climate are increased incidents of drought, shortened growing season and decreasing crop productivity.

In all the study villages it was acknowledged that rainfall pattern has changed over time for the past 20 years becoming more unreliable as well as showing a decreasing trend and amount (Table 4).

Table 4. Rainfall patterns during the last 20 years in Pande, Kidomole and Matipwili villages

Rainfall patterns during the last 20 years	Villages		
	Kidomole	Pande	Matipwili
Decreasing	76	83.3	80.0
Fluctuating	24	13.3	18.2
Do not know	0	3.3	1.8
Total	100	100	100

Source: Field survey 2008.

The key informants in all the study villages reported that rainfall has become uncertain. In the past they used to have three rain seasons namely long rains (*masika or mvua za mwaka*) starting from the end of February to June, with peak rains in March/April; and short rains (*vuli*) starting from October to December; and some little showers (*manyelweza*) in January and February. The above rain seasons implies three major agricultural seasons. For example they used to grow paddy during the masika rains, maize during vuli and masika rains; and they used *manyweleza or kitope* rains to grow vegetables. In recent years, there has been a change on the onset of short rains and *manyweleza*; which either delay or sometimes disappear completely. This puts agricultural production at risk.

3.2. Perceptions on temperature. The perception on climate changes was reported as an increase in temperatures and extreme events such as floods and droughts. For example, the elders in Matipwili village remember three big floods which occurred in 1961, 1968 and 1979. Villagers further reported that temperatures have become high particularly during *Kaskazi* (i.e. from November to January).

Perceptions on changes in wind have been of concern mostly to fishermen such as in Matipwili, Pande and Saadan villages. Focus group discussions with fishermen in the fishing villages revealed that increasingly they noticed strong winds and irregular tides which interfered with their fishing activities. For them, the state of winds is very crucial, as it is important to have a state of calmness (*shwari*), for fishermen to set their fishing nets properly[1]. They also mentioned the importance of having a predictable tidal regime, so that the time of high tide (*bamvua*) and low tide (*maji mafu*) is predictable. The former is conducive for fishing activities. Also, with regard to fishing four major seasons were associated with wind directions and intensity. These were:

[1] The State of the Environment Report (URT 2006) concurs that the monsoons have a dominant influence on wind direction and strength, temperature and rainfall. There are two monsoon seasons namely the northeast monsoon (*Kaskazi*) which prevails from November to February and is characterized by high air temperatures (> 30ºC) and weaker winds and the Southeast monsoon (*Kusi*) which lasts from April to September and is marked by lower temperatures (approximately 25ºC) as well as strong winds.

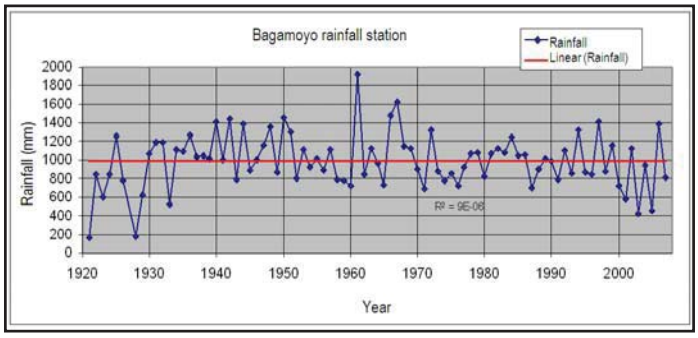
- *Kusi* – south-easterly monsoon winds (July, August, September);
- *Maleleje* (October);
- *Kaskazi* – north-easterly monsoon winds (November, December, January);
- *Parataza* (April, May, June).

Key informants reported that the *Kusi* and *Kaskazi* are associated with high availability of fish, whereas the *Parataza* winds (i.e. from April to June) are very strong and result in a decline in fish catches.

Sea level rise has also been perceived as indicators of climate change and variability by communities in the villages along the coast. The key informants mentioned a number of indicators that show a rise in the level of the sea. It was reported that in Wami River, for example, in the past water was very fresh, but now it had become salty. They argued that due to increasing salinity it is difficult to get fresh water fishes as they move far upstream where there is fresh water. The above phenomenon was due to decrease in water level in the river because of increased droughts resulting into upstream sea water intrusion during high tides.

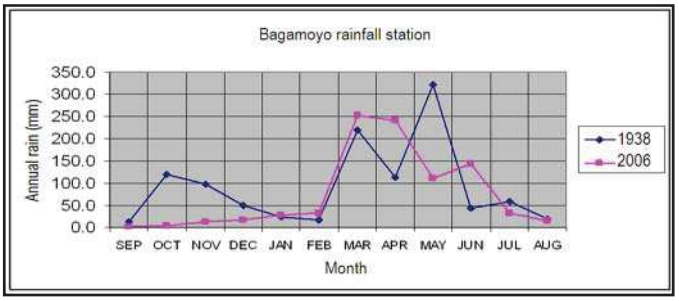
Key informants also reported that in other villages along the coast, such as Matipwili and Saadani further downstream of Wami River in Kajanjo area, the sea shore had advanced forward by an acre or 70 m inland. Through focus group discussions it was revealed that in some wetland areas where people used to grow vegetables and rice are no longer productive due to high salinity from sea intrusion. Other crops affected included banana, maize and cowpeas because of high salinity levels.

3.3. Trends and patterns of climate change and variability. Generally the climate of Tanzania including Bagamoyo District is characterized by two main rain seasons namely the long rains and the short rains which are associated with the southward and northwards movement of the ITCZ. The long rains (*Masika*) begin in the mid of March and end at the end May, while the short rains (*Vuli*) begin in the middle of October and continues to early December. Most of the rainfall is convective in nature and distinctly organized. The study reveals that late rainfall onset and early withdraw (cessation) are becoming common in the study area. Such situation has also been reported to be common in most parts of Tanzania (Mongi et al., 2010). Observational evidence from the local communities as already indicated above are suggesting a seasonal shifts in rainfall pattern, a decrease in rainfall amount and an increase in temperature in the study area. Analysis of annual rainfall time series for Bagamoyo for a period of 87 years (1920-2007) indicates a normal trend (R2 = 9E-06) with high inter-annual variability (Figure 2). Therefore, there is pronounced variability over time with relatively constant pattern. It is evident that there is no overall trend of annual rainfall in Bagamoyo. Annual rainfall appears to have fluctuated about a mean of 1000 mm. However, it is noted that as from 1999 to 2008 rainfall has been decreasing over time.



Source: TMA 2008.

Fig. 2. Temporal annual variation of rainfall, Bagamoyo rainfall station

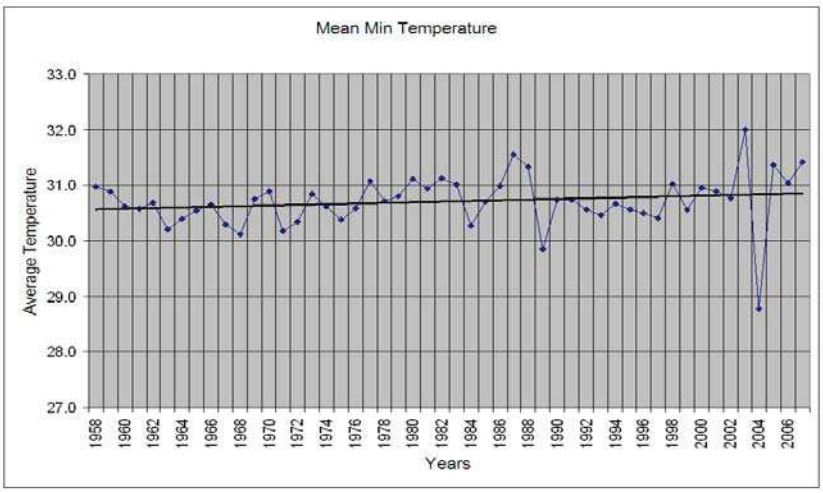


Source: TMA 2008.

Fig. 3. Mean monthly rainfall variation

Usually the *Vuli* rain season ranges from October-December year while the long rains range from March-May. In Figure 3 above rains during 1938 (shown in blue color) were higher than those during 2006 (shown in pink color). However, during the long rains seem to have started about the same time in February but those in 2006 were slightly higher than that of 1938. Subsequently, they all picked up to reach a peak March/April but those 1938 stretched a bit further to May.

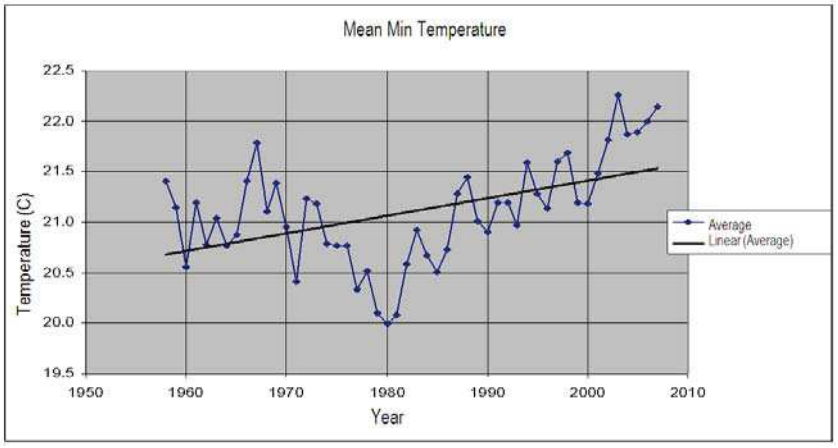
Analysis of temperature data obtained from Dar es Salaam International Airport (DIA) station (the nearest station to Bagamoyo) covering 49 years (1958-2007) shows that the mean maximum temperature has been consistently increasing from 1958 to 2007 (Figure 4). It is noted that the mean maximum temperature has been increasing steadily from 1958 to 1987. Thereafter, the temperature decreased steadily to 1989 to pick up again with a general increase to 2003. In 2004 the temperature dropped to the lowest level, i.e. below 29°C and picked up again. The general increase ranged from 30.6°C to 30.8°C which is about a difference of about 0.2°C.



Source: TMA 2008.

Fig. 4. Mean maximum temperature at Dar es Salaam International Airport

The minimum temperature in the study area generally shows that there have been three periods of temperature regimes. From 1960 to 1970 it was a period of temperature increase and thereafter a drop of temperature to the lowest figure in 1980. As from 1980 to date the temperature has been increasing steadily as evidenced in Figure 5. From 1980 to date there is about 2°C increase in the minimum temperature which is quite substantial. What made 1980 to be a turning point towards steady increase in the minimum temperature could, however, not be established. On average, the minimum temperature has increased more than the maximum temperature.



Source: TMA 2008.

Fig. 5. Mean minimum temperature at Dar es Salaam Airport

A comparison of the local perception of climate change and analysis of empirical data from TMA has shown a common trend of change in rainfall patterns over time. It was reported that the change

was related to the amount and distribution/reliability of rainfall. Other factors included the duration of dry spells and the frequency of droughts. Also villagers have expressed their concern on the disappearance of short rains in some years with more frequency of bad years than good years.

4. Impact of climate change on livelihood activities in Bagamoyo District

As already discussed in the previous sections agriculture, fisheries and non-farm activities including small business and off farm employment constitute livelihood activities in Bagamoyo District. Such livelihood activities have been impacted by both climatic and climatic factors making them more vulnerable to change. However, it may be difficult to make clear distinction on the impact by each of them.

4.1. Impacts on agriculture. Production of various crops in the study area depends largely on *Masika*, *Manyelweza* and *Vuli* rains i.e. from April/May, August and from October to December, respectively. However, currently, it was reported that the climate has changed and villagers depend mainly on *Masika* rains or what is also locally known as *Mvua ya mwaka* for their agricultural activities. It was further learnt that the Masika rains are mainly important for production of rice (paddy). Villagers further revealed that the little showers (*Manyelweza*) were responsible for flowering of mangoes and cashew nut; and production of pigeon peas, cowpeas and cassava. This implies that a decline in these rains could adversely affect production of these crops. It was further learnt that the agricultural calendar has changed; currently due to climatic changes villagers can no longer follow this calendar due to unreliability of rainfall. It is noted that sometimes there are delays on onset of rains and the rains are inadequate. Consequently, this situation has affected the time of sowing of rice, which is currently done in February instead of January. Furthermore, due to little rains, the rice which is sown in February germinates in March, which again delays the weeding activity. In some years, it was reported that villagers do not receive any rain between January and March. As a coping measure to such situation farmers currently delay some of their farm activities such as land preparation so as to avoid repeated weeding.

It was also revealed that in Pande village the production of maize had declined. The decline in maize was mainly attributed to soil factors, since maize performed well when planted in fields that had been recently cleared (change) in the forest areas. Key informants further narrated that in the past they used to practice shifting cultivation; however, currently they can no longer practice shifting cultivation since they have already cleared most of their forest for charcoal making and for establishment of settlements.

One of the impacts of climate change in the agricultural sector in the Kidomole village includes abandonment of cultivation by some villagers in favor of exploitation of forest products such as charcoal burning and timber exploitation. It was established that some villagers have been forced to abandon crops like rice due to inadequate water in the previously potential swampy areas. It was also mentioned that maize production has decreased due to inadequate rains. Also vegetable farming has been negatively affected by the drying of swampy areas where they used to be cultivated. The agricultural calendar has changed, with unreliability of the *vuli*, which used to occur regularly in September-October.

The study has revealed that agricultural productivity trend has declined due to inadequate rains. For instance, in Pande village, it was accordingly reported that in the past they used to obtain 5-10 bags of maize per acre. The productivity has declined to 3-4 bags per acre. In the case of cassava, it was reported that previously this crop was mainly used as a food crop. However, currently cassava also serves as a cash crop and the current productivity is 30-40 bags of (50kg each)/acre.

The decline in crop productivity in Pande village was also reflected in the reported coconut harvests. The production of coconut in the past was as follows: From 50 coconut trees, one was able to harvest 2000 coconuts. Apparently, the current production is 200 coconuts from 50 coconut trees. The decline in coconut production was however, associated with frequent harvest of the crop. Regarding this situation, villagers explained that in the past they used to have an interval of three months before harvesting the coconuts; the current food security situation has resulted into increase in harvesting frequencies, which has resulted into reduction of harvesting interval to 3 weeks. The harvested coconut is then sold to obtain cash, which is used to buy food.

Besides the impact of climate change on the livelihood activities it was noted that other non climatic factors are cross cutting affecting most of the livelihood activities. Example of such factors includes:

- High poverty levels which limit households to purchase various inputs such as improved seeds, farm implements, fertilizers and agrochemicals for improvement of agricultural production.
- Inadequate extension services, lack of reliable markets for crops, poor transport infrastructure, uncontrolled fire devastating cashew and coconut

trees, uncertainty of water sources/availability for irrigation due to multiple users and communication problems, declining soil fertility and increasing soil salinity in some areas.

4.2. Impacts on fisheries. Fisheries is among livelihood activity affected by climate change and variability. The key informants in Pande and Matipwili villages reported that fishing activity is impacted by climatic factors such as wind and rainfall patterns. Accordingly, they reported that, if the rains are adequate then they obtain a lot of fish. This is due to high accumulation of feeding materials deposited to the shore by inland to sea surface runoff. Further discussions regarding changes in fish catch, revealed that several species of fish that were available in the past have declined. The fish species included mkizi, nguru, hongwe, papa, songoro, ndowaro and kolekole. The main reasons provided by villagers were changes in climate and overfishing by the foreign investors. Studying the effect of climate change/variability on availability of fish species is an aspect that needs further research.

Besides the impact of climatic factors such as rainfall and wind on fishing activities, the following non climatic factors were reported to impact fisheries.

- Limited access to improved fishing gears and equipment for processing and handling fish due to lack of financial capital to buy such equipments; inadequate education on environmental management and extension knowledge in fishing; limited capacity of village environmental committees and Beach Management Unit to manage marine resources. More education and working facilities are needed.
- Destruction of fish habitats including coral reefs due to economic activities such as excavation of construction materials and salt mining. Also existence of resource use conflicts between fishermen and sea weeds (Mwani) farmers contribute to destruction of fish breeding sites as well as sea weeds.

5. Adaptation mechanisms to the impact of climate change in Bagamoyo District

The study revealed that there are various strategies adopted by the community to cope and or adapt to the impact of climate change and variability. However, the nature of adaptive capacity undertaken varies from one household to another depending on the ownership of livelihood assets.

For example it was revealed that for the communities which depend much on agriculture such as in Kidomole village which also have woodlands, the coping and adaptation mechanisms included planting of drought resistant crops such as cassava, selling of mangoes fruits, engage in charcoal making and selling, and getting assistance from relatives. However, households such as *Sukuma* and Gogo who keep cattle were able to sell some of their animals to buy foods.

In fishing community such as in Matipwili and Pande villages the adaptation mechanisms included increasing fishing frequency whereby they go twice per day instead of once, buying and selling coconuts, increasing engagement in off farm activities such as tourism related activities (selling handcraft made from coconut leaves), casual employment in salt mines, petty business e.g. selling fish and foods, and social network. For the fishermen with financial strength were able to buy more improved fishing gears such as motorised boats and nets to enable them to fish in deep waters compared to women who were unable to fish away from the shore due to poor fishing gears. Focus group discussion and key informant interviews further narrated that it is easier for people in the coastal areas to cope in times of climatic calamities due to availability of alternative livelihood activities e.g. fishing. They provided statements such as "*Njaa ya Bara na Pwani ni Tofauti*" and "*Mgaa gaa na Upwa Hali Wali Mkavu*" to reflect the differences with regard to food insecurity by comparing people from the coastal areas and the hinterland. Accordingly, with regard to dependence on livelihood activities, it was mentioned that those who depend solely on agriculture are the ones that are most affected. This implies that agricultural sector is one of the vulnerable sectors to climate change as compared to other livelihood activities in the coastal areas and livelihood diversification is among the way to adapt to such changes.

In all the study villages it was revealed that because of rainfall unreliability and increasing poor performance of crop cultivation many potentially productive youths have resorted to petty trading migration to urban centres and unsustainable harvesting of forest products such as making charcoal and selling poles. It was revealed that the number of youth involved in charcoal making has increased leaving cultivation to the vulnerable elders who perceive farming as part and parcel of their life. However, key informants were aware that deforestation caused by charcoal making was denying them of other forest products such as traditional medicine but are more concerned about their daily livelihood.

Conclusion

The coastal communities in Bagamoyo are experiencing the impact of climate change on their livelihood and they are aware that climate is changing

with increase in temperature and rainfall variability. The risks from climate change in the coastal zone of Bagamoyo are increasing, and in some areas will be more felt in the near future. Communities have pursued different adaptation strategies including increasing cultivation of wetlands, increase cultivation of drought resistant crops keeping small stocks, selling of charcoal and increasing frequency of fishing. While diversification is an important adaptation to some members of the community, more concerted effort is needed including development of adaptation plan to reduce risks and enhance the community adaptive capacity to the impact of climate change.

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