Climate Change Adaptation Series: Document 7

LIVELIHOODS, CLIMATE AND NON-CLIMATE THREATS AND ADAPTATION: BAGAMOYO DISTRICT COASTAL VILLAGES

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Prepared by the Pwani Project

In Partnership with the Bagamoyo District Council

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COASTAL RESOURCES CENTER
University of Rhode Island

This report is part of the Tanzania Climate Resilient Coastal Communities series, which includes the following documents:

1. Coastal and Marine Ecosystems in a Changing Climate: the Case of Tanzania.
2. Workshop Proceedings: Tanzania Coastal Climate Change National Adaptation Planning Workshop
3. Village Vulnerability Assessments and Climate Change Adaptation Planning (V & A): Kitonga, Bagamoyo District
4. Village Vulnerability Assessments and Climate Change Adaptation Planning (V & A): Mlingotini, Bagamoyo District
5. Rapid Assessment of Shoreline Characteristics and Dynamics of the Lazy Lagoon at Mlingotini Village, Bagamoyo
6. Livelihoods, Climate and Non-Climate Threats and Adaptation: Pangani District Coastal Villages
7. Livelihoods, Climate and Non-Climate Threats and Adaptation: Bagamoyo District Coastal Villages
8. Village Vulnerability Assessments and Climate Change Adaptation Planning (V & A): Jambiani and Paje, Zanzibar
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List of Abbreviations

BMUs	Beach Management Units
CBO	Community Based Organization
DED	District Executive Director
DIDMAC	District Disaster Management Committee
DP	District Profile
EPMS	Environmental Protection Management Services
EPZA/SEZ	Export Processing Zone Authority/Special Economic Zone
GDP	Gross Domestic Product
MLFD	Ministry of Livestock and Fisheries Development
NBS	National Bureau of Statistic
NGO	Non Governmental Organization
SACCOs	Saving and Credit Cooperative Societies
SMEs	Small and Medium Enterprises
SANAPA	Saadani National Park
TAFORI	Tanzania Forest Research Institute
TCMP	Tanzania Coastal Management Partnership
TMA	Tanzanian Metrological Agency
UNEP	United Nations Environmental Program
UNHABITAT	United Nations Habitat
URT	United Republic of Tanzania
VPO	Vice President's Office
VICOBA	Village Community Bank
WSDP	Water Sector Development Program
WATSAN	Water and Sanitation

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Foreword

Climate change is a global issue posing challenges to the very survival of mankind and preventing sustainable development. The adverse potential impacts of climate change are now evident in Bagamoyo District. Bagamoyo District villages are exposed to climate change and non-climate related stresses. The impacts pose danger to livelihoods, social assets and the natural environment.

This report seeks to understand the vulnerabilities specific to coastal communities in the District with the view of providing guidance for planning directed at improving livelihood resilience and reducing vulnerability in communities to climate and non-climate stressors.

Bagamoyo District appreciates the assistance of the University of Rhode Island's Pwani Project in carrying out this effort and invites village leaders in all Bagamoyo villages to learn from the findings in this report.

DISTRICT EXECUTIVE DIRECTOR
BAGAMOYO DISTRICT COUNCIL

1. INTRODUCTION AND APPROACH

There is now wide agreement by most scientists and climate change professionals that climate change and increased climate variability are already occurring and having serious consequences for many African countries, including Tanzania. The predictions from the experts on climate change are that the problems caused by climate changes will increase and make management of coastal ecosystems and improvements to community resilience even more difficult. The following threats are predicted to cause major problems for coastal resources and the well-being, safety, and food security of coastal communities:

1. More unpredictable precipitation (seasonality and intensity)
2. Increases in strong storms
3. Sea level rise
4. Increased sea surface and ambient air temperatures
5. Increased ocean acidification

These climate and chemical threats and the problems they create are in addition to existing local stresses such as deforestation, over fishing, deterioration in water supply and quality, and development pressures.

Beginning in 2010, the University of Rhode Island's Pwani Project initiated an effort to help local leaders and government to assess climate change impacts and find ways to adapt to current and future climate change impacts in a strategic way using their own resources and knowledge. This is part of a larger coastal management effort in a partnership with the government of Tanzania and the United States Agency for International Development (USAID). The Pwani Project has a geographic focus on the island of Unguja in Zanzibar and the ecologically important northern coast of mainland Tanzania – Bagamoyo and Pangani Districts. The overall goal is to help sustain the flow of environmental goods and services; revise the trend of environmental destruction of critical coastal habitats; and improve the wellbeing of coastal residents in the Bagamoyo-Pangani and Menai Bay Seascapes.

This report documents climate change susceptibility and exposure of the marine dependent livelihood for selected coastal villages in Bagamoyo district in order to help set priorities for scaling up community level vulnerability and adaptation planning. The villages of Kitonga and Mlingotini are among the pioneers in local adaptation planning in coastal Tanzania. This assessment employs a qualitative approach to determine likely community vulnerability to the impacts of climate change, incorporating an initial understanding of their adaptive capacity. The selected locations represent the coastal and marine resource dependent community vulnerability. The assessment examines the most susceptible factors to climate change which in turn affect livelihood of the Bagamoyo community.

TCMP-PWANI project facilitated the district climate change task force team to meet and set up criterion for Bagamoyo coast representative sample. The Climate change task force team is comprised of climate change related district sections namely fisheries, agriculture, forest, community development, water and health, The villages were selected for inclusion based the type of marine ecosystem, socio -economic status, and natural resource set up and coastal

resource governance. Selected coastal villages include Makurunge, Kiharaka, Kaole, Dunda, Pande, Kondo and Saadani.

Approaches for the assessment included transect walks, key informant interview, and focus group discussion. Before the transect walk, the village resource map was drawn and the transect line drawn. A transect table was be drawn and used to collect climate change affected natural resource information. Key informant interviews were used to get vulnerability information from village leaders, extension officers, famous villagers and elders.

Focus group discussion drew a diverse sample of villagers based on livelihood practice, age, gender and experience. Focus group of not more than 8 individuals discussed main themes based on: - leadership and governance, Coastal resource management, risk awareness and emergence response, and economy and society. The group further provided information on climate change exposure, sensitivity, existing adaptation options, and individual adaptive capacity. Information collected was compiled together by the district climate change task force team after each village. More key informant interviews were held with district climate change related departments to get an insight of the district climate change adaptation views.

2. OVERVIEW OF THE BAGAMOYO DISTRICT SITUATION

This section outlines the general overview of Bagamoyo district. It details biophysical and socio-economic overview characteristics of the district. The section outlines the districts' location, population dynamics, existing economic activities, biophysical characteristics, that is, district climate, vegetation and drainage. The section also emphasizes on the rationale of conducting the coastal district vulnerability assessment.

2.1 Location and administrative setup

Bagamoyo is one among six districts of the Coastal (Pwani) Region of Tanzania. Bagamoyo District is situated 75 km north of Dar-es-Salaam (UNH, 2009). It is bordered to the north by the Tanga Region, to the West by the Morogoro Region, to the East by the Indian Ocean and to the South by the Kinondoni and Kibaha Districts (Bagamoyo District, 2009).

Bagamoyo District lies between 37^0 and 39^0 Longitude and between 6^0 and 7^0 Latitude (DP, 2006; 2009). The district covers an area of 9,842 km^2 , where 855 km^2 is covered by water (Ocean and river) while the remaining part, which is 8,987 km^2 is occupied by dry lands (Bagamoyo District,2009). The District has two parliamentary constituencies that are Bagamoyo and Chalinze. It is divided into six administrative divisions and sixteen wards (Bagamoyo District, 2006). The district capital is Bagamoyo town.

2.2 Demography

According to the 2012 Tanzania National Census, the population of the Bagamoyo district is 311,740; with 154,198 males and 157,542 females with the average household size is 4.4 (NBS, 2013).The population of Bagamoyo now is highly mixed due to migration and settlement of different ethnic groups. Existing ethnic groups include the Kwere, Zaramo, Zigua, Doe and Masai.

2.3 Economic activities

The main economic activities in Bagamoyo include small holder farming, artisanal fishing, livestock keeping, mariculture (sea weed and prawn farming), salt production, trade, and tourism. Bagamoyo area has become an important cultural, beach and conference tourist hub along the coast of Tanzania (http://www.tanzania.go.tz/regions/COAST.pdf as of March, 2013). This transformation has both created social and economic development opportunities while adding new to the key economic and social challenges facing the area. This is one of the factors resulting into Bagamoyo acquiring small township status that needs further infrastructure upgrading.

2.3.1 Fisheries

Bagamoyo District has 10 permanent landing sites (and 1 temporal) and an estimated 1,751 fishers (Bagamoyo District, 2009). The marine fishery (of which 96 percent catch is from the artisanal fishery) is very important in Bagamoyo district where majority of the population depends on the fishing activity as their major sources of daily income and food for their families (Tobey et al.,2011). Most of the marine artisanal fishers in Bagamoyo obtain their fish in shallow water habitats and nearby reef areas in the vicinity of the coastline (TCMP, 2007). The Wami and Ruvu river estuaries also provide good diversity of fish types to Bagamoyo residents.

2.3.2 Mariculture

Mariculture has contributed to the ability of some Bagamoyo communities to improve family incomes as a supplement to traditional income sources. Seaweed farming is one of mariculture activities in the district (example Mlingotini village). In order to maintain and increase income generated from seaweed farming, some villages, with the aid of TCMP-PWANI project engaged in seaweed related products like soap and skin oil making. The sale of seaweed itself generates little income compared to product generated from seaweed hence seaweed related product making is the main driving force for the activity. Prawn farming and crab fattening is mainly practiced at Mbegani Fisheries Development Centre (Mutatina, 2008).

2.3.3 Tourism development

Bagamoyo District is blessed with an amazing historical and cultural heritage and was recently designated a United Nations Educational, Scientific, and Cultural Organization (UNESCO) World Heritage Site (UNH, 2009). Bagamoyo has developed beach hotels that attract many visitors from Dar es Salaam. Most of the facilities are within 60 meters the highest tidal mark which is the limit for development activities. Issues such as access to beach; waste (liquid and solid) and visual impacts are of concern to local people and visitors.

2.3.4 Agriculture and livestock keeping

Although agriculture is facing a number of climate hazards, coastal communities still depend on it heavily as a livelihood. Agricultural activity is largely subsistence and low value crops (Andrew, 2009; Mushi, 2009). Common cash crops in the district are coconut, fruits, cashew nuts, sesame and cotton while important food crops include maize, sorghum, paddy, cassava, legumes and sweet potatoes (Bagamoyo District, 2009)

Livestock in Bagamoyo district include Cattle, Goats, Sheep, Pigs, Donkeys, Dogs, Cats, Horses, Camels Chicken and Ducks. The district is gradually receiving large influx of livestock keeper every year due to limited pasture and water in upcountry pastoral regions. Good grazing area and adequate water supply along Wami and Ruvu river systems attractive livestock keepers. The major source of land conflict in the district is high resource use competition between farmers and livestock keepers, for example there is a growing concern of grazing big cattle herds along in SANAPA along the Wami –Ruvu river.

2.4 Biophysical characteristics related to climate issues

2.4.1 Climate

The humid tropical climate has a seasonal average temperature ranging from 13^0 C- 30^0 C and humidity as high as 98% (EPMS, 2006) covers Bagamoyo district. 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 (District Profile, 2006; Andrew, 2009; Mushi, 2009).The driest months are June to September when monthly rainfall is generally less than 50 mm per month.

Annual rainfall time series analysis for Bagamoyo for a period from 1920-2007 indicates a normal trend (R^2= 9E-06) with high inter-annual variability (Figure 1). Distinct variability over time with relatively constant pattern is observed. It is evident that there is no overall trend of annual rainfall in Bagamoyo. Annual rainfall appears to have fluctuated about 1000 mm averagely. However, it is noted that as from 1999 to 2008 rainfall has been decreasing over time.

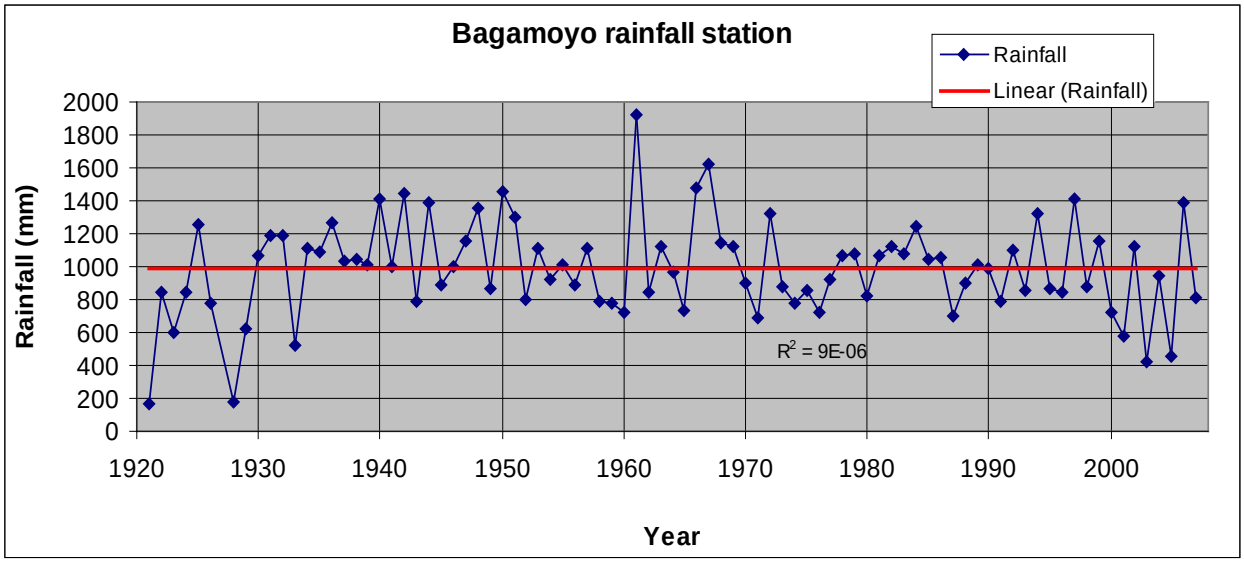


Figure 1 Temporal annual variation of rainfall, Bagamoyo Rain Station

Data source: Tanzania Meteorological Agency, 2008

The mean monthly variation of rainfall between two distant years, 1938 and 2006(Figure 4) documents that in 1938 rainfall were higher in *Vuli* but now it had decreased considerably. However, in *Masika* the rainfall is still available but marginally lower than in the past. Apparently, the rains in *Masika* appear to come earlier than before. It is noted that rains ceased earlier than before. For example, in 1938 rains in May were higher than the rains during the similar period in 2006.

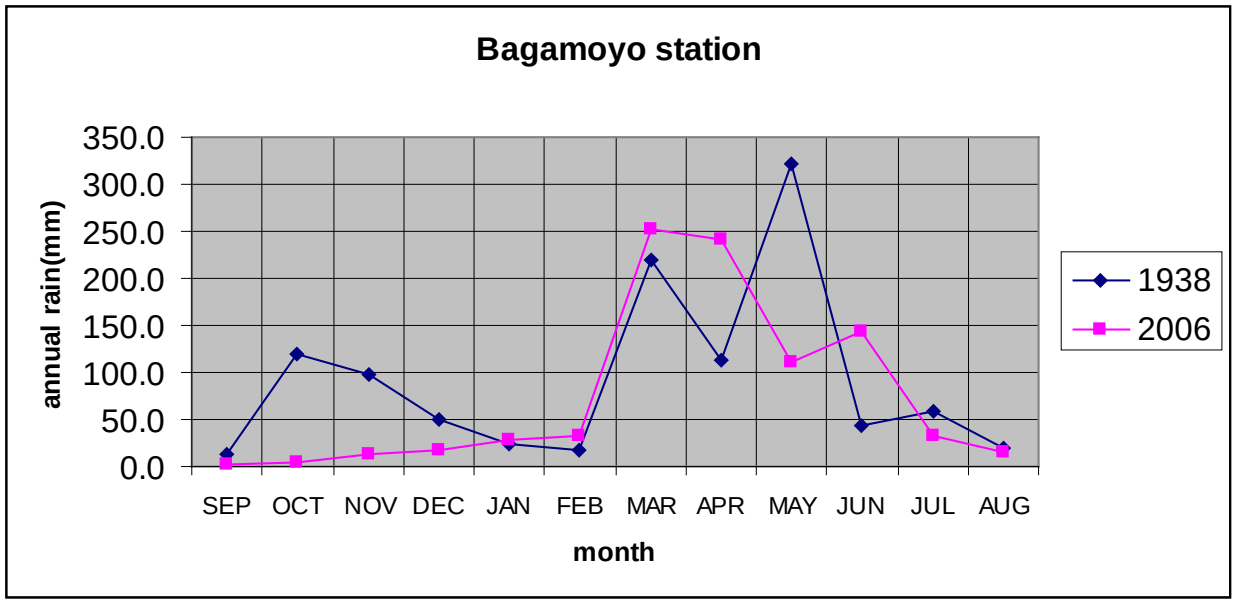


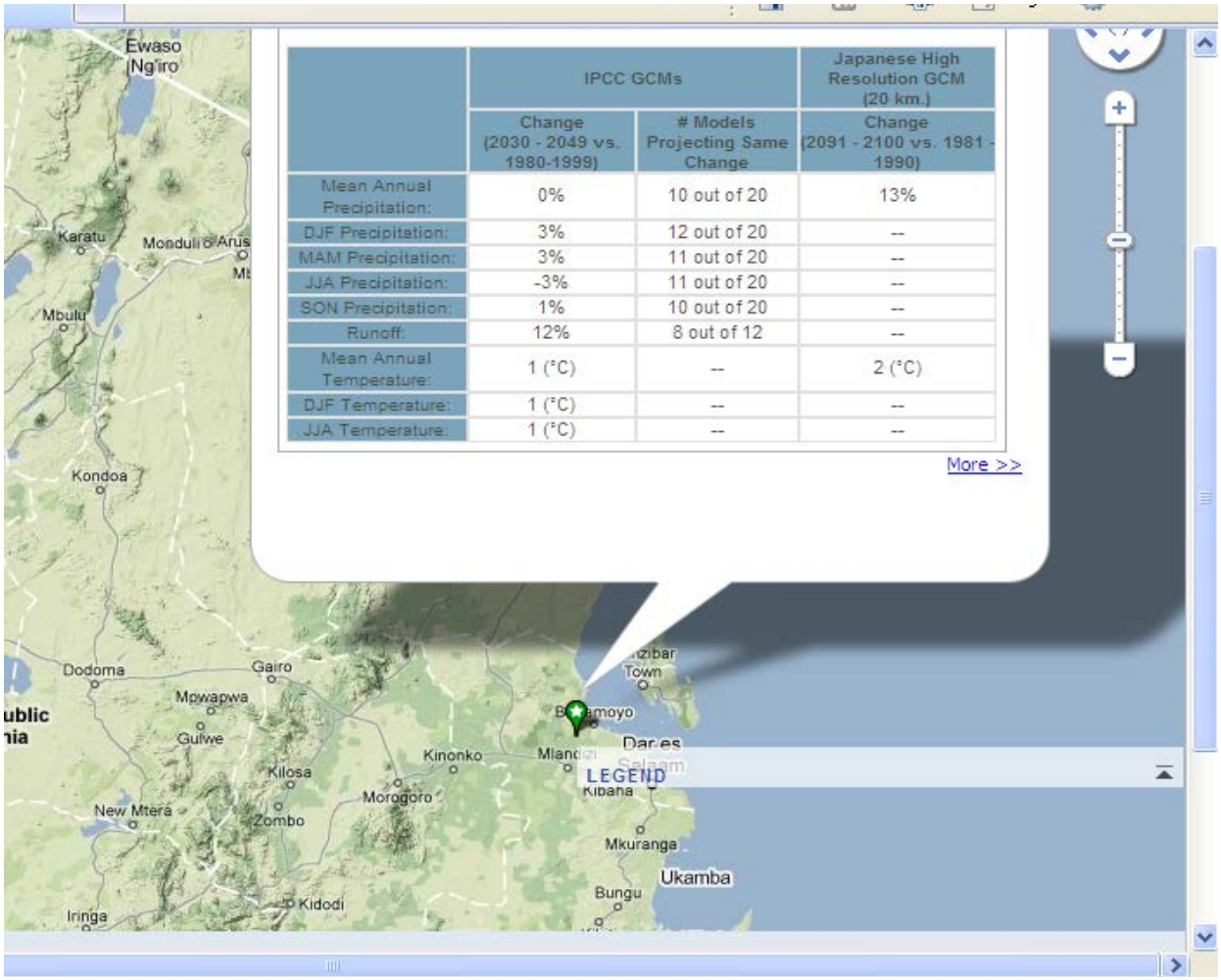
Figure 2 Mean monthly rainfall variation Data source: Tanzania Meteorological Agency, 2008

From the World Bank Climate data portal (http://sdwebx.worldbank.org/climateportal/) , Bagamoyo climate projection analysis shows projection using various General Circulation Model (GCM) (Table 1 and Figure 3). Based on the IPCC, GCM it was predicted that in Bagamoyo, the Mean annual rainfall will increase by 1 % while the mean annual temperature

will increase by 1^0C . Runoff will increase by 15% a situation which contributes to floods. Japanese model has predicted Mean Annual rainfall to increase by 4% while Annual mean temperature increase will be by 4%

Table 1 Climate change Projections in Bagamoyo

Projections	IPCC GCMs		Japanese Resolution GCM (20km)
	Change (2030-2049) vs (1980-1999)	#Models Projecting same change	Change (2091-2100) vs (1981-1990)
Mean Annual Rainfall	1 %	12 out 20	4 %
Dec, Jan, Febr Rainfall	4%	14 out 20	-
March , April, May Rainfall	4%	13 out 20	-
June, July August Rainfall	-3%	12 out 20	-
Sept, Oct, Nov rainfall	0%	10 out 20	-
Runoff	15 %	9 out 20	-
Mean Annual Temperature	1^0 C	-	2^0 C
Dec, Jan, Febr Temperature	1^0 C	-	-
June, July , August Temperature	1^0 C	-	-



	IPCC GCMs		Japanese High Resolution GCM (20 km.)
	Change (2030 - 2049 vs. 1980-1999)	# Models Projecting Same Change	Change (2091 - 2100 vs. 1981 - 1990)
Mean Annual Precipitation:	0%	10 out of 20	13%
DJF Precipitation:	3%	12 out of 20	--
MAM Precipitation:	3%	11 out of 20	--
JJA Precipitation:	-3%	11 out of 20	--
SON Precipitation:	1%	10 out of 20	--
Runoff:	12%	8 out of 12	--
Mean Annual Temperature:	1 (°C)	--	2 (°C)
DJF Temperature:	1 (°C)	--	--
JJA Temperature:	1 (°C)	--	--

Figure 3 Climate change projection for Bagamoyo area

Source: (http://sdwebx.worldbank.org/climateportal/.)

2.4.2 Vegetation

The Bagamoyo District Profile (2009) classified land cover and the vegetation into two (2) ecological zones. The coastal strip is characterized by savannah and bush; in contrast to the East North and Western up country which is covered with natural dense forest .The coastal strip usually receives relatively more precipitation than the upcountry part (Bagamoyo District, 2006).The general district topography is characterized by gentle undulating plains covered by sparce vegetation . Mangroves swamps and trees cover the costal belt. Dominant soil types include Sand, Loamy, Sandy- loamy and clay soils (Bagamoyo District, 2006)

2.4.3 Drainage

The District has three main perennial rivers namely Wami, Ruvu and Msua. Charcoal dams (locally made dams in the black cotton soil that temporally stores water for small scale irrigation) and small ox-bow lakes are also available in some areas. According to the Tanzania drainage system, the Wami and Ruvu rivers in Bagamoyo district are among the largest three rivers in the country (National Bureau of Standards, 2007) and contribute significantly to the economic values of people in the district. They are used either as agricultural potential zones or as source of fishing industry, and water for domestic use.

2.5 Rationale for a rapid assessment of coastal community vulnerability and adaptive capacity

Bagamoyo coastal communities have experienced climate change impacts on their livelihoods (NAPA, 2007). Climate change effects on fishery and agricultural livelihoods have forced coastal farmers to explore ways to adapt to the existing climate shifting patterns (IUCN, 2009). These small adaptation actions are of great importance to Bagamoyo communities as they pursue more sustainable livelihoods (Raihan *et al*., 2010).

Previous coastal climate change studies in Bagamoyo emphasized the effect of climate change on coastal tourism (Mushi, 2009), and adaptation indigenous knowledge (Andrew, 2009, Tobey et al., 2011; Ngana *et al*. forthcoming) with less emphasis on marine coastal resource dependent community vulnerability. This study will focus on the overall Bagamoyo marine coastal resource dependent community vulnerability status. The analysis will help planning future effective and workable district adaptation actions for all coastal marine resource dependent communities.

3. VULNERABILITY ASSESSMENT RESULTS / SOCIETY ADAPTIVE CAPACITY

3.1 Adaptive capacity category comparison

Each village was rated on 40 different questions linked to four main themes:

Governance and leadership
Coastal Resources Management (CRM)
Risk Awareness and Emergency Response (RA)
And Economy and Society (ES)

The raw scoring is not reported here, rather summarized in Table 1 by location and by theme based upon the fraction of total possible score for each factor. Overall, governance and leadership was rated the highest and risk awareness/emergency response the lowest. Coastal resource management was the second highest rated capability followed by economy and society aspects. (Table 1). Governance and leadership capacity scores may be linked to changes in District administration as a result of disciplinary actions from Prime Minister's Office Regional Administration and Local Government (PMO-RALG). Central government has taken on a strong measure of control of Bagamoyo district decisions. Coastal resource management's relatively high rating could be influenced in part by a decade of TCMP work in Bagamoyo promoting coastal community good governance. More recently a number of NGO s have expanded their work in Bagamoyo communities to promote good natural resource governance.

Risk awareness and economy of the society fall well below the district average. . The major source of income in Bagamoyo's coastal communities is fisheries and small scale agriculture which are all climate dependent. There has also been a gradual shift to alternative sources of income such as upcoming tourism industry, new infrastructure providing new employment opportunities, and increasing socio-economic supporting NGOs.

The very low risk awareness scores in the villages examined is due to the very limited district engagement in natural hazard and climate change adaptation activities. A few projects like PWANI, conducted selected vulnerability assessment and facilitated small doable adaptation and CBOs such as the Bagamoyo Non-Governmental Organization Networking (BANGONET) has also conducted some few climate change adaptation outreach programs in selected villages. The low scores in risk awareness and emergency response indicate a need for much stronger district leadership, as villages by themselves cannot improve the network of communication and capacity for response.

Table 2 Vulnerability/adaptive capacity scores for assessed villages

ADAPTIVE CAPACITY CATEGORY Scores represent fraction of total possible score for the category					
Villages	Governance and leadership (GL)	Coastal resource Management (CRM)	Risk Awareness and Emergency Response (RA)	Economy and Society (ES)	Total score for village as percent of maximum possible
Kondo	0.622	0.406	0.271	0.222	0.380
Pande	0.844	0.406	0.313	0.361	0.481
Kaole	0.533	0.531	0.167	0.444	0.419
Dunda	0.622	0.563	0.417	0.361	0.491
Kiharaka	0.444	0.563	0.167	0.417	0.398
Makurunge	0.733	0.594	0.333	0.472	0.533
Saadani	0.444	0.406	0.229	0.472	0.388
Overall average Score per category	0.606	0.496	0.271	0.393	
Overall district average score					0.441

3.2 Village adaptive capacity inter-comparison

Bagamoyo villages exhibit a wide range of adaptive capacity scores. Some villages are above the district average capacity and some are well below (Table 2) For example, Makurunge, Dunda, and Pande have scores for adaptive capacity that are above the district average, but for different reasons. Makurunge village has fairly strong leadership that is closely influenced by its proximity to Bagamoyo town due to the new town setup. The village also scored the highest in natural resources management.

Dunda village is situated at the heart of Bagamoyo town in which there are more tourism activities and alternative livelihood sources. The village is also influenced by the presence of the district capital which necessitates local good governance administratively and in natural resource. The village is also where most of Bagamoyo district employees live and where DIDMAC meets, thus ranking fairly high in emergence preparedness and society economy.

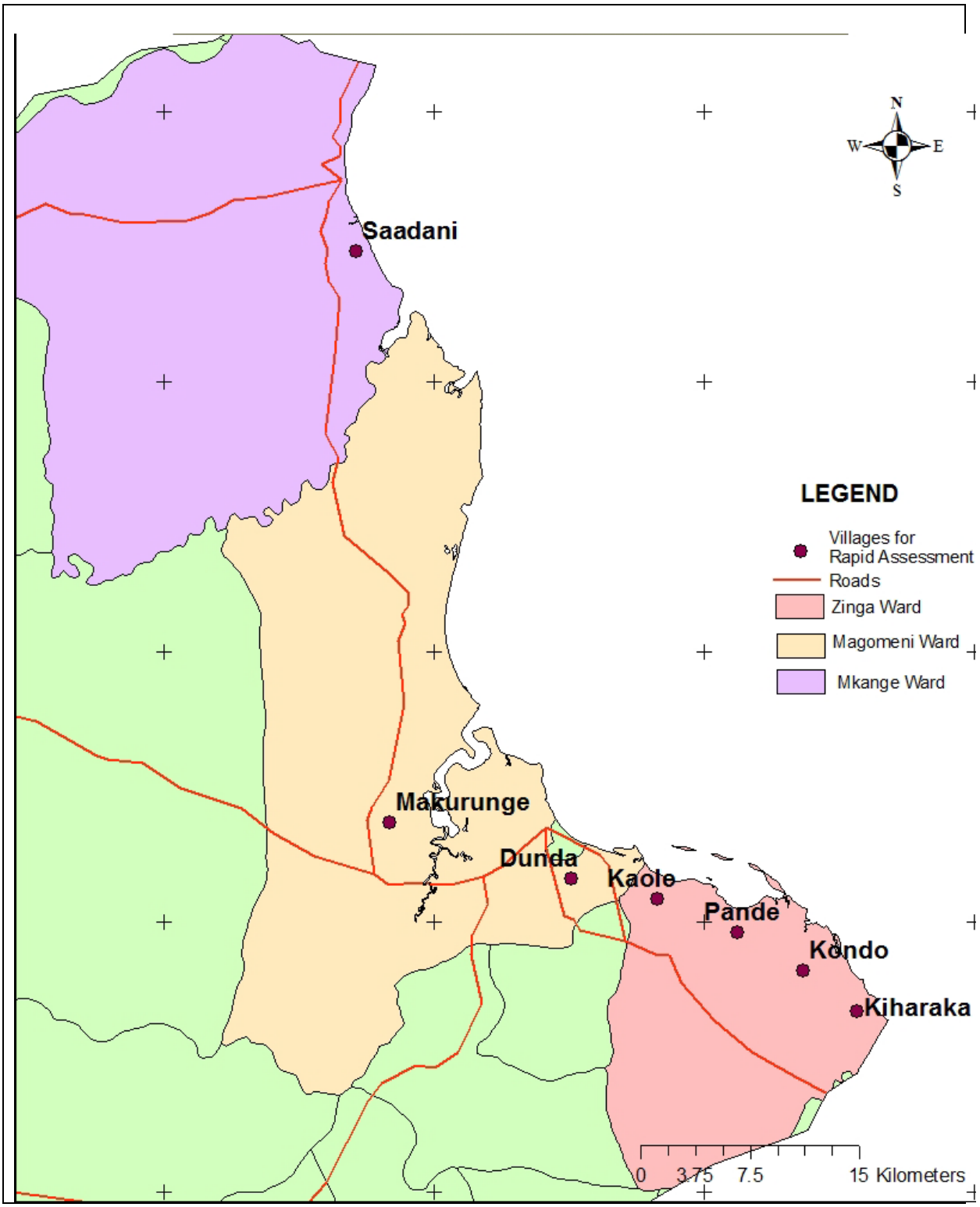


Figure 4 Location of villages included in assessment

Pande village is very close to the district administrative center. The village has strong leadership and fair risk awareness. Risk awareness is due in part to PWANI previous climate change activities, and district promotion of alternative livelihoods due to fish catch fall.

On the other hand some villages like Kiharaka and Kondo are among those with less adaptive capacity. Kiharaka has local governance problems, low risk awareness with few alternative livelihood sources. The village's main source of income has remained to be fisheries and agriculture which are all climate dependent. The village has a lot of land disputes due since it borders Dar es Salaam whose population is growing very fast. Kondo village has slightly below district average risk awareness due to the NGOs and district preference working with the neighbor Mlingotini village. The Kondo economy is also weak due to high dependence on climate dependent livelihoods

3.3 Climate change impact on key sectors in Bagamoyo

3.3.1. Agriculture

From the key informants and interviews conducted it was noted that apart from fisheries and ecotourism, agriculture is an increasing activity for the typical Bagamoyo resident. District officials and village key informants pointed to decreased production of both food and cash crops in recently years is among other factors caused by changing climate patterns and shift in seasons. For example, in 2005 the production was at its peak, and gradually dropping in 2006 through 2008.Overall the general trend shows decreasing in production with exception of 2004/2005 increment (Figure 5).

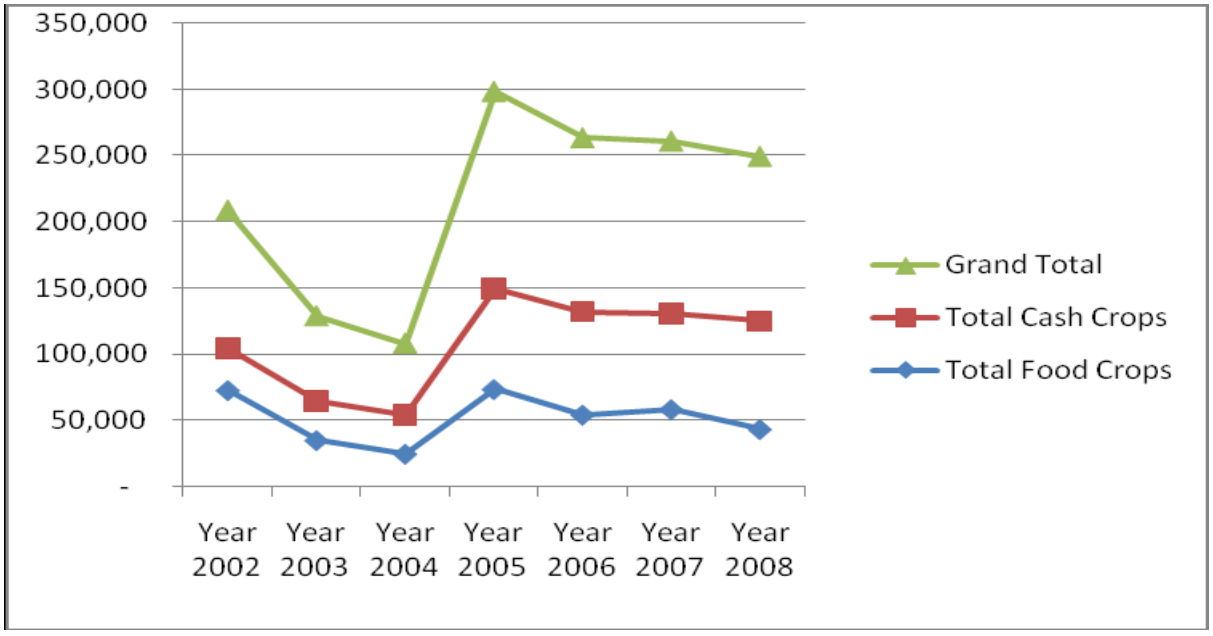


Figure 5 Bagamoyo cash and food production trend

Source: Bagamoyo District, 2009.

3.3.2 Fisheries

Bagamoyo is one of the prominent fishing districts in Tanzania. Conducted survey indicated that apart from increasing effort and bad fishing practices, increasing temperature is the major concern contributing to low catch for most of the fishers. For example, artisan fishers conduct fishing activities mainly near shores and in coral reefs. To get good catch during hot seasons, fishers' have to go further seaward. With poor vessels and gears, deep sea fishing is not possible in many cases resulting into the decrease in the catch per unit effort (Figure 6).

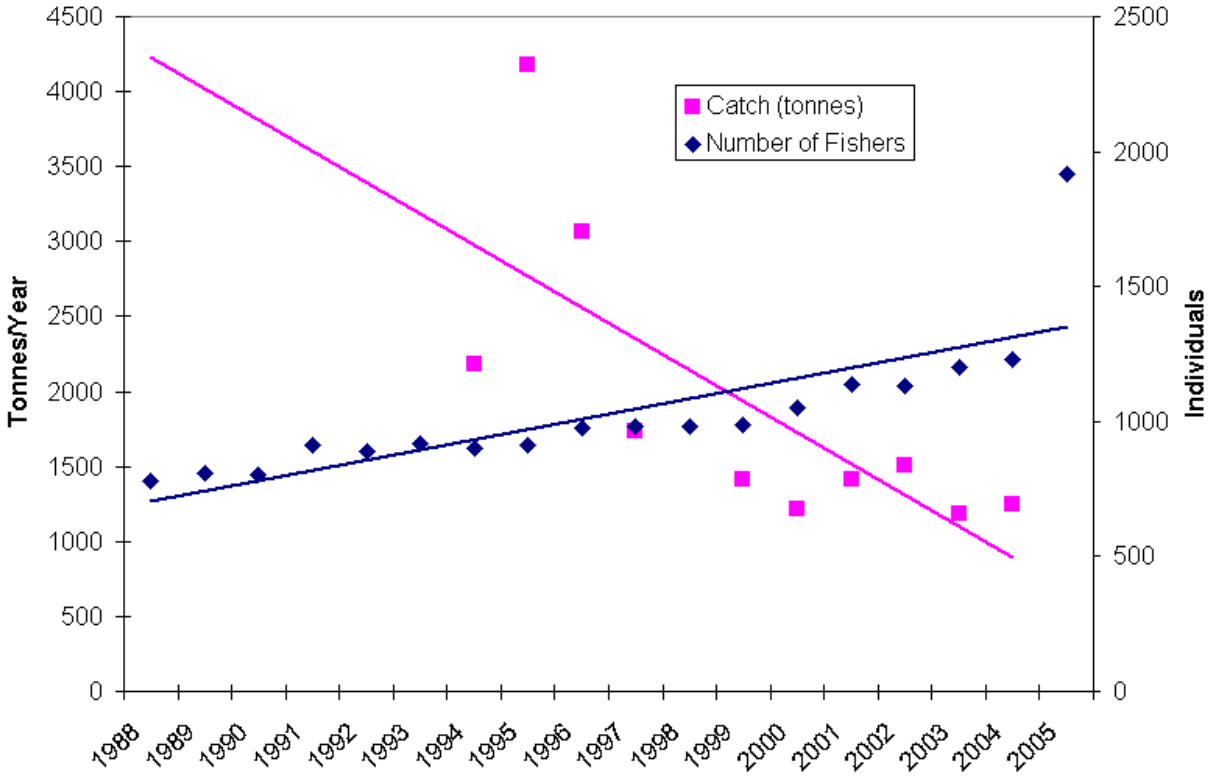


Figure 6 Artisanal Catch and Number of Licensed Fishers In Bagamoyo District

Source: Bagamoyo District Natural Resource Office, 2005, reproduced from Coastal Resources Center, 2005).

3.3.3 Tourism

Bagamoyo community has shown that coastal tourism related natural resources are vulnerable to coastal erosion and shoreline changes. Villagers have witnessed eroded beaches and shifting shorelines. These have affected old historical buildings, bomas, and have claimed beautiful scenery beach (Figure 7). Changes in turn affect coastal tourism, one of the increasingly booming activities in Bagamoyo district.

Figure 7 Beach erosion collapsing old Boma important tourist visit areas at "Kastamu/Customs", Bagamoyo

3.4 Indigenous sustainable adaptation options

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The Bagamoyo community has for some time experienced the impact of climate change in their livelihoods. To counteract the effect of the change, the community has had employed some of the long term sustainable measures. These measures are termed as adaptation options to climate change. Some of the adaptation options that the community has employed involve climate independent activities such as petty business, increased access to financial services (SACCOs and VICOBA), shift of livelihood activities, enhancing growing indigenous drought resistant crops, homestead small scale irrigation, and small scale water harvesting. Examples of different adaptation options identified in the course of the analysis are listed in Table 3.

Table 3 Summary of the different existing adaptation options

Village	Potential adaptation activity
Kiharaka	Irrigated gardening from piped water and Mpigi river Cassava[1] farming Existence of Women VICOBA supported by CARE to support small scale business and diversify livelihood. Free villagers mason training offered by the Catholic church
Pande	A few women practice vegetable small scale irrigation Change in livelihood and employ non climate dependent activities The use of natural drought resistant crops(Cassava) The presence of VICOBA as supported by CVM/APA
Kondo	Cassava growing Livelihood diversification, i.e. Fisheries to petty businesses Beekeeping
Dunda	Shift in socio economic activities, i.e from fishing/agriculture to petty and tourism business and masons Cassava cultivation Migration to more agricultural productive areas, for example Kiwangwa.
Kaole	Incorporate villagers into village growing economy by:- • Establishing tourism market center where villagers could sell local commodities • Rationing part of the Kaole antiquity earnings to the village governments • Employ unskilled and semi-skilled manpower to the forthcoming nearby EPZ/SEZ. Enhance alternative livelihood by providing technical support and value add to sell to tourists and Kaole growing population Providing access to small grants such as SACCOs
Makurunge	Shift livelihoods, i.e. Fishing and upland farming to lumbering Adopt additional crops form immigrants(Pineapples) The village government has village reserved land for future planning District distributed early maturing crops such as Cassava and maize Awareness raising by NGOs such as Red cross
Saadani	Migration to other villages for agricultural activities i.e. from Saadani to Mkange village Shift of livelihoods from agriculture and fishing to saltworks, and petty business School water harvesting tanks

[1] Cassava is a drought resistant crop

4. CONCLUSION AND RECOMMENDATIONS

This assessment has yielded observations of climate change signals in Bagamoyo district. The district has evidence of shoreline changes, beach erosion, unreliable rainfall and increasing temperatures in dry seasons. These have seriously affected Bagamoyo community coastal agriculture, fisheries and partly booming tourism industry. Unless there are serious efforts to adaptation, the district is vulnerability to the impacts of climate change will increase in a few decades. Increased district vulnerability will also have a multiplier effect to the country's GDP. Recommended actions to minimize climate change impacts from a district wide perspective fall into the four main themes addressed in the assessment. Every one of the villages reviewed in this assessment would benefit from an individualized vulnerability assessment.

Governance and leadership (GL)

Although most of villagers get climate change extreme weather condition information thought radios, they do not have adequate knowledge on adaptation/coping measures to take. The district should consider upgrading existing "information section" which is under DEDs office to disseminate information and promote knowledge on adaptation and/or coping mechanism to village level. The information section can also attract investors to set up district radio specials to discuss district issues, climate change adaptation included.

Currently issues pertaining to climate change adaptation have no specific funds allocated and are addressed as emergency cases under DIDMAC. In order to secure permanent fund from the central government for adaptation, special capacity building attention needs to be made to village leaders at grassroots. This is because the Government of Tanzania has adopted "Bottom up" planning approach which will allow adaptation funds planned from the village priorities.

Coastal Resources Management (CRM)

Bagamoyo community residents have some indigenous adaptation measures that villagers use to survive. Though these measure have low productivity due to lack of expertise and extension service, there need to enhance and provide technical assistance to indigenous adaptation options. This value addition to existing knowledge will increase efficiency and save time and money to successful adaptation.

BMUs are the other grass root legal entities in which the district can reduce impact to climate change. BMUs under the district fisheries section have the mandate to conserve and manage coastal resources. Under the conservation aspect, these legal entities can be strengthened and capacitated to advocate climate change adaptation at grassroots level. The groups can be used to stimulate the community engagement into alternative co-benefiting livelihoods, that promote conservation at the same time strengthening community purchasing power. District forest department has laid out plans to conserve existing forest and planning new fast growing trees. These good plans, however the plans could be value added by integrating agriculture, forest and beekeeping at district level to produce a sound output catering for

climate change adaptation. For example instead of planting mere fast growing trees, three departments could have a combination of fruit trees that will benefit community around and provide an incentive to conserve the forest. Nectar from pollinating fruit trees will also serve beekeeping activities. The sale from fruits and honey will provide and alternative source of income and good health to the community. Alternative source of income, good health and sustainable less climate dependent livelihood (beekeeping) contribute significant in build a resilient community.

TAFORI is tasked to closely work with district to produce sound results to the central government decision makers. This collaboration can be well utilized by the district to request for research on different tree and tree products that adapt to climate changes. For example forest departments would request research on improved tree varieties that withhold nectar for a long time or have long time seasonal flowering to serve beekeeping as an alternative livelihood to climate change.

Risk Awareness and Emergency Response (RA)

Bagamoyo district has a weather gauging station which has only rainfall reliable data. The station has to transfer data to TMA for analysis and processing into secondary usable form. To improve efficiency in climate change adaptation, the district in collaboration with the agency may consider the upgrade the water gauging station to weather forecast small town satellite station. Information obtained from the station will directly be utilized by DIDAMAC, fisheries, and agriculture and water sectors at district level to make appropriate adaptation decisions. The information section under DEDs office can also us the information to directly alert villages to take appropriate adaptive decisions.

Economy and Society (ES)

District community development department has the mandate to coordinate NGOs and/or CBOs activities pertaining to community wellbeing in the district. From African context and climate change perspective, vulnerable groups whose wellbeing need close attention include women, children, disabled and people living with HIV/AIDS. Community development department has an opportunity to use the CBO/NGO coordination function to introduce the climate change adaptation of concept to all CBOs/NGOs activities to improve the wellbeing of the marginalized and community. The department has also an opportunity to scale up existing TCMP-PWANI project pilot demo adaptation activities in Bagamoyo to other NGOs and/or CBOs

Under WSDP funded by World Bank, and VPO coastal water program funded by UNEP Tanzania districts have the mandate to select critical water insecurity villages to implement water projects. This opportunity can then to be utilized by coastal district to reduce water scarcity to coastal salt inundated well in Bagamoyo district by introducing sustainable rain water harvesting systems. Water accessibility will also address gender issues in many perspectives, that is, women time saved to fetch water to be used in alternative livelihood, community sanitation issues, increased girls' school performance due to saved time, and pregnant mother health. Moreover, the district should consider strengthening established village WATSAN committees to properly manage and conserve water making water projects sustainable.

Like the rest of the districts, DADPs program under the ministry of food security and irrigation has been operating in Bagamoyo. The program offers opportunity secure alternative livelihoods, SMEs trainings and technical support, and improved seed variety experimentation and distribution. The program has been successful in non-coastal villages but has limitation to Bagamoyo coastal villages due to the threat of EPZ establishment. On other hand, the district has an opportunity to use the program to establish climate change adaptation intellectual capacity building and facilitate movable livelihoods that cannot be affected upon establishment of EPZ. Moreover, with EPZ established, the program can establish strategies for accessible and reliable cash crop markets for small scale farmers

Bagamoyo district has collaborations with Chambezi Experimental station, a substation of Mikocheni Agricultural Research Institute under the Ministry of food security and irrigation. Collaboration strengthened can result into agriculture department increased efficiency in obtaining and distributing improved climate change adaptive seeds and crops to subsistence coastal smallholder farmers. This is because Chambezi Experimental station is utilizing Bagamoyo weather to experiment on crops and seeds developed, and is near Bagamoyo town thus saves cost and time.

Tourism is one of the major booming activities in Bagamoyo town. According to the district forest officers, the use of tourism value forest non-wood products is still low. Value addition of forest non-wood products such as curving, ornament, tested and certified herbal medicine, the use trees resins as glue and processed bark cloth is another safe way to diversify coastal fisheries and agriculture dependent livelihoods

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APPENDIX 1

Table 4 Transect walk GPS points

Transect walk GPS points summary table						
Village	POINT A	POINT B	POINT C	POINT D	POINT E	POINT F
Kiharaka	0510202 9272741	0510303 9273299	0510227 9273498	0510139 9273634	0510193 9273833	0510354 9274292
Pande	0497617 9282083	0497618 9282074	0496064 9283834	0494748 9283854	0494384 9284137	
Kondo	0500909 9283299	0500828 2983119	0500569 9282865	0500569 9282635	0500396 9282450	0500388 9282272
Dunda	0489977 9288349	0489838 9288125	0489789 9288033	0489290 9288166	8489331 9288731	
Kaole	0493208 9258762	0493311 9258793	0493298 9285807	0493438 9285978	0493523 9286100	0493655 9286313
Makurunge	0475547 9284130	0475815 9284535	0475905 9284744	0475976 9285228	0475985 9285382	
Saadani	0475624 9332071	0475183 9332214	0474637 9332133	0474123 9332123	0474659 9332275	0475279 9332243