

Climate Change Adaptation Series: Document 3

VILLAGE VULNERABILITY ASSESSMENT AND CLIMATE CHANGE ADAPTATION PLANNING (V&A): KITONGA VILLAGE, BAGAMOYO DISTRICT, TANZANIA



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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
9. Village Vulnerability Assessments and Climate Change Adaptation Planning (V & A): Kitonga and Mlingotini Villages, Bagamoyo District (Summary Report)
10. Village Vulnerability Assessments and Climate Change Adaptation Planning (V & A): Mwembeni, Pangani District
11. Village Vulnerability Assessments and Climate Change Adaptation Planning (V & A): Sange, Pangani District

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Cover photo: New rice culture technique being tested in Kitonga
Photo credit: Don Robadue

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1. INTRODUCTION

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 on top of and in addition to existing local stresses. In most of coastal Tanzania, these include deforestation, over fishing, deterioration in water supply and quality, and development pressures.

Beginning in 2010, the 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). This 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.

The initial work on climate change targeted two coastal, rural villages in Bagamoyo District – Mlingotini and Kitonga. Kitonga is not directly on the coast, but is in the flood plain of the Ruvu River (Figure 1). Here, people are also very dependent on the natural resource base for agriculture, especially rain fed rice farming, vegetables and fruits. In these rural villages people are close to the sea, the rise and ebb of the tide, and the seasonality of rain and prevailing winds. They are aware of climate change and climate variability and how it is impacting their lives.

The Pwani Project, in partnership with District government staff and CEEST, a local NGO began a process of meeting with and working with village leadership in the two locations to conduct village-level climate change vulnerability assessments and adaptation planning (V&A). In each village, a 12 person Community Climate Change Committee (4C), with an equal number of men and women was formed. This report documents the methods used and results of the V&A.

Specific objectives of village-level V&A include the following:

- Develop awareness and understanding of climate change impacts, vulnerability and adaptation options

- Find local champions for climate change adaptation actions
- Demonstrate low cost, low technology methods for vulnerability assessment and adaptation planning
- Share experience and best practices across villages and with District government

The overall goal is to maintain healthy coastal ecosystems and reduce the harmful effects of climate change impacts on coastal communities. The intention of the Pwani project is to transfer and build on the lessons learned from this experience in V&A to other coastal villages in the Pwani Project area.

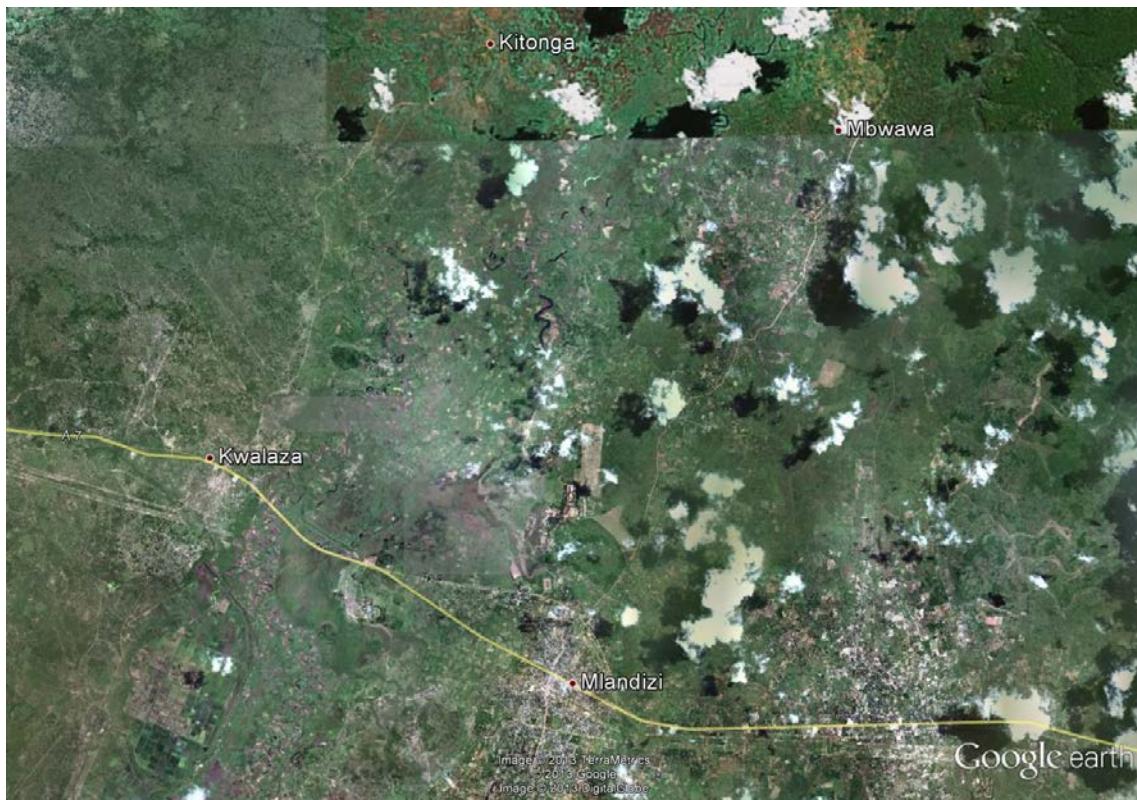


Figure 1 Aerial View of the Ruvu River Flood Plain along with position of Kitonga Village

2. METHODOLOGY

Vulnerability is defined as the degree to which a human or natural system is susceptible to, or unable to cope with, adverse effects of climate change. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity.

Following the guidance of the USAID report “Adapting to Coastal Climate Change: A Guidebook for Development Planners” (available at <http://www.crc.uri.edu/download/CoastalAdaptationGuide.pdf>), this V&A exercise sought to understand the **potential impact** of climate change and climate variability and develop an initial list of response options (planned adaptation measures). **Planned adaptation** is a process of deliberate decision making to take societal actions to reduce harm or exploit beneficial opportunities in response to actual or expected climatic changes or their impacts.

Potential impact is a function of both climate and non-climate stresses and vulnerability factors. Vulnerability factors are the types and amount of assets at risk (**exposure**), the degree to which those assets and people are impacted (**sensitivity**), and the ability to cope with actual or expected changes (**adaptive capacity**).

Kitonga was selected because of its vulnerability to climate change threats and locally expressed interest in assessing climate change and finding ways to limit harmful impacts. Kitonga village is located close to the Ruvu River and is influenced by river flooding events. Kitonga village was formally a sub village of Kidogozero village but now is a registered village with 5 sub villages (these are Mtambani, Shuleni, Msawanga, Mji Mpya and Kisiwani). Kitonga is relatively small in population size, in the order of 2,000 residents.

Qualitative focus group meetings were used to gather information from villagers on vulnerability and adaptation options in August 2010. The focus group comprised of 12 individuals, with an equal number of men and women. Focus Group members were comprised of village leaders from the Village Council and other positions of leadership.

When meeting the group, the objectives of the meeting and the meaning of climate change were explained. In Swahili, climate change can be translated as 'tabia nchi' = climate and 'badiliko' = change'. Most of the participants were already aware of climate change and how menacing it can be though the main understanding focused on weather change.

During the discussion, a flip-chart was used to record information. This was done by one researcher and another acted as a facilitator of the session. The facilitator moderated the group process and also:

- Acted as a catalyst between the individuals of the group
- Integrated dominant and quiet people and made sure that all group members were able to express their opinions
- Made sure that the group kept to the topic while being flexible in handling additional important information
- Repeated in his own words what people said to confirm that there was a good understanding
- Supported the note-taker in gathering all relevant information



Figure 2 Focus Group discussions at Kitonga Village

Participatory Rapid Appraisal (PRA) tools were applied with the village focus group. The tools that were used included the following:

1. **Seasonal calendar.** A seasonal calendar is a participatory tool to explore seasonal changes (e.g. rainfall patterns, food availability, income, gender-specific workload, diseases, and expenditure) that affect vulnerability.
2. **Community time line.** The purpose of the time line is to help the community better understand what historic natural and human events have influenced the lives of the communities. It facilitates discussion and examination of past trends and problems. It is useful in adaptation planning to think back on these past events and experiences and look at how they influence present attitudes and community responses. The events which are recorded on the time line may include movements of people, introduction of new technology, natural disasters, and development decisions. In developing a time line community members record back as many generations as they can.
3. **Community animal and plant inventory.** The purpose is to collect information on local biodiversity. Communities often build an intimate knowledge of the plants and animals which share their land. The inventory provides for a quick method of obtaining what plant and animal types are known to be within a community's boundary.
4. **Review of results** and linking results from different tools to climate change. The purpose is to identify climate change impacts with respect to the seasonal calendar, community time line and inventory of plants and animals. This can include changes in seasonality, changes in the intensity and frequency of storms and precipitation, and changes in abundance of plants and animals and their cause.
5. **Identification of concerns and opportunities.** The purpose is to help the focus group to identify and prioritize specific community concerns and to look for possible ways to solve or address them.
6. **Identification of community values.** The purpose is to encourage discussion about what community members feel are important objects, assets or cultural values and what they wish to maintain into the future.

7. **Priority community values.** The purpose is to assist the focus group to determine which objects, assets or cultural values are of greatest importance to the group as a whole.
8. **Root cause analysis.** The purpose is to determine whether climate change is a contributing factor to identified community concerns. Root Cause Analysis is a useful tool that enables the focus group to identify the many parts of a problem, the dominant causes and the most effective areas for action.
9. **Two way vision.** The purpose is to determine how communities perceive climate change will impact their lives and how they would like their future to be like instead.
10. **Assessment of adaptation options.** The purpose is to identify a range of actions that could be undertaken to address issues relating to impacts of climate change or integrity enhancement objective (for example, maintain a certain reef area in good condition, or protect a certain forest area) while also meeting community development objectives. Systematically, the focus group assesses the appropriateness and prioritizes each of these possible actions for each climate change issue or objective.
11. **Community action plan.** With agreed to priority adaptation actions, the focus group defines WHO will be responsible for it, WHAT resources will be needed and by WHEN it will hopefully be completed.

3. CLIMATE CHANGE PROJECTIONS AND TRENDS

Large scale climate change models and projections, such as those of the Intergovernmental Panel on Climate Change (IPCC), as well as on-line regional mapping tools and downscaling models provide a starting point to understand large-scale climate change projections but lack the resolution and specificity needed to assess climate change at the scale of individual villages, or even Bagamoyo District.

The overall projection for Tanzania is that sea level will rise, surface water temperature and ambient air temperature will rise, the sea will become more acidic from carbon sequestered in the sea which then forms carbonic acid, and areas with bimodal rainfall patterns (as in Kitonga) will experience increased rainfall events, but also drought. These are the trends suggested by existing models and research.

More intense rainfall over the rainy season can cause flooding and loss of crops. Higher sea temperature can result in coral bleaching and mortality, increase incidence of disease in marine animals, and alter the seasonality of biological events and abundance and distribution of fish.

From this starting point, the village level V&A sought to overlay local knowledge on climate trends that are beginning to show themselves in the village and to plan accordingly. For example, local knowledge can help answer the basic question: “Has the frequency, magnitude, or timing of precipitation, flooding, or drought events changed in the last several decades?” By integrating best available scientific knowledge with local knowledge, communities and government can take responsible action even in situations where there is imperfect climate change information.

4. LOCAL KNOWLEDGE ON CLIMATE CHANGE TRENDS AND IMPACTS

The use of the Participatory Rapid Appraisal tools with the focus group in the village resulted in information on seasonal changes, historical trends, and changes in plant and animal biodiversity that could be partly caused by global climate change and climate variability. Kitonga has been subject to a long history of environmental degradation and non-climate stressors making it difficult to associate many of the environmental and resource trends with global climate change.

Kidogozero village, about 70 km inland from Dar es Salaam, consists of a number of discrete groups of homesteads, separated by seasonally-flooded land, extending more than 2 km along the west bank of the Ruvu River and set back about 0.5 km from it. Kitonga sub-village is a nuclear settlement, well away from the river and 2 km from Kidogozero.

The Ruvu River has permanent water, though seasonal levels vary by about 10 meters; at its lowest level, water in the main sandy riverbed may be less than 1m deep. It is at this season when crocodiles (which are protected under Convention on International Trade in Endangered Species - CITES) present a maximum risk. Kitonga village has about 300 households. These households are involved in production of different vegetables. These perishables are taken to Dar es Salaam market every day. Some fishing (in river channels and lakes) is also carried out in lakes formed by the meandering of the Ruvu River.

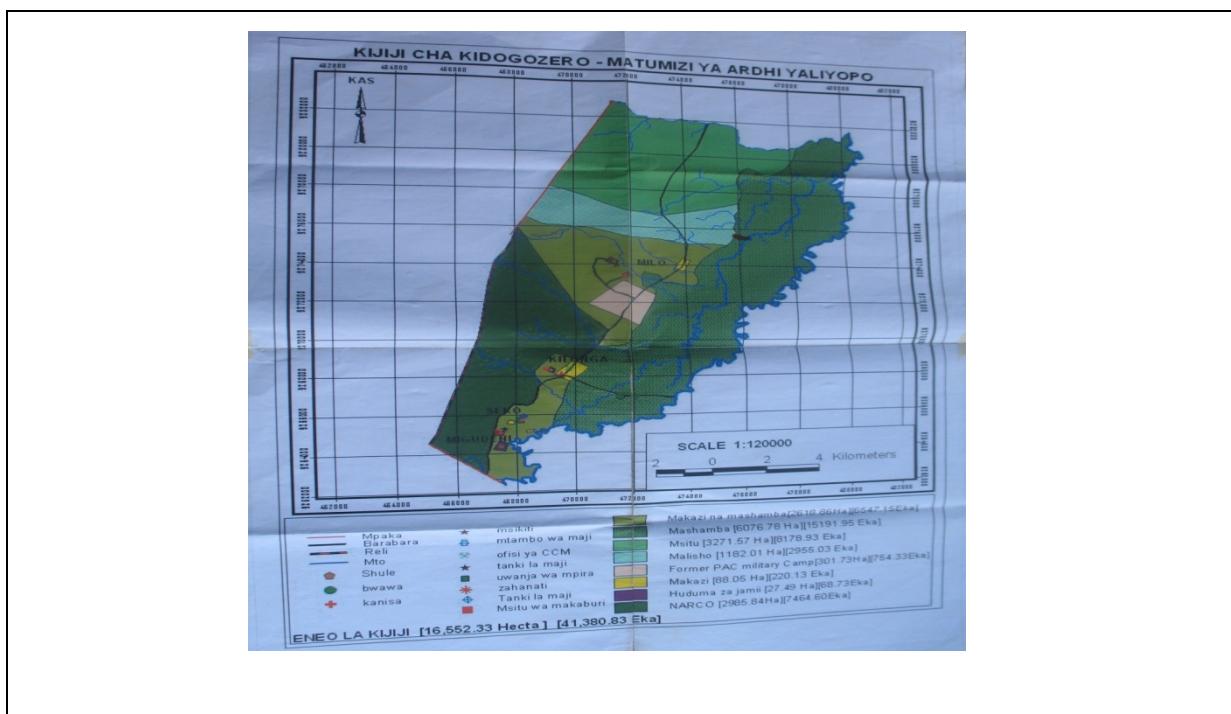


Figure 3 Kidogozero Village Land Use Plan including Kitonga

Although the climate models predict areas with bimodal rainfall patterns will experience increased rainfall, the observation of the Focus Group is that there is an increasing tendency for both floods and drought. It seems that while there is more intense rain during periods of the rainy season, there is less rain at other times. These trends are validated by historical data on Ruvu River mean flow. The two figures below show that flow during rainy season has

increased significantly in the past 50 years while there is a declining trend in mean annual flow (Yanda, 2007).

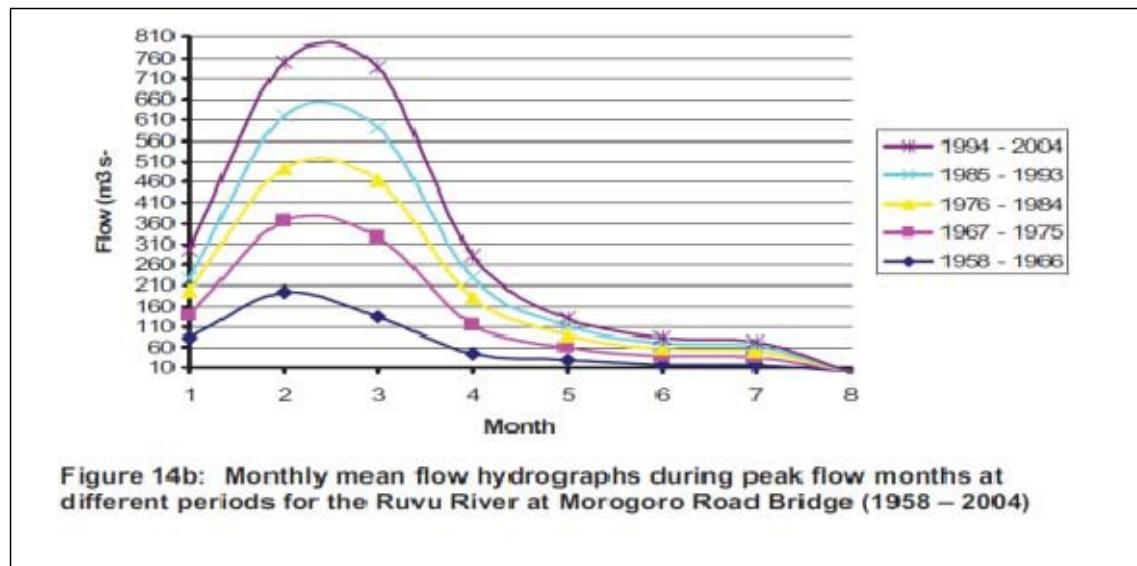


Figure 14b: Monthly mean flow hydrographs during peak flow months at different periods for the Ruvu River at Morogoro Road Bridge (1958 – 2004)

Figure 4 Monthly mean flow of the Ruvu River near Kitonga Village

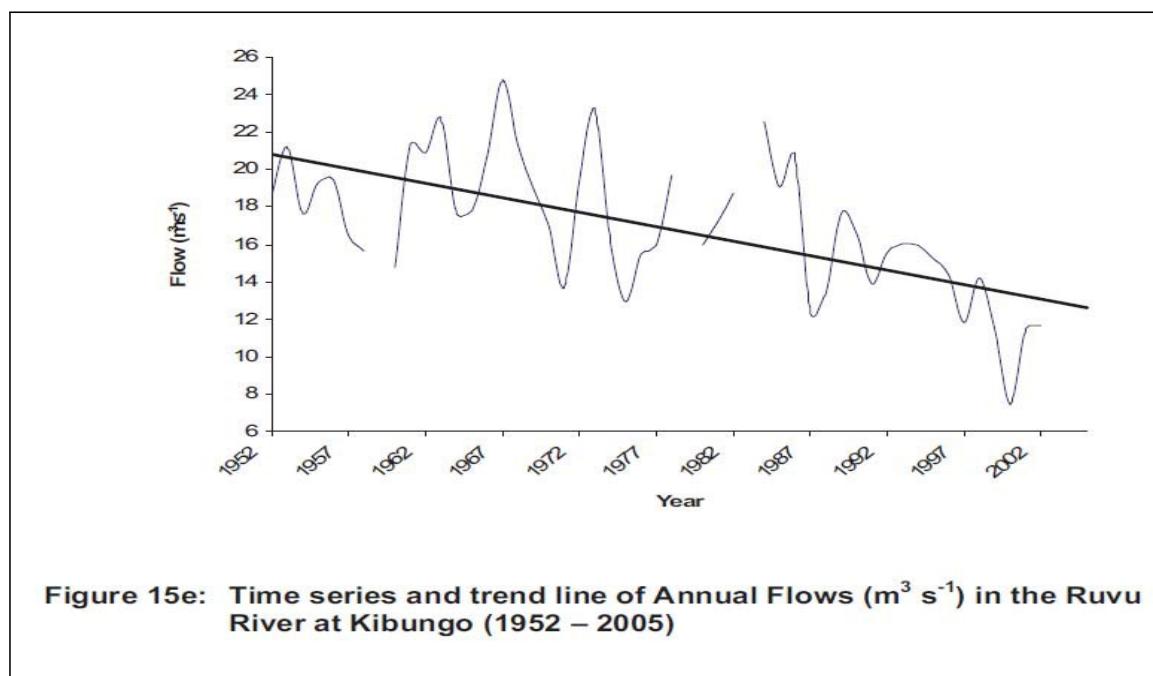


Figure 15e: Time series and trend line of Annual Flows ($\text{m}^3 \text{s}^{-1}$) in the Ruvu River at Kibungo (1952 – 2005)

Figure 5 Annual flow trends of the Ruvu River

The timing and intensity of the long and short rains are no longer reliable. In the past, rains early in the primary rainy season were heavy and these were followed later by small continuous rains which resulted in a good soaking of the soil. Presently rains early in the season are heavy and these are followed by dry conditions, which are not conducive to crop growth. For example, the drizzle that used to fall at the end of the rainy season has disappeared. This drizzle helped cassava to grow well. Now, yield and quality of cassava has diminished. Rains in the smaller rainy season in October are now of short duration (barely

more than two weeks) and they are usually of low intensity compared with the past. Without predictable primary rainy season precipitation and smaller rainy season, agricultural planning under rain fed agriculture is difficult and food security is endangered.

In Kitonga, the primary impacts of concern, which the Focus Group believed are tied to anthropogenic causes of global climate change, are floods and drought. In 1996 and again in 2006, floods destroyed all food crops resulting in wide spread hunger in the village. Drought was experienced in 1997, 1998, 2000-2004, 2008 and 2009.

The seasonal calendar for Kitonga village falls within four periods, namely December to April, April to May, June to September and October to November respectively according to Table 1:

- October to February agricultural activities include land preparation and planting paddy. These activities are carried out by both men and women. In this period food is abundant in the village and is in the period of the end of the short rains and beginning of the long rains.
- March to May is the “Masika” (long rains) rainy period. The main activities are weeding paddy and scaring away birds. Food and income are very scarce at this time of the year.
- June to July some people would be tending crops (weeding and scaring away birds) while others would be harvesting paddy. The food situation is usually satisfactory at this time of the year.
- August to October is the beginning of the short rainy season. Agricultural activities include cultivation and harvesting of vegetables (pigeon peas, cowpeas, and maize). Food is usually abundant at this time of the year as every house hold will have harvested paddy.

Table 1 Summary of agricultural activities carried out in Kitonga Village

Month	Activities	Food Situation
October – February	Land preparation for agriculture and planting paddy	Food is abundant
March- May	Weeding paddy and scaring away birds	Food scarcity and low income
June - August	Weeding paddy and scaring away birds, paddy harvesting, and cultivation of vegetables	Food is abundant
September - October	Harvesting vegetables, short rains crop production (pigeon peas, vegetables, cowpeas, and maize)	Food is abundant

5. VULNERABILITY ASSESSMENT

Participatory rural appraisal methods were used in the assessment process to capture issues that members of the community were concerned with:

- 1) Increased food insecurity due to drought, plant pests and diseases and floods
- 2) Inadequate water for domestic use due to the long distance to get water by foot, and the high cost of purchasing water from water vendors
- 3) Damage to homes due to frequent floods
- 4) Low income due to lack of employment and differentiated products
- 5) Animal diseases as a result of inadequate fodder and water in the dry season

The participants further analysed their concerns and identified potential opportunities for addressing them.

Table 2 Concerns and Opportunities for Kitonga Village

Concerns	Opportunities
Decrease in food security as the results of: <ul style="list-style-type: none"> • Drought • Plant pests and diseases • Flooding of crops 	<ul style="list-style-type: none"> • Use of Ruvu River for irrigation • The use of dams for fish production • More vegetable production for food diversification • Careful use of pesticides to prevent crop diseases
Water problems for domestic uses: <ul style="list-style-type: none"> • Cost of water from vendors • Long walk to fill water containers and carry back 	<ul style="list-style-type: none"> • Construction of dam or wells for storing water • Constructing tanks for storing water • Development of a solar energy water supply system
<ul style="list-style-type: none"> • Destruction of homes from flooding 	<ul style="list-style-type: none"> • Construction of brick or cement houses with good foundations
<ul style="list-style-type: none"> • Loss of income <ul style="list-style-type: none"> ◦ No employment as the results of drought and floods ◦ No agricultural products to sell at the market 	<ul style="list-style-type: none"> • Irrigate using Ruvu River during drought • Grow fish by creating dams • More household vegetable production
<ul style="list-style-type: none"> • Inadequate fodder and water supply for livestock 	<ul style="list-style-type: none"> • Construction of wells for water storage
<ul style="list-style-type: none"> • Plant diseases 	<ul style="list-style-type: none"> • Careful use of pesticides

As described earlier, vulnerability factors are the degree to which the particular area and people are impacted (**sensitivity**), the types and amount of assets at risk (**exposure**), and the ability to cope with actual or expected changes (**adaptive capacity**).

Assets at risk and the community impact in Kitonga are shown below.

Table 3 Potential Impact of Climate Change –Kitonga

Asset at risk	Degree of impact
Property and Infrastructure	
Roads and property	Flooding erodes roads and damages homes, vegetation, and livestock along the main inundation and water flow routes
Ecological Assets	
Agricultural land and crops	Changing precipitation patterns and both flood and drought events have a dramatic impact on crop productivity and in some cases total loss of production
Landscapes and habitat	Flooding of the Ruvu River has been responsible for the inundation of riparian habitat
Social Assets	
Health and education	Flooding, drought, and changes in seasonality reduces agricultural productivity and the community's nutritional health. Reduced income affects families' ability to financially support children in school and may lead to children being pulled out of school.

Adaptive capacity refers to the ability of society to change in a way that makes it better equipped to manage its exposure and/or sensitivity to climate influences. A community with the capacities to adapt is likely to be more resilient or able to recover from stressful events and conditions.

A broad range of factors reflect adaptive capacity:

- Political leadership and commitment
- Systems of local government
- Resource availability (e.g., human, physical, technological, and financial)
- Social capital
- Communication systems
- Health of the environment

On a practical level, assessing adaptive capacity needs to answer questions such as:

Adaptive Capacity Questions
How well do community members work together on coastal development planning and coastal management, including coastal hazards?
What practices are currently employed to cope with natural hazards? Who is responsible for developing and implementing such measures? How effective are they?
Are decision-makers and the community in general informed and engaged?
Do most people rely on the same activity for their livelihoods? For example, does everyone rely on fishing or agriculture, such that a single event could leave everyone in the community very vulnerable?

In an emergency, are there multiple means of communicating or transporting people and supplies? Or will damage to a single road or bridge isolate the community?

How healthy are the ecosystems and how well are natural resources managed?

Assessing adaptive capacity of a place helps in understanding why vulnerability exists in the first place. To reduce vulnerability, stakeholders must understand its root causes. Root causes might include poverty, natural resource dependency and strong dependence on single livelihoods, weaknesses in local governance, degraded resources, and insecure or inequitably distributed property rights. Adaptive capacity can be strengthened through policies and actions that address the root causes.

On many levels, adaptive capacity in Kitonga is weak. Pervasive **poverty** and **lack of rules for effective water management** were identified as root causes of vulnerability. Also, it is the case that most people rely on the same activity for their livelihood (fishing, agriculture, or seaweed farming). In Kitonga, the health and resilience of the ecosystems has been compromised by deforestation for charcoal making. Finally, the community is dependent on a single road.

Kitonga has the benefit of fertile soil for agriculture and a permanent water source as it is located in the Ruvu River flood plain. Flooding is damaging to food crops, but there is land further from the river where agriculture can be practiced. Moreover, rice paddies need a substantial amount of water to grow.

6. ADAPTATION OPTIONS

The vulnerability assessment identified numerous climate change risks and potential impacts. It showed some of the root causes for weak adaptive capacity. In both villages, there are more climate change risks than can be acted upon based on local funding availability, and institutional and technical capacity.

The villages and district government need to look for adaptation measures that are doable with concrete benefits, or actions that increase the adaptive capacity and reduce the sensitivity of assets to climate change. Given these criteria, the initial discussion and brainstorming of opportunities to adapt to climate change included the following:

- Form a Committee with District assistance and in cooperation with the Wami- Ruvu Water Basin Office to set rules for effective water management
- Plant fruit trees to generate an alternative source of income to reduce food insecurity
- Improve or introduce the use of efficient irrigated agriculture from the Ruvu River after seeking assistance and permits from the Wami-Ruvu Water Basin Office.
- Apply good practices in rice production to increase harvests and food security, and reduce climate change impacts. These include appropriate spacing and density of seeds, water retention techniques, and use of drought resistant seed. In addition, the village suggested better control of pests and diseases in crops and in livestock; storing fodder for dry season feeding; and, adapting better livestock feeding techniques.
- Develop a local education program to raise awareness on the importance of forest conservation
- Seek assistance on energy efficient technologies to reduce consumption of wood used for cooking
- Seek government or donor assistance to develop rainwater storage systems and adequate water tanks for water storage

Some of these opportunities can be done with existing local resources and skills, others require outside assistance and funding.



Figure 6 Establishing a mango fruit tree planting orchard – one of the recommendations from the V&A assessment

Other options were listed during brainstorming sessions on opportunities that are longer term and would require major outside investments (e.g. building or improving health or educational facilities; improved home construction; road improvements; well construction; water delivery systems; irrigation systems; and, construction of dams for fish farming).

A characteristic of the short-term responses listed above is that they are all “**no-regrets**.” This means that they yield benefits independent of climate change. These measures address current vulnerabilities and focus on increasing the ability of ecosystems and communities to cope with current environmental pressures and climate variability. They provide a benefit now, a benefit in the future, and potentially provide a benefit whether or not the projected climate changes become reality.

7. STUDY TOUR EXCHANGE

On two different days, the 12 Climate Change Focus Group members from Kitonga Village made a study tour to Mlingotini (another Bagamoyo District village that had also been part of a V&A process) and vice-versa. The aim was to increase each village’s awareness of climate change impacts, vulnerability, and adaptation options, and extract indigenous knowledge from the communities. In the climate change exchange visit between villages, Bagamoyo district staff also participated. The involvement was an opportunity for the district to understand in depth the climate change problems in the community with the hope that future district plans mainstream adaptation measures.

The study tour visits were also an opportunity for district extension staff to offer suggestions for change to reduce climate change vulnerability. For example, during the visit, Bagamoyo district staff provided technical assistance regarding good practices in rice production to increase harvests and food security, and reduce climate change impacts. These practices include water retention techniques, appropriate spacing of the plants, appropriate quantity of seeds per acre, and consideration of drought resistant seed.

Kitonga villagers showing Mlingotini study tour members the effect of climate change to rice production.	Mlingotini villagers showing Kitonga study tour members the area where there was “Poteza Forest” that in the past was dense with wild animals.
	

Figure 7 Exchange between Kitonga and Mlingotini

8. CONCLUSIONS AND RECOMMENDATIONS

The V&A exercise demonstrated that with appropriate PRA exercises and local knowledge, it is possible to conduct a vulnerability assessment and identify response options. Once strategically selected adaptation measures are implemented, their effectiveness and impact needs to be tracked, and improved approaches or new responses selected based on changing circumstances and new information.

Having completed this exercise with the villages, it raises some questions and information gaps. These questions and gaps can help focus the District, donors, and researchers on work in the future. For example, basic scientific information is needed on the inherent dynamics of the natural environment (e.g. coastal processes of sand movement, erosion, and accretion), sea level monitoring, and time series data on rainfall to better evaluate trends in high precipitation/flooding events, drought, and seasonality. Without such information, it is difficult to determine whether the observed climate changes are evidence of global climate change or not.

Also, to aid in assessing vulnerability and adaptation planning, it would be helpful to have remotely sensed land use/land cover maps to visualize climate change scenarios and biophysical impacts (e.g. maps of the shoreline to visualize erosion and maps of potential flooding or inundation from sea level rise and storm surge).

Another important finding from this work is that the problems being faced in Kitonga are similar to what other coastal villages face throughout Bagamoyo District, and that some of the problems cannot be solved at the village level. They require concerted action at the district, national, as well as Water Basin level.

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Notes:

The PRA tools are described in length in the document "Climate Change Vulnerability and Adaptation Planning Template," manuscript, September 2010, available on request from James Tobey (Tobey@crc.uri.edu).

A full description of climate trends that were revealed in the two villages is available in a report prepared by the Centre for Energy, Environment, Science and Technology (CEEST), available on request (hemeena@yahoo.com).