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Fall 2018

# Pemban Farmer Agency in Adapting to Climate Change

Rachael Hood  
*SIT Study Abroad*

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# Pemban Farmer Agency in Adapting to Climate Change



Rachael Hood

Fall 2018

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SIT Zanzibar

**Table of Contents**

1. Acknowledgements.....	2
2. Abstract.....	3
3. Introduction.....	4
4. Background.....	6
5. Methods.....	9
6. Results.....	10
7. Discussion.....	27
8. Conclusion.....	32
9. Recommendations.....	34
10. References.....	37
11. Appendices.....	40

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Thank you to my fellow students, who inspired me to do meaningful work and to believe in my abilities to create that work. As Juma says, “Jiamini!” Finally, thank you to my parents, who have encouraged be to be bold for as long as I can remember, and to my grandma, who has never ceased to believe in me and who I know will read every single word of this report. Without your love, support, and advice, I never would have made it here. Ninakupendeni.

## **Abstract**

As a result of climate change, agricultural societies will be challenged by a variety of altered conditions, including increased severe weather events, saltwater intrusion, pest and disease outbreaks, and higher temperatures. The island of Pemba, in the Zanzibar archipelago, is home to many small-scale agriculturalists. During this study, I interviewed Pemban farmers in the districts of Wete and Micheweni about their awareness of the impacts of climate change and the mitigation strategies that they have implemented. The results from Pemba were compared to relevant academic literature regarding climate change to explore whether disparities exist between models of climate change in the region and the lived experience of farmers.

## **Ufupisho**

Matokeo ya tabia nchi, jamii za wakulima zilikabilowa changamoto za mabadiliko tofauti, ikiwa ni pamoja na kubadilika kwa hali ya hewa, kuongeze ka kupauda kwa bahari, kuongezeka kwa wadudu wanuoharibu mazao pamoja na mripuko wa maradhi na kupanda kwa joto. Kisoua cha Pemba ikiwa na sehemu ya Z'anzibar ni sehemu ya jamii ya wakudi ma wadogo wadogo. Wakati wa utafiti huu nilifanya mahojiano na wakulima wa wilaya ya Micheweni Pemba kuhusu athari za mabadiliko ya tabia nchi pamoja na mikakati ya kupungusa athari zake, ambayo walitumia. Matokeo ya utafoti wa Pemba yalili nganishwa na tafiti rejea kuhusiana na mabadiliko ya tabia nchi ili kuweza tofauti baina vigezo tojauti uya mabadiliko ya tabia nchi na uzoefu wa wakulima wa Pemba.

## Introduction

Climate change is a global issue, but it is not predicted to affect all parts of the globe equally. The effects will be particularly severe in developing countries, where most people are considered to be poor, and 80% of people depend primarily on agriculture that is maintained through rainfall, both for food and economic subsistence (Sanga et al., 2013). Forty-six percent of Tanzania's GDP is sustained by agricultural production, but people working in the agricultural sector also compose the majority of the 12.5 million people below the national poverty line in the country (Rowhani et al., 2011). Zanzibar's economy is itself also very dependent on a predictable climate (Watkiss et al., 2012a). While development plans from the government have in part accounted for climate change, little action has been taken in response to short-term trends in climate variability or for future climate change.

The climate in Tanzania is considered to be highly variable and unpredictable, with studies concluding that Tanzania is vulnerable and prone to extreme weather events such as droughts and floods (Shemsanga, 2010; cited in Sanga, 2013: 170). The drought in 2007 on Zanzibar that resulted in decreased and erratic rain led to one of the worst agricultural harvests that reduced the island's GDP by 2-4% and led to malnutrition for 300,000 people in 2008 (Watkiss et al., 2012a). In addition, studies have shown that the cropping patterns are changing and are attributed to climate change (Rowhani et al., 2011). The effects include the disappearance of crops that were previously produced in certain areas, the outbreak of crop diseases, and the outbreak of diseases like malaria, since increased temperature and reduced rainfall have enabled the growth of some microorganisms and pests that cause such diseases. Both inter-seasonal increased temperature and intra-seasonal increased precipitation as a result of

climate change are predicted to reduce yields of maize, sorghum, and rice, three of the major cereal crops on mainland Tanzania (Rowhani et al., 2011). Rainfall is projected to increase significantly in the rainy season and decrease in the dry season in Zanzibar, as well as change in its onset and seasonal patterns (Watkiss et al., 2012a). On Pemba and Unguja, during the rainy season there has been less rain overall, but rain events have been very intense, the combination of which is detrimental to agricultural production (Richard Walz, personal communication November 7, 2018).

The people of Pemba have historically faced food shortages and insecurities, in part as a result of the occurrence of rainy and dry seasons and the lower precipitation on the eastern side of the island. One of the most extreme cases is the famine in Pemba from 1971-1972. During this time, people were forced to eat whatever food they could obtain, regardless of its previous presence or absence in the local diet (Walsh, 2009). While this tragedy could have been avoided by improved government policy, it also demonstrates the ability of agriculturalists on Pemba to adopt strategies and mitigate the consequences of environmental challenges. The climate change of the 21st century presents additional, and perhaps more severe, challenges that will only serve to exacerbate threats like food insecurity.

The first question that I will pursue through this project is as follows: How are farmers on Pemba implementing strategies to mitigate the impacts of climate change on the productivity of their farms? The second aspect of my project will inquire: How do the narratives of Pemban farmers about environmental conditions contrast with global and national predictions of climate change in the archipelago?

Climate change has been comparatively understudied in Zanzibar and in the tropics at large (Reyes-Garcia et al., 2011). However, most of the developing world lives in the tropics, and tropical environments are highly vulnerable to the multiple impacts of climate change, including extreme weather, water loss, and increased disease. Most research regarding global climate change in local places has been top-down, concentrating on methods using climate change scenarios from global models that do not have detailed regional/local specificity (Wilbanks and Kates, 1999). However, local resource users observe their surroundings and its changes at smaller scales and in greater detail, which can provide evidence for or against the models made at larger scales. Studies have shown that combining local climate knowledge and climatology has the potential to provide more reliable and relevant representations on climate change, which are critical to well-planned adaptations (Marin, 2010).

This study is not targeted at validating or confirming the stories shared by farmers; it is intended to combine quantitative perspectives on climate change in Zanzibar with detailed narratives shared by Pemban farmers. This enables a comparison of information at different spatial and temporal scales and may elucidate mechanisms to explain observations. In cases where local and scientific observations agree, the confidence in these observations is increased, while in cases where they disagree, further studies may suggest how one is flawed, how different mechanisms are involved in the two cases, or how there are varying interpretations of the same data-observations.

## **Background**



“Climate change” is a phrase that encompasses global warming from natural and anthropogenic greenhouse gas emissions as well as the numerous impacts of this warming. Often, climate change refers to the changes in average temperatures and maximum high and low temperatures. However, climate change also encompasses climate variability, including the variety of conditions seen in an environment over time, such as the frequency and intensity of extreme weather events like storms and floods (Rowhani et al., 2011). Climate variability itself encompasses both intra- and inter-seasonal variability. “Intra-seasonal variability” is the range of climatic conditions given a certain time of year (for example, the long rainy season in the archipelago in March - May), and “inter-seasonal variability” is the range of conditions between seasons (for example, between the rainy season and the dry season in June - October).

“Agency” refers to intentional human action, in this case, taken in response to climate change. The scale of human action is typically inherently local (Wilbanks, 1999). While climate change is a global challenge, many of the major decisions regarding adaptation and mitigation are local. Adaptation, the context of global warming and climate change, refers to responses that look to reduce the natural and social vulnerability of a community to these changes. Again, these adaptations take place at a local scale, although they can be assisted by national and global, government, organization, or corporation policies (Wilbanks, 1999).

This study also addresses “visibilist” and “invisibilist” narratives of climate change. Visibilism argues that climate change and its effects can be observed by the human senses and recognized as such. Invisibilism asserts that global climate change and global warming are inherently undetectable to the naked eye and can only be understood through scientific, empirical studies. There are social and cultural reasons why each narrative is asserted relating to power

dynamics of international scientists and local people (Rudiak-Gould, 2013). This study looks to hybridize these frameworks, recognizing the strengths and weaknesses of both.

This study will take place in the Zanzibar archipelago, which includes the islands of Unguja and Pemba, off the coast of mainland Tanzania in East Africa. Unguja and Pemba fall under the control of both the mainland government and the Zanzibari semi-autonomous government. Pemba Island is about 1000 km<sup>2</sup> in size and is separated from Unguja and the mainland by a deep sea channel. Pemba presents more topographical variation than Unguja, as a result of its previous attachment to the Eastern Arc Mountains in mainland Tanzania (Said Juma, personal communication October 16, 2018).

During the 1800s, much of the forest in western Pemba was cleared of natural vegetation and planted with clove trees, which dominated the island economy (Sheriff, 1987; cited in Walsh, 2009). Clove cultivation resulted in increased importation of basic foods, which has made the island more vulnerable to famine (Bowles, 1991; cited in Walsh, 2009). A previous study by SIT student Jordan Teamer (2018) looked at Pemban farms in Limbani to determine their awareness of climate change, the problems that climate change causes, and any adaptations or preparations that they developed. His study reported that farmers consistently noticed changes in rainfall patterns, whether in shortage of rain, concentrations of rain, or missed seasonal rains.

The island experiences two rainy seasons: the short rains (*vuli*) between November and December, and the long rains (*masika*) between March and May. The farmers interviewed in this study live on Pemba, in Wete and Micheweni districts. Wete District is located on the western side of the island, which receives higher rainfall. As a result, it is a highly productive area for

agriculture, but also more prone to flooding extremes. Micheweni District receives less rainfall, especially to the east, where much of the agricultural land is coral rag and more prone to drought.

## **Methods**

To gather qualitative data about farmer mitigation strategies, I conducted a series of interviews and farm visits around the Wete and Micheweni regions of Pemba. I relied on my mentor and translator, Ali Hamad, to execute these interviews. Some of the interviews were scheduled ahead of time with farmers that he knew, while some interviewees were selected simply by walking throughout *shamba* (fields) and villages and encountering farmers who were open to conversations.

I asked basic demographic questions first, including name, age, education level, and marital status. Then, I inquired as to their experience with farming, including which crops they grow. The final section of my questions focused on changes that they had noticed in environmental conditions. Some of the questions included: What changes have you noticed on your farm in the past twenty years? Why do you think these changes have happened? Have you changed your techniques because of these changes? A list of formalized interview questions is found in Appendix A. After two of the three weeks of data collection, I modified my questions to explore some different themes relating to social networks of resilience in the context of changing climate. These modified questions are found in Appendix B.

These interviews were more conversational. There was plenty of opportunity for follow-up questions and elaboration, based on what the interviewee said. In addition, I would sometimes add questions that I felt were relevant to the person who I was speaking with, relating

to climate change or other issues about farming. Thus, each interview follows a general structure in questions but may also have some variability. This conversational style was important to the creation of narratives and representations by individual farmers.

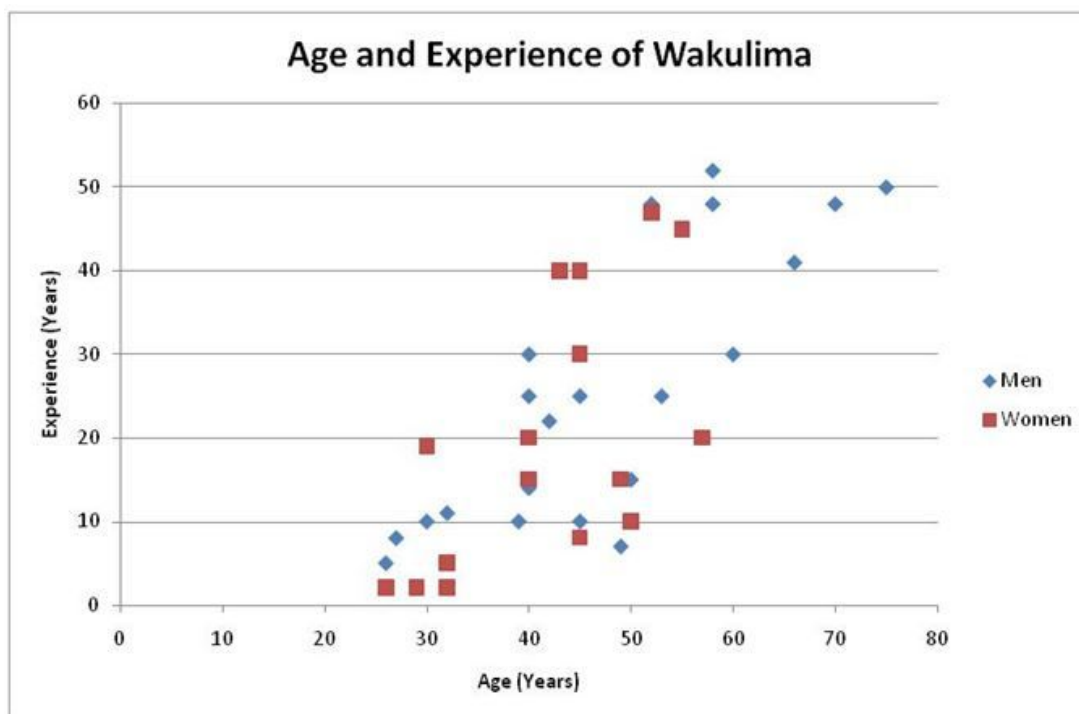
I also created a short survey. This survey included questions like, “Has rainfall increased or decreased in the past twenty years?” The objective of this survey was, firstly, to be able to collect a quantitative data set, and secondly, to be able to collect data without the assistance of a translator because the questions were short and intended to have dichotomous answers. However, some of the surveys were performed with Ali Hamad present. Ultimately, the results of this survey are not presented in this study, for reasons articulated in the Recommendations section. However, they were helpful in understanding some of the barriers around translation of concepts such as “climate change.” The survey questions can be found in Appendix C.

## **Results**

I conducted 36 interviews over the course of 18 days. Thirty interviews were in Wete District, in villages and areas including Weni, Limbani, Gando, Tungamaa, and Kisiwani. Six interviews were in Micheweni District, in Micheweni town and Maziwang'ombe. Most interviews were conducted one-one-one, but in some, several people had gathered at one time to do interviews, so they heard each other's responses, creating somewhat of an unintentional focus group. While this was not ideal, there did not seem to be a noticeable influence of one person's responses on another's. During one interview, a woman's husband appeared, and she became noticeably more shy and reserved, with her husband sometimes interjecting or correcting.

Additionally, one interview was conducted with a husband-wife duo, so some questions have 37 responses instead of 36.

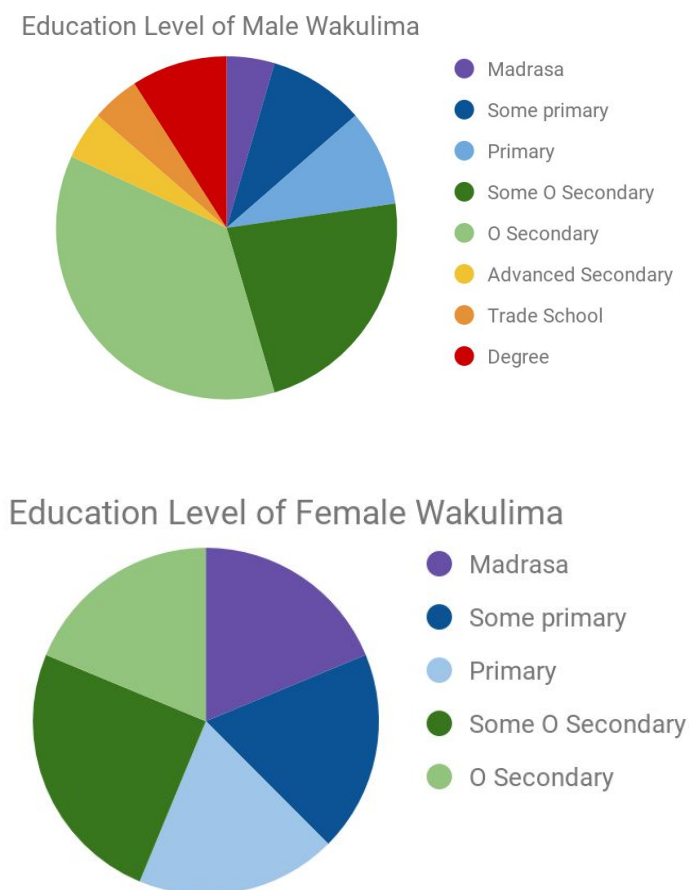
I was able to interview 20 men and 17 women. They ranged in age from 26 to 75, with time spent farming ranging from 2 years to 52 years. Figure 1 shows the age and experience levels of both women and men *wakulima* (farmers).



**Figure 1. Age and Experience of Wakulima.** Women interviewees are represented by red squares, while men are represented by blue diamonds.

There appears to be a greater correlation between age and number of years spent farming for men than there is for women. This may result from a variety of factors not explored in this study, including child-rearing obligations for women. Additionally, it could be that, as opposed to the past, two workers are needed by their families to overcome changes in environment and society, such as climatic changes.

There is also a noticeable difference in education levels between men and women farmers, as seen in Figure 2.

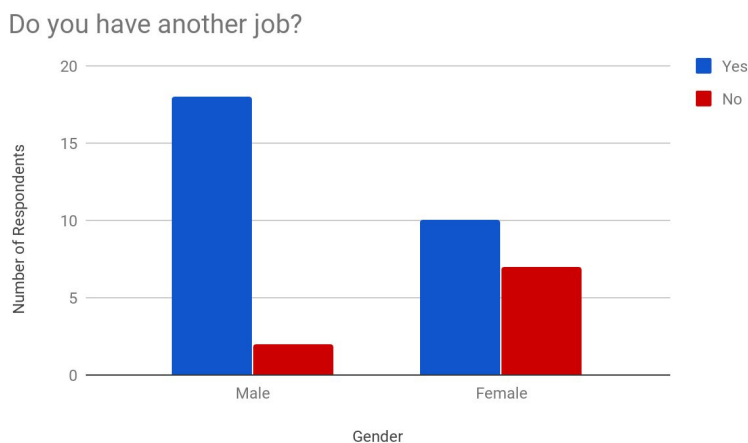


**Figure 2. Education Levels of Male and Female Wakulima.** Male farmers are accounted for in the top circle plot, while women are accounted for in the bottom pie chart.

The highest education level for women is Ordinary Secondary School, while several men had received degrees from university. Over half of the men surveyed had complete at least Ordinary Secondary, while less than a fourth of women surveyed had completed this level of education.

A number of farmers also held other jobs, in addition to farming. This economic diversity can be a factor in personal resilience to a changing agricultural climate. The proportions of men and women with other jobs is seen in Figure 3 below. Four men have a government job with the

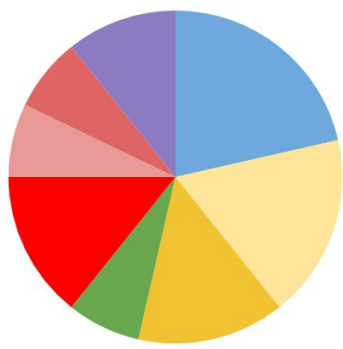
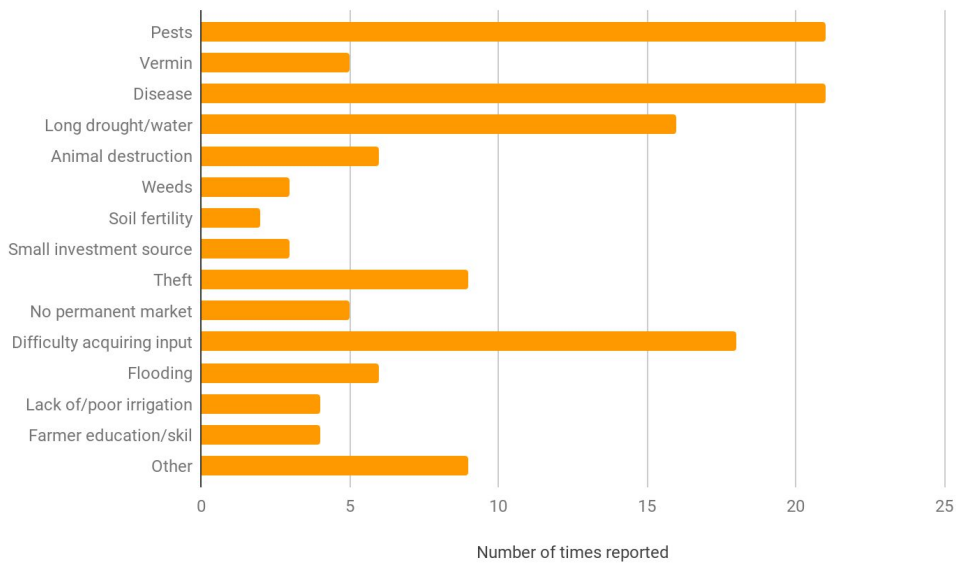
Ministry of Agriculture; one of these employees is also a house painter. Five men and three women participate in livestock keeping, including cows, chickens, ducks, and rabbits; two of these men (both in Maziwang'ombe) also participate in fishing. One man and four women have shops for selling commodities including breads and soaps. One of those women sells soaps through an entrepreneurship group in Maziwang'ombe. Two men are teachers, and three are or were previously carpenters. Two women work in handcraft and one works in preparation of baobab fruits. One man was retired Tanzanian Army Defense Force, one is a porter at Wete harbor, one is a seasonal daladala conductor, and one woman works in the Ministry of Health.



**Figure 3. Frequency of another job outside of farming for both male and female *wakulima*.** The blue column represents the number of respondents who do have another job, while the red column represents those respondents who do not.

Farmers pointed to a wide variety of challenges in farming at their particular locations. Challenges mentioned repeatedly are seen in Figure 4. By far, the challenges most frequently cited were pests and disease, followed by difficulties acquiring agricultural inputs and shortage of water. Regarding pests, almost a fourth of those reporting this challenge were facing problems from cassava mealybug (*Phenacoccus manihoti*). Another third were facing worms and hispa pests (*Dicladispa armigera*) in rice crops. The most frequent disease faced by farmers is cassava

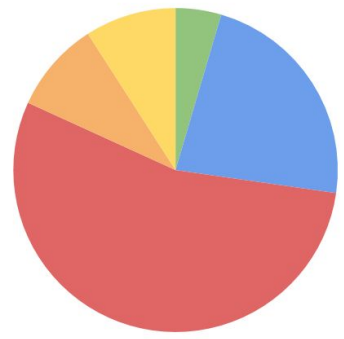
brown-streak virus, which turns the center of the tuber brown. Over half of the farmers, when discussing difficulties acquiring agricultural inputs (because of both cost and availability) were referring to manure.



- Cassava mealybug
- Worms
- Rice hispa
- American
- Fruit flies
- Snails
- Orange dog
- Other



- Black sigatoka
- Rice yellowing
- Wilting and death
- Fungus
- Tomato blight
- Brown-streak
- Cassava rot
- Other

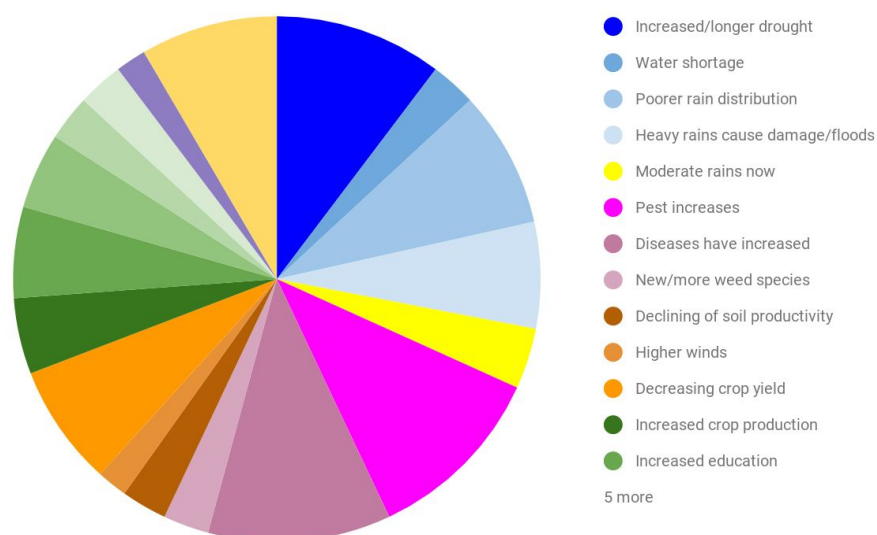


- Pollard
- Seeds/seedlings
- Manure/fertilizer
- Farm implements
- Dawa



**Figure 4. Challenges in Farming in Wete and Micheweni districts.** The top graph shows a variety of challenges mentioned repeatedly and the frequency at which they were mentioned. The middle left graph expands on the frequency at which specific pest problems were mentioned, the middle right on specific disease problems, and the bottom on specific agricultural input problems.

Farmers were asked to reflect on the changes that they have seen in farming during their time as farmers. They were not asked specifically about environment or climate, so as to avoid a leading question, and so provided a wide array of responses. However, the most common answers can be seen in Figure 5.



**Figure 5. Changes Observed in Farming in Wete and Micheweni districts.** This graph is color-coded with blue tones relating to issues of water, pink colors having to do with pests and disease, orange colors having to do with decreased production, and green colors having to do with increased production.

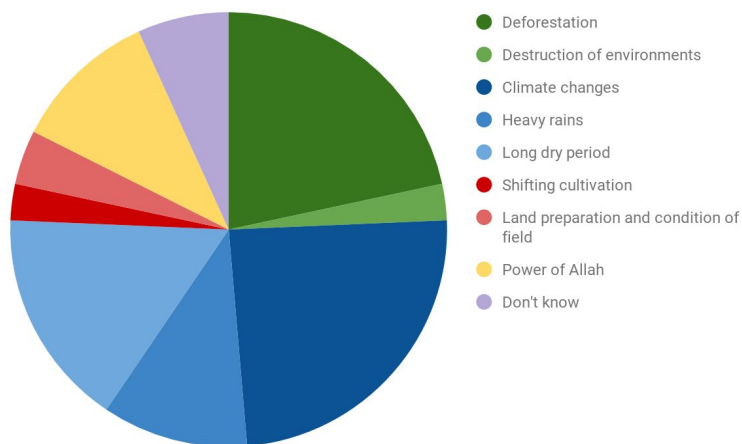
About a fourth of the changes observed concerned increases in pests, diseases, and weed species.

Almost a third of the changes observed concerned changing distributions of rain, including

heavier rainfall and flooding and a longer drought period. Almost a fourth of respondents have

seen positive changes on their farms, including increased productivity, crop diversity, and access to education.

Farmers were also asked to comment on why they believe these changes had occurred, as shown in Figure 6.

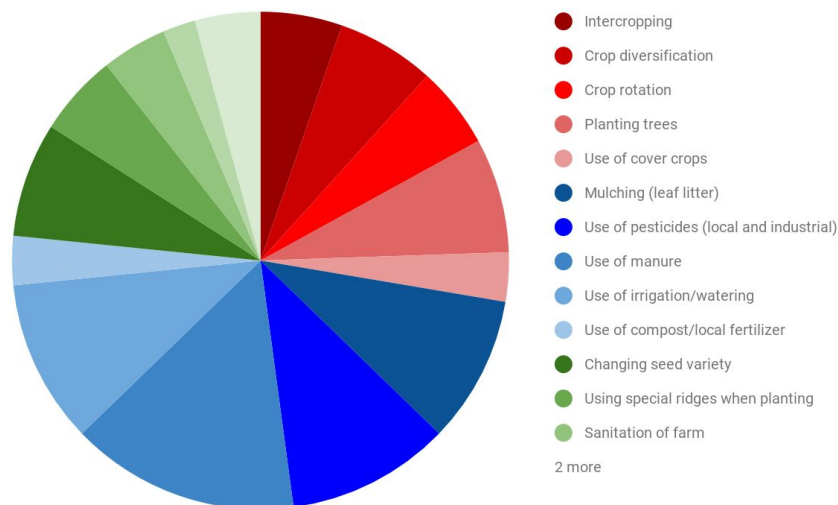


**Figure 6. Reasons for Changes Observed in Farming in Wete and Micheweni Districts.** Responses relating to climatic changes are color-coded in blue and those relating to destruction of environments in green.

Almost half of responses ascribed the changes that they have observed, including increasing diseases and declining productivity, to climatic changes, such as heavy rains and a long dry period. Another fourth of responses attributed the changes to deforestation and the destruction of environments generally. Several respondents also ascribed these changes to the execution of the will of Allah, which reflects the presence of the Islamic faith as a key tenet of community life in Pemba.

Thirty-six out of thirty-seven respondents confirmed that they had changed their agricultural techniques in response to the changing environments. Many of these changed techniques are represented in Figure 7. About a fourth of responses regarding changing planting strategies and field planning, including intercropping and the use of cover crops. Almost half of the responses referred to uses of mulching, manure, pesticides, compost, and irrigation. The other

fourth of responses included technical solutions like using new seed varieties, removing water from the field to prevent yellowing disease, and sanitation of the farms.



**Figure 7. Changed Techniques in Response to Changes in Agriculture.** Red responses refer to issues of crop choices and planting, blue responses refer to use of agricultural additives, and green responses encompass a variety of technical solutions.

In the updated survey, 12 respondents were asked whether they gave gifts or shared in good production seasons. Almost all respondents replied that they shared with (extended) family members and friends, as well as neighbors (*jirani*). One farmer who works in a site far from his home said that he will also share his produce with some in the village, even though he does not know them well. Another said that during Ramadan, when gifts are common, people may come for gifts of banana and cocoyam, important foods for this religious holiday. Ali Hamad explains that “according to our culture, we are sharing a lot of things. If I give somebody crops from my field, I am closer to him or her. If I have a problem, it is easy for me to go to them for support. I am building good relationships with others.”

Respondents were then asked who they rely on when they have poor production seasons. Some farmers are only relying on themselves. They might prepare to cultivate different crops,

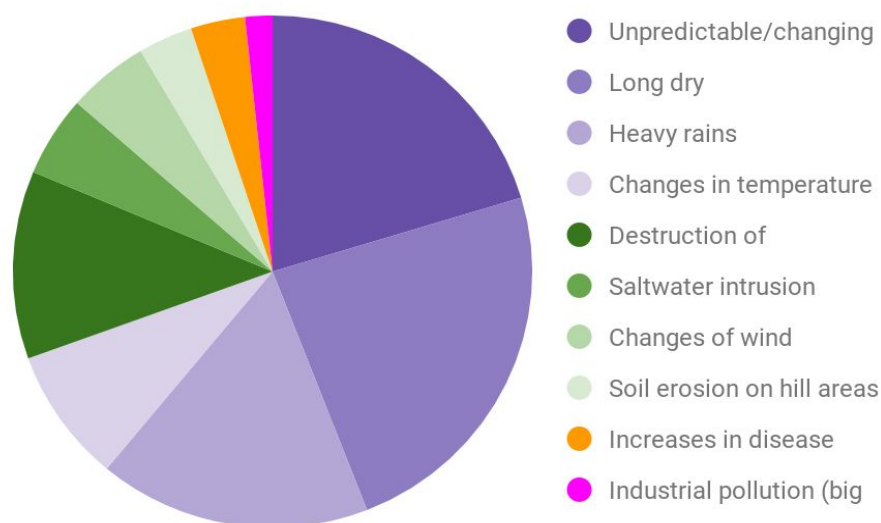
make money through different activities, or rely on the income of their spouses. However, most of them are turning to someone for help. They seek support from neighboring farmers and borrow money or supplies. One farmer said “our farms are close together. Everyone is giving support to others. We are interacting and supporting each other and sharing information.” Some will borrow money from family members, friends, or neighbors to invest for the next season, at which point they will be able to repay the money. Most of these connections are located in the villages where the farmers lived, although some are in other places in Pemba as well as in Unguja. Additionally, one farmer reported that she seeks help from the permaculture officers at Community Forests Pemba (CFP) for seeds and knowledge.

Finally, farmers were asked if they work closely with any other farmers. Some said that they were independent, but many said that they work closely with neighboring farmers, “sharing in knowledge and ideas.” One farmer said that sometimes his neighbors will water his farm if he can't visit it. Ali Hamad said, for example, “there is a disease in banana. We are sitting down to discuss what we can do. For sweet potato and cassava, we are discussing where we can get the new variety. I am bringing new things and learning from them.” He is also trying to build relationships with buyers in and outside of Wete.

One respondent shared a particularly interesting network of support. Firstly, he can seek aid from the government in difficult times; if he does not have seeds, the Ministry of Agriculture will provide them. Additionally, in his rice field there is *Umoja bwa Bonde* (The Union of Bonde). This group of about 100 farmers was created with the aid of the World Food Program. Land was distributed to farm in 0.25 acre plots, and farmers worked together to make dams and furrows. Farmers can go to this committee for support with planting, labor, and collaborative

help. In poor seasons, he can also go to members of the Bonde for support in food and/or farming implements. Finally, he shared that if certain individual farmers perform well, they can get a special price through the government to travel to the mainland and go on a study tour of farms on the mainland. This farmer has developed a network of support at both local and national scales, through family, friends, his Bonde, and the government.

The last question asked of farmers was about their knowledge of climate change. This question was last so as to avoid priming in other questions, some of which have been discussed above. Thirty-three out of thirty-six respondents replied that they knew what climate change was and cited some symptoms or causes of climate change. Those characteristics commonly named are found in Figure 8.



**Figure 8. Characteristics of Climate Change Named by Farmers in Micheweni and Wete Districts.** Characteristics having to do with changes in weather and climate are coded in purple, while changes having to do with physical characteristics of the land and environment are coded in green.

Almost two-thirds of responses related to changing seasons, changing temperatures, and changes in rainfall (including long dry periods and heavy rains). Most of the other third of the responses

regarded other changing environmental conditions, including destruction of environments, saltwater intrusion, and soil erosion.

The trends and quantitative analyses of the interviews are a crucial aspect of understanding farming and climate change on Pemba, but they do not tell the whole story. Capturing the stories of some of these farmers is critical in recognizing their own agencies and ingenuities in response to this global phenomenon. Below, I have shared the stories of a few key farmers that I spoke to, which I feel capture both the hardships faced by these farmers and the hope that they present for the future of farming.

**Saleh Mohammed Alim and Nadhifa Rashid Bakar** walked by when I was talking to another farmer and patiently waited for me to finish with him so that they could show me their nearby farm in the Weni village. Saleh, 30, was wearing a “Beautiful Tanzania” shirt with a map of the country and a power fist, in addition to jeans and blue rain boots. Nadhifa, 20, was wearing a green and white patterned kanga that said Mola ni Wakushukuriwa, which means “God is to be thanked.” They have both completed their secondary education and have three children together. Saleh, who primarily answered questions, has been farming for 10 years. Throughout different plots in the Weni districts they grow African eggplant, chilis (pilipili), tomato, watermelon, eggplant, okra, cucumber, rice, cassava, and banana, in addition to keeping livestock. When I asked about the challenges he faces, he brought up the wilting and death of crops, especially African eggplant, eggplant, and tomato; during the dry season, there is a shortage of water for irrigation, especially if the rains take time to arrive. He took some of these wilted plants to the Agriculture Office, where he was told that the problem is either a

soil-borne disease, or that the seeds themselves are not resistant for some reason. He has already changed the variety of eggplant from a short-growing type to a long-growing type, but it does not seem that there is a solution to this problem, so for now they are relying on planting different types of crops. He paused, and said something quietly to Ali, who translated, “He wants to know if he could talk about his cows.” I replied affirmatively, to which Saleh beamed a little before beginning to talk about his livestock. A difficulty with his livestock is that he does not have a permanent market for the milk. “We used to produce 60 or 70 liters a day, but because of the market problem, it has been reduced down to 30 L. There is a shortage of money to invest in food for the livestock.” He feeds his cows pollard to increase their production of milk, which he has to purchase and can be difficult to acquire in the needed amount.

One of the most important changes that he has observed is diseases of crops. “I can manage the farm well but yield will still be reduced by disease.” Sometimes, heavy rains can also damage crops (especially vegetables), and long and sunny dry seasons can cause blossom and rot for tomatoes especially. He has linked these changes in heavy rains and dry spells to climate change, which he believes has resulted from unplanned deforestation in areas including where he lives. He has discussed his harvests with other farmers to establish market linkages, given that one of his greatest challenges is the shortage of market. In response to issues of soil fertility, he has used organic manure of both cows and poultry (samadi ngombe and samadi kuku, respectively), and he has also used continuous cropping to return more nutrients to the soil.

**Juma Salim Musa** is a central member of the Gando community. He has completed Form 6 education and now has 9 children at the age of 42. He has been farming on an inheritance plot in Gando for 22 years and is currently growing cassava, sweet potato, vegetables, sweet peppers, African eggplant, watermelon, and pumpkin, in addition to beekeeping. His primary employment is as a mwalimu (teacher) at a primary school where he teaches Kiswahili, Kiarabu (Arabic), Islamic knowledge, geography, history, civics, and social science. Challenges that he faces in agriculture include lack of agricultural inputs (especially manure), the cutting of trees that prevent the development of agriculture, and a lack of irrigation infrastructure. In addition, he believes that there needs to be more farmer education.

Over the past 20 years, he has observed the loss of trees in Gando. In addition, he has noted a declining of soil fertility and lowered production of crops, specifically cassava, sweet potato, and coconut. One of the changes that concerns him is his increasing use of manure on his farm, as a result of declining soil fertility, coupled with the shortage of manure seen in Gando. To confront this challenge, he and other farmers have started collecting manure from free range cows and keeping poultry, in addition to buying manure from a variety of farmers. Some are also keeping their own cattle for a supply of manure and income stream. Farmers are practicing crop rotation, which includes the use of short term varieties of crops and agroforestry systems.

He believes that the changes he has observed are a result of unplanned deforestation, which has reduced rain formation patterns, and an effect of climate change. He also believes there is a problem in the culture of agriculture: “some farmers, instead of cultivating crops which can support each other, cultivate and harvest crops and then leave the land abandoned and bare without and support.” In addition to adaptations with the use of manure, he has been expanding



into more short-term cultivation methods, crop rotation, and planting different types of trees. He has also looked into substitute agriculture practices like bee- and poultry-keeping. To address the issue of water, he has constructed a tower and tank for irrigation that is three meters in height with a 3,000 liter capacity. Once he acquires the financing for drippers, he will no longer have to use a watering can on his crops.

Some of these techniques he learned at the farmer festival, which he spoke very highly of. There, he was also able to learn more about the selection of good seeds, production in small areas to increase yields, livestock keeping, and different technologies in agricultural production. He learned about mbogamboga (vegetable) production specifically at a Farmer Field School supported by USAid's Feed for Future program. When he encounters a challenge, he often talks to his teacher from this school, a Zanzibari employed through this program, in addition to Community Forests Pemba, agriculture service extension workers, and other farmers who discuss with and support one another.

Juma recognizes climate change as resulting from the destruction of the environment, and says that he has a "big worry" about this, which is why he is "making changes in means of cultivation to prepare for that." The community of Gando has been working on a variety of fronts to confront climate change. This including seed planting and reforestation events as well as encouragement on an individual level. There is a sheihia committee on conservation that works on many of these issues. There has also been work done to create ridges and plant mangroves to prevent or reduce seawater intrusion. When I asked what Gando needs to face climate change, the first answer Juma had was "more education on climate change issues." He also cited

improved implements of agriculture and capacity building for people who are interested in keeping livestock.

**Haji Kombo Ali** has been farming in Maziwang'ombe for the last 5 of his 26 years, with his wife and two kids. He farms in the Msituni area, which had been cleared for many years, but now he and other farms have started replanting trees and conserving those trees that are still standing. He grows a variety of crops, including cassava, sweet potato, papaya, coconut, cowpeas yam, banana, pumpkin, maize, sorghum, millet, and cocoyam. In addition, he works in livestock keeping, uvuvi (fishing), and he is a representative of a youth group within the Citizen United Front (CUF) political party.

Diseases in his crops is one of the biggest challenges facing his farm, including the brown-streak disease in cassava. Pests are another large challenge, including fruit flies with pumpkin, millbug in cassava, and snails on banana plants that destroy the youngest shoots and leaves. In addition, there is a shortage of rain and a long dry period, as well as a small shortage of manure. In response to the shortage of water, he is looking into irrigation, which would rely on the digging of a well because of the condition of the land (coral rag). However, he and other farmers would need a lot of money to dig this well, but if they were able to come up with it they would be able to access 7-10 meters of water.

He is part of many conversations in Maziwang'ombe relating to the poor farming conditions and condition changes, including poor timing of rain and increased winds. One of their most discussed issues, as a result of the condition of the land, is that they should be using manure to improve the soil condition. Farmers report issues of pests and disease to extension

workers, and they collaborate on how to solve these problems. As a result of destruction of crops by cows and goats, there are community bylaws that carry penalties to the owner for this destruction. They are starting to discuss new methods of agricultural systems to improve and develop, which includes the agroforestry system and reforestation/conservation of available forests, in addition to cultivating crops that are in demand in markets. This relates to larger conversations about market issues, given that agriculture is no longer about household production on Pemba. Finally, something that is discussed a lot in this community is the conservation of land relating to climate change, with the planting of different trees and the conservation of indigenous trees rather than destruction.

One of the most important causes of these changes is environmental destruction, including the loss of old trees and forest from their community for a long time. Shifting cultivation has also been an issue, and now he and other farmers are trying to maintain the land. He also described climate change as change of weather conditions, including wind, sun, and rain, some of which favor crops and some of which can negatively affect crops. “Even in fishing activities we are looking at climate change issues.” The use of manure, local pesticides like neem and garlic, and intercropping have all worked to avoid risks associated with these changes. When confronting water shortages, there are a variety of techniques he uses. These include the use of manure and leaves to conserve soil moisture (and increase fertility), the use of cover crops like cowpeas and pumpkin, and the planting of banana and coconut trees to provide shade.

When I asked if he was worried about the future of farming, he said that he can’t “afford so many things to be protected from climate change,” and so he has a low ability to face those changes. “[He] could produce by using irrigation system but can’t afford to invest, and still

climate change is around.” Haji was excited to be in Micheweni village the day I met him to teach other farmers about the things he has learned and help them be more resilient to these changes.

**Asha Juma Kombo** farms in Micheweni. She is 26 years old and has three children. She completed Standard 7 (primary school) and has been farming for two years, starting with local cultivation and now intending to expand into improved agriculture. She farms crops including cassava, banana ndizi, and rice, which she farms on a plot outside of Micheweni town (but within the district). She faces several challenges on her farm, including the long dry period (kali sana), low technical aspects and skills, and a market problem. However, when asked about the changes that she has seen in farming, she reflected on the fact that food from her shamba feeds her family and brings in a small fund to send her children to school.

The primary way in which she has been resilient to these changes is through a cooperative group of farmers. One of the members received training from the National Microfinance Bank on creating such a group, and when he came back to Pemba, 30 people from Micheweni and Maziwang'ombe came together to establish the group. Through this group, it is easier to get loans from the government, which can be shared among the individuals, and it improves the ability for capacity building. The activities of this group are three-fold. First, they prepare and sell soaps. Secondly, they prepare stones from the coral rag blocks they dig up in their farming activities. Third, and perhaps most centrally, they support each other in farming activities. For example, one woman has experience of producing horticultural crops and gives (not sells) the seeds to others in the group. The group was able to invest in goats (mbuzi) and

each individual has their own, but they collect a portion of manure for sharing in the group. They are currently in the process of looking to start a nursery. When I asked her if she was worried about the future of farming, she said no. “I am prepared if there is any problem. I can overcome according to my ability.”

## **Discussion**

The narratives that I have shared reflect the thoughtfulness and innovation demonstrated by Pemban farmers, as well as their eagerness to share this knowledge with both other farmers and a curious *mzungu* (white person; translates literally as “person who looks lost”). Knowledge networks exist between extension workers and farmers, among neighbors, between teachers and students at farmer field schools, within farmer entrepreneurship groups, and among those who organized and attended the farmer festival in Chamanangwe. Through these knowledge networks, communities like Gando and Maziwang'ombe have been working on initiatives like reforestation and mangrove replanting. About a fourth of interviewees have reported positive changes on their farm, like increased crop diversity and education, and almost all have adapted their techniques to a changing environment, which serves as a testament to their ability to be resilient.

These stories also represent the serious challenges faced by smallholder agriculturalists in a developing island. Destruction of environments compounded with a changing culture and economic system present a variety of barriers to continued subsistence agriculture. While farmers have shown an inclination for adaptation and resilience, they also require institutional support, primarily from the Ministry of Agriculture. Specifically, they are seeking more

education on agricultural issues and capacity building for addressing these problems. Costs are obviously prohibitive for the vast majority of small-scale farmers, and some have suggested subsidized microfinance loan programs to enable farmers acquiring the technologies and infrastructural equipment needed for some adaptations relating to water collection and irrigation or tools for planting (Watkiss et al., 2012b).

The changes that farmers have observed concerning increases in pests, diseases, and weed species are consistent with global predictions about the effects of a changing climate on these agricultural issues (Kocmánková et al., 2009). Given that the challenges of pests and disease are also the most frequently cited challenges in farming, it is critical that resources are invested in affordable and localized solutions to managing these issues. For example, there was an Integrated Pest Management farmer field school, for which Ali Hamad was a facilitator. It is crucial that this knowledge continue to be passed on through further workshops and social networks.

Social networks are a key aspect of adaptive capacity for Pemban farmers. The gift giving that occurs in productive seasons as a part of the informal economy reinforces social relationships that can be relied on in times of hardship. The hybridization of these relationships with innovations in agriculture and other employment create a fabric of resilience strategies for these small-scale agriculturalists. Additionally, the social relationships exist at different scales, with fellow village members and Pemban residents, as well as family and friends in Unguja. These relationships exist in a heterarchy in which any scale might dominate in a moment based on given conditions. Although these farmers operate in a capitalist system, they are small scale and do not have much wealth, so social networks remain very important for sharing of

knowledge, resources, and skill. It is important to note, however, that those having strong relationships outside of their communities are in the minority among those interviewed regarding this topic.

Additionally, many rely on government support. There are monetary incentives through programs like subsidized seeds, and the government also works to facilitate the creation of farmer field schools and present agriculture extension workers to share knowledge and expertise. However, some of these programs, such as the extension service, are limited in scale and are not accessible to all farmers. Additionally, while the farmer field schools do provide important knowledge of some conservation strategies, such as mulching, they also may be providing a dominant narrative of Western development that dissuades local farmers from seeking to innovate through their own ideas. A point of note is that NGOs were very rarely mentioned as being of assistance, outside of Community Forests Pemba (CFP).

It should be recognized that the results of this study indicate a disparity in access to education between male and female farmers. The lack of correlation between age and number of years spent farming for women also may indicate reduced access to occupational interests for women. Given that one of the recommended strategies for confronting climate change is increased access to education and other rights for women (Kwauk and Braga, 2017), it seems critical for the farming industry in Pemba to support its women farmers in expanding their education and ability to pursue occupational pathways.

Future climate projections for medium- and long-term periods were developed by Global Climate Adaptation Partnership using statistically downscaled global modeling with local meteorological data from the archipelago. These were created based on global climate models,

which are typically at a range of 200 to 400 km in resolution, too coarse for those dealing with national, let alone regional, issues like agriculture. These projections utilized data from the local climate, which is a function of a larger climate scale but is affected by local forces like topography. These models project significant increases in average temperature between 1.5 and 2°C by the 2050s and 2 to 4°C by the 2090s (2081-2100).

The models for changes in precipitation are more complex; nationally, they vary with region, season, and even whether increases or decreases are projected in changes. Overall, there is more uncertainty in patterns of rainfall in the future, including changes in onset, seasonal patterns, and variability. There are consistent indications, though, of increasing rainfall during the wet season in March-May and in January and February, with decreasing rainfall during the dry season during June-October. Essentially, these changes would increase the severity of current patterns, with increasing rainfall during the rainy season and lower rainfall during the dry season. The models also show indications of a shift with a weaker early rainy season and stronger later rainy season. Trends in extreme events, while complex and with even greater uncertainty ranges than rainfall, show some distinct trends. Most models indicate an intensification of heavy rainfall, especially in the rainy season, which increases the threat of floods. They also show an intensification of dry spells in the dry season.

The changes observed in distributions of rain are consistent with Zanzibari reports on climate change, and with the research conducted by Jorden Teamer in Spring 2018, but not necessarily with global climate models. These models often simply predict increased rainfall, which may appear to increase agricultural production, or increased drought, which threatens agricultural production. However, the changes that have been observed by many of the farmers



include longer drought periods separated by short and very heavy rainfall, which leads to flooding. When developing climate change resilience strategies, it is critical to address water from both of these perspectives. Increased access to affordable irrigation schemes that do not overburden local water sources will be critical for a sustained future in farming. These methods include rainwater harvesting, which was on display at the farmer fair in Chamanagwe and which several farmers referenced in their hopes for the future. In responding to flooding, strategies such as planting of cover crops and trees and structuring farms with ridges to allow for drainage will be key accessible adaptation measures.

The notion that local people cannot be aware of or observe climatic changes is countered by the results of this study. Even those farmers who responded that they did not know what *mabadiliko ya hali ya hewa* (climate change) is observed changes in their environments over the time they had been engaged in cultivation. The aspects of climate change that were most recognized, including changing seasons and changes in rainfall, are also those that are most relevant to farming. Farmers were less able to explain the causes of these changes; processes like carbon emissions and global warming are more nebulous and technical. There is an awareness from many that these changes are a result of the mismanagement of natural resources by human populations, and some are even able to connect this to global problems of industrialization and pollution. This awareness is indicative of a potential to teach new practices, such as agroforestry and soil conservation, through a lens of sustainability and stewardship.

There is value in western scientists engaging local people, such as small-scale subsistence farmers, to obtain local weather and environmental change observations. Additionally, the large-scale projections developed by these scientists could be potentially valuable for local

communities as they look to adapt to and plan for change. These relationships can be seen in the study done by the Global Climate Adaptation Partnership using downscaled global climate models. The creation of collaborative partnerships between scientists and local people will produce more, improved observations and may also create new and better understandings of processes and mechanisms (Huntington et al., 2004). Studies in southern Africa have indicated that there is a significant gap between information provided by meteorologist services and that needed by small-scale farmers (Stigter et al., 2005). This pattern also seems apparent at the sites of this study.

Twenty-six respondents were asked whether they have worries about the future of farming. Nineteen farmers responded that they did. Reasons for these worries included fears about missing or heavy rains, a lack of income to afford strategies for protection from climate change and increasing environmental destruction. As one farmer put it, "Agriculture is a living thing. Anything can happen." However, seven respondents did not claim to have worries about climate change. "I can sit down with others to get knowledge on how to solve problems. I have prepared for future seasons," said one *mkulima*. Ali Hamad, who has received lots of education on climate change issues, is also not worried. "I am interacting with so many technical people. I can learn from them. I am prepared with knowledge and am looking for means of overcoming. I am making efforts to educate the community. We will adapt."

## **Conclusion**

This study has portrayed the ways in which Pemban farmers perceive changes in their environment and their agency to adapt their practices as a result. Additionally, it has compared

these observations to national and international findings of the effects of climate change in Tanzania and Zanzibar, which is critical in the development of robust understandings of climate change and resiliency plans. This analysis is an important contribution to the reservoir of research in Zanzibar for a few reasons. The first importance is that it contributes to climate change research in an area that has been vastly understudied. It also can be used as part of a longitudinal perspective into the ways in which farmers in the archipelago have talked about climate change, when paired with the previous research of students like Teamer and Reid (2018, 2012). Secondly, this study recognizes the agency of Pemban farmers to tell the stories of their own innovations and resiliencies, not those touted or argued for by NGOs and international charities. In response to increasing globalization and marginalization of indigenous and local people, it is essential to share their stories and promote their competencies and agency.

Responses to global climate change will not succeed if they are not feasible and accessible to localized and small-scale peoples in the developing world. Additionally, literature has indicated that in places more vulnerable to disaster or insecurity, simple solutions should be more successful in prevailing farming systems (March, 2001 as in Stigter et al., 2005). Reports such as this of people's lived experiences in agriculture illuminate their resources, struggles, and capacities. These experiences give reality and urgency to scientific reports on climate change, and these reports unite disparate communities around this topic and provide a methodological approach to the vast reports of changes observed by local peoples (Rudiak-Gould, 2013).

The people of Pemba have historically faced food insecurities, and the threats of climate change will only exacerbate these issues. In the face of these challenges, utilizing hybrid frameworks such as those presented in this study, which combine international scientific

knowledge with lived local experiences of farmers, are essential in identifying challenges and feasible solutions in response to climate change.

## **Recommendations**

### *Institutions in Zanzibar*

Farmers on Pemba are very reliant on the government for support in their activities. As a result, it is critical that the Ministry of Agriculture incentivize and support sustainable agricultural practices. For example, techniques such as expanded use of pesticides and new seed varieties are important to a diverse cultivation system *if* properly managed. Instruction in use of pesticides as a part of an Integrated Pest Management system is critical to ensure sustainable agricultural systems, and the Ministry of Agriculture should take care to ensure that these new seed varieties do not lead to only a few genetic varieties being cultivated, which may collapse in the face of a new threat.

Over half of farmers who voiced difficulty in accessing agricultural inputs were referring to manure. Manure is a reasonably affordable, organic, and sustainable way of both increasing soil fertility and conserving moisture. Given that many farmers tend to get agricultural inputs such as seeds and fertilizer from the Ministry of Agriculture, they might consider shifting or expanding their subsidizing programs to include access to manure. Additionally, programs for low-risk/interest loans for infrastructure like irrigation might be explored, given the lack of capital expressed by several farmers. However, this recommendation is given with recognition that previous programs in the archipelago have been unsuccessful given that loans were not paid

back. Perhaps these challenges might be overcome through the utilization of entrepreneurship groups and other social networks through which repayment would be expected and encouraged.

### *Future Students*

The use of the quantitative survey presented several challenges and was ultimately unsuccessful in resulting in a quantitative data set. The first challenge was that respondents did not seem to understand the questions when presented in a quantitative setting. Often, when I asked the question, I would receive a puzzled look in response. Respondents would start to respond, but instead of saying “Yes” or “No,” they would speak on the topic in a few sentences, which was difficult for me to translate in the moment. During those surveys when my translator was present, I would ask a question, and then he might translate it more into terms that the respondents understood. This, however, would result in responses that were not necessarily a direct answer to the question. This seems to be more than just an issue in translation of language, but also in translation of concept. Quantitative questions do not seem to make sense, and are difficult for respondents to answer in a way that fits the objectives of the survey. Interview questions, which were much more descriptive and open-ended, resulted in very valuable information in part because they were understood more readily.

Future students might consider exploring whether those with more localized social networks have also been more inclined toward local innovations as a result of increased exposure and vulnerability in agricultural production. I would also highly encourage studies into Islam’s influence on environmental action taken (or a lack thereof), specifically in agriculture, and how it might be used as a framework to encourage adaptations and sustainable practices. Finally,

studies might look into whether the influence of western narratives and technologies has led to loss of more locally-based technologies and innovations.

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## Appendix A: Farmer Interview Questions (November 11 - 21)

1. Can I record you? *Ninaweza kukurikodi tafadhali?*
2. What is your name? *Jina lako ni nani?*
3. Where are you from? *Unatoka wapi?*
4. How old are you? *Una miaka mingapi?*
5. Do you have a spouse? Do you have children? How many children? *Una mke/mume?  
Una watoto? Wangapi?*
6. What is your education level? *Una kiwango gani cha elimu?*
7. How long have you been a farmer? *Umekuwa mkulima kwa muda gani?*
8. Where do you farm? *Wapi unaendesha kilimo?*
9. Which crops do you grow? *Mazao gani unayolima?*
10. Do you have another job? *Una kazi nyingine?*
11. What are some challenges in farming here? *Unapata changamoto gani katika kilimo  
hapa?*
12. What changes have you seen on your farm in the past \_\_\_\_\_ years? *Mabadiliko gani  
umeona juu ya shamba lako katika kipindi cha miaka \_\_\_\_\_ iliyopita?*
13. Do you talk to other farmers about the changes you have seen? *Je, unajadiliana na  
wakulima wengine kuhusu mabadiliko uliyoyaona?*
14. Why do you think these changes have happened? *Kwa nini unadhani mabadiliko haya  
yamefanyika?*
15. Based on the changes, have you changed the things you do on your farm? *Kulingana na  
mabadiliko haya, umebadilisha mambo unayofanya kwenye shamba lako?*

16. What techniques have you utilized? *Nini mbinu gani ulizotumia?*
17. Did you attend the World Farmer's Festival in October? What did you learn there? *Je, ulihudhuria maonyesho ya wakulima yaliyo fanyika Oktoba hapo Chamanangwe? Umejifunza nini/chochote?*
18. Have you attended a farmer field school? Which school? *Uliwahi kuhudhuria katika shamba darasa? Darasa ipi?*
19. When you have a problem, who do you go to for help? *Unapokuwa na tatizo je, unaongea na nam?*
20. Are you worried about the future of farming? Why (not)? *Wewe na wasiwasi kuhusu hali ya baadaye ya kilimo? Kwa nini?*
21. Do you know what climate change is? Can you explain it to me? *Unajua nini mabadiliko ya hali ya hewa? Unaweza kueleza kwangu?*
  - a. Are you worried about climate change? *Wewe na wasiwasi kuhusu mabadiliko ya hali ya hewa?*

## Appendix B: Farmer Interview Questions (November 22 - 30)

1. Can I record you? *Ninaweza kukurikodi tafadhali?*
2. What is your name? *Jina lako ni nani?*
3. Where are you from? *Unatoka wapi?*
4. How old are you? *Una miaka mingapi?*
5. Do you have a spouse? Do you have children? How many children? *Una mke/mume? Una watoto? Wangapi?*
6. What is your education level? *Una kiwango gani cha elimu?*
7. How long have you been a farmer? *Umekuwa mkulima kwa muda gani?*
8. Where do you farm? *Wapi unaendesha kilimo?*
9. Which crops do you grow? *Mazao gani unayolima?*
  - a. Where do you sell your crops? *Wapi unauza mazao yako?*
10. Do you have another job? *Una kazi nyingine?*
11. What are some challenges in farming here? *Unapata changamoto gani katika kilimo hapa?*
12. What changes have you seen on your farm in the past \_\_\_\_\_ years? *Mabadiliko gani umeona juu ya shamba lako katika kipindi cha miaka \_\_\_\_\_ iliyopita?*
13. Why do you think these changes have happened? *Kwa nini unadhani mabadiliko haya yamefanyika?*
14. Based on the changes, have you changed the things you do on your farm? *Kulingana na mabadiliko haya, umebadilisha mambo unayofanya kwenye shamba lako?*
15. What techniques have you utilized? *Nini mbinu gani ulizotumia?*

- a. Where did you learn that from? *Wapi ulijifunza?*
16. When you have a good season, is there anyone you gift or share your produce with?  
*Unapokuwa na sababu nzuri, unampa nani?*
17. When there is a poor production season, who do you rely on for support? *Unapofeli, nani anakusaidia?*
- a. Where are they? *Wako wapi?*
18. Do you work closely with any other farmers? Who are they? *Je, unafanya kazi pamoja na nani?*
19. Have you attended a farmer field school? Which school? *Uliwahi kuhudhuria katika shamba darasa? Darasa ipi?*
20. Are you worried about the future of farming? Why (not)? *Wewe na wasiwasi kuhusu hali ya baadaye ya kilimo? Kwa nini?*
21. Do you know what climate change is? Can you explain it to me? *Unajua nini mabadiliko ya hali ya hewa? Unaweza kueleza kwangu?*
- a. Are you worried about climate change? *Wewe na wasiwasi kuhusu mabadiliko ya hali ya hewa?*

## Appendix C: Short Questionnaire

Can I record you please? <i>Ninaweza kukurikodi tafadhali?</i>	
What is your name? <i>Jina lako ni nani?</i>	
How long have you been a farmer? <i>Umekuwa mkulima kwa muda gani?</i>	
Which crops do you grow? <i>Mazao gani unayolima?</i>	
Have you seen changes in rainfall in the past _____ years? <i>Umeona mabadiliko yoyote ya mvua katika kipindi cha miaka _____ iliyopita?</i>	Yes                      No
Has the frequency of rain increased or decreased? <i>Mzunguko wa mvua yameongezeka au yamepungua?</i>	Kuongezeka              Kupungua
When it rains, are the rains big or small? <i>Wakati mvua, mvua ni kubwa au ndogo?</i>	Kubwa                      Ndogo
Has your crop productivity increased or decreased in the past _____ years? <i>Je, mazao yako yameongezeka au yamepungua katika kipindi cha miaka _____ iliyopita?</i>	Kuongezeka              Kupungua
Have there been more fungus outbreaks recently? <i>Kumekuwepo na mlipuko wa maradhi ya ukungu kuzuka hivi karibuni?</i>	Yes                          No

<p>Have there been more insects/pests? <i>Je, wadudu wameongezeka?</i></p>	Yes	No
<p>Are you worried about the future of farming? Why? <i>Wewe na wasiwasi kuhusu hali ya baadaye ya kilimo? Kwa nini?</i></p>	Yes	No
<p>Have you attended a farmer field school? <i>Uliwahi kuhudhuria katika shamba darasa?</i></p>	Yes	No
<p>Did you attend the World Farmer's Festival? <i>Je, ulihudhuria maonyesho ya wakulima yaliyo fanyika Oktoba hapo Chamanangwe?</i></p>	Yes	No
<p>Do you know what climate change is? Are you worried about climate change? <i>Unajua nini mabadiliko ya hali ya hewa? Wewe na wasiwasi kuhusu mabadiliko ya hali ya hewa?</i></p>	Yes	No

## Appendix D: Crop Names and Frequencies

<b>English Name</b>	<b>Swahili Name</b>	<b>Number of Farmers</b>
Acacia tree	?	1
Agroforestry system	<i>Mchanganiko</i>	3
Amaranthas (spinach)	<i>Mchicha</i>	16
Apple, Pemban	<i>Tafar</i>	1
?	<i>Mbirimbi</i>	2
Avocado	<i>Parachichi</i>	7
Banana	<i>Migomba / Ndizi</i>	32
Beekeeping	<i>Nzinga wa nyuki</i>	1
Black Pepper	<i>Pilipili manga</i>	2
Breadfruit	<i>Shelisheli</i>	1
Carrot	<i>Karoti</i>	1
Cashew nut	<i>Nikorosho</i>	2
Cassava	<i>Mihogo</i>	35
Cinnamon	<i>Mdallasini</i>	4
Cardamom	<i>(H)iliki</i>	1
Clove	<i>Karafuu</i>	11
Coconut	<i>Minazi</i>	9
Cocoyam	<i>Majimbi</i>	8
Cow	<i>Ngombe</i>	2
Cowpeas	<i>Kunde</i>	7
Cucumber	<i>Matango</i>	5
Duck	<i>Bata</i>	1
Eggplant	<i>Bilingani</i>	14



Eggplant, African	<i>Nyanya</i>	6
Ginger	<i>Tengawizi</i>	1* * one is in process
Grapes	<i>Zambarau</i>	1
Grapefruit	<i>Belungi</i>	1
Groundnut	<i>Karanga</i>	1
Guava	<i>Mapera</i>	1
Hog plum	<i>Embe sakua</i>	1
Indigenous trees, general	<i>Miti ya sili</i>	3
Jackfruit	<i>Fenesi</i>	2
Kashuarina	<i>Nvije</i>	2
Lime	<i>Dimu</i>	2
Livestock, general	<i>Mifugo</i>	1
Mango	<i>Embe</i>	3
Mangosteen	<i>Tanga</i>	1
Maize	<i>Mahindi</i>	3
Millet	<i>Wele</i>	4
Neena		1
Okra	<i>Bamia</i>	3
Onion	<i>Vitunguu</i>	4
Orange	<i>Chungwa</i>	6
Papaya	<i>Papai</i>	2
Passionfruit	<i>Passion</i>	1
Pemba almond	<i>Mikungu</i>	2
Pepper, Chilis	<i>Pilipili</i>	2

Pepper, Sweet	<i>Pilipili boga</i>	5
Pineapple	<i>Nanasi</i>	8
Poultry	<i>Kuku</i>	1
Pumpkin	<i>Maboga</i>	3
Rabbit	<i>Sunguro</i>	1
Raumbtam	<i>Shokishoki</i>	2
Rice	<i>Mpunga</i>	21
Sorghum	<i>Mtama</i>	5
Soursop	<i>Stahfeli</i>	4
Sugarcane	<i>Mua</i>	1
Sweet potato	<i>Viazi vitamu</i>	12
Sweet potato vegetable	<i>Matembere</i>	1
Tomato	<i>Tungule</i>	12
Tumeric	<i>Manjano</i>	1
?	<i>Umanga</i>	1
Vanilla	<i>Vanilla</i>	7
Vegetables, general	<i>Mbogamboga</i>	13
Watermelon	<i>Tikiti</i>	9
Yam	<i>Viazi viku</i>	6