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Factors Influencing Farmers' Choices of Responses to Climatic Stressors in Tanzania

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ABSTRACT

The viability of food production by smallholder farmers in Tanzania's semi-arid regions is threatened by climate variability and change. This study's main goal was to comprehend the available options for farmers in Tanzania's Great Ruaha River Sub-Basin and the factors that influenced their decisions. We used both quantitative and qualitative data collection methods. Primary data were gathered through focus groups and household questionnaire surveys, while secondary data came from records collected by government organizations. A logistic regression analysis was undertaken so as to determine factors that influence smallholder farmers' perceptions and choice of response measures during dry years. Smallholder farmers mostly relied on their prior knowledge and locally accessible resources when developing their response strategies. Findings indicate that climate awareness, gender, age, education level, village location, wealth rank, and farmer experience are factors that have a substantial impact on farmers' decisions regarding choice of adaptation strategies to climate change. Therefore, decision-makers at all levels of government, from local authorities to the national level, should play a crucial role in improving adaptation strategies appropriate for a given climatic shock on the research area. The study suggests that GRRB farmers increase their knowledge and understanding of climate change. In order to successfully adapt to climate change, farmers should also work to create associations that will operate as a forum for knowledge exchange about indigenous farming techniques.

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INTRODUCTION

Climate change and variability is a global contemporary challenge that is strongly impacting development sectors on the African continent (Niang *et al.*, 2014; Pauline et al., 2017; IPCC, 2021). Africa is generally acknowledged to be the continent most vulnerable to climate change and East Africa is one of the most vulnerable to the vagaries of the climate, following the scope of the impacts of climate variability over the last four decades (IPCC, 2007). Recent food crises in sub-Saharan Africa are reminders of the continuing vulnerability of the region to the vicissitudes of climatic conditions. Climate change poses a great threat to human security through erratic rainfall patterns and decreasing crop yields, contributing to increased hunger (Obayelu et al., 2014). Tanzania is not in isolation with regard to such changes, as stated in the recent 6th IPCC assessment report, where changes in temperature and rainfall levels in East Africa and Tanzania show an erratic pattern (IPCC, 2021). Projections reveal that a 20% decrease in precipitation and 2°C increase in temperature are likely to impact on cereal yields in Tanzania by 2050 (Rowhani *et al*., 2011).

Despite the fact that climate change is a global issue, there are large variations in vulnerability based on the location, coping capacity, as well as other socioeconomic and environmental factors (Marie et al., 2020; Mwambo et al., 2022). According to Kihila (2017), the impact of climate change is thought to be worse in Africa, which is partly due to a lack of ability to adapt and an excessive reliance on agriculture dependent on rain. Rain-fed small-scale agriculture provides a living for more than 70% of the rural people in Sub-Saharan Africa (SSA) (FAO, 2016). Accordingly, the disaster not only affects farming operations but also raises the amount of poverty in already vulnerable communities. This dependency makes the rural people vulnerable to the detrimental effects of climate change (Marie et al., 2020).

Coping strategies are viewed by the Intergovernmental Panel on Climate Change (IPCC) as short-term responses to crises that develop suddenly, such as food shortages, droughts, and floods (IPCC, 2007). Planning coping mechanisms is crucial in the semi-arid regions, where people rely on rainfall for food production (Pauline et al. 2017; Shirima et al., 2017). It is advised to lessen exposure and sensitivity, as well as improve coping skills and reinforce coping mechanisms by enhancing current coping mechanisms (Shirima et al., 2017). Previous research, including those by Alemayehu and Bewket (2017), Kihila (2017), Mulinyac (2017), and Shirima et al. (2017), highlighted and centered on the adoption of response strategies against climate change to increase agricultural output. However, the characteristics that affect the response strategies that are chosen are insufficient to strategically guide farmers and the agricultural industry at large. While other factors, such as prices and seasonal disease outbreaks, may contribute to food shortages, climate change appears to have the most impact on them, as reported by USAID (2006) in the Tabora region during the 2002–2003 growing season. The GRRB, which is a part of Tanzania's semi-arid areas, has been observing a discernible reduction in crop production as a result of periodic droughts (Malley et al., 2009). Therefore, this study aims at investigating factoring influencing smallholder farmers' choices of coping and adaptation strategies to climate change and variability in the semi-arid region context of the GRRB in Tanzania.

Managing one's current climate change impacts helps in increasing one's ability to adapt to its effects in the future (Pauline et al., 2017). The ability of a system to respond and adapt to changes is known as adaptive capacity (Tubiello & Rosenzweig, 2008; Sivell et al., 2008). Different significant and minor adjustments to practices, and occasionally institutional structures, are part of the adaptive process. The ability of an individual or group to change in order to handle current survival threats while also strengthening its capability to cope with future stresses is explained by the concept of adaptive capacity as a whole (Yohe & Tol, 2002). Thus, factors such as institutional structures, flexibilities in policies and resource distribution, are closely linked to the adaptive process (Eakin & Luers, 2006; Sivell *et al*., 2008, Pauline et al., 2017).

There are two types of variables that affect adaptive capacity (Obayelu 2014). Aspects of climatic impacts like floods and drought are included in these categories, both generally and specifically. Generic determinants include factors as money, education, and health, whereas particular determinants include factors like institutions, knowledge, and technology (Downing & Patwardhan, 2003; Tol & Yohe, 2007). Other researchers have offered a distinct classification of variables, including demographic traits, agricultural techniques, resource accessibility, and institutional contexts (e.g., Adger et al., 2003; Reid & Vogel, 2006). Additionally, research indicates that factors influencing local farmers' ability to adapt include farm size, access to information, financial resources, technological advancements, institutional policies, the environment in which adaptation takes place, and political will (Ayanlade et al. 2017; Mkonda et al. 2018). Furthermore, it is important to take into account in this study the various variables impacting the response options used by farmers. These determinants include the location, wealth level, and demographics of the household, such as the age, sex, and marriage status of the household head, as well as access to information (such as extension and climate services). These were examined to demonstrate how they affect farmers' choice on their response options when climatic stress occurs.

METHODS AND MATERIALS

Description of study area

The Great Ruaha River Sub-Basin (GRRB), which spans 83,979 km^2, is situated in southwest Tanzania (Figure 1). Between latitudes 6° and 9° S and longitudes 34° and 36° E is where the sub-basin is located. It is a sub-basin of the Rufiji River Basin (177,000 km2), Tanzania's largest basin and a quarter of the country's total land area. The principal river that drains the entire sub-basin is the Great Ruaha River. It comes from a variety of sizable and tiny streams on the southeast slopes, where there is a lot of rainfall (SMUWC, 2001; Pauline et al., 2017).

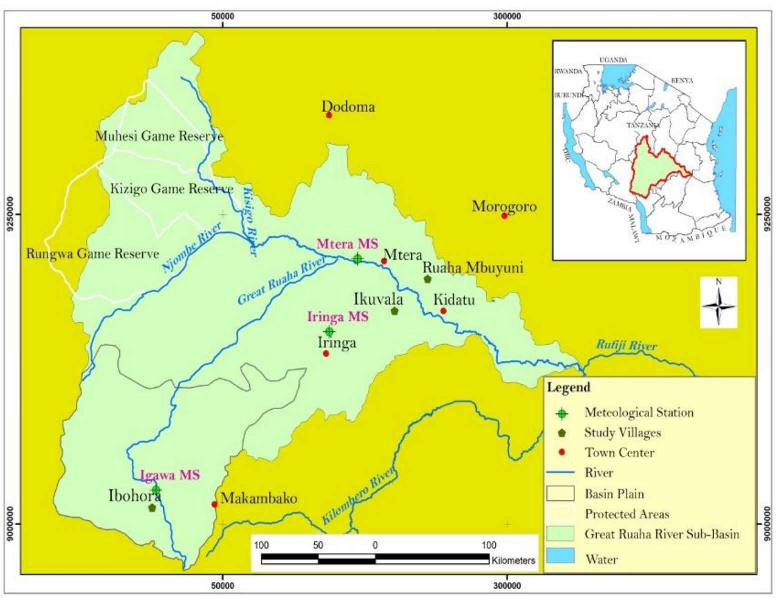

Figure 1: Map showing the Great Ruaha River Sub-Basin.

The Great Ruaha, Little Ruaha, and Kisigo are the three separate river systems that make up the GRRB (Figure 1). The sub-Basin has a wide range of climatic conditions. Rainfall in GRRB is very localized, strongly seasonal, and varies geographically (SMUWC, 2001; Pauline et al., 2017). There are just two distinct seasons: a wet one from November to May and a dry one (June to October). From the lowlands to the highlands, the GRRB's mean annual rainfall ranges from 500 mm to 1600 mm. With a mean annual rainfall of only 500 mm, the region north of the sub-Basin is semi-arid. Southwards, rainfall intensifies, reaching up to 1,800mm in certain places. There is just one rain season due to the rainfall pattern (mid-November to May). There is a tendency for the dry season to set in earlier in the GRRB than for example, the Kilombero sub-Basin. Runoff patterns in the GRRB are closely related to the rainfall pattern. Most rivers start rising in December, with a peak in March to April (SMUWC, 2001; Pauline et al., 2017).

The sub-Basin of the Great Ruaha River is crucial for delivering water to many uses both upstream and downstream. River water is mostly used by:

a) Over half of the nation's electricity is produced by the Mtera and Kidatu hydroelectric projects, which rely on the waters of the Great Ruaha River.
b) residential water supply in both urban and rural areas
c) Agriculture (i.e., irrigated). In order to provide the rural poor with a means of subsistence during the dry season, valley bottom cultivation, or Vinyungu, is commonly used. Paddy, maize, millet, cassava, sweet & Irish potatoes, beans, sugarcane, fruits, and vegetables are among the crops cultivated.

The study's locations are three villages spread across three agro-ecological regions in the GRRB in southwest Tanzania (Figure 1). The sites were purposefully chosen based on information from prior studies (e.g., Birch-Thomsen et al., 2001; Pauline et al., 2017; 2018), allowing for comparisons and building on prior knowledge. The main crops farmed in the GRRB were taken into consideration when choosing the study locations. Ikuvala is situated in the midlands region of the river (highlands), where maize and tomatoes are key crops, while Ruaha Mbuyuni is in the downstream part of the sub-Basin. The first village, Ibohora, is in the upstream of the sub-Basin (Usangu plains), where rice and onions growing is prevalent. The three agro-ecological areas provide a useful range in land-use types from which to address issues including different levels of vulnerability, different/or similar perceptions and experiences, coping and adaptation strategies to climatic extreme events, and different livelihood activities.

Methods of data collection and analysis

In the context of farming and food availability, in particular, factors impacting response decisions to climate change and unpredictability on rural lands are examined. When speaking with smallholder farmers and government representatives, both quantitative and qualitative data collection techniques were used. Focus groups and household questionnaire surveys were used to gather primary data, and records kept by government agencies were used to gather secondary data. These methods work in concert and offer multiple viewpoints while attempting to address various issues (RDSU, 2003). For the questionnaire survey, 90 households (10% of the population) were chosen at random (i.e., 30 households per village). Purposive sampling was utilized for FGDs to make sure that specific knowledgeable individuals were chosen for group interview. 12 household heads participated in each of the two FGDs that were conducted in each community. Men and women participated in one FGD, while women only participated in the second (Pauline et al., 2017). Microsoft Excel and the 16th version of the Statistical Package for Social Science (SPSS) software were used to code and process the survey data. To complement the quantitative data, the qualitative information was divided into topics and discussed. The analysis was strengthened by the use of direct quotations.

Logistic regression analysis

A logistic regression analysis was undertaken so as to determine factors that influence smallholder farmers' perceptions and choice of response measures during dry years. Four groups of factors were tested: (i) demographic characteristics (ii) access to information/education level (iii) location and (iv) wealth rank of the household (Table 1).
The dependent variable, which is Y, is either an adaptation or a coping strategy for food shortage presented in Table 1. The general model is:

$$Y=b0 + bX1 + bX2+\dots\dots\dots. +bXn \quad (1)$$

Y= either 0 or 1 where 0 means no use of a strategy and 1 represents use of a strategy.

Table 1: Variables influencing the choice of response strategies

Demographic	
X1- Age of household head	Age of household head in years
X2- Sex of household head	Sex of household head 0=Male, 1=Female
X3 -Marital status	Marital status of household head 0=Single (single, divorce, widowed), 1=Married (married, polygamist)
Access to information and technologies	
X4 – Education level of household head	Education level of household head 0=No formal education, 1=Have primary, secondary or tertiary education
X5 – Access to weather information	Household access to climate/weather services 0=No, 1=Yes
X6 – Change in weather pattern	Observed weather or climate changes by household in the past years 0=No, 1=Yes
Location	
X7- Village	Name of village
Wealth rank	
X8- Wealth	Household level of poverty 0=Poor, 1=Medium or Rich

Selected strategies for responding to food shortage and how they are influenced by different factors include, amongst others: selling livestock (S. livestock), selling household assets (SHA), consuming seed stock (CSS), eating food that is not normally eaten (AFNE), reducing amount of food eaten (RAFE), eating fewer meals per day (AFPD), seeking daily work for cash outside farm (SDWFC), migrating (MIGR), borrowing cash to buy food (BCBF), borrowing food (BF), working in other people's farms for food (WPFF), selling firewood (SFW), renting out land (ROL), and looking for relief (e.g. government food aid and remittances) (LFR). In contrast, selected farming practices in climate variability or weather changes are such as ripping, use of crop residue, using chemical weed control, tied ridging, ox-plough, pump irrigation, growing drought tolerant varieties, changing crops, mulching and intercropping.

RESULTS AND DISCUSSION

Factors influencing the perceptions on climate change and variability

The factors influencing the perceptions of households on climatic changes are examined. Three groups of factors were tested in the logit model, which include access to information and technologies (i.e., education level of the household head), location of the village, and farming experience of household heads (Table 2).

These factors were selected with the view that they determine farmers' perceptions and eventual response to climate variability. A number of perceptions common to all villages were selected to be tested against these factors. The perceptions include significant change in weather (SCW), change in frequency of rainfall (CFR), change in intensity of rainfall (CIR), rainfall starts late (RSL), rainfall starts earlier (RSE), rainfall not consistent (RNC) and days with dry spells (DWDS) (Table 2).

Table 2: Factors influencing smallholder farmers' perceptions to climate change and variability

	SCW	CFR	CIR	RSL	RSE	RNC	DWDS
Access to information and technologies							
Education level of household head	0.041 (0.958)	0.409 (0.539)	-0.259 (0.665)	0.532 (0.367)	0.404 (0.537)	-0.226 (0.704)	-0.027 (0.965)
Location							
Village	-1.813 (0.000)**	-1.355 (0.000)**	-0.770 (0.014)**	-0.816 (0.008)**	0.397 (0.217)	-0.819 (0.009)**	-0.794 (0.014)**
Farming experience							
Head of household farming experience	0.000 (0.999)	0.159 (0.282)	0.316 (0.057)	0.128 (0.377)	0.301 (0.121)	0.355 (0.037)**	0.319 (0.065)

** Significant at 5%

In the study area, farmers' perceptions are not influenced by their access to information or technologies. The model's findings demonstrate that there is no relationship between household heads' education levels and the chosen perceptions (Table 2). This might be explained by the farmers in the study area having a moderate degree of education. According to a study conducted in the South African Limpopo basin, farmers' perceptions of changes in weather patterns are not influenced by their level of education (Gbetibouo, 2009). In contrast, several studies have shown that farmers' views of climate change are influenced by their access to agricultural technologies and services (e.g., O'Brien & Vogel, 2003; Yanda & Mubaya, 2011).

According to the findings, six of the seven selected perceptions and the location of the village are significantly correlated (Table 2). These perceptions include significant changes in weather patterns (P = 0.000), decreased rainfall frequency (P = 0.000), increased rainfall intensity (P = 0.014), the start of the rainy season being later than usual (P = 0.008), inconsistent rainfall (P = 0.009), and a higher likelihood of dry spells during the rainy seasons (P = 0.014). This suggests that the village's location inside the research area affects how farmers view changes in weather patterns.

The model examined the number of years of agricultural experience to determine its impact on farmers' views of climate change over the preceding 40 years in the research area. The model's findings reveal a strong association (P = 0.037) between household heads' farming experience and their view that rainfall has been inconsistent recently compared to the 1970s and 1980s. This suggests that more seasoned farmers, as opposed to farmers in the research area with less farming experience, hold the belief that rains are not predictable. Similar findings were found in the study by Gbetibouo (2009), which was conducted in the South African Limpopo basin. Farmers with more than 30 years of experience stated "rainfall is declining and that the frequency of droughts and floods has changed". As a result, farmers are more likely to notice a change in weather patterns the more expertise they have.

Factors influencing choice of responses to climate change

Perception of changes as discussed in the previous section is the pre-requisite to adaptation, meaning that one starts responding once they perceive a change. Findings indicate that households used a variety of strategies to respond to the impacts of climate change (Table 3).

This study demonstrated that smallholder farmers respond to climate stressors by using locally available resources, including their own labour. The majority of responses to unexpected food shortages can be categorized as coping mechanisms (e.g., selling household assets, reducing the amount of food eaten, eating fewer meals per day, seeking daily work for cash and temporary migration). Other researches claimed that rural societies' frequent and significant response options to climate challenges is the depletion of household assets, such as livestock and bicycles (Nhemachena & Hassan, 2007; Mutekwa, 2009; Mertz et al., 2010). As an adaptability strategy, farmers adopt various farming techniques throughout dry and rainy growing seasons. The majority of adaptation options are based in part on recommendations from agriculture extension officers and, to a lesser extent, on lessons acquired from past climate pressures. These include growing crops with short growing seasons and drought tolerance, planting vegetable gardens, and using weather forecast data to supplement conventional methods of weather prediction. The same goes for Marie (2020), who listed a few countermeasures to the effects of climate change, including mixed farming, mixed cropping, early and late planting (changing the sowing period), drought-resistant crop varieties, the use of soil and water conservation methods, shifting to non-farm income activities, and irrigation. The ability to choose response options to climate change is influenced by a variety of social and economic factors, according to Deressa et al. (2011). These elements could be the household size, the sex and educational background of the head of the household, the possession of assets (such as cattle), access to extension and climate services, and financing availability.

Results show that the choice of response options during a food scarcity is likely to be influenced by the age of household heads (Appendix Table 4).

Table 3: Coping and adaptation strategies

Study villages	Coping strategies	Adaptation
Ibohora	Selling household assets, out-migration and selling own labour	Planned canal and pump irrigation, agriculture intensification and planting drought tolerant crops.
Ikuvala	Hiring irrigable land, selling household assets, out-migration and selling own labour	Agriculture intensification and commercialization, planting drought tolerant

		crops, savings in a form of livestock keeping and building house for rent in urban centres.
Ruaha Mbuyuni	Renting-out land, selling household assets and selling own labour	Planned canal and pump irrigation, agriculture intensification and commercialization, planting drought tolerant crops, savings in a form of livestock keeping, business enterprises, employment and building house for rent in urban centres.

The findings demonstrate a significant correlation between the age of the family head and response actions like selling firewood and working on other people's farms for food (P = 0.02 and 0.046, respectively). Results from focus group discussions show that because these measures don't involve any kind of cash, elderly men and women who lead families are more likely to select them than younger household heads. The model study also reveals a negative correlation between these response strategies and the age of the household head (Table 4). The negative sign indicates that there is a lower possibility of using these adaptation measures during a food crisis as a result of household head age. This can be because elderly individuals find it harder to work on farms or gather firewood for selling.

The results show that the choice of response methods is likely to be influenced by the gender of household heads. When there is a food shortage, gender and response strategies such consuming less food are positively and significantly connected (P = 0.012) and eating fewer meals throughout the day (P = 0.013). Because they could conserve and utilise the little amount of food they had for a longer period of time, female-headed households, particularly widows, are more inclined to employ these strategies. It was discovered that during times of food scarcity, men frequently migrate, leaving their wives and kids behind. Women in these situations are left with little choice but to save what little food they have. In contrast to households led by men, those headed by women are consequently more susceptible to climatic pressures and less inclined to adjust to them. Studies in Tanzania (Tenge et al., 2004), Uganda (Buyinza & Wambede, 2008; Nabikolo et al., 2012) and Ethiopia (Nhemachena & Hassan, 2008), for instance, found that male-headed households are better positioned to adopt adaptation strategies and have access to new agricultural technology and suitable land. This implies that the family head's gender affects the selection of response actions in times of food scarcity.

The model's results also show a strong relationship between the household head's marital status and the response methods they choose, such as reducing the amount of food consumed (P = 0.019) and eating fewer meals per day (P = 0.013). However, there is a negative correlation between the household head's marital status and these response techniques (Table 4). The negative indication indicates that there is a lower possibility of selecting these options during a food crisis if the household head is married.

Among the three villages under study, the village's location is a variable that may affect households' decision-making regarding their response plans in the event of a food shortage. The model's findings show a positive and significant correlation between village location and response strategies like selling firewood and borrowing money to buy food (P = 0.010). As a result, a village's location is a factor that positively determines how adaptation options are chosen in times of food scarcity. Farmers in Ruaha Mbuyuni village, for instance, had more options for business than those in Ibohora and Ikuvala villages. As a result, the latter was more willing to work for hire and start their own businesses when there was a food scarcity.

According to model results in table 4, wealth rank is the component that is most likely to have an impact on farmers' choice about their response strategies. The findings indicate a positive and significant relationship between wealth rank and the strategies chosen, including selling household assets (P = 0.016), using seed stock (P = 0.002), consuming less food (P = 0.000), eating fewer meals per day (P = 0.000), looking for daily work for money outside the farm (P = 0.001), borrowing money to buy food (P = 0.016), borrowing food (P = 0.020), working on other people's farms for food (P = 0.001). The findings imply that the household head's financial situation is more likely to affect the choice of response actions during a food crisis. The belief among farmers that wealthier households have more options for adjusting to the shocks of climate change is consistent with this. Relatively wealthy households have more options and resources that can be employed in times of food shortages, claims Agrawal (2010). The model's findings support what farmers said in focus group discussions, who said that poor households lack savings to help them in times of food shortages. As a result, they heavily rely on human labour and the local natural resources for their survival. Farmers emphasized that if the current weather trends continue, a poor farmer will continue to be even poorer because they spend the majority of the growing season working for money on other people's farms rather than working on their own farms (Pauline et al., 2017).

According to model results in table 4, access to information and technology (i.e., household heads' educational levels) is less likely to have an impact on farmers' decisions on chosen response strategies during a food shortage. This is not a surprise outcome given the vast range of activities that individuals who have access to information and technology engage in, which makes them less likely to be negatively impacted by a food crisis. Higher education reportedly enhances opportunities for engaging in non-farm occupations, thus use such options to address food shortages, according to Yanda and Mubaya (2011).

According to the study, farmers are generally less likely to adopt and employ indigenous climate-related adaptation practices, while having considerable awareness of them. The key predictors of farmers' awareness of indigenous climate-related adaptation practices include their education, farming experience, farmer-to-farmer extension services, and membership in a farmer organization. Farmers' levels of education, agricultural experience, interactions with farmer extension agents, membership in farmer organizations, labor availability, and age all have a significant impact on the indigenous climate adaptation strategies they choose. Farmers are urged to self-organize into organizations so that more seasoned farmers can teach younger farmers about traditional methods of coping with climate change. Findings are inline with other studies, who found that farmers' level of education, age, gender, years of farming experience, household size, knowledge of climate change, access to credit, farm income, non-farm income, ownership of livestock, and contact with extension agents are among the factors that explain their choices concerning climate change adaptation (Obayelu et al., 2014; Alhasan, 2018).

Findings from this study are congruent with others, which show that household size, farm size, harvested yield, and various agro-ecological zones were among the socioeconomic factors and other aspects of the farmers that were shown to influence the farmers' choice of enhanced maize varieties (Mutanyagwa, 2015; Marie, 2020). Likewise, others discovered that factors such as cultivated land area, seed, fertilizer, pesticides, water, age, education level, experience, income, and the size of the field had a substantial influence on farmers' choices to use adaptation strategies. The key explanatory variables that influenced adaptation strategies were cultivated land area, water, and training, whereas labor and land tenure did not play a significant role (Deresa, 2009; Esfandiari et al., 2020). In a similar vein, Kinuthia (2018) and Kom (2020) found that receiving weather information, the age of the household head, the size of the household overall, the level of education of the household head, noticing changes in mean annual rainfall and the onset of rains, and the land tenure system were all significant influences on the response strategy choice.

CONCLUSION

Conclusions drawn from this study and others listed therein show that, while local resources influence the perceptions and response options used, there are more parallels than differences in the coping and adaptation techniques used within the GRRB and between the GRRB and other developing nations. Smallholder farmers mostly relied on their prior knowledge and locally accessible resources when developing their response strategies. In order to identify previous experiences of farmers in addressing the effects of climatic pressures, adaptation to climatic stresses in this example was explored at the local-scale. According to the research, factors that significantly influence farmers' decisions about how to adapt to climate change include climate knowledge, gender, age, education level, location of the village, wealth status, and farmer experience. Therefore, through strengthening adaptation measures suitable for a specific climate shock on the research area, policy makers from local authorities to national levels should play a vital role. The study advises raising the level of knowledge and climate change awareness among GRRB farmers. Farmers should also make an effort to develop associations that will serve as a forum for knowledge sharing about indigenous farming practices for successful climate change adaptation.

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Appendix: Table 4: Factors influencing the choice of response strategies during food shortage (**Significant at 5%)

Factor	Selling livestock	SHA	CSS	AFNE	RAFE	AFPD	SDWFC	Migrated	BCBF	BF	WPFF	SFW	ROL	Remittances
Demographic														
X1- Age of household head	0.007 (0.761)	0.006 (0.807)	-0.013 (0.598)	0.002 (0.939)	0.019 (0.466)	0.032 (0.233)	-0.063 (0.004)	-0.062 (0.256	-0.013 (0.642)	-0.014 (0.493)	-0.046** (0.020)	-0.053** (0.046)	0.037 (0.156)	0.031 (0.129)
X2- Sex of household head	-1.530 (0.103)	0.352 (0.739)	-0.768 (0.487)	0.085 (0.949)	3.377** (0.012)	3.434** (0.013)	-1.755 (0.055)	-3.419 (0.112)	-0.717 (0.581)	0.170 (0.851)	-0.913 (0.259)	-0.039 (0.971)	-3.046 (0.036)	-0.439 (0.610)
X3 -Marital status	0.287 (0.751)	-2.159 (0.068)	-0.921 (0.409)	-0.064 (0.960)	-3.311** (0.019)	-3.667** (0.013)	0.911 (0.268)	2.516 (0.266)	-0.332 (0.794)	-0.673 (0.444)	0.618 (0.408)	-1.018 (0.325)	2.446 (0.066)	1.435 (0.074)
Access to information and technologies														
X4 – Education level of household head	1.214 (0.138)	-0.304 (0.694)	-0.167 (0.826)	-0.906 (0.370)	0.444 (0.569)	0.935 (0.268)	-0.338 (0.610)	-3.021 0.116	0.272 (0.766)	0.162 (0.810)	0.224 (0.725)	-0.361 (0.639)	-0.492 (0.512)	0.735 (0.257)
X5 – Access to weather information	-1.005 (0.167)	-0.306 (0.432)	-0.440 (0.467)	-1.080 (0.448)	0.093 (0.709)	0.065 (0.798)	0.178 (0.402)	1.016 (0.085)	-0.165 (0.636)	-0.162 (0.619)	-0.120 (0.654)	0.252 (0.285)	-0.232 (0.529)	-0.201 (0.502)
X6 – Change in weather pattern	-0.301 (0.649)	-0.591 (0.463)	0.145 (0.862)	-0.689 0.568	1.040 (0.197)	1.170 (0.161)	0.654 (0.341)	-5.405 (0.128)	0.568 (0.498)	0.084 (0.902)	-0.062 (0.924)	1.342 (0.116)	-0.040 (0.962)	0.599 (0.375)
Location														
X7- Village	0.508 (0.185)	0.264 (0.601)	0.410 (0.405)	-0.426 (0.528)	0.588 (0.185)	0.526 (0.250)	0.516 (0.169)	-3.974 (0.159)	1.455** (0.010)	0.519 (0.200)	0.148 (0.678)	1.068** (0.030)	-0.369 (0.413)	0.206 (0.558)
Wealth rank														
X8- Wealth	0.459 (0.515)	2.097** (0.016)	2.763** (0.002)	0.822 (0.488)	3.079** (0.000)	3.513** (0.000)	2.553** (0.001)	1.254 (0.455)	2.236** (0.016)	1.666** (0.020)	2.183** (0.001)	3.752** (0.000)	0.055 (0.944)	1.147 (0.072)