**ANALYSIS** 3(12), October - December, 2017

ISSN 2394–8558
EISSN 2394–8566

Climate Change

# Adapting smallholder farming to climate change and variability: Household strategies and challenges in Chipinge district, Zimbabwe

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**Article History**
Received: 20 July 2017
Accepted: 05 September 2017
Published: October-December 2017

**Citation**
Emmanuel Mavhura, Desmond Manatsa, McDonald Matiashe. Adapting smallholder farming to climate change and variability: Household strategies and challenges in Chipinge district, Zimbabwe. *Climate Change*, 2017, 3(12), 903-913



## ABSTRACT

Africa is one of the most vulnerable continents to climate variability and change partly because of multiple stresses and low adaptive capacity. The need for robust climate change adaptation strategies appears to be much high among many African rural communities that depend on rain-fed farming. The adaptation strategies are needed to improve the resilience of the farming system and ensure food security. The study therefore, examines the household adaptation strategies of smallholder farmers in a poor agrarian district of Chipinge, Zimbabwe, and the challenges they face. The data came from questionnaires, interviews, focus groups and field observations. A thematic approach and descriptive statistics were used to analyse the data. The findings show four categories of adaptation strategies: crop management practices, land use management strategies, livestock management strategies, and non-climate dependent livelihoods. However, the smallholder farmers face challenges including lack of weather forecast specific to the study area, inadequate information to decide on crops and cultivars to plant as well limited finances. These challenges and others, reduce the smallholder farmers' adaptive capacity to climate change.

**Key words:** Adaptation; Chipinge; Climate change; smallholder farmers

## 1. INTRODUCTION

Climate change is one of the biggest threats facing mankind today (GoZ, 2016). The impact of climate change and variability are becoming more evident with increased incidences of droughts, floods, hailstorms and heat waves among others in many countries (Cretat*et al*. 2012, Kusangaya *et al*. 2013, Vincent *et al*. 2013). Bryan *et al*. (2013) argue that climate change is expected to reduce production of key staple foods including maize, sorghum, millet, groundnut, and cassava especially in rainfall dependent farming systems of Africa. The Intergovernmental Panel on Climate Change (IPCC) fourth assessment report concluded that by 2020, rain-fed farming yields could be reduced by up to 50% by 2020 in some African countries (IPCC 2007). The report further notes a decrease in the size of arable land, the length of growing seasons and yield potential, particularly in semi-arid and arid areas of Africa in the coming decades. This would further adversely affect food security and exacerbate malnutrition in the African continent.

Modelling results indicate that the period 1997 to 2011 were the warmest years on record with 1998 and 2010 being the hottest in southern Africa (GoZ 2016). Southern Africais experiencing more hot and fewer cold days than before as a result of climate change and variability (Gaughan *et al*. 2015; GoZ 2016). The sub-region's annual mean surface temperature has warmed by about $0.4^{0}$C from 1900 to 2000(Jury 2013). The period from 1980 has been the warmest in Zimbabwe. The timing and amount of rainfall received are becoming increasingly uncertain (Gaughan *et al*. 2015). The frequency and length of dry spells during the rainy season have increased while the frequency of rain days has declined (Mukwada and Manatsa 2013, Vincent *et al*. 2013). This situation adversely impacts on the economy which is primarily agro-based with over 70 per cent of the population living in rural areas and dependent on climate-sensitive livelihoods such as arable farming and livestock rearing (Moyo *et al.*2012; Mukwada and Manatsa 2013; Robert Jordan, 2017). For instance, the Zimbabwean Government estimated that 2.44 million – 26% of the population required food aid during the 2015-2016 agricultural season partly as a result of El Nino Southern Oscillation induced drought (https://www.wfp.org/stories/el-nino-faces-drought-zimbabwe) [Accessed on 23 June, 2016].

Africa remains vulnerable to climate variability and change partly due to multiple stresses and low adaptive capacity (IPCC 2007). As such, climate variability adaptations are particularly important for countries such as Zimbabwe, where the poverty rate is above 76 percent, while about 70 percent of the population depends on rain-fed agriculture for their livelihood (Mukwada and Manatsa 2013, ZimStat 2013, Gaughan *et al*. 2015). The need for robust climate variability and change adaptation strategies appears to be much high among many rural communities. In agro-based economies, adaptation both at national and household levels are needed to improve the resilience of the farming system, protect the livelihoods of the poor, and ensure food security. Adaptation can be defined as the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates potential damages or take advantage of beneficial opportunities (Forino *et al*. 2014).One of the most important factors shaping the adaptive capacity of individuals and communities is their access to and control over resources. On this regard, adaptation to climate change and variability at the national level will require large-scale investments not only in irrigation infrastructure or technology and drought-tolerant varieties, but also in social protection programmes and integrated strategies to reduce livelihood risks (Bryan *et al*. 2013). At the household level, adaptation to climate variability can include changes in crop, livestock and land use management practices as well as other livelihood strategies. Crop management practices that may require changes include choice of crop varieties, fields, planting dates and planting densities (Mburu *et al*. 2015). Livestock management practices such as choice of livestock to rear, their feeding programmes, transhumance timing and destinations may need to be considered in line with place-specific climatic conditions. Land use and land management practices include fallowing, irrigation and water harvesting, soil and water conservation measures, tillage practices, soil fertility management or and livelihood strategies (Bryan *et al*. 2013, Mburu *et al*. 2015).

Since the impacts of climate change are greatly felt at the local level by the poor communities, this study is conducted at the household level in a poor agro-based district. The study examines the adaptation strategies of smallholder farmers to climate change and variability, and the challenges they face. A better understanding of smallholder farmers' adaptation measures, and the challenges they face, is important to inform policies aimed at promoting successful adaptation of the agricultural sector. Consistent with calls for more participatory approaches in understanding climate variability in farming regions (Bryan *et al.* 2013), this study adopts a case study approach. This study acknowledges that the smallholder farmers are better positioned to implement climate change adaptation strategies. The case study approach allows for a holistic consideration in local management of the complex issue of adapting to climate change and variability, and how these experiences may assist in supporting other rural communities in their adaptation to climate change. This study is motivated by answering these two questions: In what ways are smallholder farmers in Chipinge district adapting to climate variability and change, and what challenges are they facing in this process?

The paper is composed of five sections. Section 2 describes the study sites and outlines data collection and analytical methods. Key findings are presented in Section 3, followed by their discussion in Section 4. Conclusions are discussed in Section 5.

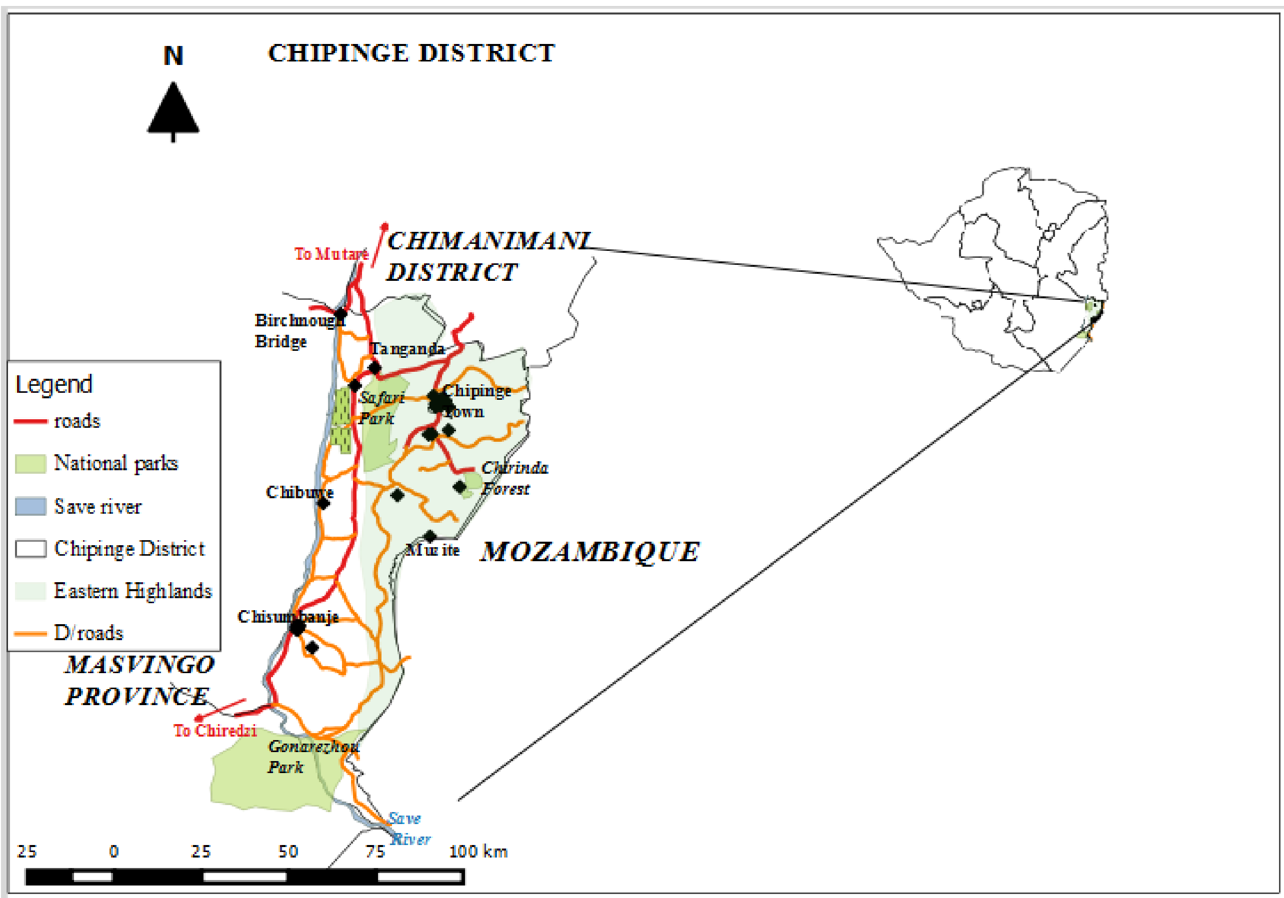


**Figure 1** Map of study area: Chipinge district, Zimbabwe
*Source: Authors*

## 2. METHODOLOGY

### 2.1 Study area

This study was conducted in the low-lying areas of Chipinge district, Zimbabwe (Figure 1). Chipinge shares boundaries with Chimanimani district in the north, Chiredzi in the south-west, Buhera in the north-west and Bikita district in the west (Marashe 2014). The district is located in agroecological regions 1, 4 and 5 in eastern Zimbabwe (Zamchiya 2011). The district has both highlands and lowlands. While the highlands -which make the agroecological region 1, are characterised by high rainfall and cool temperatures, the lowlands – that constitute agroecological regions 4 and 5, experience little precipitation and high temperatures. The low-lying areas are located in the rain shadow of the Chimanimani mountains, hence the steep gradient in agroecological region transition.

They are characterised by mid-season dry spells and droughts. On average, the district receives 520 mm of rainfall every year. However, the average annual potential evapotranspiration (600-1000 mm) exceeds the available water supply (Zamchiya 2011). Chipinge district has an aridity index ranging between 0.2 - 0.5. The average monthly temperature is 23.5˚C. The hottest months of the year are September and October in which temperatures of above 34ºC are recorded. The coolest average temperature is 5˚C recorded in July.

A large portion of southern Chipinge has sand soil that does not promote much of agricultural activities. Mopani trees which are drought tolerant and sturdy are found in the low-lying areas of the district. The drainage of southern Chipinge is dominated by the Save River. The district has a total population of 300 792 of which about 46 per cent are male and 54 per cent are female (ZimStat 2012). Smallholder farming is the main economic activity in the district with a poverty prevalence rate of about 85 per cent (ZimStat 2015).

### 2.2. Data collection and analysis

Data for this study was collected using questionnaires, interviews, focus groups, and field observations. Six hundred and fifty questionnaires were randomly administered to smallholder farmers, agriculture extension officers and local authority representatives in December 2016. Both closed and open-ended questions were used. The fixed-response questions (in form of rating scales) were useful in that they generated frequencies of responses amenable to statistical analysis that were quicker to code and analyse than open-ended questions. The open-ended questions enabled participants to explain and qualify their responses (Cohen *et al.* 2011).

Thirty-six (36) key informants were interviewed including ward counsellors, smallholder farmers, agriculture extension officers, village heads and other representatives from the Ministry of Agriculture, Mechanization and Irrigation. The interviews enabled gathering data from multi-sensory channels: verbal, non-verbal, spoken and heard (Cohen *et al*. 2011). The use of open-ended questions and probing during the interviews gave the participants the opportunity to respond in their own words rather than forcing them to choose from fixed responses as closed questionnaires do (Mack *et al.* 2005).

Five focus groups were held with smallholder farmers purposively selected from Chipinge.The participants were invited through ward councillors and village heads.The focus groups discussed adaptation strategies and the challenges faced by the smallholder farmers in adapting to climate change. Each group's participants ranged from six to ten people whose ages are between twenty-four and sixty years. This was a manageable number because a very small group could have suffered from intra-group dynamics that exert a disproportionate effect. At the same time, a large group could have turned unwieldy and hard to manage, denying a voice to inarticulate members when disagreements arose. The groups were gender balanced and produced more filtered, socially controlled and more neutral findings (Silverman, 2013). Field observations were used to assess the adaptation strategies employed by smallholder farmers. Engaging in overt semi-structured observations in natural settings allowed gathering data that illuminated and explained the smallholder famers' adaptation in a less pre-determined manner. The observations were undertaken alongside questionnaire survey and face-to-face interviews.

Descriptive statistics were used to analyse survey data, while a thematic analysis of the large volumes of raw data from interviews, field observations and focus groups was conducted (Silverman, 2013). Thematic analysis is a recognised analytical approach for qualitative research. Each research question was used as theme heading, and then all responses for each question were examined to identify any areas of consensus and differences, as well as any sub-themes emerging (Cohen *et al.* 2011). Any additional, unanticipated themes were noted and their responses were recorded. This approach was very useful because all the relevant data from various streams provided a collective answer to a research question. In this way, there was a degree of systematization in that numerical data for a particular research question followed qualitative data or vice versa. This enabled the exploration of patterns, relationships and qualifications across data types. The thematic analysis emphasised on richness, diversity and complexity rather than trying to identify consensus within themes (Denscombe, 2010, Silverman, 2013).

## 3. FINDINGS

### 3.1. Adaptation Strategies

Smallholder farmers were asked to state the adaptation strategies they had made in response to climate change threats in the past ten years. The survey revealed fourteen strategies (Table 1) that can be categorised into (a) crop management strategies, (b) land use and management strategies, (c) livestock management strategies, and (d) non-climate dependent livelihoods.

#### *3.1.1. Crop management strategies*

There are four major crop management strategies that are practiced by smallholder farmers in response to changes in rainfall and temperature patterns. These strategies include planting drought tolerant crops, horticulture production, inter-cropping and choice of short-seasoned crops and varieties that mature early. Survey results (Table 1) show that most of smallholder famers in Chipinge district grow drought tolerant cultivars (88 per cent) such as pearl millet, sorghum, rapoko and cotton. These crops are able to withstand low soil moisture and high temperatures. The cropped areas varied greatly among the smallholder farmers who plant maize as the staple crop, on the greater part of their land. What is also interesting in this study is that the smallholder farmers usually switch from maize to sorghum or pearl millet when there is a threat of drought-induced food insecurity. However, almost every household had a piece of land under a drought tolerant crop. Those with small land holdings of about an acre or less indicated preferences of growing maize at the expense of small grains those are drought-tolerant. The highest proportion of smallholder farmers grew sorghum (57 per cent), followed by pearl millet (33per cent), cotton (15per cent) and rapoko (8per cent) (Fig.2). Interviewees explained that cotton was grown as a cash crop for purchasing food at the market.

**Table 1** Smallholder adaptation strategies to climate change during the past 10 years

| Adaptation strategies | Frequency | % |
|---|---|---|
| Growing drought tolerant crops | 572 | 88 |
| Planting short-cycle crops and varieties | 546 | 84 |
| Mixed farming | 469 | 71.2 |
| Inter-cropping | 429 | 66 |
| Small-scale irrigation | 364 | 56 |
| Market gardening | 221 | 34 |
| Cross-border trading | 182 | 28 |
| Water harvesting | 143 | 22 |
| Sand abstraction | 117 | 18 |
| Planting early or late in the season | 104 | 16 |
| De-stocking | 71 | 10.9 |
| Asset disposal | 39 | 6 |
| Soil and water conservation | 36 | 5.5 |
| Zero tillage practices | 29 | 4.5 |

*NB: Total is more than 100% because of multiple responses; (n=650)*

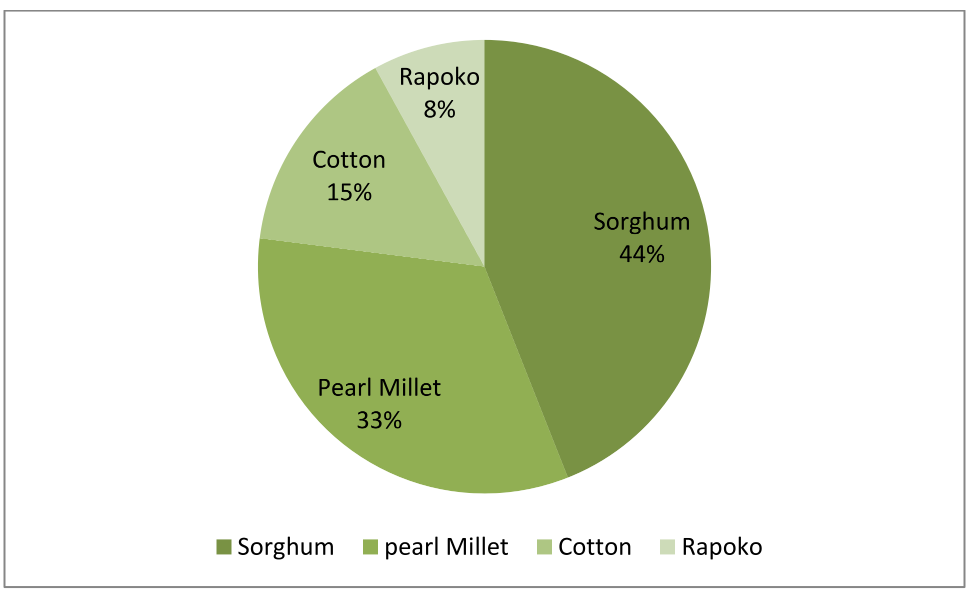


**Figure 2** Drought tolerant crops grown in Chipinge

Some smallholder farmers are also adapting to observed climate changes by planting early or late in the rain season (16per cent).Early planting is being facilitated by the use of techniques of soil and water conservation (5.5per cent) and zero tillage (4.5per cent). Inter-cropping is a common climate change adaptation practice among smallholder farmers (66per cent) in Chipinge. Inter-cropping involves planting two or more crops in the same field. This may increase productivity per unit land although it may also increase nitrogen and water demand at the same time. The smallholder farmers usually mix maize with water melons and cucumbers. In some situations, early sowing may allow intercropping of, for example ground nuts and round nuts. If one of the crops gives good yields it is sold for income generation to buy maize and even to send children to school. Horticultural crops including cabbages, tomatoes and onions, and some short-cycle crops and varieties are sometimes preferred by smallholder farmers especially when these crops have potential to fetch good markets. The majority of the survey respondents (90per cent) admitted that they were practicing horticulture at small scale. In addition to these crops, some smallholder farmers (21per cent) adopt short-to-medium season crop varieties that are early maturing. The crops can be harvested within two and half months making it reliable and conducive for smallholder farming.

***3.1.2. Land use management strategies***

Water harvesting, irrigation, soil and water conservation measures, mixed farming and tillage practices are some of the land use/management practices being carried by at household level smallholder farmers in Chipinge, Zimbabwe. About 22 percent of the respondents were involved in water harvesting both in their homesteads and on farms (Figure 3). Two forms of water harvesting are practiced in Chipinge: rainwater harvesting from either rooftops or *in situ*, and runoff collection. Rainwater harvesting is mainly for domestic use and horticulture (market gardening) in small plots. Very few farmers (0.6per cent) use the harvested water to supplement their staple food production. About 79per cent of the respondents attributed their lack of harnessing rainwater to inadequate finances and other resources. Among these, 20per cent of the respondents are harvesting rainwater from roof tops. Very few had water tanks while others are digging earth dams in their fields to capture running water. Homesteads with grass thatched roofs were not suitable for rainwater harvesting. Respondents attributed this deficit to lack of resources for digging retention ditches for storing the storm water and allowing a slow seepage into the farm. Respondent farmers practicing this technique reported improved food security in their households.

**Figure 3** Rain water harvesting from roof tops
*Source: Authors*

Despite having advantages, water harvesting practices are constrained by the social and economic conditions of the smallholder farmers. Construction of infrastructure to divert and store the water is limited by the amount of land, water and financial resources available to smallholder farmers.

A significant number of key informants (56per cent) confirmed that they were involved in small-scale dry-land irrigation. They reported an average of 20% increase in annual income since adopting irrigation, and in some cases, up to 30per cent, due to intensified production. Nutrition was said to have improved as various vegetables became locally available. The most successful households have increased their assets, particularly livestock which is an important form of saving and wealth accumulation. Some have bought new farming equipment to further increase productivity. In this way irrigation, can lead to increased production and improved income generation, and some households acknowledged that their livelihoods had been 'transformed'. Irrigation is practiced using tape water for market gardening and river water into small plots. This is the common system in most villages that are close to major perennial rivers such as Save. The smallholder farmers believed that it is too risky to entirely depend on rain-fed cultivation. Having access to water allows the farmers to grow vegetables for sale, which have shorter cycle and do not need too much water to attend, allowing them to cultivate as many times in a year as possible. The sale of the produce gives the farmers some income to buy staple food.

Some households do not irrigate because of the location of their land, and these households have had mixed experiences since the introduction of irrigation. Hiring and share-cropping arrangements allow cultivation on irrigated land for extra income, and some have constructed their own irrigation ponds after seeing the benefits. In some sites increased local production has created opportunities for trading vegetables. Some smallholder farmers reported that food security has improved because a greater variety of food is available locally, at lower prices, and they are able to borrow cereals from neighbors at times of scarcity. However, some households also said that irrigation has reduced their water access and falling crop prices have had a negative impact.

A significant number of smallholder farmers adopted market gardening (34per cent) as a way of adapting to climatic variability and change. The smallholder farmers own and control a community garden with a water source. Each household has a piece of land in that garden where horticultural crops are grown both for subsistence and for sale. One such garden is the Zvikombero Community Garden in Mkundi village. About three quarters of smallholder farmers with plots in the Zvikombero Community Garden admitted that they were harvesting enough for family consumption.

### *3.1.3. Livestock management strategies*

Many smallholder farmers engage in mixed-farming (72per cent) as an adaptation strategy. They rear cattle and donkeys which provide draught power. Other livestock kept include goats and sheep which can be traded at the market to purchase food in years of yield deficits. The livestock adaptations include de-stocking (10.9per cent)which interviewees said is done following poor pasture production, fire management to control woody thickening, and using more suitable livestock breeds or species. These activities are partly informed by climate forecasts at differing time scales at local level using ethno-based methodologies.

### *3.1.4. Non-climate dependent livelihoods*

There are non-climate dependent livelihood strategies undertaken by stallholder farmers in Chipingeas forms of adapting to climate change. These include sand abstraction, cross border trading and asset disposal. About 18per cent of the respondents are involved in sand harvesting on their farms, along the road sides and in the rivers, mostly the flood plains of Save River (Figure 4). Sand abstraction has attracted many young men in the district during the past decade. The sand is used for construction purposes in surrounding towns including Chipinge, Chiredzi and Mutare City.

**(a)** **(b)**

**Figure 4** Sand harvesting in (a) Save River and (b) along road sides
*Source: Authors*

Cross border trading into South Africa and Mozambique is sustaining many smallholder farmers in Chipinge. These two countries are very close to Chipinge district. Rice, maize meal, macaroni and cooking oil are some of the food items imported from South Africa and Mozambique for family consumption. Cross border trading is also a way of generating income which is used to buy other household needs.

When faced with food insecurity, some smallholder farmers dispose household assets (6per cent) as a coping strategy. The most common assets sold are cattle and goats. Some smallholder farmers sell their livestock to earn income which is used to purchase food, farm implements and inputs that are used to increase food security. Others slaughter their livestock to get food. Some exchange livestock with food while others sell farm implements to purchase food. One interviewee echoed:*'I was forced to sell two beasts so that I can purchase food which could last my family until the next* (farming) *season.'*

To cope with the persistent droughts, 3 percent of the interviewed households were forced to fall back on savings, whilst 5per cent sold household assets (cattle, goats and wheel barrows) they had accumulated over the previous seasons. However, the average income contribution of savings and asset disposal was very low because of extreme poverty within many households. At the same time, resorting to savings and selling of asset holdings prevented many of the smallholder farmers to make large farm investments which could have reduced the impact of climate and provided enough food for family consumption. For example, one smallholder farmer who had attained enough farming equipment for his family was forced to sell them so as to purchase food. Thus, the family food needs were provisionally met at the expense of better-quality tillage equipment. This meant that the family would be unable to produce food in the coming season even if there might be normal to above normal rainfall.

### 3.2. Challenges faced in adapting to climate change and variability

Eight key challenges face smallholder farmers in adapting to climate change (Table 2). Lack of weather forecast for Chipinge area (94per cent) was cited as the major challenge. Key informants explained that they needed weather information to decide on crops and cultivars to plant as well as on whether to plant early or late in the rain season. Limited finances (90.8per cent) affect all climate change options including inputs for drought tolerant crops and varieties, irrigation infrastructure, intensifying market gardening and other non-climate dependent livelihoods such as sand abstraction and cross-border trading. The economic challenges reduce the smallholder farmers' adaptive capacity (87.2per cent) to climate change. Inadequate adaptive capacity involves limited access and control over resources that not only constrain the ability of the smallholder farmers to bounce back from climate shocks, but also adapt to long-term changing climate.

**Table 2** Barriers to climate change adaptation

| Barrier | Frequency | % |
|---|---|---|
| Lack of weather forecast specific to local area | 611 | 94 |
| Financial constraints | 590 | 90.8 |
| Inadequate adaptive capacity | 567 | 87.2 |
| Inadequate irrigation infrastructure | 401 | 61.7 |
| Inadequate information on benefits of the adaptation options | 340 | 52.3 |
| Inadequate information on climate change impacts/risks | 276 | 42.5 |
| Insufficient land | 312 | 48 |
| Cultural acceptability | 143 | 22 |

*NB: Total is more than 100% because of multiple responses; (n=650)*
*Source: Authors*

Inadequate irrigation infrastructure (61.7per cent) means that smallholder farmers are unable to invest in intensive farming to overcome the negative impacts of climate change. There are limited dams and the famers cannot afford irrigation pipes. Furthermore, smallholder famers lack information on benefits of the adaptation options (52.3per cent) and climate change impacts/risks (42.5per cent). The lack of such information is hindering informed decision making. Other challenges include insufficient land (48per cent) and some cultural acceptability (22per cent). Some focus groups explained that they had no other land options and others viewed their cultural preference of maize as staple food as a barrier to their choice of other small grains.

## 4. DISCUSSION

This paper examined the adaptation strategies to climate change and the challenges that are faced by smallholder famers in mitigating impacts of climate change. The key strategies are categorised into crop management practices, land use management strategies, livestock management strategies, and non-climate dependent livelihoods. The adoption of a variety of crop management practices is enabling small holder farmers in Chipinge cope with the adverse impacts of climate change. The practice is intensified at household level. Similar practice was observed in Morogoro, Tanzania, where many smallholder famers had switched to horticulture farming that gave them 4-6 harvests in a year (Paavola 2008).

Although irrigation has the potential to improve crop production in arid and semi-arid places (Galipeau *et al*. 2013, Tilt and Gerkey 2016), it is still done at small scale in Chipinge. Up-scaling irrigation in this district may enhance crop production not only in this district, but also in other surrounding semi-arid environments. Just as large investments in formal irrigation were important in Green Revolution to enhance food security (Hanjra *et al*. 2009), such investments are needed as well in adapting to climate change in Zimbabwe. Enfors and Gordon (2008) posit that supplemental irrigation system has the potential to improve the capacity to deal with agricultural drought by bridging dry spells, reducing runoff and evaporation, and enhancing infiltration. Rain water harvesting is helping mitigate the effects of temporal and spatial variability of rainfall, and the high risk of intra-seasonal dry spells that characterize Chipinge district. Some studies have shown that the yield of agricultural production can be significantly improved with water harvesting practices (Inocencio *et al*. 2003, Enfors and Gordon 2008). Farmers in Burkina Faso provide an example where water harvesting is used to improve food security (Rockstrom *et al*. 2002). In Tanzania, there is evidence of water harvesting practices although it is mostly opportunistic with some traditional techniques used for actively managing runoff collection and distribution (Inocencio *et al*. 2003). Given that small-scale irrigation increases agricultural productivity and households' ability to cope with climate variability, accompanying measures are required to ensure that (a) water sources themselves are always available to Chipinge and (b) the supporting infrastructure is affordable to the poor.

Although some smallholder farmers in Chipinge district dispose their assets as an adaptive strategy to climate change, the practice has been observed to be a driver of what seems to be climate-related poverty traps in Tanzania (Enfors and Gordon 2008). The major items that are sold include livestock which provide draught power and are a form of wealth among the smallholder farmers. Selling household goods can lead to asset depletion at household level that prevents the household from investing in income generating activities. This would reduce the household's adaptive capacity to climate change. Adaptive capacity involves making proactive and informed decisions about alternative livelihood strategies based on changing conditions (Smith *et al*. 2015). Interventions to improve adaptive capacity are aimed at improving the flexibility of households and communities to respond to longer-term social, economic and environmental changes. This necessarily entails promoting livelihood diversification, supporting asset accumulation, and improving the social and human capital available to vulnerable populations. However, adaptive capacity is context-specific and multi-dimensional as it varies by individual, household, community and over time (Frankenberger *et al*. 2012). In Chipinge, adaptive capacity may be improved by addressing the challenges that smallholder farmers are facing. These include lack of income, irrigation infrastructure, weather forecast and knowledge on adaptation options and climate change risks. The smallholder farmers need to recognize the need to adapt to climate change and variability in their agroecological regions that are characterised by dry spells. As demonstrated by this study, a range of adaptation strategies is available and possible. For example, the use of short duration cultivars is desirable so as to reduce exposure to end-of-season droughts and high-temperature events. Flexibility in planting dates and varieties according to seasonal conditions is important with ongoing climate change. The smallholder farmers may need to show willingness to undertake and upscale one of the adaptation strategies. This would entail deploying resources in an appropriate way.

## 5. CONCLUSION

Smallholder farmers in Chipinge district are adapting to climate change by changing practices in the management of crops, livestock and land use, and use of non-climate dependent livelihoods. Some of the adaptation strategies are sustainable, while others are not. Proactive support from government and other private agencies may needed to work with the locals to tape their local knowledge, experiences and insight into dealing with climate change at specific large scales. This would minimize the reactive approach to climate change or drought because it is detrimental to continue with drought-centric approaches. There is need to move beyond just coping and reacting to drought towards strategically dealing with on-going climate change. At the same time, shortage of income and other constraints prevent smallholder farmers from altering climate change adaptation strategies. No single solution would improve smallholder adaptation strategies in Chipinge district. Rather a multi-sectoral approach is required.

## RECOMMENDATIONS

Based on the research findings, the study recommends the following:

- Develop irrigation projects in the context of wider natural resource management planning, considering the sustainability of the water resources being used.

- Ensure that irrigation development is accompanied by complementary investments in market development, transport infrastructure and communications in rural areas. Without these, irrigation development will bring limited returns and will not generate the desired food security.
- Provide ongoing support for farmers following construction of irrigation schemes. This should include agronomy training, marketing support, and support for management and maintenance of the irrigation scheme.
- Encourage the twin-track approach to hunger reduction; that is, address both the threats to food security caused by climate change, and the opportunities that arise
- Encourage targeted social protection programs to ensure that everyone is able to access the food they need for a healthy life. Help producers, especially small-scale farmers, to boost food production.

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