Article

Unpacking Climate Change Adaptation Strategies: An Account of Smallholder Farmer Experiences in Chimanimani District, Zimbabwe

Happwell Musarandega
https://orcid.org/0000-0002-9989-3325
University of Fort Hare, South Africa
hmusarandega@gmail.com

Wisemen Chingombe
https://orcid.org/000-0001-7203-4822
University of Mpumalanga, South Africa
wisemen.chingombe@ump.ac.za

Abstract

This article reports on a study that analysed a myriad of adaptation practices adopted by smallholder farmers in Chimanimani District, Zimbabwe. Using a predominantly qualitative design, some in-depth interviews were conducted with purposefully selected key respondents. Focus group discussions with 8 to 12 smallholder farmers per group were conducted in each of the district's 22 wards. These were corroborated by the guided observation method. The data was analysed using thematic content analysis, where broad strands of responses were synthesised and condensed into narrow themes that made them easier to interpret. Accordingly, smallholder farmers opted for drought tolerant crop and animal species, indigenous seed preservation techniques, aquaculture and conservation farming. The off-farm practices included craftwork, bee-keeping, artesian mining and trade. The sustainable livelihoods framework (SLF) was used as an analytical lens to appraise the sustainability of smallholder farmers' choices and practices. Therefore, as farmers switched from one practice to another, many of their adaptive options reflected short-term livelihood benefits with concealed medium- to long-term environmental detriments. Strangely, some malpractices have their roots in short-sighted government policy frameworks mainstreamed to alleviate grass roots poverty. A thorough evaluation of adaptive policies is recommended so as to strengthen the adaptive capacity of smallholder farmers against the background of climate change.

Keywords: climate change adaptation; smallholder farmer; resilience building; sustainable development; adaptive capacity

UNISA university of south africa PRESS

Africanus: Journal of Development Studies
https://upjournals.co.za/index.php/africanus
Volume 50 | Number 1 | 2020 | #5730 | 21 pages

https://doi.org/10.25159/2663-6522/5730
ISSN 2663-6522 (Online)
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Introduction

Poverty eradication, hunger elimination and taking urgent action to combat climate change and its impacts are three objectives the global community has committed to achieving by 2030 by adopting the sustainable development goals (Lipper et al. 2018). Agriculture has always been a principal practice in the elimination of hunger, poverty and all forms of food insecurity (FAO 2015). Zimbabwe, like many other developing countries, thrives on an agrarian economy (Dube et al. 2018; Mavhura, Manatsa and Matiashe 2017; Mutami 2015), with smallholder farmers constituting the greater percentage of the country's population. As such, agriculture remains the chief livelihood practice, contributing up to 70% of the country's revenue (Moyo et al. 2012; Shoko and Shoko 2013). Unfortunately, the continued change of weather elements, such as temperature and rainfall, has resulted in climate change. Therefore, the way agriculture is managed over the period up to 2030 will determine whether or not the country's sustainability thrusts are fulfilled.

According to the Intergovernmental Panel on Climate Change (IPCC 2014, 5), climate change is defined as:

> a change in the state of the climate that can be identified (e.g., by using statistical tastes) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcings such as modulations of solar cycles, volcanic eruptions, and persistent anthropogenic changes in the composition of the atmosphere or land use.

Therefore, climate change is a shift in the general long-term condition of weather patterns which short changes both human and natural systems. Communities have lived with climate variability and climate change for a long time (IFAD 2008) and have fought to build resilience to the related stressors using local knowledge systems (Makondo, Chola and Moonga 2014; Makuvaro et al. 2017; Mburu, Kung'u and Muriuki 2015; Nakashima et al. 2012). Unfortunately, the recent magnitude of change has outpaced the coping capacity of many people all over the world. In Africa alone, about 70% of the population live in rural areas where their main livelihood activities are agro-based (FAO 2015; World Bank 2008). In particular, the Southern African region has been recognised by the IPCC (2014) as being highly susceptible to climate change. For instance, while Zimbabwe's annual mean surface temperature increased by 0.40 °C between 1900 and 2000 (GoZ 2016), the post-1980 farming seasons have increasingly been marked by the prevalence of persistent dry weather conditions, with the period from 1997 to 2011 in particular proving to be the warmest (Mavhura, Manatsa and Matiashe 2017).

Given the above background information, the intensification of the climate change phenomenon over recent years has severely constrained smallholder farmers' food production capacity. While the agricultural output per unit of land has risen in

Zimbabwe for those who moved into resettlement areas, the overall level of agricultural production has remained low for the majority in communal lands (Mutami 2015). Vulnerability for the smallholder agricultural sector is high because the farming activities are largely rain-fed, with a limited number of farmers using irrigation on a relatively small scale (Makuvaro et al. 2017).

In line with related climate change constraints, there is a great need for adaptation to the climate change phenomenon in order for farmers to continue to sustain their food and other household needs. The IPCC (2014, 5) defines climate change adaptation as "adjustment to actual or expected climate and its effects". Adaptation aims to "moderate or avoid harm or exploit beneficial opportunities". The concept generally refers to a shift in livelihood practices with the aim of coping with newly emerging climatic conditions. Climate change affects communities to various degrees; hence, adaptation by smallholder farmers also differs depending on the opportunities and assets at the farmers' disposition.

It is acknowledged that a broad range of literature on adaptation initiatives already exists (Dube et al. 2018; Makondo, Chola and Moonga 2014; Makuvaro et al. 2017; Mavhura, Manatsa and Matiashe 2017; Mburu, Kung'u and Muriuki 2015). However, adaptation to climate change is aligned to belief systems which are bound to change with time (Hulme 2011; Jooste et al. 2018). Given these dynamics, more area-based studies to reflect adaptation are deemed highly necessary (Dujardin, Hermesse and Dendoncker 2018; Groulx et al. 2014). This article is premised on the viewpoint that all societies are fundamentally adaptive in their nature (Adger et al. 2003), although the adaptive capacity may vary. Communities the world over are unique in their choices and practices and this makes adaptation to climate change a locally defined (Elum, Modise and Marr 2017) subject of enquiry worth exploring.

The sustainability of smallholder farmers' choices and practices called for an in-depth study. Therefore, the current study drew its framework of analysis from the sustainable development perspective. Sustainable development is defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (UNGA 1987, 43). It seeks to maintain livelihood advancement while guarding the long-term value of the environment (IHU 2015). Accordingly, the sustainable livelihoods framework (SLF) was used to critique smallholder farmers' adaptive choices and practices. The SLF is characterised by five major capitals, namely: natural capital, human capital, social capital, financial capital and physical capital. Communities that are resilient to climate change are the ones that are fully endowed with all five capitals (DFID 2000). Above all, the Department for International Development (DFID 2000, 1) asserts that a livelihood is sustainable "when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets, both now and in the future, while not undermining the natural resource base".

Smallholder farmers are part of the low-income population group who earn a living from an assorted collection of activities, which gives them incomes by using the various assets at their disposal. Therefore, when climate change adaptation and sustainable development concepts are put together, smallholder farmers are expected to experience a livelihood improvement through their increased resilience, a development that should be seen to benefit even the future generation of farmers. The fact that specific experiences of localised smallholder farmer communities in Chimanimani District, Zimbabwe, and how these have evolved, are not documented implies that a gap still exists in the climate change adaptation discourse. Therefore, the key objectives of the study were to:

- identify the choices and practices adopted by smallholder farmers in Chimanimani District in the wake of climate change;
- discriminate between long-term and short-term adaptive benefits;
- recommend appropriate planning to guide the choices and practices undertaken by smallholder farmers in order to ensure the sustainability of the environment.

Methodological Issues

Study Area

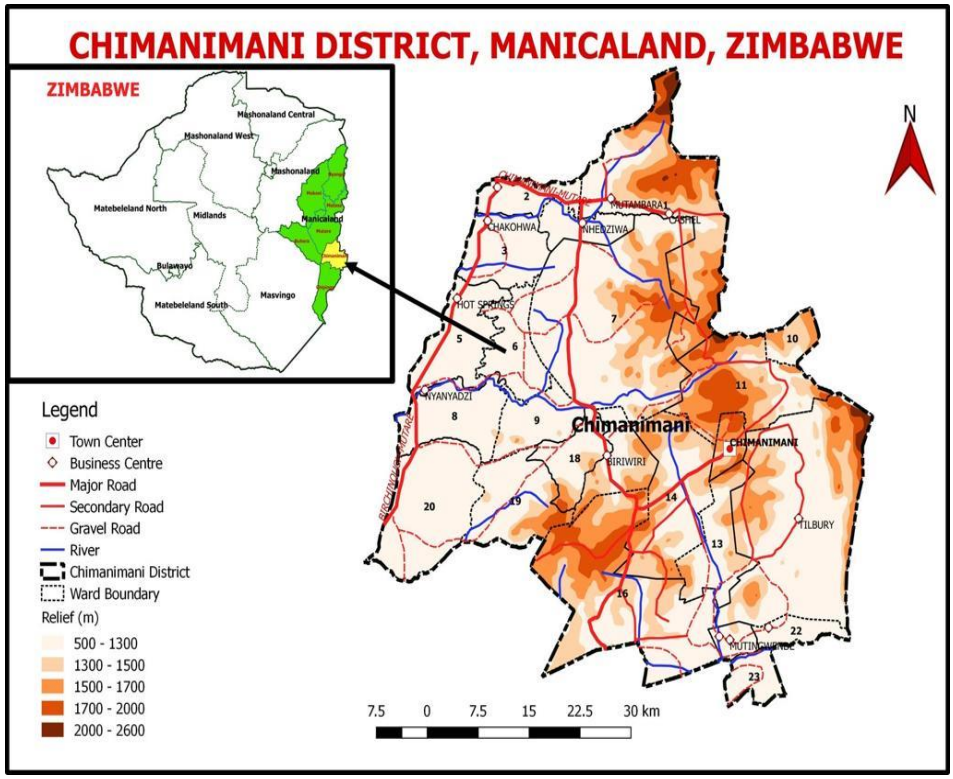

Figure 1: Location of Chimanimani District in Manicaland Province, Zimbabwe (Source: Authors)

The study was carried out in Chimanimani District, which is situated in the extreme south-eastern part of the country along the border with Mozambique. The district is located between coordinates 32°85′0.00″E and 32°88′0.00″E and 19°78′0.00″S and 19°81′0.00″S. The district covers a geographical area of 3 353 km^2 and its total population is 1 752 698 (ZIMSTAT 2016). It is unique in the sense that it is home to all agro-ecological regions I, II, III, IV and V (Oxfam-UNDP 2015). The eastern part of the district is predominantly an area of rugged mountain terrain with relatively cool temperatures and over 1 000 mm of annual rainfall. Soils vary from the deep clays in the high altitude areas of Rusitu, Gwindingwi and Chikukwa to the rocky reddish-brown clays of the medium-altitude zones around Biriiri, Mhakwe, Chikwakwa Shinja and Bumba.

The greater part of Chimanimani District lies in the Save River Basin. There is progressive aridity due to the escalating frequency of drought events in this part of the district. It receives between 350 and 450 mm of annual rainfall (GoZ 2016). Natural regions II and III, which used to cover a huge part of the district, have greatly reduced in size (Mugandani et al. 2012). There are high temperatures with extreme inter- and

intra-seasonal rainfall variability. Like the rest of the Save Valley, the soils are mainly granitic sands with a mix of alluvial deposits in low-lying river environments.

Smallholder farming forms the mainstay of the district's economic activities (Oxfam-UNDP 2015). Households own patches of dry land and the sizes of the farms average between 1.5 and 2 hectares. Dry land farm sizes generally increase westwards into the low veld where open land is more abundant but with drier climatic conditions and sparse population. Several irrigation schemes exist in the drier areas, such as Nyanyadzi (Ward 8), Chakohwa (Ward 3), Mutambara (Ward 4) and Mhandarume-Mushowani (Ward 2). In all these schemes, farmers draw water from nearby major rivers using open canals to irrigate their plots.

In terms of its traditional leadership, the district has four chieftainship divisions administered by Chiefs Muusha, Mutambara, Chikukwa and Ngorima. Each chief has at least two headmen and several village heads as part of their traditional leadership hierarchy. There are also Ward Development Committees (WADCO) and Village Development Committees (VIDCO) that work closely with the Ward Councillors and local traditional leaders to foster community development programmes.

Method

The study was predominantly qualitative and executed following a case study design. It employed an inductive approach, with much focus on non-probabilistic, purposive selection of respondents (Ibrahim 2012; Tongco 2007). By adopting an "exploratory" philosophical journey into hidden climate change experiences and perspectives, the study population did not rigidly begin with a predetermined sample size but remained loose and flexible (Armstrong 2010; Kumar 2011) till data collection reached saturation point. In this regard, the participants were not necessarily chosen based on specifically designed or fixed samples as in pure quantitative research but purposively selected to explore smallholder farmers' in-depth perceptions. At least two agricultural extension workers (specialising in crop and animal extension service, respectively) were selected in each of the 22 rural wards as key informants and focus group discussion facilitators. The study participants were selected according to the purpose of each stage of the study, including the questions under investigation (Bricki and Green 2009).

Smaller but focused samples of participants were used to compose focus discussion groups, an approach recommended in qualitative research with much focus on the respondents' perspectives (Bricki and Green 2009). A minimum of two focus group discussions were held in each ward, with extra sessions being added in areas where new information continued to emerge. Extension workers and local traditional leaders were ideally selected for the study since they have regular contact with smallholder farmers; hence, they form key aggregate constituencies of smallholder farmers' perceptions. Instead of running a costly and time-consuming pre-test survey to identify ideal respondents, extension workers and traditional leaders who had ready knowledge of

smallholder farmers' routine practices helped the researchers to select ideal participants in the focus group discussions.

To validate the respondents' data, researcher transect walks were undertaken across Chimanimani District. In order not to lose sight of the respondents' stated experiences and views, transect walks were conducted in each ward immediately after a focus group discussion was held. Due to the predominantly qualitative nature of the study, the frequency of visits varied in number, depending on the phenomenon under investigation. The rationale was to view the farming environment and to verify recorded perspectives. Due to the huge amount of qualitative data sourced, a thematic content analysis approach was used to pick repeated patterns (Armstrong 2010; Kumar 2011). The data from the focus group discussions and in-depth interviews was coded and indexed accordingly (Krippendorff 2004) in order to note recurrent patterns regarding the choices made and practices adopted by the smallholder farmers. The use of thematic content analysis was the most appropriate method for the huge qualitative explanatory responses that smallholder farmers gave reflecting their choices, actions and thoughts, thus aligning with Ibrahim's (2012) approach. The results were presented in summary using graphical, tabular and narrative methods substantiated by citations from key interviewees.

Findings

Climate Change Perceptions in Chimanimani District

The study findings indicated that the majority of smallholder farmers in many wards in the district were aware of unfolding changes in terms of seasonal patterns and the climate in general. Many interviewed farmers reported cases of delayed rains, mid-season drought and early cessation of the rainfall season. For that reason, they broadly acknowledged that they had since opted for various adaptive choices and practices in response to the change. When smallholder farmers in various settings were probed to explain why the climate was changing, different perceptions emerged depending on their conceptualisation of the phenomenon.

Many older (over 60 years) respondents in highly remote settings had a tendency to associate climate change with failure by responsible traditional governance systems to honour the expected reverence practices. Where some traditional practices are still undertaken, these were reportedly failing to meet expected cultural standards meant to appease spirit mediums. For instance, many elderly respondents bemoaned the tendency by some traditional leaders who hail from Christian backgrounds to engage in traditional rain making ceremonies. One respondent explained the shortage of rainfall in this way:

> The current generation of traditional leaders is different from the one we used to have in the past. They want to be both Christians and traditional leaders at the same time applying mixed belief systems. They no longer lead in performing of effective

traditional rain-making ceremonies each year because they were taught that it is evil to do so.

The perceptions of the majority of young and middle-aged smallholder farmers showed that climate change was a result of human activities with negative environmental effects such as pollution from industries. What was not clear from their explanation was the scientific link between human activities and the climate change phenomenon. Practices which relate to what the smallholder farmers do in their communities were rarely stated as a cause of climate change.

Climate Change Adaptation

The adaptive practices of smallholder farmers were not akin throughout the district. A senior extension officer at the district office explained that while some activities were age-old practices, they were revitalised against the backdrop of climate change. The farmers' adaptive practices were categorised and summarised as indicated in Table 1.

Table 1: Summary of adaptive practices in Chimanimani District by ward and climatic zone (Source: Authors' field data)

Climatic zone	Related wards	Age-old (usual) practices	Recently growing adaptive practices
Relatively wet windward eastern side (Mountain belt)	1, 10, 11, 12, 13, 14, 16, 21, 22, 23	Fruit production area with avocado pears, naartjies, bananas, mangoes, pineapples, cassava; Limited livestock rearing; Timber estates employment	Terracing mountainsides; Increased fruit trading (e.g. bananas, pineapples, yams, cassava, mangoes, avocado pears); Spring water harvesting; Timber trading; Beekeeping
Medium to relatively dry belt (Mid-altitude zone)	4, 6, 7, 9, 17, 18, 19	Mainly rain-fed agriculture zone with livestock keeping, especially cattle and goats; Hunting	Growing tendency towards irrigation and off-farm activities (e.g. aquaculture and bee-keeping) mostly funded by NGOs; Nutritional gardens; Conservation farming
Relatively dry low lying western side (Save Valley)	2, 3, 5, 8, 20	Mainly rain-fed agriculture zone with livestock keeping, especially cattle and goats; Hunting	Irrigation farming in small plots and nutritional gardens; Drought resistant livestock farming (goats, donkeys, cattle); Off-farm activities (craft ware making, brick moulding, bee keeping)

Adaptation Strategies

Irrigation Farming

As the rains continued to decline, many farmers switched from rain-fed crop production to irrigation farming. The greater part of the district, particularly the western low veld, is characterised by extreme inter- and intra-seasonal rainfall variability. For that reason, several irrigation schemes were introduced in relatively dry areas, such as Nyanyadzi (Ward 8), Chakohwa (Ward 3), Mutambara (Ward 4) and Mhandarume-Mushowani (Ward 2). In all these schemes, the farmers draw water from nearby major rivers using open canals to irrigate their plots. Several community nutritional gardens were initiated in many wards in the district. Nutritional gardens in Chimanimani District are characteristic of one large fenced plot at a water point (usually a borehole) in which sub-plots are shared by individual farmers. Examples include the Chandimara and Dzitiro garden projects measuring 1.5 hectares each with 60 beneficiaries.

While some village heads alluded that gardening was reportedly undertaken by many in the past, the current approach has changed in many ways. Under the nutritional garden scheme, smallholder farmers are encouraged to move away from river banks and irrigate their gardens using water from boreholes and not directly from the river. Firstly, this was done to minimise stream bank cultivation, which results in siltation. Secondly, by pooling smallholder farmers together, extension workers find it easier to disseminate agro-knowledge to the farmers on correct adaptive strategies.

Before the nutritional garden scheme, many smallholder farmers near perennial rivers, such as Nyanyadzi, Biriiri, Changazi, Mvumvumvu and Haroni, used to extract water directly from rivers individually. Currently, community gardens with shared water resources have mushroomed particularly in the western low veld part of the district. Whilst small individual plots continue to exist, participants in the focus group discussions in affected wards revealed that the culture of community gardens has grown since farmers use the opportunity to learn and share new crop breeding and nurturing techniques that are practicable in the wake of climate change. However, the study established that not all smallholder farmers have been absorbed into these sustainable nutritional garden schemes. Others still adapt to rain shortage by choosing to cultivate their crops on stream banks with rich alluvial soils.

Many smallholder farmers showed a lot of enthusiasm from the high yields they obtained from stream bank fields and gardens. They were researcher probed during the focus group discussions inwards with major rivers (Biriiri, Nyanyadzi, Changazi and Mvumvumvu) to explain the possible consequences of increased stream bank cultivation. They revealed that many farmers had heard about the negative effects of siltation and fertilizer release into rivers. Agritex officials who were interviewed explained weed proliferation based on the frequent release of fertilizers and manure into rivers. They added that farmers involved in this practice often do so when they direct agrochemical-rich water back to the river after each day's work. Acute financial

incapacitation to buy pipes to abstract water over long distances forces farmers to situate their gardens as close to rivers as possible. Again, high fertilizer costs reportedly force farmers to cultivate on stream banks where they utilise natural fertility from deep alluvial soils.

Water Harvesting

Smallholder farmers, particularly in the mountain areas, are increasingly opting to use spring water for both domestic and farming purposes. Although the practice has been in place for many years in Ngorima A (Ward 21), Ngorima B (Ward 22) and Ndima (Ward 23), the practice has extended to several other areas in the district, such as Biriiri (Ward 17), Gwindingwi (Ward 16) and Mhakwe (Ward 18). As boreholes and wells increasingly dry up, smallholder farmers track water sources up the mountains to connect water harvesting pipes. In Biriiri, Towards Sustainable Utilization of Resources (TSURO), a humanitarian non-governmental organisation (NGO), funded a project in which water is harvested from Chingundu spring to serve households in Saurombe and Mutakura villages. This adaptive practice has brought nutritional benefits to farmers through the availability of vegetable produce. It has also spared them from purchasing expensive vegetables and other garden utilities from the market.

Rainwater harvesting initiatives have also mushroomed in the district. Such initiatives were noted at Chikukwa (Ward 10), Shinja (Ward 6) and Gudyanga (Ward 20), where some smallholder farmers have managed to establish successful adaptive projects of their own. On-site interviews with the smallholder farmers revealed that the harvested rainwater has the potential to sustain backyard crops long enough to overcome the moisture deficit that the midsummer season drought brings. Agritex officials who have worked with such smallholder farmers helped to confirm that this adaptive practice has helped many smallholder farmers to reserve additional water for domestic use.

Conservation Farming

Smallholder farmers have adopted minimum tillage and crop mulching is done using grass and leaf foliage. Instead of using ploughs, smallholder farmers dig sink pits which they half-fill with manure and soil to allow them to capture water and retain moisture over extended periods. Mulching is done by cutting grass and covering crop plots to minimise moisture loss during dry periods. Increased adoption of minimum tillage in Chimanimani District autonomously manifested following a sharp decline in the availability of draft power as many cattle died over the past years due to drought. Farmers are also taught by Agritex officials the benefits of minimum tillage, which include minimisation of soil erosion and reduced unlocking of soil carbon and its release to the atmosphere. It was noted that in line with this initiative, World Vision, Christian Care and German Agro Action have actively assisted smallholder farmers with the skills to undertake these initiatives. This adaptive practice makes farmers concentrate on a small piece of land, while realising higher yields than they used to get on bigger land pieces.

Repeated field visits of up to three times per season between 2015 and 2019 – particularly in the district's mid-latitude belt (Biriiri, Mhakwe, Chikwakwa, Bumba, Shinja, Zimunda, Takaengwa and Chayamiti) – have shown that crop yields were higher in areas that were zero tilled and mulched. Such observations were triangulated with records of Agritex officials who also concurred in alluding that crop yields had indeed improved through conservation farming.

Adoption of Small Grains

Smallholder farmers have generally shifted from their traditional practices of growing crops that favour high rainfall to those that thrive under moisture stress. Many farmers currently grow sorghum and millet that are tolerant to intra-seasonal rainfall shortages. Sorghum and millet may go dry on the outside for weeks, but once the rains resume, the crops resurge and continue to grow. In the Save Valley, a peculiar type of sorghum known locally as *mupositori* is widely grown. During the mid-season drought, its surface leaves dry out and curl downwards to reduce transpiration. As the rains resume, fresh leaves emerge together with the grain. Small grains were recently opted for as an adaptive practice in Chimanimani District due to persistent yield failure experienced with large grains which require a huge abundance of water. Small grains are common in Gudyanga, Wengezi, Chakohwa, Mhandarume and Nyanyadzi where the amount of rainfall is severely reduced.

To assist smallholder farmers in this small grain initiative, TSURO introduced a cheap seed banking programme in the district. Under the scheme, TSURO educates farmers on how to select and store grains after harvesting in order to prepare for the next agricultural season. Relatively cheap methods of seed preservation for the smallholder farmers are used. One such method involves hanging the seed under thatched traditional kitchen roofs where they are coated with smoke. The smoked seeds become resilient to pest attack and last up to the next planting season. The cheap traditional seed preservation method is meant to caution farmers against the cost of purchasing expensive grains from the conventional market. Also, farmers have developed home-grown seed banking techniques since small grains reportedly became scarce on the conventional market.

Zunde raMambo Initiative

The *zunde raMambo* (Chief's granary scheme) initiative is part of the local people's indigenous knowledge systems which originated many years ago, but reportedly entered a waning paradigm in Chimanimani District around the 1970s. However, the scheme has been revived in the wake of climate change driven food shortages in many villages. Under the scheme, a community plot is created in which members of the community work together under the governance of the local chief. Proceeds from the scheme are stored in a granary built at the chief's homestead only to be devolved to needy households, particularly in the wake of illness in the homes or other circumstances preventing them from working in their plots. A traditional leader in Biriiri (Ward 17)

alluded that the *zunde raMambo* initiative existed well before climate change became noticeable in the district. However, it was rejuvenated as an adaptive strategy to protect some families against drought-induced food insecurity.

The fact that many smallholder farmers' families are losing out to climate change means there is a greater need for assistance, hence the scheme's revival. Accordingly, four *zunde raMambo* projects were visited repeatedly after they were named by many respondents. In wards 10 (Chikukwa) and 23 (Ndima), the schemes are supplemented by irrigation water supply, which helps them continue to thrive in the wake of climate change. Throughout the projects visited, male members of the community pay homage to local traditional authorities and ancestral spirits through a reverent clapping of hands which is locally known as *hlombe*, and the women ululate in response. Such acts are meant to appease ancestral spirits. In return, it is believed that the ancestors bring rains, prevent hydro-meteorological disasters and contain pests and diseases that foil anticipated harvests.

Off-Farm Activities

Trading activities have also increased in the district as dependence on farming alone continues to be challenged by climate change. To supplement their household incomes, smallholder farmers trade a diverse range of wares at busy market places, such as Nyanyadzi, Nhedziwa, Chakohwa, Hot Springs and Machongwe. They sell commodities, like timber, firewood, domestic and wild fruits, vegetables, craft ware and second-hand clothing items. Smallholder farmers are increasingly engaging in wild fruit gathering as a livelihood practice. In some areas, such as Wengezi, Chakohwa, Hot Springs, Gudyanga and Changazi, smallholder farmers reportedly switched to fruit gathering and selling rather than dryland farming. Under dry conditions, baobab trees which are common in the area, continue to produce fruits called *mauyu*. Of late, many smallholder farmers have learnt to utilise the fruits in a variety of ways. The whitish seed coat is ground to make a powder that produces nutritious thick porridge. Alternatively, the powder is made into a paste with sugar and other additional flavours before freezing the mixture into an edible product locally called "ice lolo". Through trade, smallholder farmers bridge the food availability gap created by poor harvests to feed their families. Some elderly respondents, however, were quick to mention that while trade has helped many people amid climate change, it has also impacted negatively on the social fabric of many communities particularly in the busy centres, such as Nhedziwa and Nyanyadzi. Cases of prostitution and other anti-social behaviour have also increased as many ventured into trade business.

Many smallholder farmers recently ventured into beekeeping in order to add-on to their livelihood sustenance. To date, multiple fishery schemes were initiated in various parts of the district for additional livelihood sustenance. Nine fish ponds funded by World Vision were built at the Mhandarume-Mushowani irrigation scheme in Ward 3 near Wengezi. At Chikwiizi (Ward 19), Karitas, an NGO, funded a fishery project and

trained the smallholder farmers how to run the project and devolve proceeds from it. Karitas further appreciated the fishery interests of smallholder farmers and funded a new fishery project at the local Nechiora irrigation scheme. Local irrigation management committee members running the project confirmed during interviews that, to date, the fishery project is sustaining many families.

Seasonal Migrations

It is a common practice for many smallholder farmers to have second homes in the wetter eastern highlands as reported during the focus group discussions. A senior Agritex officer in the district indicated that the widespread movement of people from the drier western parts of the district to the wetter areas, such as Gwindingwi (Ward 16), Machongwe (Ward 14), Charles Wood (Ward 12), Cashel Valley (Ward 1) and Chikukwa (Ward 10), was necessitated by the government-led land reform agenda. Site visits were made to confirm this practice in each of the farming seasons from 2015 to 2018. Thus, as climatic conditions continue to tighten in the drier low veld areas of the district, the smallholder farmers have adapted by moving to occupy pieces of land in the eastern highlands. They produce and transport their harvest back to their permanent home area. Unfortunately, this adaptive measure comes with costs. Routine visits to occupied forest lands, complemented by reports from Agritex personnel, showed that smallholder farmers have perpetrated severe acts of deforestation in the wetter mountain areas. Whilst most have realised improved harvests, the effect of their practices on the environment has been highly damaging.

Livestock Translocation

Before the toughening of climatic conditions in the district, livestock enjoyed the abundance of water and pastures and thus would access these resources almost anywhere. Recently, the distance between water points and good pastures has widened severely as pastures continue to recede towards mountain areas, especially during the dry season. In the hardest hit area of Gudyanga (Ward 20), cattle travel approximately 15 km from Makura Mountain to the perennial Save River to drink water during the dry season. In Takaengwa (Ward 9), cattle travel about 12 km from Dziike Mountain to either Dzanyi or Nyanyadzi to access water. Many animals, particularly cattle, succumb to the shortage of water and eventually die in large numbers.

As an adaptive practice, smallholder farmers shift their drought-reduced livestock as close to water points as possible during the extended dry season. The practice is common alongside the Save, Odzi, Nyanyadzi and Biriiri rivers where patches of green vegetation remain during the long dry season. This adaptive practice was prompted by the fact that many animals stayed over the mountains to graze, but would fail to descend to nearby rivers to drink water since they were scared of the sun's scorching heat. Many smallholder farmers lost large cattle herds due to this complexity. A triangulation of perspectives from smallholder farmers, Agritex personnel and local traditional leaders revealed that grazing animals near rivers pollutes and eventually depletes the resource.

Observations undertaken during the study also revealed that although local farmers were benefiting from the practice, water pollution and river siltation due to routine livestock presence was also a huge future challenge. However, lack of capital to buy supplementary livestock feeds was widely reported as leaving smallholder farmers with no cheaper option except to utilise cheaper stream bank pastures.

Discussion

To add value to the climate change adaptation discourse, the study extended beyond the regurgitation of smallholder farmers' practices by discussing them using the sustainability lens. The study advocates for discrimination between long-term (sustainable) adaptation and short-term (maladaptive) adjustment in farming practices. Accordingly, the United Nations Development Programme (UNDP 2011) views maladaptive measures as those that deliver short-term gains or economic benefits leading to exacerbate the vulnerability of people in the medium to long-term. After all, a livelihood becomes sustainable if it can maintain the long-term productivity of natural resources and if it does not undermine the livelihood options of other people (Kollmair and Gamper 2002). It became evident from the study that when smallholder farmers strive to enhance their livelihoods by building one capital, they compromise the other capitals due to their misguided choices and practices.

It is critical to understand smallholder farmers' perceptions of climate change in Chimanimani District prior to unpacking their adaptation choices and practices. This is so because the process of adapting agriculture to climate change rests on whether farmers recognise its occurrence, including the risks that come with the climate change phenomenon (Habtemariam et al. 2016; Tripathi and Mishra 2017). The fact that the majority of smallholder farmers expressed an awareness of climate change taking place is in tandem with studies done in a wide range of other cases (Dube et al. 2018; Makuvaro 2017; Mavhura, Manatsa and Matiashe 2016; Risiro et al. 2012; Shoko and Shoko 2013). However, smallholder farmers lacked clarity of conceptualisation on the dynamic nature and scientific occurrence of weather and climate phenomenon of which such shortfalls have been noted in several other studies (Mburu, Kung'u and Muriuki 2015; Nzeadibe et al. 2011; Shoko and Shoko 2013).

The climate change-induced drought, which is forcing smallholder farmers in Chimanimani District to transform their practices, is widely corroborated in the literature. Downscaled future climate change scenarios for the Save River Basin in southeast Zimbabwe for the period 2046 to 2065 and 2081 to 2100 predicted a temperature increase of between 1.5 °C and 3.5 °C across the basin (Mtisi and Prowse 2012). The district is currently experiencing the late onset of rainfall, mid-season dry spells and early rainfall cessation (Oxfam-UNDP 2015). This corroborates the increase in temperature over recent years, which many smallholder farmers mentioned as a major challenge forcing them to reorient their livelihood practices. Such hard climatic

conditions force the smallholder farmers to switch to more resilient practices using the assets that are readily available to them.

Communities in Chimanimani District are rich with a wide range of assets that smallholder farmers can utilise to build more resilience to climate change. Though not equally available across all wards in the district, water in perennial rivers, such as Nyanyadzi, Biriiri, Haroni, Rusitu and Changazi, forms an essential natural capital needed to combat food shortages through irrigation. *Mikando* (income saving and lending schemes) within communities create the necessary financial assets while the huge rural population in the district is creating the human capital (labour) for resilience building. What lacks in the majority of instances is the appropriate scientific knowledge and organisational atmosphere to increase the adaptive capacity of the farmers. Such lack of knowledge is a common scenario, particularly where appropriate resilience-building guidance lacks. Nwankwoala (2015) asserts that effective programmes of action are achievable when the public is taught how the natural environment functions, including how people can manage the environment and ecosystems in order to live sustainably.

The adoption of adaptive practices in the wake of climate change has paid dividends in many ways and to a wide range of localised settings in Chimanimani District. Conservation farming, which smallholder farmers have embarked on, was also done successfully in other semi-arid environments in Southern Africa. In Zimbabwe, it was implemented in other districts such as Gokwe North, Gokwe South and Nyanga under the guidance of the Concern World (Wagstaff and Harty 2010). Accordingly, it has been proved to be a worthwhile option given the fact that many farmers lack draught power following periods of extended drought. Again, use of pits to plant seeds significantly retains fertiliser and manure in the event of storm flow and wind erosion (Twomlow et al. 2008). Thus, as an adaptive practice, many smallholder farmers' yields have greatly improved due to the introduction of this conservation farming system which stores moisture and sustains crops when rainfall delays to come.

The *zunde raMambo* initiative is a package of multiple capitals beneficial to communities. For instance, it is a cultural capital from the social pillar of sustainable development (Soini and Dessein 2016). Its practice helps to maintain the community's traditions, rules and sanctions needed to safeguard local resources. Members of the community use their culture to collectively connect and share decisions. To combat climate change using conventional scientific methods alone remains challenging at a local level (Musarandega, Chingombe and Pillay 2018; Risiro et al 2012; Shoko and Shoko 2013). Therefore, the *zunde raMambo* initiative exists within the mainstream of traditional governance within communities. This is because traditional leaders are custodians of the rural cultural systems and hence enjoy allegiance from their subjects more than external agents (Mapara 2009; Musarandega, Chingombe and Pillay 2018). Unfortunately, the capital capacity of the *zunde raMambo* initiative to sustain vulnerable households is fast dwindling. Its survival is highly jeopardised by the advent

of Christianity and western governance systems (Manyanhaire and Chitura 2015; Shoko and Shoko 2013). For many people nowadays, the traditional practices are unfavourable to their own religious choices.

What some farmers in the district perceive as sound adoption was critically viewed as mere livelihood transformation with maladaptive outcomes in the long term. Such fateful environmental scenarios were previously noted in other studies (Makondo, Chola and Moonga 2014; Mburu, Kung'u and Muriuki 2015) where smallholder farmers indirectly harm their environment in an attempt to transform their practices. Such paradoxes are inevitable within poor communities such as in certain parts of Chimanimani District. Smallholder farmers may realize the negative effects of their choices, but due to poverty, they continue to engage in practices that add harm to the environment.

Like in many other developing world regions, additional pressure from climate stress may indirectly hamper development by shifting the focus from sustainable development to non-environmentally compliant adaptive practices (Jooste et al. 2018). While some smallholder farmers in Chimanimani District were excited to get access to irrigated land, the output not equally translate to an improvement in their livelihoods. The wetter eastern highlands are fast undergoing biodiversity degradation due to migrant smallholder farmers whom Makondo, Chola and Moonga (2014, 400) refer to as "climate refugees". This is typical of the "controversies and contestations" that marked land occupations under the pretext of the country's national land reform programme (Manase 2016, 3). A continued decline in water quantity and quality, as well as deteriorating land quality due to overpopulation in some parts of Chimanimani District, reflect the maladaptive side of choices and practices taken by smallholder farmers.

Whilst a lot of smallholder farmers expressed a lot of enthusiasm from the high yields they obtained from cultivating in fertile alluvial soils, stream bank cultivation often comes with costs related to siltation and eutrophication. The practice is usually associated with the heavy release of silt, fertilizers and manure leakage into rivers. Farmers who are involved in this practice often do so when they direct agrochemical-rich water back to the river after each day's work. Unfortunately, agrochemicals have been noted to bear deadly effects on the ecological environment (Bhandari 2014). Again, it was appalling to notice land cover deterioration in and around crop fields generally increased as smallholder farmers kept on cutting grass and tree leaves to mulch the land.

Conclusion and Recommendations

As is the case in many other parts of Zimbabwe, and the developing world in general, smallholder farmers constitute the greatest proportion of rural dwellers in Chimanimani District. The study has shown that smallholder farmers in the area are transforming their livelihood choices and practices against the background of climate change. Livelihood

transformation in Chimanimani District is inevitable, given the fact that communities are already experiencing the negative effects of climate change. The nature of adaptation is twofold. Firstly, smallholder farmers autonomously reorient their choices and practices out of their ambitions. Secondly, their practices shift due to the planned initiatives of agencies which mainstream adaptation initiatives within communities. Smallholder farmers are increasingly engaging in water harvesting, irrigation farming, fruit harvesting and selling, beekeeping, craftwork and adoption of drought-tolerant crop varieties and animal breeds. The study took adaptation practices in Chimanimani District beyond the narrative scope by viewing them through a sustainable development lens. There has been a lot of livelihood improvement in the smallholder farming community in the district. However, in some instances, farmers undertook certain choices and practices that act against environmental sustainability thrusts and hence resulting in typical mal-adaptation. Given the fact that some of the smallholder farmers' choices and practices are antagonistic to the livelihood asset enhancement drive, there is a dire need for appropriate planning to guide the choices and practices undertaken by smallholder farmers in order to ensure the sustainability of the environment. Climate change adaptation should be undertaken from a sustainable development perspective rather than mere adjustment in practices which yields short-term benefits at the detriment of the local environment.

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