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Understanding adaptation to climate variability in smallholder farming systems in eastern Zimbabwe: a sociological perspective

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Abstract The literature on climate change in Zimbabwe continues to grow, but literature specifically focusing on how people in rural communities are responding to it is still comparatively limited. Only a few scholars have sought to offer a reasonably detailed account of farmers' concerns and adaptation from localised, qualitative case studies based on farmers' narratives. As such, this article is empirically based, using mainly qualitative data from a broader research on understanding climate variability and livelihood adaptation conducted in Mutoko District in rural Zimbabwe. In doing so, the aim is not only to contribute empirical data to existing knowledge but also more importantly to theorise adaptation sociologically. The main argument is that farmers are reflexively engaged in various adaptive strategies predominantly at the household level not only to adapt to increasing climatic variability but also to simultaneously navigate a difficult socio-economic landscape. The adaptive strategies are underpinned by diverse structures, processes and conditions that are enabling and constraining. Hence adaptation is unfolding as a complex and reflexive process under specific socio-spatial conditions.

Keywords Climate variability · Farmers · Adaptation · Adaptation processes · Reflexivity

Introduction

A consistent conclusion among climate change scholars in Zimbabwe is that the country is experiencing both climate change and variability. At the same time, there is emerging evidence that local communities are already grappling with the adverse

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effects of climate change and variability. Research on adaptation by local communities is increasingly becoming critical, yet it remains insufficient and fragmented. As such, this paper specifically outlines farmers concerns regarding changes in climate variability, describes their adaptive strategies and analyses the structures, processes and conditions underlining these. Theoretically, the paper is underpinned by the sociological theory of Margaret Archer. The idea is to develop and extend an analysis of climate variability, and the processes underpinning adaptation. This is done from a backdrop of an almost non-existent sociology of climate change generally in Zimbabwe. Methodologically, this article derives from a broader empirical research on adaptation to climate variability conducted in Mutoko District in the eastern part of Zimbabwe. The research work was premised on the historical timeline 1992–2014; the temporal dimension was important specifically because livelihood decisions occur within specific historical and agro-ecological conditions. Empirically, the research used an exploratory case study approach and qualitative methods to collect data from smallholder farmers.

Regarding data collection, the life history interview was used as the primary data collection method because it privileges the narration of personal biographies by research participants. The whole idea was to undertake research that articulated nuances on contextualised farmers' experiences of changes in climate, and narratives on responding to that particular change. Therefore, a qualitative approach certainly provided a different window on the study of processes of climatic and livelihood change by drawing attention to local farmers' interpretations and understandings. Based on such, a small survey was conducted with 60 farmers paying attention to the timeframe of the study. The survey primarily provided an entry point for selecting households for qualitative, detailed life history interviews.

The analysis of adaptation processes in this article is confined to the morphogenetic theory on structure and agency formulated by the critical realist Margaret Archer. Her sociological theory has hardly been used in climate change adaptation research (Davidson 2012) despite its sociological significance and appeal. The theory is applicable when attempting to understand how risks from climate change and variability are construed, negotiated and managed in highly dynamic contexts. What is more appealing is Archer's notion of reflexivity, if one wants to unpack how people (such as farmers) understand climatic changes and formulate responses to them.

As defined by Archer (2007:5), reflexivity is 'the means by which people consciously develop and implement personal projects according to their individually-defined values and concerns, given their situation'. Her philosophy is that without reflexivity, there is no society. We therefore see that divergences in people's trajectories through life derive from human reflexivity, a faculty which is accomplished through internal conversations (Archer 2010). This way people ceaselessly contemplate their situations and redefine their interests and life projects. This brings attention to the deepening of contextual discontinuities in the contemporary world. Archer (1982) emphasises rupture and transformation (morphogenesis instead of a morphostatic condition marked by stability and continuity). These discontinuities pertain to the presence of 'excess'. This simply means that there is no longer an abiding and lasting fit between habitual and routinised activities and social conditions and context (in the sense articulated by Pierre Bourdieu). This promotes greater prospects for human reflexivity irreducible to what exists. In a world characterised by complex risks, these

cannot be negotiated through the realms of embodied knowledge and conventional practices alone. We therefore find new reflections, framings and practices, as peoples map a way in this world through innovative and adaptive forms of agency irreducible to the past or the present *status quo* (Chalari 2012).

Compared to the scope and innovativeness of Archer's structure-agency (morphogenetic) theory, its scant application in climate change adaptation research is striking. Thus, the strength of Archer's theory is clear in that 'she has positioned herself critically vis-a-vis substantive theories that reduce social structures to the aggregate effects of individuals, reduce individuals to the position of bearers of structural relations, and collapse the distinction between social structures and agents' (Lopez 2009:173). Her theory is therefore one which is capable of linking structure, culture and agency in a nuanced and non-reductionist manner. More so, Archer's approach privileges narrative history as the paradigmatic form of explanation with a focus on the specificities of both time and place (Porpora 2013). As such, the analysis of adaptation to climate variability by subsistence farmers in Zimbabwe cannot be frozen in time. And, the particularities of the spatial location and processes within which the research site is embedded also become crucial. In this light, Archer's theory allows for a cross-scale analysis of adaptation.

Confronted by nascent morphogenesis (increasing climatic variability), small-holder farmers deploy agential reflexivity. They are able to reflexively make sense of and evaluate their circumstances and create adaptive strategies in view of what matters to them most (Bhatasara 2017). Specifically, Archer's notion of the internal conversation strongly establishes and gives personal powers to the agential or individual subject (farmers in Mutoko) in relation to their aims and aspirations (ibid). Through their internal conversations, and alongside their personal circumstances and goals, farmers deliberate and then, using reason, intentionally commit themselves to particular courses of action that they deem worthwhile (Bhatasara 2017). In some way then, adaptation to climate variability is about de-routinisation as an essential condition of existence in which subjects typically re-evaluate *modus vivendi* and prevailing social arrangements (Archer 2010).

Having said the above, the next section briefly outlines the broader trends on climate change, and its impacts particularly on agriculture in Zimbabwe. This is followed by a localised discussion on how climate variability is manifesting in rural, marginal ecological regions in the country. The discussion puts emphasis on rainfall which is increasingly becoming more variable. The questions which are driving this article (how are farmers adapting and what structures, processes and condition underpin adaptation as a complex process?) are answered in the last two sections. The sociological theory of Margaret Archer is used to develop various arguments.

Climate change and impacts in Zimbabwe

Based on the existing studies and climate projections employing diverse quantitative models, Zimbabwe is experiencing climate change and increasing climate variability. Increased variability of rainfall levels, number of rain days and temperature are considered as realistic pointers of climate change and variability. For instance, historic and future climate change scenarios have been examined using observed climate data

and seven global climate models (see IPCC 2007). Overall, these studies show that even though the climate in Zimbabwe is regionally distinguished, it is by and large getting warmer with numerous erratic rainfall patterns.

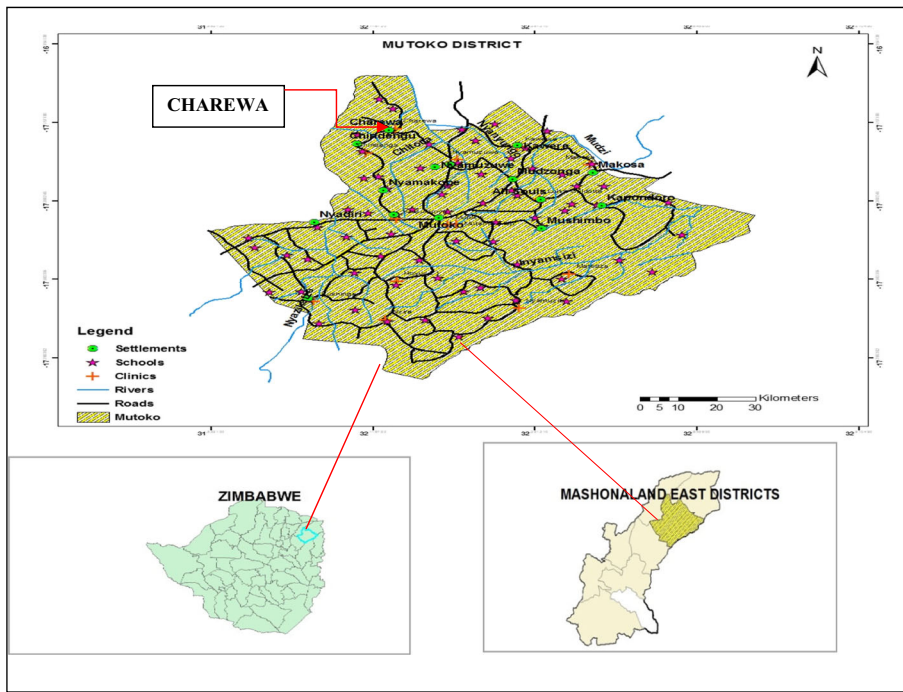
At a national level, annual rainfall variability has increased since the early 1980s, manifesting in frequent droughts and floods. The driest period in the country was recorded between 1986 and 1995, and annual rainfall is expected to continue diminishing. Actually, since the beginning of the twentieth century, annual rainfall has generally declined nationwide (Ministry of Environment and Natural Resources Management 2008). Again, from 1980, the timing and amounts of rainfall have become highly variable, with droughts and heavy precipitation occurring in the same rainfall seasons. Between 1900 and 1993, precipitation declined by 1% per decade (Simba et al. 2012). Changes in temperatures are also occurring, reflecting the regional and global warming trends. The Meteorological Department in the country reported that daily minimum temperatures increased by approximately 2.6 °C over the last century, while daily maximum temperatures rose by 2 °C during the same period. It is also anticipated that temperature will rise by 2–4 °C by 2100.

Zimbabwe's economic crisis can be explained by many factors; however, it is indisputable that climate change is exacerbating the crisis by threatening agro-based livelihoods. In earlier studies, Magadza (1994) and Muchena (1994) highlighted that an increase in ambient temperature (by a 2 °C) and a 4 °C rise in mean temperature have drastically lowered crop yields among small-scale farmers in Zimbabwe. Recent studies (see Brown et al. 2012) also indicate that climate change is rendering land increasingly marginal for rain-fed agriculture, posing a significant menace to the agrarian economy and the livelihoods of the rural poor. With more than 90% of small farmers in Zimbabwe depending on rain-fed agriculture, the effects of uncertain rainfall patterns and increasing frequency of droughts could be devastating, unless tangible steps are taken to enhance the resilience of rain-fed agriculture (Unganai and Murwira 2010). It is against this background that this paper focuses on climate variability and adaptation processes in local scales.

Climate variability and adaptation in Mutoko

This paper shows sociologically how adaptation processes are occurring and evolving in a particular semi-arid, marginal and fragile ecosystem in rural Zimbabwe. In the following discussion, it will be highlighted how small-holder farmers are problematising and interpreting climatic shifts occurring in their context. The paper then discusses how the farmers are responding and shows how adaptation is irreducible to an event by discussing the various processes, structures and conditions underpinning it. The map of Mutoko district is shown below, and a brief description is provided underneath (Map 1).

Mutoko is a semi-arid district located in the eastern part of Zimbabwe. Mutoko growth point is located 143 km from Harare and 90 km from the Zimbabwean border with Mozambique. The growth point was established as an administrative outpost for the British administrators in 1911 after it had been delimited as part of Mashonaland (and placed under the Salisbury magisterial district in 1899). Mutoko spans over 428,916 ha of land, and it is divided into 29 wards, with 19 being communal wards,



Source: Adapted from Mudowaya (2014).

Map 1 Map of Mutoko District

4 small-scale commercial farming wards, 5 resettlement wards and one growth point ward. Mutoko is marked by extensive rain fed crop production specifically food crops which include small grains (sorghum and millet), maize, groundnuts and Bambara nuts as well as sunflower and cotton production on a small scale. Cropping patterns in most of the communal areas are biased towards self-reliance, though cash cropping is also discernible. Horticulture, to a great extent practised in communal areas, is a vibrant farming system in the district. There are also a few formal irrigation schemes in resettlement areas where fine beans and carrots are widely grown. Apart from crop farming, farmers rear livestock such as cattle, goats and poultry.

Increasing climate variability: a moment of morphogenesis

Climate change constitutes a shift in meteorological conditions that last for a long period of time (usually centuries), and climate variability are short-term fluctuations happening from year to year (Burroughs 2001). The intention here is to understand the changes occurring in climate variability by elaborating on farmers’ concerns. Archer (2007) conceived that everyone has concerns in the natural, practical and social order of reality. The idea is therefore to first understand how farmers problematise climate variability (or what Archer would call problem identification) before elaborating on livelihood challenges and adaptive strategies. The understanding driving this approach is that peoples’ courses of action are rooted in their concerns. People can design and determine their responses to the structured conditions in which they found themselves,

in the light of what they personally care about most (Archer 2007). As such, courses of action are anchored in the concerns of the individual and taken forward through their reflexive calculations.

As a starting point, farmers' livelihoods are depended on climatic conditions; therefore, it is not surprising that they are not oblivious to the changes occurring in their context. They find climatic uncertainties real and problematic in their everyday practices. Their concerns are by and large centred on increasing rainfall variability. This is equated to a moment of nascent morphogenesis or contextual/structural discontinuity that sociologist Archer (2012) speaks about but, in this case, characterised by shifting climatic conditions. From the survey, the majority of farmers (58%) selected rainfall patterns as the current most important thing, 29% considered temperature, 9% said both rainfall and temperature were equally important and 4% said none of the two.

Indeed, rainfall patterns have become more unpredictable and unreliable as narrated by the farmers. They were overwhelmingly anxious regarding the unpredictable and unreliable rainfall owing to the complex nexuses between their livelihoods and how the rainfall season behaves. Above most of the things, farmers want certainty in rainfall patterns hence predictability and reliability in rainfall are critical. Although rainfall seasons were construed as distinct, over the past years, inter-annual rainfall variability has become more unpredictable. It was also becoming increasingly challenging for the farmers to predict rainy season onset and cessation. Farmers also raised concerns pertaining to rainfall reliability, distribution, adequacy, quality and extreme rainfall events. Sociologically, there is a crisis in normativity (Archer 2016) regarding rainfall patterns.

Pertaining to rainfall onset, the majority (78.4%) of farmers in the survey agreed that the rainfall season does not start when it normally used to and 21.6% disagreed. The usual rainfall season should start around 15 October yearly, but farmers are now experiencing a significant shift in the onset of the rainy season. The farmers exhibited heterogeneous responses regarding the exact years when they started noticing delayed rainy season onset from their descriptions. However, what is discernable is that they indicated to have been observing this regularly since the early 2000s. Specific reference was made to the 2011/2012, 2012/2013 and 2013/2014 seasons in which rain sufficient to make seeds germinate were only received in December. Memorable occurrences and life events such as during their childhood years and before they got married were meaningful in describing the changes in the onset of the rainfall season.

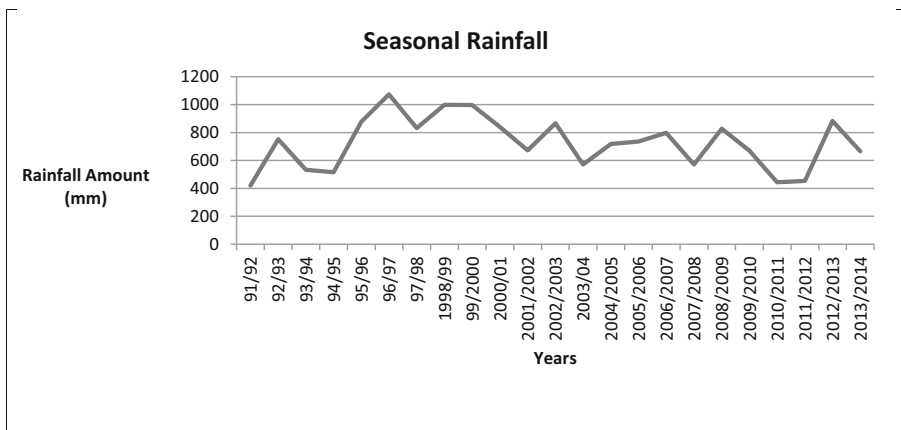
Farmers are also grappling with early rainfall cessation. A normal rainy season occurs between October and March. This period is adequate for crops to fully mature and also enable farmers to grow some crops towards the end of the rain season (around the third week of February). This period also enabled farmers to organise their activities such as harvesting. Important from this qualitative study is that whilst it remains very common in literature to characterise a season as normal based on the total amount of rainfall, farmers in Mutoko construe a normal rainy season based on its length, amount received and the implications of received rainfall on crops.

Extreme and intense rainfall events and occurrences were also a nuisance to the majority of the smallholder farmers. Most farmers (64%) pointed out that they had experienced occurrences such as rainfall with intense winds at some point since 1992 and 36% had not. At the same time, 48% noted that extreme events had increased since 2000, 34% said they had decreased and 18% said there was no change. In addition, a

significant number of farmers (86.7%) said they had witnessed increasing incidences of droughts since 2000, 9% said they had not and 4.3% said there was no change from what they had observed in the 1990s. The droughts in 1992, 2002 and 2008 were considered as extreme events. However, the 1992 drought was remembered and described as the worst in their lifetime. Mostly those who were young at the time could not narrate in detail the horrors brought by the drought. Episodes of heavy rains in the 1998/1999 season and cyclones, especially cyclone Eline as well as incidents of heavy rains between 2012 and 2014 were also viewed as critical rainfall events.

For people whose livelihoods are rainfall dependant, seasonal amount of rainfall is as important as the distribution within the season. This resonates with what Cooper et al. (2008) highlighted that whilst seasonal rainfall totals and their season-to-season variability are in themselves important, the nature of ‘within season’ variability can also have a major effect on crop productivity. Therefore, the farmers are concerned about increasing and prolonged dry spells occurring during the rainy season. Occasional menaces were also generated by sporadic wet spells. Although farmers mentioned that they had experienced dry spells mostly during drought years, a number of farmers used the 2013/2014 rain season for reference as well. Figure 1 below shows rainfall distribution in Mutoko.

At the same time, livelihoods conundrums are arising from changes in spatial distribution of rainfall. This finding is a significant departure from a number of Zimbabwean studies based on farmers’ perceptions that dwell much on seasonal rainfall distribution only thereby neglecting spatial dimensions (see Moyo et al. 2012; Mtambanengwe et al. 2012). In Mutoko, the understanding of spatial distribution was expressed by farmers in terms of rainfall at times eluding the area within the season. Comparisons were made with other surrounding areas to explain how spatial variability was unfolding. Likewise, Meze-Hausken (2004) reported that people repeatedly alluded to the Afar saying which goes, ‘while it rains on one horn of the ox, it can be dry on the other’ in her study in Ethiopia. This indeed signifies the importance of localised rainfall, which can benefit one farming area while leaving the neighbouring



Data Source: University of Zimbabwe Geography Department, 2014.

Fig. 1 Seasonal Rainfall Distribution in Mutoko. Data from University of Zimbabwe Geography Department, 2014

area completely dry. Again, Simelton et al. (2011) found that during the past few years, rains come on one side of the farm and not the other in central Malawi.

Concurrently, farmers are confronted with inadequate rainfall and increasing number of seasons with low rainfall in their farming area. Importantly, when comparing farmers' perceptions with results of analysis of meteorological data done for Mutoko District, there were contrary indications of annual precipitation increasing in the district. This was also confirmed by Mudowaya (2014) that there is a positive trend in annual mean precipitation for Mutoko district from 1978 to 2010 which therefore indicated that precipitation has been increasing during this period. Notwithstanding this paradox, most farmers noted that rainfall had only been substantial since 1992 during two recent consecutive seasons, which are 2012/2013 and 2013/2014. The years 2007–2011 were regarded as dry years that followed the drought in the 2007/2008 season. However, this discrepancy between farmers' perceptions and meteorological data is not unusual. Moyo et al. (2012) and Hertter et al. (2012) realised the same incongruities in Zimbabwe and Uganda, respectively.

Without getting into comparisons between meteorological data and farmers' perceptions, it is not the intention of this paper to validate farmers' perceptions. However, the paper clarifies two issues. Firstly, from the interactions and conversations with farmers, it was clear that they pay particular attention to droughts and related extreme events (just like farmers in other contexts in sub-saharan Africa). In particular, the drought of 1991/1992 seemed to have left a lasting impact on farmers' lives. Droughts that followed were also negatively perceived as having caused hardships in their lives. Overall, farmers are sensitive to rainfall amounts. Therefore, it is likely that farmers blended the seasons and years of droughts together to form their own perceptions on rainfall amounts. Secondly, the issue of rainfall adequacy suggests that it is not enough to rely only on average annual rainfall to conclude that rainfall is increasing. It may therefore be important to conduct a qualitative inquiry to understand the nuances surrounding the meanings of rainfall amounts and rainfall events.

Morphogenesis denies stable livelihoods

What is critical to argue is that changing climate variability is imposing complex livelihood conundrums in this smallholder farming community. Over and above everything else, farmers had pessimistic views on the nexus between climate variability and their livelihoods. Increasingly changing climate variability has generated what Archer (1995) calls 'logical inconsistency' in their livelihood system. The major challenges that were identified by farmers are categorised as the disruption of the agricultural calendar, harvest failures and livestock losses, landscape degradation, depletion of water resources and problems with ecological aspects. Extended dry spells, extreme occurrences (mainly drought), rising temperatures and high rainfall intensity were perceived to have mostly induced these livelihood problems. In this case, one of the striking challenges farmers have to grapple with is the disruption of their agricultural calendar. By and large, the increasing disruption of the agricultural calendar by variations in the onset of the rainy season militates against the proper planning of agricultural activities, resulting in crop failures.

Still, the implications are quite complicated. For instance, when the start of dry season activities is delayed, this has implications not only on growing horticultural

crops, but it ruptures social relationships surrounding the management of livestock. According to Jennings and Magrath (2009), changes in the seasons can be described broadly as creating existential shocks to individuals and to societies through threatening belief systems, cultural practices and, as a result, social relationships. To augment on how the changes in rainfall patterns are undermining social practices, I draw attention to the following quotation from a key informant in the study:

.....That is a challenge. People in this area are hard headed. Who will go around telling people that that they cannot let out their cattle roam around on 1 June? It is like people do not care who has maize in the fields especially if they do not have any. They just tell you we agreed on 1 June that livestock should be set free. Anyone with crops in the fields, it is their own problem (In depth interview with village head, April 2014, ward 3).

In addition, farmers' own seed varieties remain a key component of agriculture systems in semi-arid areas (Leclerc et al. 2014), yet their survival in Mutoko is being threatened by climate variability. The disappearance of traditional seed varieties owing to increasing years of droughts has created what can be termed contextual incongruences (Archer 2012). Farmers in this semi-arid, smallholder farming community have grown traditional varieties for generations and have retained the seeds as well. However, successive years of droughts have clearly led to the erosion of 'farmers' varieties' of groundnuts, rapoko, millet and sorghum thereby reducing crop diversity. Chagutah (2010) argues that the lack of diversity and the minor role played by traditional drought-tolerant staples such as sorghum, millet and cassava increase the vulnerability of food systems to the effects of climate change and variability. Resultantly, farmers have been left to rely on hybrid varieties, particularly of maize, that are ill-suited to the climatic conditions of agro-ecological region four.¹

A situational logic of competition (Archer 2012) over natural sources has ensued in the farming area. In a related manner, there is a proliferation of competing identities and claims (Berry 1984) over resources such as water which are getting increasingly scarce. Increasing water scarcity and deterioration of water sources are escalating competition for water among different farmers. The intensified competition becomes translucent when regarded in the context of irrigators and non-irrigators because those with irrigation pipes are able to draw more water from the remaining limited sources and some farmers enclose water along the river/stream channels (Bhatasara 2017). Besides impacting on crop production, this is also affecting the social fabric. For instance, some farmers reported that some of the irrigation pipes are vandalised and weir dams are filled with sand. Analytically, it may also apt to regard these as signs of a decaying moral economy that Watts (1983) speaks about.

Importantly, structural uncertainties such as rainfall unpredictability, unreliability, and rising temperatures are interacting with other elements. Borrowing the concept used by O'Brien et al. (2004), farmers' livelihoods are exposed to multiple stressors. The interface between climatic and non-climatic is also best captured using the conceptual framework of double exposure developed by O'Brien and Leichenko

¹ An area which receives between 400 and 650 mm of rainfall per year and is subject to seasonal droughts, and is suitable for livestock production and drought resistant crops.

(2000). The framework of double exposure explores the interaction among various shocks and stressors to understand the full impacts of climate change or global environmental change. As applied in the current paper, the framework indicates that climate variability at the local level connects with poverty, economic decline, natural resources depletion, and poor farming techniques in compound and complex ways.

Again, using the concept of double exposure, it is apt to argue that climate variability is producing majority losers and few winners in the farming community. This simply derives from the point espoused by Leichenko and O'Brien (2008) that the impacts of climate change are heterogeneous. In the midst of climatic adversity and risks, some people may find opportunities. Although most farmers suffered from the drought in Mutoko, those with irrigation pipes and gardens located near Dorongoma dam, for instance, were able to grow crops that fetched good prices at the market in the capital city, Harare, for example, during the drought of 2002 (Bhatasara 2017).

Adapting lives and livelihoods

Farmers in Mutoko are not entwined in perennial cycles of livelihood impoverishment at the mercy of adverse climatic events. They are adapting their lives and livelihoods. Borrowing from van der Ploeg et al. (2004), there is novelty production or peasant innovativeness (Osti 1991) taking place. In the context of the current paper, this means that farmers are generating something new; new practices, new insights, new artefacts and innovative social or institutional arrangements. Interestingly, using various strategies, farmers are not only responding to climate variability but are also reflexively navigating difficult socio-economic conditions. This indeed shows that climate variability acutely affects rural livelihoods and agricultural productivity, yet it is just one of many stresses with which vulnerable rural households have dealt with (Ziervogel and Calder 2003). Thus, it is appropriate to argue that humans do not only tread a changing biophysical reality when adapting to climate change, but also a changing social, political and economic one, and often in novel and surprising ways (Nielsen and Vigh 2012). Simultaneously, as the findings reveal, farmers in the study site have responded to problematic climatic, political and socio-economic events several times before 1992. Therefore, farmers' adaptive strategies in this paper should be read primarily in terms of intensification, expansion, reframing, reviving and reorganisation. Table 1 below summarises farmers' adaptive strategies as highlighted by Bhatasara (2017).

Structures, processes, and conditions underpinning adaptation

This paper argues that farmers' adaptive strategies are produced, situated and sustained within specific structures, processes, conditions and dynamic social relations. These facets are both enabling and constraining adaptation processes. At the same time, they point to the complexity surrounding adaptation in rural spaces. Hence, it is apt to argue that how adaptive strategies have emerged cannot be construed in a simplistic manner. The strategies are also dynamic; hence, some farmers have abandoned, scaled down and re-negotiated their strategies in view of various nascent forces they encounter.

Table 1 Farmers' strategies

Strategy	Key features
Re-organising crop production practices	<ul style="list-style-type: none"> - Shifting planting dates - Replanting - Drought resistant crops - Early maturity crops - Staggering crops - Multiple fields and gardens
Intensifying and expanding micro-irrigation	<ul style="list-style-type: none"> - Informal irrigation channels - Syphoning water manually from rivers and streams - Pumping water using engines
Increasing crop and livestock diversification	<ul style="list-style-type: none"> - Multiple cropping of varieties with different risk attributes - Integrating horticulture in main agricultural season - Added horticultural crop varieties e.g., okra - Expanded integration of traditional and hybrid seeds - Adoption of smaller livestock, mainly goats
Conservation farming	<ul style="list-style-type: none"> - Tilling land manually - Moisture conservation - Soil fertility improvement - Minimal use of inputs such as fertiliser
Water management technologies	<ul style="list-style-type: none"> - Rain water harvesting - Construction of weir dams on public and private spaces - Catchment water conservation using local plant varieties
Informal and formal networks	<ul style="list-style-type: none"> - Micro-irrigation groups - Consolidated gardens
Increasing the role of indigenous knowledge	<ul style="list-style-type: none"> - Rain-seeking ceremonies - Reading rainfall patterns
Emphasis on the role of trees	<ul style="list-style-type: none"> - Drought-resistant trees e.g. <i>musawu</i> (<i>Ziziphus mauritiana</i>), <i>Jatropha</i> (locally known as <i>mujirimo</i> and known scientifically as <i>Jatropha curcas</i> L.) - Multiple purpose trees (prevention of erosion from <i>gukuravhu</i> (high intensity rainfall), food supplements in drought years and land reclamation)
Doing nothing	<ul style="list-style-type: none"> - Disillusionment - Entangled in circumstances beyond one's control

Adapted from Bhatasara (2017: 559)

Socio-structural constraints and enablements

Evidently, there are diverse structures which are to a great extent complicating farmers' strategies. For instance, household labour shortage and lack of wealth were perceived as outstanding constraining factors in strategies such as conservation agriculture and increased crop and livestock diversification, respectively. Household labour shortage

was perceived as constraining in the adaptation process by 63% of the farmers, whilst 37% thought that it was not a constraint. Conservation agriculture was regarded as arduous and involving many processes. Tilling on dry land, and then mulching whole fields, required significant labour that most households stated they could not easily provide. The labour demands under conservation agriculture forced farmers to disregard other strategies. For example, it was difficult to balance the labour requirements of hoeing and mulching fields and at the same time work in gardens that required serious mulching towards the end of the dry season. This finding resonates with what Giller et al. (2015) highlighted that if herbicides are not available, the labour burden for hand weeding under conservation agriculture is increased, particularly for women. Consequently, this strongly limits the area under conservation agriculture to what can be managed by a farming family without having to hire additional labour (ibid). This seriously questions scholars (see for example, Doets et al. 2000) who argue that conservation agriculture is labour saving. Simultaneously, lack of household wealth was viewed by most (62%) respondents as constraining the opportunities for increased crop and livestock diversification as well as the ability of farmers to construct and expand weir dams and purchase pipes so as to irrigate crops.

On a different note, for 60% of the farmers, farming experience combined with local knowledge seemed to have created favourable conditions for adaptation. Farming experience allowed continued production under unpredictable and unreliable rainfall conditions. This paper concurs that people react circumstantially, imaginatively and consciously to constraints and opportunities, drawing upon their cultural repertoires, texts or acquired behaviours (Long 2001). The re-organisation of crop production, transition to conservation agriculture and diversification of indigenous and hybrid crop varieties were permitted by experiences and knowledge deriving from years doing farming in this semi-arid region. The experience of living in and farming in this locality for a number of years coupled with acquired knowledge from formal farmer trainings meant for example that farmers know deeply the types of soils suitable for new crop varieties, early maturity crops and drought-resistant crops. Therefore, they were not only able to assess soil moisture content but to allocate the new crops to fields according to moisture and fertility requirements. And, farmers' reliance on experience and local knowledge suggests that their novelties are largely embedded in the local context.

At the same time, emergent exogenous forces are crucial in shaping farmers' innovations in the face of adverse climatic tendencies. Institutional actors, external actors' agendas and particular events have been fundamental in the evolution of farmers' adaptive strategies. To be very specific, farmers regarded the current discourse on conservation agriculture as mainly propagated by development actors. The emergent conditions that led to farmers engaging in the practice were related to activities of Cluster Agricultural Development Services and Community Technology Development Trust, two organisations that were regarded as the key players. These farmer-oriented non-governmental organisations were targeting smallholder rural farmers with various technologies and concepts under the banners of sustainable livelihoods development, enhancing food security and addressing climate change. These actors entered rural communities as wielders of knowledge on adaptation practices and adaptation resources. The government also supported the adoption of conservation agriculture through the provision of extension services. All these facets simply oriented farmers

or provided strategic guidance (Archer 1995) but did not determine the adoption of practice.

Nevertheless, these findings should not be read in linear or deterministic fashion because when farmers were presented with conservation agriculture and consolidated gardens (owned by a group of farmers producing a variety of horticultural crops), the adoption of these practices was not automatic. Hence, external forces did not impose themselves on farmers such that their reflexivity was lost. They responded to these structured circumstances by developing what Archer (1995) calls vested interests. In terms of consolidated gardens, farmers invoked their reflexivity by showing interest in these innovations, accepting them and agreeing to organise as groups. Some farmers also contested the discourse of conservation agriculture as labour intensive. As a result, some farmers who adopted the practice when it was first promoted have since abandoned it or reduced land size under cultivation. Others have modified it by not following all the process it requires as they regarded them as mundane, whilst others have greatly integrated the practice within their existing farming practices. For instance, almost all farmers who have won first prizes for farming have been using conservation agriculture since it was promoted. Farmers also articulated their own interests within innovations promoted by external actors. Some farmers decided to get involved in conservation agriculture simply because they were interested in the farming inputs that were being given. They regarded farming inputs as a major challenge; hence, they regarded the projects as platforms to gain access to free farming inputs.

It is also important to argue that farmers are not being forced to adapt by external actors in this rural community. The rhetoric of dominance and subordination is thus not discernible. To illustrate, given that farmers were no longer extensively engaging in formal cooperatives, they could easily have rejected the idea of forming consolidated gardens; instead, they reacted to the organisation that brought the idea (conceived here in Archerian terms as structural enablement) by agreeing to formally organise themselves into groups. All the same, the role of external actors remains very crucial in understanding farmers' adaptive strategies, as their withdrawal has also threatened the continuity of some strategies. In particular, respondents noted that conservation agriculture has been discontinued by some households because organisations withdrew their support with farming inputs.

Contestations around adaptive strategies are inevitable in a context of morphogenesis. On one hand, there were sentiments by extension officers that farmers are no longer taking extension services seriously because they did not turn up on field days or simply resisted taking their advice. Extension officers still believe that they are important sources of modern or technical agricultural knowledge and their roles are especially elevated in view of new challenges generated by climate change. On the other hand, whilst farmers still largely believe in the legitimacy and expertise of extension workers, they had questions or reservations regarding some of their ideas. As stated before, farmers are re-organising crop production, which involves planting new non-traditional or hybrid drought resistant and early maturity crops. However, some farmers do not entirely trust these varieties because they believe that they are prone to diseases, are of poor quality, easily get affected by grain borers whilst still in the fields, and also require too much crop protectant when stored in granaries. Therefore, farmers' adaptive strategies involve tensions between different bodies of knowledge.

Socio-interactional constraints and enablements

Importantly, adaptation involves the mobilisation of a set of social relations. In other words, micro-level relationships and interactions that farmers are part of, and the values and discourses they uphold are driving their adaptation. This resonates with the idea that the ability to create and expand social networks is part of the ability to live with change and uncertainty (see Nyamwanza 2012). These relationships and interactions here construed as social capital are, albeit not necessarily, associated with survival and recovery from disasters induced by climate variability. Following this, whereas some farmers' innovations were on one hand enabled by exogenous processes and actors, the formation of networks on irrigation was an endogenous process. The ability of farmers to self-organise, together with the existence of trust and remnants of a cooperative ethic among farmers, largely enabled them to confront problems of depletion of irrigation water sources through forming irrigation groups. Local linkages and interactions such as farmer to farmer extension were also cited as very important in this smallholder farming community. They were regarded as sources of farmers' knowledge, for example, on how to handle new crop varieties and manage new crop and livestock diseases. As such, this paper shows how social capital is a source of novelty production in responding to increasing climate variability.

Internal conversations

Inner dialogues farmers engaged in during the process of adaptation are fundamental in understanding adaptation as a complex and reflexive process. Through inner dialogue or internal conversation, people reflect upon their situation in light of current concerns and projects (Archer 2003). Individuals conduct a conversation between their subjective self, which asks a question, and their objective self, which provides the answer (McMerrin 2007). It is a method for arriving at self-knowledge and decisions through the process of 'discernment, deliberation and dedication' (Archer 2003:138). Internal conversations govern peoples' (agents') responses to their objective circumstances, in this case, climate variability.

In that regard, the paper invokes Archer's theory of reflexivity to argue that most farmers are reflexive, as evident in the internal conversations which they conducted in their daily reflections on the world about them, a world being altered by increasingly changing climate variability. Still within the Archerian discourse, farmers are also reflexive as shown in their reflections on the nature of their personal projects (adaptive strategies) within this changing world. At the same time, although Archer (2007) argues that internal conversations result in distinct modes of reflexivity, findings in this paper cannot be read neatly from these modes of reflexivity. What are evident are merely internal conversations within the process of adaptation.

Farmers had conversations about their future living in this semi-arid region. In this case, climate variability is not only felt in the present by farmers but is also projected into the future. Therefore, when some farmers came up with coping and adaptive strategies, they sought to act in the immediate as well as move towards positions in the yet to come. They sought to transform their situations, and not just to accommodate change but to retain meaningful future lives for themselves and their children. Adaptive strategies are thus mediated by aspirations for an improved future. For some farmers,

hope for a better future was fundamental in them increasing crop and livestock diversification, expanding horticulture and intensifying micro-irrigation. Unlike food for work programmes and borrowing from friends and relatives, these strategies were capable of taking them into the future. In this respect, adaptation to climatic variability should never really be understood as a matter of adapting to the present only but rather adapting to a multiplicity of proximate, mediate and future perforations (Nielsen and Vigh 2012).

Furthermore, internal conversations about the past are evident. Although the findings are inadequate to conclude that the process of adaptation is being underpinned by past experiences, some farmers divulged nostalgia on how good things were during the times they were growing up. They conversed about the past and had memories of what they perceived as 'good old days'. In a related manner, farmers compared a number of aspects during the 1990s and after 2000, and had positive views of the former and pessimistic interpretations of the later. Thus, conversations and memories of better lives in the 1990s and increasing difficulties after 2000 were crucial in the adaptation process. Although farmers highlighted that they had no control over the late onset of the rainfall season and they could not 'get back the lost seasons', these memories underlined how they re-organised their crop production practices.

At the same time, enthusiasm for change was also highlighted. Having gone through successive droughts, mid-season dry spells and short seasons that were accompanied by harvest failures, what some farmers wanted was change in their lives. This was not only limited to changes made in horticulture, addressing water scarcity and other strategies but also change associated with socio-economic conditions. For instance, enthusiasm to gain income and regain productive livelihoods underscored the expansion of micro-irrigation and increasing crop, and small livestock diversification.

In addition, more than 50% of the farmers indicated that they were afraid of the consequences of not adapting. Bewilderment and a sense of insecurity were often profound in life histories, along with sadness and fears for the future if things remained unchanged. These farmers had conversed about the losses they had encountered (income, crop and livestock losses) and the anxieties these had created. Others seemed to have been upset and haunted by the events of the drought in 1992 and indicated that they were not prepared to relive those kinds of experiences. In this case, when they conversed about that drought, they were overwhelmed by fear, and therefore, they had to come up with life projects (Archer 2003). Others were scared that if they did not do something, the situation would degenerate into something beyond their control. Therefore, if they did not construct weir dams, form irrigation groups and adopt various water management practices, it was then impossible to maintain and expand dry season horticulture. More so, some farmers conversed repeatedly about what life would be like if they had to abandon horticulture for good.

Lastly, conversations about obligations and duty to one's family are present in the process of adaptation. This relates to communicative reflexivity in Archer's typology of dominant modes of reflexivity. Some of the aspects found in the data that shed light on this included farmers saying 'I thought about my sick husband', 'I have orphans that I am taking care of' and 'I could see there was nothing to eat for my wife and children'. Some farmers decided to travel for casual labour in resettlement and small-scale commercial farming areas, buy mealie-meal from supermarkets and work in food for work programmes during years of droughts because they wanted to fulfil their family

obligations. On the contrary, whilst farmers gave the impression that they struggled with so many inner questions and would do anything to fulfil family obligations in the face of adversity, they were not prepared to do the same to fulfil communal obligations.

Conclusion

Adaptation is an evolving complex and reflexive process linked to contingent structures, conditions and broader social processes. Evidently, farmers have come up with a myriad of innovations and technologies that are not merely enabling them to maintain their livelihoods but survive harsh climatic events. However, it is important to note that farmers in rural spaces have always dealt with environmental transformation before and farmers in Mutoko are no exception. Their creativity spans generations but what this paper underlines is that they are facing unprecedented uncertainties in climate; hence, this requires novelty. In this case, farmers are being reflexive when they re-organise crop production, engage in and intensify micro-irrigation and increase crop and livestock diversification. Farmers interact among themselves and with other actors, to varying degrees, in order to find new ways of maintaining their livelihoods, producing and reproducing alternative conservation regimes. Yet, the landscapes or spaces for adaptation should be understood as complex. Farmers' adaptive strategies are embedded in diverse structures, processes and conditions.

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