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Sources of vulnerability to a variable and changing climate among smallholder households in Zimbabwe: A participatory analysis

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ABSTRACT

Vulnerability analysis is essential for targeting adaptation options to impacts of climate variability and change, particularly in diverse systems with limited resources such as smallholder farms in sub-Saharan Africa. To investigate the nature and sources of vulnerability of smallholder farmers to climate variability and change, we analysed long term climate data and interviewed farmers individually and in groups in Makoni and Hwedza districts in eastern Zimbabwe. Farmers' perceptions of changes in climate characteristics matched the recorded data. Total seasonal rainfall has not changed, but variability in the rainfall distribution within seasons has increased. The mean daily minimum temperature increased by 0.2 °C per decade in both Makoni and Hwedza. The mean daily maximum temperature increased by 0.5 °C per decade in Hwedza. The number of days with temperatures >30 °C also increased in Hwedza. Farmers indicated that livestock production was sensitive to drought due to lack of feed, affecting resource-endowed farmers, who own relatively large herds of cattle. Crop production was more sensitive to increased rainfall variability, largely affecting farmers with intermediate resource endowment. Availability of wild fruits and social safety nets were affected directly and indirectly by extreme temperatures and increased rainfall variability, impacting on the livelihoods of resource-constrained farmers. There was no evidence of a simple one-to-one relationship between vulnerability and farmer resource endowment, suggesting that vulnerability to climate variability and change is complex and not simply related to assets. Alongside climate variability and change, farmers were also faced with biophysical and socioeconomic challenges such as lack of fertilizers, and these problems had strong interactions with adaptation options to climate change. Diversifying crops and cultivars, staggering planting date and managing soil fertility were identified as the major adaptation options to stabilize yields against increased rainfall variability. There is need to evaluate the identified adaptation options on farm and with the participation of farmers to provide empirical evidence on the best options for different households.

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Introduction

While climate variability and change are global phenomena, vulnerability differs by location. Sub-Saharan Africa (SSA) has been identified as the most vulnerable region to climate variability and change because many areas inherently receive unpredictable rainfall (IPCC, 2007). Zimbabwe is one of the 'hotspots' for climate change, with predicted increases in temperatures and rainfall variability (Lobell et al., 2011; Rurinda et al., 2013), and increased probability of extreme events such as droughts and flash floods (Houghton, 1997). Smallholder farmers are vulnerable to impacts of the changing climate because of multiple interacting stresses, such as soil degradation (Mapfumo and Giller, 2001), lack of lucrative output markets (Nyikahadzoi et al., 2012), a declining natural resource base linked to population pressure (Frost et al., 2007), and deterioration of societal 'safety nets' related to extreme poverty (Mapfumo et al., 2013). Climate variability and change is therefore an extra burden that exacerbates existing challenges.

Patterns of vulnerability vary among smallholder households, even within the same community (Westerhoff and Smit, 2009). Smallholder farmers are often classified into different categories largely based on resource endowments in different regions in SSA (Mtambanengwe and Mapfumo, 2005; Tittonell et al., 2005). First, these distinct endowments and livelihood options between smallholders would be impacted differently by either single or multiple climatic variables leading to differential vulnerability. Farmers practicing improved soil fertility management were less vulnerable to increased temperatures than non-practicing farmers with respect to wheat production (Luers, 2005). Second, the variation in endowments among smallholder households is associated with different responses to hazards (Adger, 2006). Larger farm size has been found to increase adaptive capacity of farmers and hence reduce vulnerability (Reidsma et al., 2009). However, in another study smallholder farmers with relatively small farms were found to be less vulnerable to droughts than privately owned large farms due to a range of livelihoods options (Toni and Holanda, 2008). These findings suggest that even the perceived marginalized households can use a range of options to reduce vulnerability. However, being resource-endowed does not necessarily mean one is less vulnerable. Furthermore, institutions and social networks within a local community also play a key role in decreasing vulnerability (Mapfumo et al., 2013).

Detailed vulnerability analyses not only require context specificity, but also involvement of the target communities at local level (Cutter, 1996). Given that the determinants of vulnerability, whether climatic, or social and biophysical conditions change over time, the target communities would play a key role in identifying indicators and thresholds for vulnerability (Cutter, 1996). In addition, the uncertainties in climate change research due to both lack of knowledge and the stochastic nature of processes underpinning climate change, prompt for bottom-up approaches to enable continual co-learning to respond to future climatic surprises (Dessai and van der Sluijs, 2007). Participatory analysis helps to integrate knowledge from both local farmers and science, particularly when comparing local farmers' perceptions of climatic exposure characteristics and measured data.

Despite the reported differences in resource endowment and management between farm types in SSA, there is little knowledge available to understand the relationship between smallholder households of different endowments and vulnerability to climate variability and change relative to other stresses such as soil fertility depletion. Yet, understanding vulnerability of different households is essential to identify 'best fit' adaptation options particularly in diverse environments with limited resources. In addition, vulnerability analysis helps to target and reach the most vulnerable households (Luers, 2005). Although research on vulnerability analysis has increased (Janssen, 2007), efforts have been focused more on building theoretical concepts and how they can be applied to systems in general [e.g. Turner et al., 2003]. Such frameworks are important to understand the concept of vulnerability, but they lack practical relevance for intervention (Luers, 2005) as their usefulness has not been tested in real situations. Given that the impacts of climate variability and change are context specific, there is a need for local vulnerability analyses [e.g. Cutter, 1996] to derive lessons on the how the relationship between farmer resource endowment and vulnerability to climate variability and change is mediated by the socio-economic and environmental resources present in the system. As a result, lessons could be learnt to share with other communities and other regions. Some analyses of vulnerability have focused on the impact of single climate variables such as drought (Eriksen et al., 2005) or temperature (Luers, 2005), which may conceal impacts of other climatic factors (O'Brien et al., 2009). Thus, analysis of vulnerability requires a holistic systems approach recognising multiple climatic exposure as well as social and biophysical constraints. Recent definitions of vulnerability recognise the interaction between external and internal forces characterised by exposure, sensitivity and adaptive capacity of a system, sub-system or system components (Cutter, 1996; IPCC, 2007).

The focus of this study was to understand the nature of, and to identify the sources of vulnerability among smallholder farming households to impacts of climate variability and change in two distinct communities representing similar smallholder environments in Zimbabwe. The objectives were (i) to analyse the relationship between vulnerability and farmer resource endowments; (ii) to identify adaptation options used by different households in response to sources of vulnerability and to link them to the socioeconomic and environmental resources available in the region; (iii) to identify opportunities for enhancing the capacity of farming households to adapt to climate variability and change for informed policy decisions.