Journal of Environmental Management 102 (2012) 9–17

Contents lists available at SciVerse ScienceDirect

Journal of Environmental Management

journal homepage: www.elsevier.com/locate/jenvman

Climate variability and change or multiple stressors? Farmer perceptions regarding threats to livelihoods in Zimbabwe and Zambia

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ARTICLE INFO

Article history:
Received 2 June 2010
Received in revised form
20 January 2012
Accepted 6 February 2012
Available online 22 March 2012

Keywords:
Farmers
Perceptions
Climate variability
Climate change
Multiple stressors

ABSTRACT

Climate variability is set to increase, characterised by extreme conditions in Africa. Southern Africa will likely get drier and experience more extreme weather conditions, particularly droughts and floods. However, while climate risks are acknowledged to be a serious threat to smallholder farmers' livelihoods, these risks do not exist in isolation, but rather, compound a multiplicity of stressors. It was important for this study to understand farmer perceptions regarding the role of climate risks within a complex and multifarious set of risks to farmers' livelihoods. This study used both qualitative and quantitative methods to investigate farmers' perceptions regarding threats to livelihoods in southern Zambia and south-western Zimbabwe. While farmers report changes in local climatic conditions consistent with climate variability, there is a problem in assigning contribution of climate variability and other factors to observed negative impacts on the agricultural and socio-economic system. Furthermore, while there is a multiplicity of stressors that confront farmers, climate variability remains the most critical and exacerbate livelihood insecurity for those farmers with higher levels of vulnerability to these stressors.

1. Introduction

There are predictions that due to accelerated anthropogenic activities, climate variability will continue to increase, characterised by heightened frequency and intensity of extreme weather conditions in Africa (Clay et al., 2003; Nhemachena and Hassan, 2008). The Climate of Southern Africa is highly variable and unpredictable and the region is prone to extreme weather conditions, including droughts and floods (Department for International Development (DFID), 1999; Kinuthia, 1997). Moreover, Southern Africa is generally expected to get drier and experience more extreme weather conditions, such as droughts and floods. In the predominantly semi-arid Southern African region, there is significant rain variation from year to year and these trends may continue with the wet season increasing and at the same time offsetting decreases in the drier months (Clay et al., 2003). However, there would be variations within the region with some countries experiencing wetter than average climate (Tyson, 1991).

Vulnerability Assessment Committees (VACs) in Southern Africa Development Cooperation (SADC), 1999, established the Regional Vulnerability Assessment Committee (RVAC). The RVAC is a multi-agency committee to address the need to broaden and improve early warning information and vulnerability assessments at national and sub national levels. This was done through spearheading critical improvements in food security and vulnerability analysis at country and regional levels. These assessments have highlighted how SADC member states were subjected to climate variations including droughts in the 2001/2002 and 2002/2003 seasons (Waiswa, 2003). Although drought has been commonly seen as the main climate issue in the region, there have been recent floods in Mozambique and extremely high rainfall in Malawi in the 2000 season (Clay et al., 2003), floods in Southern Zambia (De Wit, 2006) and some parts of Zimbabwe (Cooper et al., 2006). These excessive rains in Malawi are considered to have played a leading role in the food crisis of 2002. Furthermore, links have been drawn between reduced production of annual cereal and maize, and the South Eastern African rainfall index for Zimbabwe alone and for both Zimbabwe and Malawi, specifically for the country specific

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doi:10.1016/j.jenvman.2012.02.005

rainfall index (Clay et al., 2003). In Southern Africa, among the countries worst affected by droughts are Zambia and Zimbabwe. Drought relief is a common feature (Mudimu, n.d.), almost every year, in the drier areas of both countries, as there appears to be an increasing trend towards a late start to the rain season, prolonged mid-season droughts, and shorter growing seasons (Cooper et al., 2007; Love et al., 2006).

It is important to note though, that climate change amplifies already existing risks for farmers. This is the case as there are non-climatic risk factors such as economic instability, trade liberalisation, conflicts and poor governance that may also be faced by farmers (Nyong and Niang-Diop, 2006). Other factors are impacts of diseases such as malaria and HIV and AIDS and lack of and limited access to climate and agricultural information (Gandure, 2005; Gandure and Marongwe, 2006). Africa is also characterised by institutional and legal frameworks that are, in some cases, insufficient to deal with environmental degradation and disaster risks (Beg et al., 2002; Sokona and Denton, 2001). In this regard, this paper highlights farmer perceptions regarding climate change and variability as a threat to livelihoods. This paper also highlights how climate change and variability is viewed in relation to other non-climatic stressors in the sampled districts in Zimbabwe and Zambia. In this paper, the distinction between 'climate variability' and 'climate change' relates to differences in time-scale. On the one hand, 'climate variability' is conceptualised as variations in the climate system over short time scales such as months, years or decades and on the other hand 'climate change' is conceptualised as longer term trends in mean climate variables of periods of decades or longer. This is the suggested distinction in definitions of the concepts in question by the IPCC (2001).

1.1. Farmer perceptions of climate change

While there is literature to demonstrate that at the centre of the adaptive process there is the individual farmer who is free to make a specific choice such as what to plant, how much land to cultivate and the resources to be employed (Crosson, 1986, 1993), there is an alternative approach which underscores how individuals perceive their environment and make decisions, with mal-adaptations attributed to problems in perception, cognition or the lack of available information (Diggs, 1991; Saarinen, 1966; Taylor et al., 1988). The main point is that from whatever level these adaptation measures are taken, the adaptation and coping measures depend on households' perceptions of extreme events and the problems associated with them (Davies, 1993).

Preliminary evidence from a number of African countries reveals that large numbers of farmers perceive that the climate has become hotter and the rains less predictable and shorter in duration (Gbetibouo, 2009; International Crops Research Institute for the Semi-Arid Tropics [ICRISAT] 2009; Maddison, 2006; Mapfumo et al., 2008; Nhemachena and Hassan, 2008). However, it has been documented that farmers perceive risk associated with variable rainfall to be greater than it is. Near Katumani in Kenya, farmers attribute declining maize yields to climate change and reduced rainfall but long-term rainfall records do not support this perception (ICRISAT, 2009). Declining soil fertility and greater land use intensity by reducing the frequency of fallow periods are primarily responsible. Similarly, at Machakos in Kenya, farmers rated nearly 47% of the seasons as poor, while historical climate data indicated that in only 27% of the seasons would maize crop failure have occurred (ICRISAT, 2009). Notwithstanding this, there are other studies that show that farmers' perceptions do tally with historical climate data: Vedwan and Rhoades (2001) in a study done in the Western Himalayas of India, Hageback et al. (2005) cited in Maddison (2006) in the Danagou watershed in China and Maddison (2006) on a number of countries in Africa. It is therefore important to understand farmer perceptions in relation to climate change and other stressors in detail in order to dissect and place possible causes of changes in farm productivity.

2. Methodology

2.1. Study areas

This study was carried out in Southern Zambia and in South-western Zimbabwe (Fig. 1). Two districts were selected for this study in each country, Monze and Sinazongwe in the former and Lupane and Lower Gweru in the latter. Land use in the districts is typical of communal lands with dry-land crop production in the rain season and animal rearing. The major crops grown in Zimbabwe are maize, groundnuts, cowpeas and *Bambara* nuts while the major crops grown in Zambia are maize, groundnuts, cotton and sorghum. Average land owned and cultivated across countries and districts is between 1.6 and 3.9 ha. The smallholder farmers also produce vegetables for sale and consumption from gardens they irrigate using water from shallow wells or small dams. While all the districts are in the semi-arid areas and receive less than 850 mm per annum, Monze district in Zambia and Lower Gweru District in Zimbabwe are wetter than Sinazongwe and Lupane respectively. The rains are erratic and ill-distributed in time and space, resulting in frequent crop failures. While annual rainfall for Lower Gweru ranges from 650–800 mm, average annual rainfall in Lupane district ranges from 450–650 mm with periodic dry spells during the rainy season. Farmers in Lupane frequently experience periods of dry spells, and drought conditions are not uncommon. Similarly, Sinazongwe is characterised by hot, dry spells, a short rainy season of 60–90 days and an average annual rainfall of 600–700 mm while Monze has an average annual rainfall of between 800 and 840 mm and a moderate temperature environment.

2.2. Data collection and sampling

To understand farmers' perceptions of climate and non-climate risks, this study employed both qualitative and quantitative methodologies. The qualitative methods of data collection used include Participatory Rural Appraisal (PRA) techniques such as historical trend analysis and matrix scoring and ranking and Focus Group Discussions (FGDs). The quantitative method used is the household questionnaire survey. The sampling procedure and two approaches are presented in the following sections.

Fig. 1. A map showing the study sites in Zambia and Zimbabwe.

2.2.1. Sampling strategy

A sample of 720 households across countries was selected for the survey, 180 households per each of the four districts. Specifically, systematic random sampling was employed to come up with six villages per district (making them 24 across countries) and 30 households per each of these villages, making a total of 380 households per country (this study was part of a big inter-institutional research-based development project).

For FGDs and PRA workshops, a group of eight to 15 participants was selected to represent the three villages per district, with approximately five representatives from each of the three villages per district. In coming up with this group, factors such as age and gender were used. In terms of gender, separate PRA workshops were held for men and women in order not to compromise the amount and quality of information that can be generated from the less confident if they were to be combined. Specifically, old men and women were incorporated into the sample for the group discussions in order to capture information related to historical trends in climate. It was envisaged that they would be able to recall as far back as they could and provide rich information on these trends. In the same context, youths were incorporated into the sample in order to validate some of the recent trends on climate suggested by the elderly.

2.2.2. Qualitative assessments

FGDs were used to first of all establish the general perceptions regarding climate change and variability and their causes and various stressors that confront farmers' livelihoods (see Appendix 2). Following this, it was considered important for this study to factor in how farmers regard climate change and variability as an obstacle to their livelihoods among the multiple stressors that they had identified. Among these stressors are climate variability in different forms, issues of financial capital, issues related to cattle pests and diseases, inadequate draught power, marketing issues and HIV and AIDS.

A matrix scoring and ranking exercise was then facilitated for farmers. Farmers were asked as a group to select from the long list of stressors the ones they considered critical for the purposes of scoring and ranking. The second step involved participants defining criteria that they would use to evaluate these stressors. These criteria include food security, income generation, crop production and livelihood security. Through group consensus, farmers then decided how much to allocate each shock out of a total of 20 points, based on the group defined criteria. Historical trend lines were used to elicit information on specific historical trends in farmers' perceptions regarding changes in climate over a period of 20 years and as far back as they could recall. Specifically, participants were asked to recall major occurrences that had a bearing on climate and weather, community resources, and even the political situation. They were then asked to indicate what occurrences had the greatest impact on their livelihoods among the cited events.

Qualitative data were categorised and analysed in four distinct themes. These themes are

- Perceptions regarding changes in weather patterns,
- Perceptions regarding causes of changes and variability in climate,
- Perceptions regarding other stressors among farmers and
- Perceptions regarding climate change in relation to other stressors.

These perceptions were established in historical trend lines, FGDs and matrix scoring and ranking and they are presented in this manner in the sections under results and discussion.

2.2.3. Quantitative assessments

The questionnaire survey was used to collect household data and complement data generated through the qualitative methods. This survey collected data on changes in crops grown over a period of five years and reasons for these changes, indicators for good and bad crop production seasons and years considered to be good or bad over a ten year period. Questions in the survey also related to changes in weather patterns over a ten year period in relation to agriculture and what might have caused these changes. General household characteristics were also captured in this survey (see Appendix 1).

Data from the questionnaire survey were entered into the Statistical Package for the Social Sciences (SPSS) and analysed by running descriptive frequencies in relation to the distinct themes highlighted in this section. These themes include perceptions regarding changes in weather patterns in general and for specific seasons and regarding causes of these changes. These frequencies were disaggregated by district and country.

3. Results and discussion

3.1. Perceptions regarding changes in weather patterns

Data from the questionnaire survey indicate that above 70% of the farmers in all the four districts have been aware of significant changes in weather patterns over the past five years (see Fig. 2). Significant proportions of farmers in both countries indicated that they have observed variability in climate for all the parameters highlighted (see Fig. 3). The highest percentage of farmers who have experienced increased floods/excessive rains is from Monze (85%) and Sinazongwe (72%), with much lower percentages for this climate parameter for farmers in both districts in Zimbabwe. This is the case because Lupane and Lower Gweru farmers indicated that what they have witnessed are rather excessive rains and not floods per se. Above 58% of farmers in all districts have experienced droughts and a greater proportion of farmers in Monze and Sinazongwe reported to have observed dry spells than in Lupane and Lower Gweru. The percentage of farmers who have observed early rains is much lower in all the districts than for the other climate parameters.

For precipitation, as reported in historical trend lines, farmers in Monze indicated that the drought occurrences that they could recall which had a major impact on their livelihoods were those of the 1992/93 and the 1995/96 seasons. The same farmers also highlighted that they experienced major floods in the 2007/08 season, but in the 2002/03 season they received destructive excessive rains which they could not quite classify under floods. While farmers in Sinazongwe highlighted the same periods as drought periods, they also added that 2001/02 was a drought year for them and that they experienced floods in the same seasons as those highlighted by Monze farmers.

Also through historical trend lines, farmers in Lower Gweru and Lupane concurred that they experienced droughts in the 1992/93, 1994/95, and 2001/03 seasons. They also highlighted that though they have not experienced floods, they have experienced excessive rains which have impacted negatively on them in many ways (crop damage, human and livestock diseases and damage to infrastructure, among others). These farmers remembered the 1978/79, 1999/2000 and 2007/08 as the seasons in which they received excessive rains. This matches with available rainfall data, which show that the 1999/2000 season was a La Nina season (Stern, 2007). However, the percentage of farmers who witnessed excessive rains is significantly and understandably higher in Lower Gweru (43%) than Lupane (28%) (Fig. 3). It is understandable because of the fact that Lower Gweru is significantly wetter than Lupane.

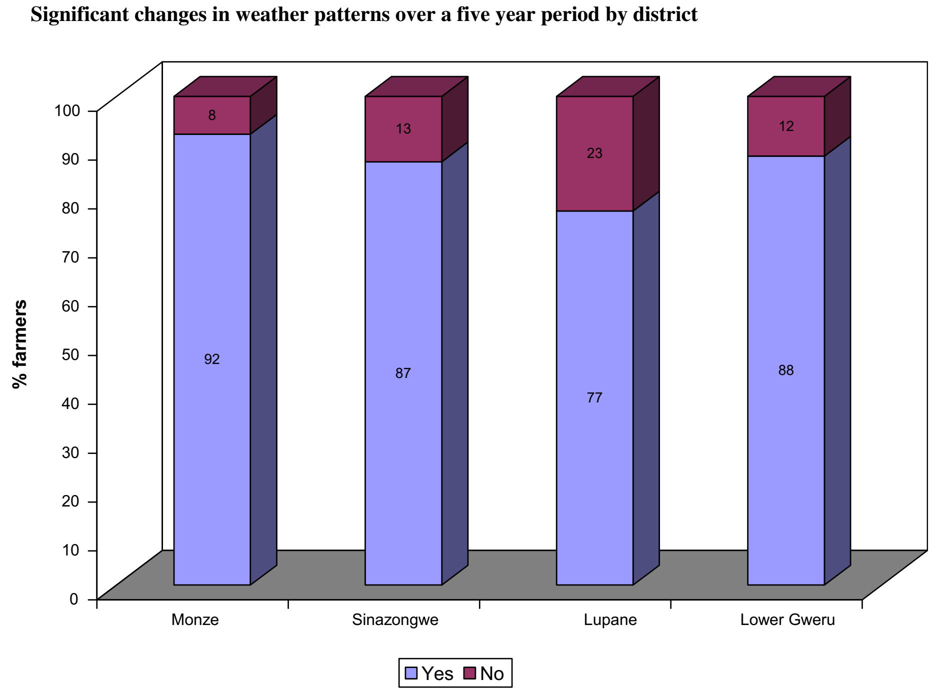

Fig. 2. Proportions of farmers who have been aware of weather changes over five years.

Farmers in Zimbabwe districts generally concurred that in the 1980s it was easy to predict the coming season and the seasons were distinct but now the rains have become more and more unpredictable beginning around 1995. Moreover, they also highlighted that now they are experiencing shorter rain seasons than before. Rains would start from October and stretch up to April but now rains are coming late around November and in most cases ending around February. Farmers in FGDs indicated that in the past, rain seasons started around 15 October but now it only starts raining around the first or second week of November. When the rains come early, like in the 2007/08 season, they normally fall heavily and cause damage to crops and people. The same

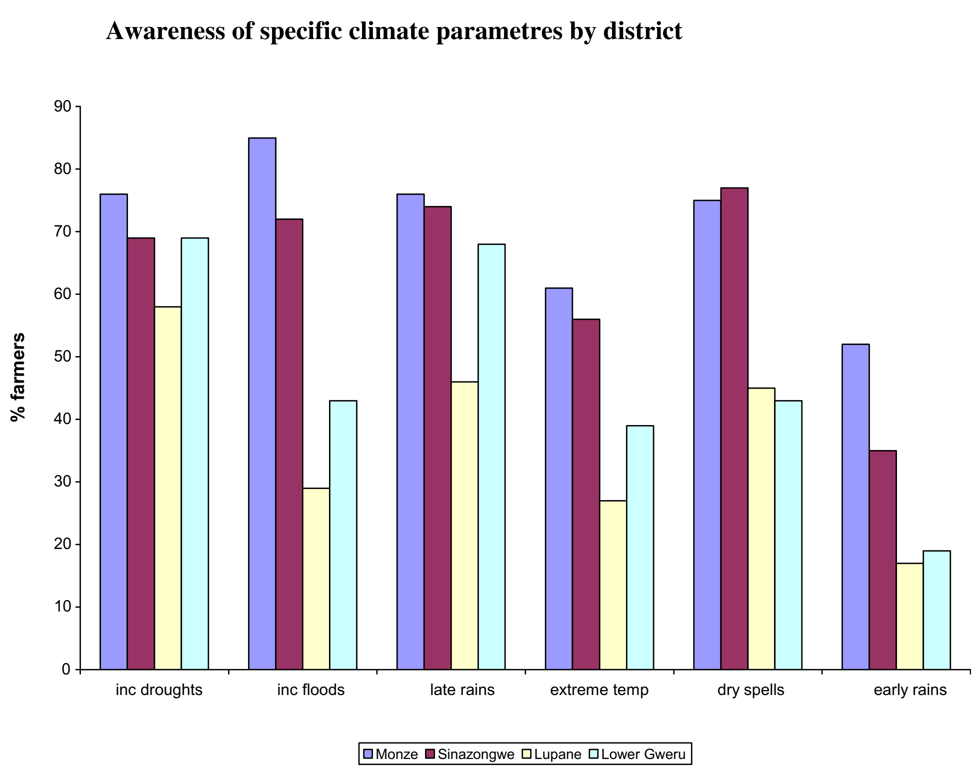

Fig. 3. Farmers' awareness of climate parameters in the sampled districts.

sentiments were given by farmers in Monze and Sinazongwe, that the rains have become more and more unpredictable than before. These farmers also said that they used to expect the first rains in October but now they have to wait for mid-November and sometimes December for the first rains to come. Farmers indicated that now there is a higher incidence of dry spells, which have also increased in intensity. However, in Monze and Sinazongwe, farmers cited the unpredictability of the rains as having started in the late 1980s. These farmers also indicated that they have started experiencing heavy rains and floods for the past two seasons. This is congruent with the finding that only small percentages of farmers in the household interviews attested to witnessing early rains (Fig. 3).

The foregoing picture of increasing climate variability in the four sampled districts is consistent with the somber picture detailed in literature on climate variability and change in Africa in general and Southern Africa in particular. There appears to be an increasing trend towards a late start to the rain season, prolonged mid-season droughts, and shorter growing seasons in Southern Africa (Cooper et al., 2007; Love et al., 2006; Twomlow et al., 2008; Waiswa, 2003). Moreover, variability in the annual rainfall total in the Southern Province in Zambia is more pronounced from the 1990s to date, where rainfall totals have frequently been seen below the 20 percentile and 80 percentile. The two lowest rainfall totals were also experienced from 1991 (Nanja, 2004 in ICRISAT, 2009). This is congruent with the observation that was made based on climate data for the Southern Province that all along, the major problem in the South is that there is often not enough rain and so the risks have been concerned mainly with drought.

With regards to temperature, farmers in Lupane and Lower Gweru highlighted that temperatures have become hotter than before. Specifically, they reported that for the past five years, while the duration of the summer season has remained consistent, that is between September and April/May, the highest temperatures have been witnessed for an extended period from October to December and sometimes January. This is unlike the situation before this period when they would experience the highest temperatures in September and October. In addition, farmers had also started experiencing warmer winters than before. These winters have in recent years been extended to mid-September, a factor which they associated with the unpredictability and the late onset of the rains. Similarly, in a study done across ten African countries, which include Zimbabwe and Zambia, farmers generally considered temperatures to have risen and precipitation to have decreased (Maddison, 2006). Farmers in Monze and Sinazongwe similarly reported that temperatures have become warmer than before.

More farmers in Monze and Sinazongwe than in Lupane and Lower Gweru indicated that they have witnessed changes in all the climate parameters highlighted in Fig. 3. This could be linked to the fact that there are significantly more farmers in Zambia districts than there are in Zimbabwe districts who have access to weather information (Fig. 4). This is based on the assumption that while farmers may already have a certain way of perceiving climate variability, access to weather forecasts enhances awareness of climate changes. Previous research has highlighted the critical role that access to weather information plays in shaping farmers' perceptions of climate variability and change (Deressa, 2009; Mano and Nhemachena, 2006). Those farmers with access to weather information could possibly be more inclined to notice changes in climate than those who have less access. For instance, at the time field work was conducted, farmers in Monze had weekly access to 'Radio Chikuni', which presents weather forecasts. Maddison (2006) shows that farmers with access to weather information and with more years of farming experience are more likely to be aware of changes in climate.

In the household survey, farmers in Lupane and Lower Gweru stressed that three consecutive seasons since 2004 were largely all bad seasons for them, while Monze and Sinazongwe farmers indicated that in the same period, these seasons were both good and bad (Fig. 5). It appears that farmers facing a lot of challenges may dedicate their attention to these challenges and be less likely to notice changes in climate. This finding is buttressed by the fact

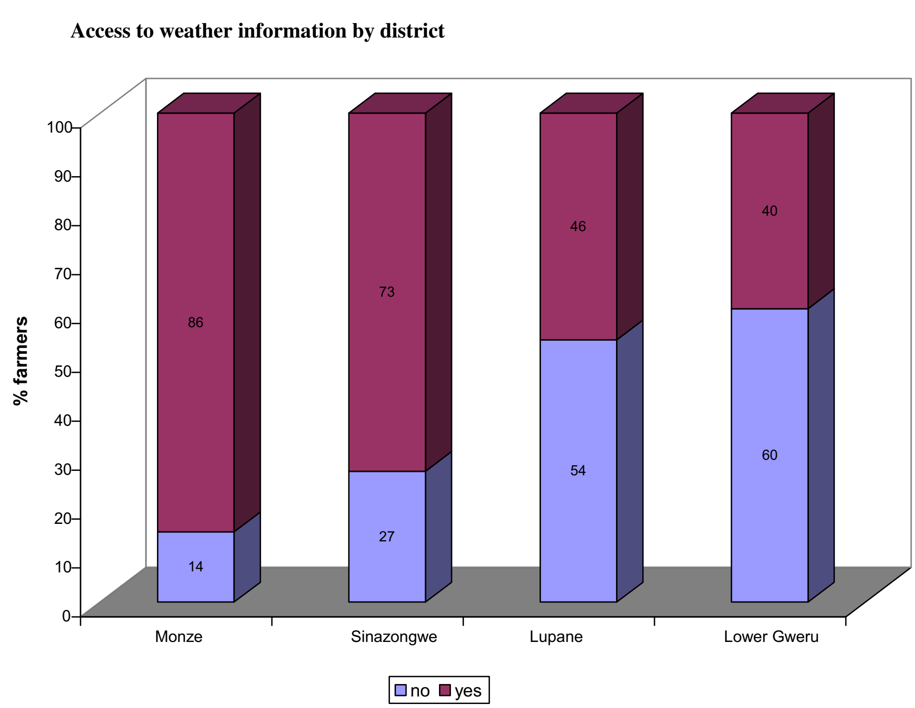

Fig. 4. Farmers' access to weather information in the study districts in Zimbabwe and Zambia.

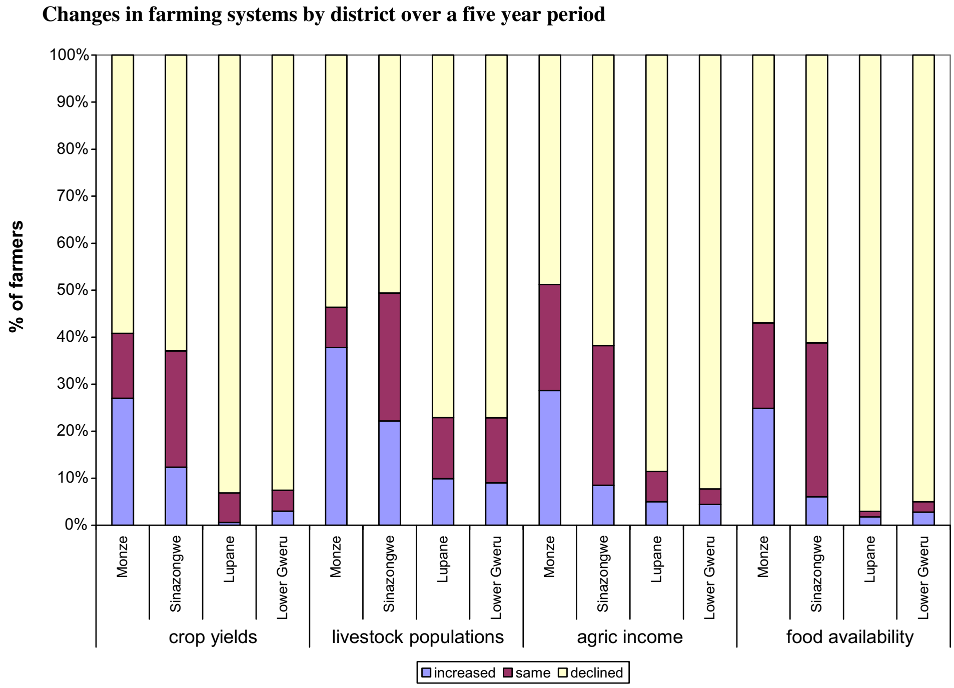

Fig. 5. Farming systems changes due to climate variability and change in the study areas by district.

that perceptions of danger and risk have been considered to be shaped by psychological, social, cultural and institutional processes (Lowe and Lorenzeni, 2006). There is an indication that perceptions of farmers were clouded by a higher incidence of multiple stressors that Zimbabwe was facing at the time (a detailed presentation of these stressors is given in section 3.3). A series of interlocking problems including hyper-inflation, perennial and acute food shortages, shortages of other basic commodities in the formal market and a critical shortage of farming inputs resulted in the ballooning of the proportion of the national population trapped in cycles of poverty and vulnerability in Zimbabwe (Gandure and Marongwe, 2006).

3.2. Perceptions regarding causes of changes and variability in climate

In the survey, the greater proportion of farmers in both countries perceived climate variability as purely a natural phenomenon, without any human intervention being responsible for this variability. This perception is more dominant in Sinazongwe and Monze than in Lupane and Lower Gweru (Table 1). These natural causes were cited as natural changes in winters, low/high temperatures and changes in wind movement, among others. In addition, there is an indication that farmers in both countries seriously disregard the role played by anthropogenic activities in the increase of climate variability and change. This fact is further reinforced by significant percentages of farmers in Lupane (45%) and Lower Gweru (27%), who assert that causes of climate change have also been due to factors such as the wrath of cultural spirits and God who have meted out punishment to Zimbabwe. The punishment has been for the failure of people to continue to appease their spirits and conduct traditional rites such as the rain making ceremony (*mukwerera*) for asking for rain from God and for showing gratitude for the rains in the previous season.

Table 1
Causes of climate variability and change by district.

Causes of climate variability and change	Monze %	Sinazongwe %	Lupane %	Lower Gweru %
Natural causes	34	35	24	31
Deforestation	33	17	5	14
Believe its god's will/nature, cultural beliefs	3	7	45	27
Does not know	30	41	26	28

Human induced causes of climate change, such as deforestation were highlighted, particularly by farmers in Monze (33%) and Sinazongwe (17%). Monze and Sinazongwe farmers who indicated that they are aware of causes of climate change dwell more on the scientific and technical issues such as natural causes than Lupane and Lower Gweru farmers who dwell more on cultural and spiritual issues. This finding speaks to the need for creating awareness for farmers in understanding the concept and causes of climate variability and change.

FGDs found that farmers in Lower Gweru and Lupane linked the political crisis in Zimbabwe at the time of the research and the decline of social and cultural practices to the variability in climate. Essentially, farmers do not only associate variability in climate with natural factors, but also with social and spiritual factors. The implication is that when there are political, social and economic problems in a country, farmers tend to link them to climate variability. In addition, the cultural context and spiritual world view play a critical role in shaping farmers' perceptions and attitudes, a factor which may cloud farmers' consciousness of the negative effects of human activities on the earth systems. Similarly, some farmers in Monze associated the beginning of climate variability with the descendancy of one of their presidents into power. The period of his leadership was marred with controversy and linked to economic problems in Zambia at this time. What is emerging is the idea that we cannot disassociate climate variability from the political, social (including the cultural and spiritual realms) and economic context. Farmers try to make sense of what is happening in their environment based on the socio-cultural framework in which they operate.

3.3. Multiple stressors at household and community levels

This section discusses farmer perceptions of a host of other stressors that compound climate variability impacts. These perceptions were gathered through FGDs. The section further displays how farmers view climate variability among other disturbances through a matrix scoring and ranking exercise.

3.3.1. Perceptions regarding other stressors and climate change among farmers

There is a general similarity in the stressors that were identified by farmers in all the four districts (Table 2). These include constraints for increasing agricultural production, such as lack of capital to purchase agricultural inputs, implements and chemicals for crops and livestock. In addition, farmers in these districts indicated that inadequate draught power also inhibits their capacity to maximise on crop yields. Loss of cattle due to disease and drought has led to limited draught power, which has reduced their ability to prepare larger pieces of land and on time. Furthermore, farmers in all districts are faced with a lack of appropriate seed varieties and improved seed and shortage of water for domestic use. Farmers highlighted the high incidence of HIV and AIDS and weakened government capacity in both Zimbabwe and Zambia districts in terms of provision of basic services to farmers. Such basic services include non-functional dip-tanks and boreholes due to lack of maintenance. This would reflect the expectation that for substantial change to occur in the agricultural sector, it would need to be at least partially subsidised by the public sector (Wehbe, 2006).

Problems unique to Monze and Sinazongwe include low pricing for both crops and livestock. In addition, the type of cattle breed in the areas is too small for them to realise higher prices. The diminishing of credit facilities from government in Monze since 1999 and the little inputs accruing from this facility were unevenly distributed. Unique challenges are more diverse in Zimbabwe than in Zambia. Farmers in Lower Gweru and Lupane have to contend with the unavailability of inputs on the market and late supply of the same inputs. These inputs are now coming from government and farmers only get them on the basis of political affiliation. Limited maintenance of roads and bridges in Lupane and Lower Gweru leads to farmers in Lower Gweru losing most of their gardening produce, which goes bad when they are in the process of finding transport to the market and hyper-inflation reduces the value of their money fast. As a result, these farmers have had to contend with a drastic reduction in income and food availability more than farmers in Monze and Sinazongwe (see Fig. 6).

Most stressors directly relate to specific economies and farmers' livelihood strategies. For instance, stressors highlighted by farmers in Sinazongwe and Lupane are related to livestock issues such as shortages of veterinary chemicals and the prevalence in Lupane of a plant that kills cattle (*mkhawuzane*). This underscores the importance of livestock in the economy of these districts. In Monze, farmers identified diminished dipping facilities. The economies of these districts are livestock based and Monze also falls within the Southern Province of Zambia, which has the largest livestock population in the country.

The background in the preceding paragraphs in this section supports the concept of 'double exposure', which refers to the fact that regions, sectors, ecosystems and social groups will be confronted both by the impacts of climate change and other factors that are not climate-related (O'Brien and Leichenko, 2000). While there is a multiplicity of stressors that bedevil smallholder farmers in all the four districts, climate variability in its different forms such as erratic rains, frost, droughts and floods are the most critical given that it was ranked first by farmers in all the sampled districts (see Tables 3–6). Data in Tables 3–6 is from the matrix scoring and ranking exercise conducted during a workshop and shows points allocated by participants to each stressor under a specific criterion. There was consensus from farmers' reports to the effect that while there are a multiplicity of challenges that they have to contend with, farmers still find that most of these challenges emanate from the recent variability of climate. This is consistent with findings from a study done by Thomas et al. (2007), that while climate does not operate in isolation from other factors, it does play a significant role in how people attempt to shape their livelihoods for the future. Farmers suggested that constraints such as lack of capital to buy food and agricultural inputs, shortage of draught power, imposed and low livestock prices and pests and diseases for crops and livestock, among others, are linked to climate variability. For Lupane and Lower Gweru, this finding is consistent with the assertion by the IMF

Table 2
Multiple stressors by District.

Monze	Sinazongwe	Lower Gweru	Lupane
Lack of financial capital to purchase agricultural inputs	Imposed low livestock prices by buyers	Late supply of inputs	Lack of chicken feed
Erratic rainfall	Lack of improved cattle breeds	Lack of capital to buy inputs and farming implements	Lack of a bridge for the major river
Inadequate draught power due to a high frequency of livestock diseases	Low market price for vegetables	Inappropriate seed being supplied	Unavailability of inputs
Dams quickly dry up- there are no running rivers in the area	Streams and boreholes dry up early	Lack of transport to market produce	Lack of capital
Few dams for livestock watering	Pests and diseases in crops (vegetables)	Climate variability (Erratic rains, frost, drought)	Inadequate farming implements
Non- functional dip tanks	Floods and droughts	Inadequate draught power	Low soil fertility
Limited knowledge with regards to farming	Lack of money to meet charges for vet services	Unavailability of chemicals for crops	Limited knowledge on farming
Low selling prices of crops and livestock	Lack of improved seed varieties	HIV and AIDS	There are few mills and are far away
HIV and AIDS	Limited draught power and farming implements	Crops destroyed by livestock	Climate variability (low/excessive rains)
Limited access to credit facilities	Shortage of livestock drugs	Bad roads	Lack of pesticides/chemicals
Untimeliness of weather forecast information	Human diseases e.g. malaria, diarrhoea and HIV/AIDS	Lack of irrigation equipment	Inadequate draught power
Reduced access to information on weather forecasting		Unavailability of drugs in clinics	Shortage of water for domestic use
		Unavailability of water for domestic purposes (Non-functional boreholes)	Diminishing veterinary services

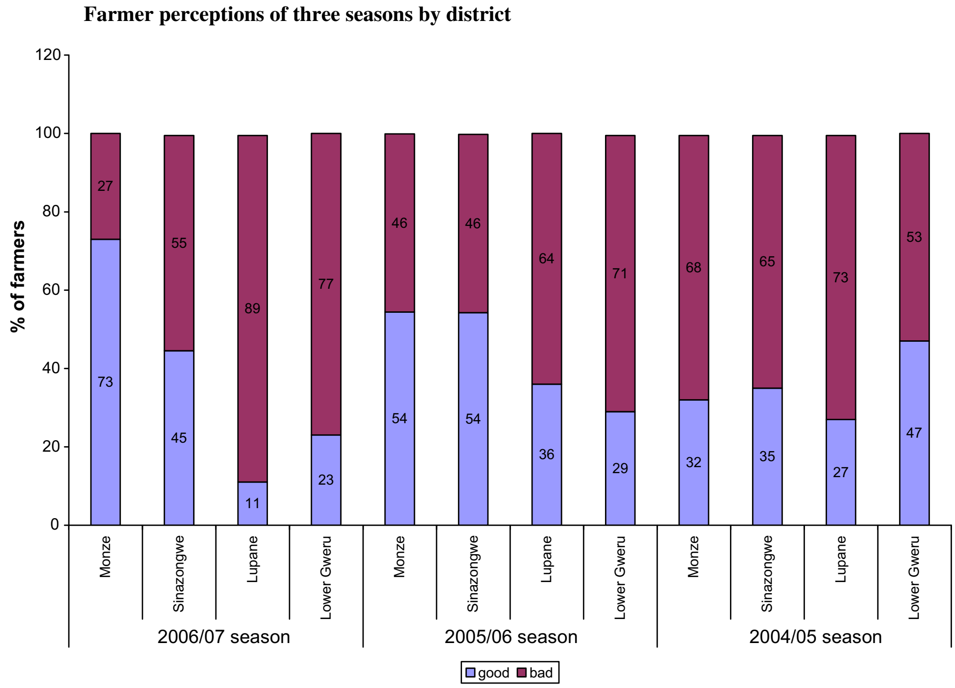

Fig. 6. Perceptions of changes in weather for specific seasons between 2004 and 2007.

Table 3
Consideration of climate change with regards to other stressors in Monze.

Stressor	Food insecurity	Loss of income	Insecure livelihoods	Total	Rank
Erratic rainfall	20	10	18	48	1
Lack of capital	10	20	15	45	2
Drying up of water sources	12	14	13	39	3
Few dams	10	15	8	33	4
Shortage of draught power	15	10	7	32	5
Lack of knowledge	9	12	10	31	6
Non- functional dip tanks	6	4	10	20	7

Table 4
Consideration of climate change with regards to other stressors in 484 Sinazongwe.

Stressor	Loss of income	Food insecurity	Total	Rank
Floods and droughts	20	20	40	1
Imposed livestock prices	15	17	32	2
Lack of improved cattle breeds	20	10	30	3
Not able to meet charges for vet services	17	8	25	4
Pests and diseases for vegetables	15	6	21	5
Streams drying up early	10	5	15	6
Low market price for vegetable	5	5	10	7

Table 5
Consideration of climate change with regards to other stressors in Lower Gweru.

Stressor	Loss of crop yield	Loss of income	Insecure livelihood	Total	Rank
Climate variability (Erratic rains, frost, drought)	18	16	16	50	1
Shortage of drugs in clinics	16	16	16	48	2
Late supply of inputs	14	16	14	44	3
Lack of transport to market produce and bad roads	10	18	12	40	4
HIV and AIDS	10	10	14	34	5
Lack of draught power	12	10	6	28	6

Table 6
Consideration of climate change with regards to other stressors in Lupane.

Constraints	Food security	Income generation	Total	Rank
Climate variability	20	20	40	1
Unavailability of inputs	15	10	25	2
Lack of farm implements	10	11	21	3
Lack of livestock chemicals	10	10	20	4
Low soil fertility	5	5	10	5

(2003) that the more recent difficulties with governance, mismanagement and inflation in Zimbabwe, for example, were not anywhere near as problematic at the time of the drought in 1992/3.

4. Conclusions

While farmers report changes in local climatic conditions consistent with climate variability, there is a problem in that these farmers may be assigning observed negative impacts on the agricultural and socio-economic system solely to climate variability. While farmers are able to recognize variability in climate and to explain low agricultural performance and low well-being in terms of climate variability, when there are political, social and economic problems in a country, farmers may not be able to disentangle contribution of each factor to observed outcomes. In addition, with wider and a complexity of challenges to deal with, farmers may be less inclined to notice changes in climate parameters. Socio-cultural and spiritual factors dominate farmers' views on why climate is highly variable. The fact that farmers link the causes of climate variability more to their socio-cultural realms than to human activities may be a cause for concern for environmental management issues as farmers may fail to realize the importance of environmental management activities. The dynamics of the differences in perceptions are therefore important to understand as this study found that local conditions determine the extent to which farmers perceive variability in climate. In this regard, there is need to acknowledge the inherent capabilities of small holder farmers and to strengthen their capacity and that of institutions for identifying and assessing climate variability. This can be done through programmes to educate these farmers and other relevant stakeholders on climate change and variability and their potential impacts on farmers' livelihoods. This study further concludes that while there is a multiplicity of stressors that confront farmers, climate variability remains the most critical for these farmers.

Acknowledgements

The authors are grateful for funding from IDRC and DFID through Climate Change Adaptation in Africa (CCAA) and also for additional funding from START and CODESRIA. The authors also thank the following who contributed as collaborators and researchers in the field work: researchers from Zambia Agricultural Research Institute (ZARI), Zambia Agro-Met and researchers and students from Midlands State University (MSU), Zimbabwe and ICRISAT, Zimbabwe.

Appendix. Supplementary material

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.jenvman.2012.02.005.

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