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Building resilience against hunger and climate change in smallholder farming communities through transformative engagement

Masters in Transformative Community Development

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Title of Research Paper: **Adaptive capacity of cattle farmers to climate change in Bolero Extension Planning Area - Malawi**

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30 June 2015

Adaptive capacity of cattle farmers to climate change in Bolero extension planning area Malawi

Abstract

This study was conducted in Bolero Extension planning Area in Rumphi district of Malawi during 2014/2015 season to assess adaptive capacity of cattle farmers to climate change. Specifically, to (1) characterize pasture and water availability for cattle in Bolero, (2) assess how cattle farmers respond to drying up of pastures in Bolero, and (3) assess how cattle farmers respond to drying up of water bodies in Bolero.

There had been evident reports that there is rapid drying up of pastures and drying of water bodies due to decreased rainfall. Land holding for cattle grazing is also diminishing in Bolero due to expansion of crop cultivation and human population growth. The research asks: What is the adaptive capacity of cattle keepers to climate change in Bolero?

The study purposively sampled 128 cattle keepers in different strata for individual interview out of 321 total cattle farm household population, giving a sample size of 40 %. Bolero has got 12 agricultural sections with 2,726 cattle. The samples were proportionally allocated in relation to population size of cattle farmers in all the 12 sections. Data was collected through survey questionnaire, focus group discussion and consultation with key informants. Collected data was analyzed using Statistical Package for Social Sciences for frequency distributions.

The study results indicate that cattle production is being impacted by rainfall variability through small grazing land, limited water points with increased distances to fetch water and pastures during dry season.

On coping mechanisms the study has established that majority of cattle keepers said they practice mobility, fetching for pasture and water during scarcity; livelihood diversification by growing crops such as Tobacco and selling surplus food crops and keeping other types of livestock such as goats, pigs and chickens. There is also cooperation within Bolero CoP and they share resources such as communal grazing land and feeding cattle on crop residues communally without restriction to owner’s crop field.

Adaptive capacity of cattle farmers to climate change in Bolero extension planning area Malawi

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MZUNI - Malawi

1.0 INTRODUCTION

The Livestock industry in Malawi contributes about 8% to the total Gross Domestic Product (GDP) and about 36% the value of total agricultural products**.** Livestock provides food, income, manure, animal traction and social security. Taking of all these into consideration, livestock may contribute up to more than 11% of the GDP (Ministry of Agriculture, 2006).

Despite the importance of livestock, Climate change greatly impact cattle production through decreasing fodder, low milk production, reduced animal weight gain affecting meat quantity, decrease in reproduction rate affecting cattle population, increase in the prevalence of vector-borne diseases, and an increase in prevalence of internal parasite infection (Rust and Rust, 2013). Changes in hydrological cycle, temperature balance and rainfall patterns have negative effects on cattle productivity through reduction of water and pasture (Mwiturubani, 2010). Hence there is need for cattle farmers to have adaptive capacity to cope up with effects of the climate variability.

Adaptive capacity is the ability or potential of a system to respond successfully to climate variability and change, and includes adjustments in both behaviour and in resources and technologies (IPCC, 2007). The IPCC TAR (2001) introduced the concept of adaptive capacity into the mainstream of climate change research, and defines adaptive capacity as one of the determinants of vulnerability. According to the IPCC (2007); Adger et al (2003, 2004)) vulnerability to climate change depends on adaptive capacity, sensitivity, and exposure to changing climatic patterns.

Elements of cattle management which predispose or render vulnerability to climate change are feeding systems whether cattle are zero grazed or extensive grazing which determines the distance covered by the cattle farmers moving with their cattle fetching for pastures and water. The impact of climate change on pastures and water (rainfall) causes vulnerability through dwindling pasture development, early drying up of water bodies if there is low rainfall or flooding if too much water (rainfall).

Figure 1.1 defines the conceptual framework on causes of vulnerability and adaptive capacity of cattle farmers who depend on cattle farming for their livelihood.

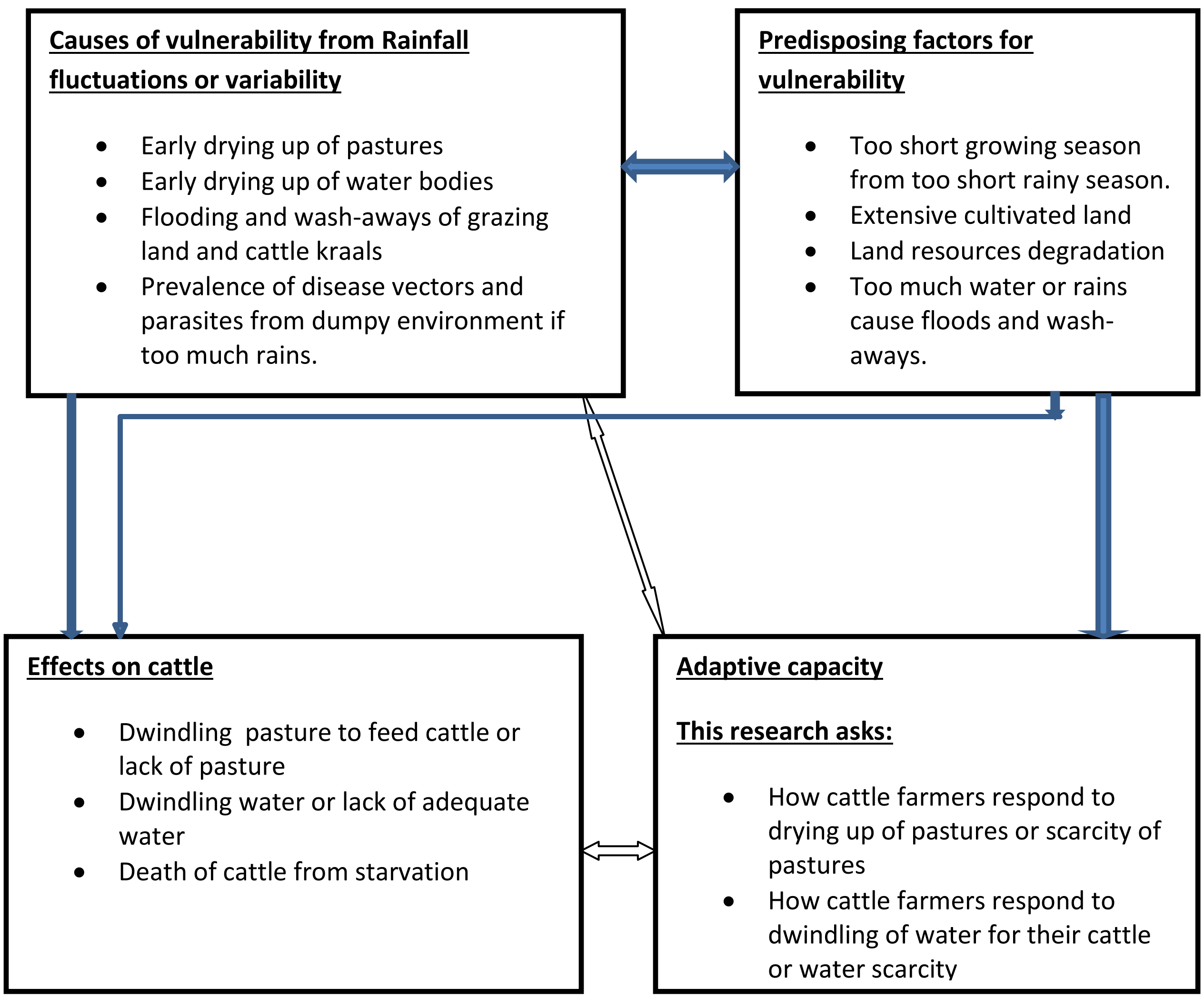

Figure 1.1 Conceptual framework on vulnerability and adaptive capacity of cattle farmers who depend on cattle farming for their livelihood.

1. 2 PROBLEM STATEMENT

Surveys have shown that 1,323 ha of Bolero area is cultivated for Tobacco and 4,392 ha for Maize beside other land uses while there is cattle population of 3,892 (Rumphi District Agricultural Office, 2013) which requires a total of 2,724 grazing land. Studies have also shown that in Northern Malawi the land carrying capacity for cattle is 1.4 cattle /ha which translates into 0.7 ha per cattle (Reynolds, 2006). However, from 2.7 hectares average land holding capacity per family in Bolero leaves only 0.4 ha per family after all other land use excluding cattle grazing have been allocated. This implies that there is not enough grazing area for cattle in Bolero which is compounded by scarcity of pastures and water for cattle during dry season (Figure 1.2). We do not know how cattle farmers respond to water and pasture scarcity in Bolero. This study assessed cattle farmers' coping mechanism by examining how they transformed their means to continue with their livelihoods.

Figure 1.2 Dried-up river with dug-out well in Bolero during dry season (captured on 7 November, 2013 during the onset of the MTCD programme)

1.3 RESEARCH QUESTION AND SPECIFIC OBJECTIVES

1.3.1 RESEARCH QUESTION

What is the adaptive capacity of cattle famers to dwindling pastures and water resources for cattle in Bolero?

1.3.2 SPECIFIC OBJECTIVES

1) To characterize pasture and water availability for cattle in Bolero
2) To assess how cattle farmers respond to drying up of pastures in Bolero.
3) To assess how cattle farmers respond to drying up of water bodies in Bolero.

1.4 JUSTIFICATION OF THE STUDY

The study was aimed at demonstrating an understanding of the conditions necessary for the transformative change in Bolero. It is expected that Bolero community, who are vulnerable to climate change, will be transformed by building adaptive capacities locally with coping mechanisms of cattle farmers from climate variability impacts on pastures and water scarcity.

The Community of Practice (COP) shall then benefit through high productivity from cattle keeping in form of products such as meat, milk, manure, hides and skins, and traction. Cow dung manure will improve crop production which together with meat and milk will lead to food security in the area, nutrition improvement through diversified intake of agricultural products and improvement in income levels from sales of farm produce. Researcher as change agent, extension agent and representative of government policy makers, after sharing knowledge with the community, will establish gaps that need to be concentrated on for improvement. All these were geared to meet the scope, the goal and Outputs/Outcomes of TEN-Hunger Project for transformation of Bolero Community of Practice.

2.0 LITERATURE REVIEW

Climate change impacts influence quantity and quality of pastures, fodder crops and grains, water availability, severity and distribution of diseases and parasites (McCarthy, 2001). Pastures shortage and water scarcity in drought areas resulting from extreme weather conditions and major anthropogenic factors have been reported (IPCC 2001). Changes in climate and extreme weather events have received increased attention in the recent years and according to the 4th Intergovernmental Panel on Climate Change (IPCC) assessment report, there is already evidence that Africa is warming faster than the global average, and this is likely to continue (IPCC 2007). The same observation has been reported by WFP (2009, 2011) who noted that rural communities in developing countries especially women, children and marginal communities are at greatest risk to suffer from potential impacts of climate change due to high exposure to natural hazards, their direct dependence on climate sensitive resources such as plants, animals, water and land, and their limited capacity to adapt to and cope with climate change. The Intergovernmental Panel on Climate Change (IPCC, 2007) has reported that climate change is real and that the poorest regions and small scale famers will be the worst affected. Studies have also shown that Sub-Saharan Africa is particularly vulnerable to climate change (Carpenter and Brock, 2008, McCarthy, 2001; Ringler et al, 2011).

Urama and Ozor (2010) reported that Climate change is having a multitude of immediate and long-term impacts on water resources in African countries. These include flooding, drought, sea-level rise in estuaries, drying up of rivers, poor water quality in surface and groundwater systems, precipitation and water vapour pattern distortions. These effects when compounded together have devastating impacts on ecosystems and communities, ranging from economic and social impacts to health and food insecurity, all of which threaten the continued existence of many regions in Africa. Vulnerability varies according to individual countries, geographical positioning and the capacity to mitigate or adapt to the changes.

Many of the world's rangelands are in semi-arid areas and susceptible to water deficits; any further decline in water resources will greatly impact carrying capacity. As a result, increased climate variability and droughts may lead to livestock loss. Specifically, the impact on animal productivity due to increased variability in weather patterns is likely to be far greater than effects associated with changes in average climatic conditions. The most frequent catastrophic losses arising from a lack of prior conditioning to weather events occur in confined cattle feedlots, with economic losses from reduced cattle performance exceeding those associated with cattle death losses by several-fold (IPCC, 2014 WGII 5.4.3.1]

Climate change will affect the water resources available for livestock via impacts on runoff and groundwater (IPCC, 2014 WG II AR5 Chapter 3). Populated river basins may experience changes in river discharge, and large human and livestock populations may experience water stress such that proactive or reactive management interventions will almost certainly be required (Palmer *et al.*, 2008). Problems of water supply for increasing livestock populations will be exacerbated by climate change in many places in sub-Saharan Africa and South Asia.

IPCC (WG II AR5 Chap 22, 2014) reported that Livestock systems in Africa face multiple stressors that can interact with climate change and variability to amplify the vulnerability of livestock-keeping communities. These stressors include rangeland degradation, increased variability in access to water, fragmentation of grazing areas, sedentarization, changes in land tenure from communal towards private ownership, in-migration of non-pastoralists into grazing areas, lack of opportunities to diversify livelihoods, conflict and political crisis, weak social safety nets, and insecure access to land, markets, and other resources (Solomon *et al.*, 2007; Smucker and Wisner, 2008; Thornton *et al.*, 2009; Dougill *et al.*, 2010; Speranza, 2010; also IPCC WGII AR 5 Chapter 7.3.2.4.). Loss of livestock under prolonged drought conditions is a critical risk given the extensive rangeland in Africa that is prone to drought. Regions that are projected to become drier with climate change, such as Northern and Southern Africa, are of particular concern (Masike and Urich, 2008; Thornton *et al.*, 2009; Dougill *et al.*, 2010). Adequate provision of water for livestock production could become more difficult under climate change. For example, Masike and Urich (2009) estimated that the cost of supplying livestock water from boreholes in Botswana will increase by 23% by 2050 under an A2 scenario due to increased hours of groundwater pumping needed to meet livestock water demands under warmer and drier conditions. Although small in comparison to the water needed for feed production, drinking water provision for livestock is critical, and can have a strong impact on overall resource use efficiency in warm environments (Peden *et al.*, 2009; van Breugel *et al.*, 2010;

Descheemaeker *et al.*, 2010). Livestock production will be indirectly affected by water scarcity through its impact on crop production and subsequently the availability of crop residues for livestock feeding. Thornton et al. (2010) estimated that maize stover availability per head of cattle will decrease in several East African countries by 2050. The extent to which increased heat stress associated with climate change will affect livestock productivity has not been well established, particularly in the tropics and sub-tropics (Thornton *et al.*, 2009), although a few studies point to the possibility that keeping heat-tolerant livestock will become more prevalent in response to warming trends. For example, higher temperatures in lowland areas of Africa could result in reduced stocking of dairy cows in favor of cattle (Kabubo-Mariara, 2008 & 2009), a shift from cattle to sheep and goats (Kabubo-Mariara, 2008 & 2009; Seo and Mendelsohn, 2008), and decreasing reliance on poultry (Seo and Mendelsohn, 2008). Livestock keeping in highland areas of East Africa, which is currently cold-limited, would potentially benefit from increased temperatures (Thornton *et al.*, 2010). Lunde and Lindtjørn (2013) challenge a finding in the AR4 that there is direct proportionality between range-fed livestock numbers and changes in annual precipitation in Africa. Their analysis indicates that this relationship may hold in dry environments but not in humid ones.

Southern Africa is experiencing change due to natural variability in rainfall and to changes in the type and intensity of land use (Dube and Pickup 2001). Recent studies indicate that Malawi is also experiencing seasonal and inter-annual variability in rainfall pattern. Records have shown that some years' mean rainfall amount reduced from 626.6 mm during 1983-1992 decade to 586.0 mm during 1993-2002 decade in Bolero then rose again to 670.5 mm during 2003-2012 decade (Chavula, 2014). These fluctuations have greatly impacted on pasture and water availability for cattle in Bolero. Ruviri River which is the most reliable water source for cattle in the area used to be perennial but is now drying up during some dry seasons. Under such conditions, in pastoral livelihood, literature indicates that cattle farmers' adaptive capacity is severely constrained. For example, Tembo (2013) argued that herders facing enclosure negotiate routes to water sources.

The study by Nyariki et al. (2009) on Land-Use change and livestock production challenges in an integrated system in the Masai-Mara Ecosystems in Kenya, observed that patterns of land-use have principally changed from nomadic pastoralism to sedentary pastoralism, agro-pastoralism, and pure cultivation. These trends adversely affected livestock production and the productive capacity of the Mara ecosystem. Water availability is one of the factors which affect cattle keeping. Rainfall affects the seasonality of water sources and quantities available from these sources (Nyariki et al, 2009).

A Study conducted in Zimbabwe observed that cattle were turned out into the harvested fields to feed on crop residues from May to July. From August to October, there was mobility of cattle farmers to some distance to look for fresh forage in wetlands and were digging wells for cattle watering in some dry-up streams (Madzudzo and Hawkes, 1996).

Delgado (1999) reported that in developing countries transformation of magnitudes of Livestock Revolutions are putting unprecedented stress on the resources used in livestock production. However, farmers can raise many more animals per unit of land by using capital-intensive mechanization that reduces labor requirements, by increasing per animal feed use and feed quality among others (Delgado et al, 1999). However, personally, I can argue that capital-intensive mechanization for cattle keeping at small holder level is not common practice in Malawi as a whole and Bolero in particular, hence the practice may require some sensitization and knowledge sharing with cattle farmers.

Vulnerability to climate change depends on its adaptive capacity, sensitivity, and exposure to changing climatic patterns (IPCC, 2007). While local communities have developed many varied ways of coping with perennial droughts, very few studies have systematically recorded its implication on livestock production. Research on adaptive capacity related to climate change is needed in order to empower livestock farmers deal with climate change issues beyond what they have experienced previously (Assan, 2014).

This study will look into the adaptive capacity of cattle farmers to climate change in the cattle feeding system on pastures and water in Bolero. From the profiling exercise conducted by TEN students of MZUNI at Bolero (2014) on the part of decision making and control of resources, the results showed that rangeland is seen as under the control of local tribal leaders, but cropland can be individually appropriated. Studies have shown how farmers are coping with climate change challenges. Intensification of crop production where inputs are available reduces competition for land between crops and livestock because there is high crop productivity from minimal hectares which reduces land pressure (Thomas and Barton, 1995). Intercropping forage legumes with cereals has been tested in Sudan (Bunderson et al., 1986), where it was concluded that research should concentrate on legumes with potential for both grain and forage production. The integration of legumes, fodder and cereals assists in diversity of livestock feed within a small unit of land which leads to high productivity from cattle keeping on a limited land resource.

Studies conducted on the Agro-pastoralists adaptive capacities and their importance in wider community in Uganda and Kenya isolated five key areas in which some of their practices signal a degree of adaptive capacity, thus: knowledge, mobility, cooperation and sharing, culling the herd and diversification (Adano et al, 2012; Benjaminsen et al, 2009; Butler and Gates, 2012).

Adano (2012) reported that the availability of common-pool resources leads to periodic conflicts. The study took place across border areas in the Kenya's dry lands. Benjaminsen and Boubacar (2009) studied the farmer-herder conflicts in the Inland Niger delta of Mali and same year Benjaminsen et al (2009) conducted a study on Political ecology of farmer-herder conflict in Tanzania. Butler and Gates (2012) analyzed the possible effects of climate change on pastoral conflicts over resources.

However, no studies on adaptive capacity of cattle farmers to climate change have been reported in Bolero which has created a gap leading to carrying out the current study to assess how cattle farmers respond to drying up of pastures and water bodies.

3.0 METHODOLOGY

3.1 LOCATION

The study took place in Bolero Community of Practice (COP) located in Bolero Extension Planning Area (EPA) in Rumphi District in the Mzuzu Agricultural Development Division (ADD), northern region of Malawi. Agriculturally, Malawi as a country has 8 ADDs.

The study was carried between November 2014 and March 2015. Bolero has 12 agricultural sections (Figure 3.1) with a population of 58,550 and an average of 5 persons per household.

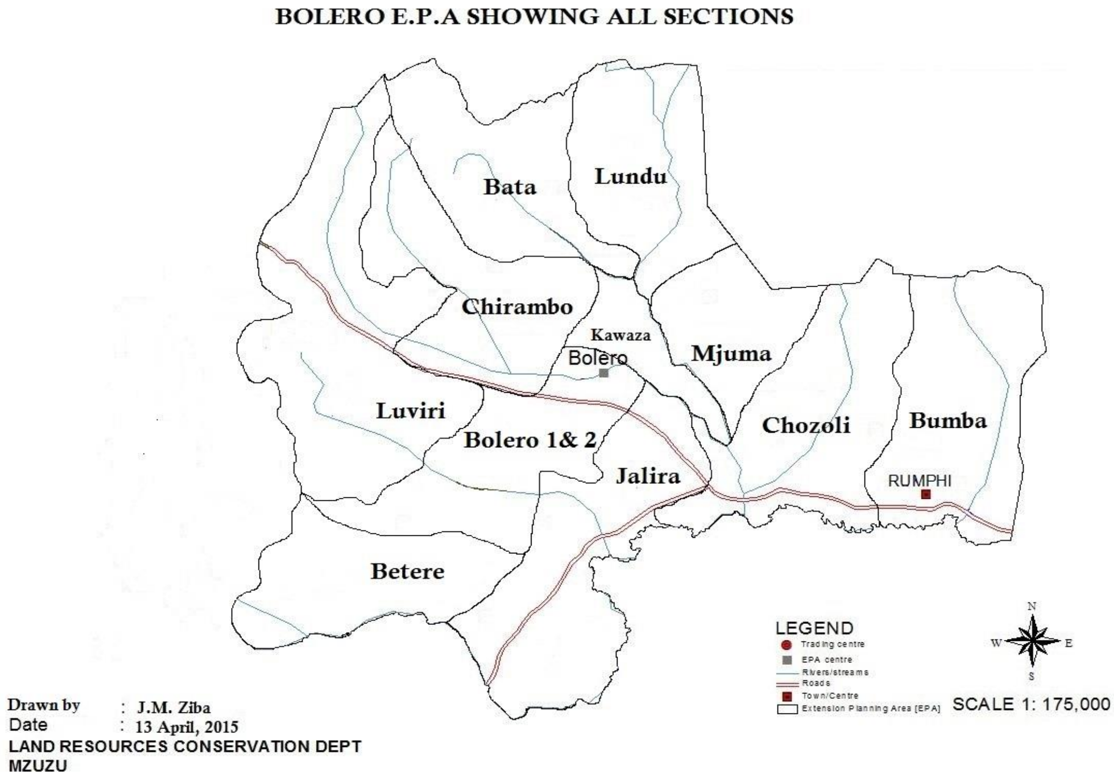

Figure 3.1 Map of Bolero EPA.

There are 112 villages with 11,710 farm households (Rumphi FISP data 2013). Bolero Extension Planning Area is also demarcated into 3 Area Development Committees (ADCs) according to ecological zones for easy management of their development programmes. The 3 ADCs are Bumba, Kanyerere /Chozoli and Bolero. The ADCs are further demarcated into total of 31 Village Development Committees (VDC) to decentralize the development activities at Group Village Headman level.

3.2 SAMPLING DESIGN

The study carried out stratified purposive sampling and targeted only cattle farmers. Respondents were sampled proportionally from all the 12 sections. Building stratification into a sample design is recommended because it increases precision for very little additional cost

(Buckingham and Saunders, 2004; Creswell, 2003; Gilbert, 2008; Kothari, 2004; Seale, 2012; Silverman, 2011 and Stark and Roberts, 2002).

3.3 SAMPLING FRAME

The study targeted 40% of total cattle farm households in the Bolero. Samples from different strata (sections) were proportionally allocated in relation to the population sizes of the section. Since an overall sampling fraction was calculated at 40 %, sample of each section was based on its size, stratum relative to the size of the population. This is sampling based on probability proportional to size (Stark and Roberts, 2002). Only 128 cattle keepers were sampled for individual interview out of 321 total cattle farm households population giving a sample size of 40 % so that the study yields results with a low standard error of less than 5 % in the qualitative study (de Paul, 2000; Gilbert, 2008). Table 3.1 narrates the sampling frame with whole cattle farm household population and cattle farm household sample.

Table 3.1 Sampling frame of the 12 agricultural sections within Bolero EPA

S/no	Section	Section cattle population	Cattle farm house hold population	Cattle farm house hold sample
1	Bata	158	13	6
2	Betere	77	8	4
3	Bolero A	422	29	15
4	Bolero B	150	26	11
5	Bumba	121	11	7
6	Chirambo	194	33	17
7	Chozoli	307	30	8
8	Jalira	108	34	9
9	Kawaza	221	24	10
10	Lundu	552	61	24
11	Luviri	87	7	5
12	Mjuma	329	45	12
Totals		**2726**	**321**	**128**

3.4 RESEARCH METHODS AND DATA COLLECTION

This study used only Individual Interviews and focus groups to collect data. It is among the methods recommended by Buckingham and Saunders (2004), Gilbert (2008) and Silverman (2011).

3.4.1 Interviews and focus groups

3.4.2.1 Individual Interview

Individual interview involved administering questionnaires face-to-face (Figure 3.2) with the cattle keepers at their cattle farm yards in Kanyerere VDC, Mjuma section.

Figure 3.2 Wellings, researcher probing as the cattle keeper explains a point during individual interview in Bolero on 19 February, 2015

The Questionnaire semi-structured with questions that were pre-coded, answers were coded on the spot by ticking or circling one of a series of answers that were already listed on the questionnaire. With open-ended questions all the responses were just noted down and the answers were coded later, thus categorizing qualitative answers to open questions as recommended by Buckingham and Saunders (2004) and Seale (2012).

There were 128 questionnaires that were administered and each questionnaire had 5 components: 1) Basic Information to capture data on the respondent's name, location and ID; 2) Household socio-demographic characteristics; 3-5) thematic areas with variables such as pastures availability and scarcity and water availability and scarcity according to specific objectives.

3.4.2.2 Focus Group Discussion

Focus group, sometimes referred to as 'group interview '(Silverman, 2011) was conducted at a later date after Individual interviews (a 'longitudinal' design) to clarify and qualify findings produced by individual interview method as recommended by Silverman (2011). The study conducted 2 focus groups discussions. The focus groups were from 2 ADCs, Bolero and Kanyerere/ Chozoli, out of the 3 ADCs, in order to have a wider representation of the area. Participants for the focus group discussion were purposefully sampled from within the targeted population of cattle keepers so that the group is homogenous (Gilbert, 2008 and Krueger, 2002). Bolero focus group had 12 participants who were splitted into sub-groups of 7 and 5 each for effective discussions. Kanyerere / Chozoli focus group had 7 participants who were also splitted into 2 sub-groups of 4 and 3 members each. Each focus group session lasted an average of 1½ hours as recommended by Seale (2012). Silverman (2011) reported that the size of focus groups varies from around 4 to 12 participants and most focus groups last for 1 to 2 hours.

The focus group discussion concentrated on 3 main issues: 1) Existence of climate change according to the participants experience; 2) Climate variability impact on cattle farming through pastures and water, and 3) The coping mechanisms of cattle farmers from climate variability impacts, focusing on pastures and water.

3.5 DATA ANALYSIS

Data analysis was dependent on variables of the specific objectives which were generated to answer the research question. All the data was analyzed using Statistical Package for Social Sciences Version 16 software for Windows 2007.

The collected data was entered on the Data View sheet of the SPSS Data Editor window to analyze the impact through pasture and water scarcity as well as responses of cattle farmers to drying up of pastures and water bodies. The data was coded. The coded data matrix was created with 128 cases representing number of respondents or questionnaire IDs and 56 Variables which were named with a maximum of 8 characters in order to be recognized by SPSS during analysis (Buckingham and Saunders, 2004; Gilbert, 2008 p340 and Seale, 2012). Then a coding frame was developed with all possible responses to a question and their accompanying numeric codes. After creating coding frame, the study developed the code book which contained the original wording of the question / variable, variable name with 8 characters, values that the variable can take and value labels that they represent.

Before analysis of data started, the study conducted data cleaning by commanding SPSS analyze frequency distribution to detect 'wild' codes. The wild codes were detected and the original data was referred to on the questionnaire and the real codes were discovered and re-entered on the SPSS Data Editor window. This study had run Frequency distribution and percentage test in SPSS on cross tabulation of variables.

3.6 RESULTS AND DISCUSSION

This section will discuss results on the impact of pasture and water scarcity on cattle farming and how cattle farmers respond to drying up of pastures and water bodies in Bolero.

3.6.1 Impact of Climate change on pasture and water for cattle

Figure 3.3 shows the size of grazing land used for cattle farming as an impact of climate change on dwindling pastures in Bolero.

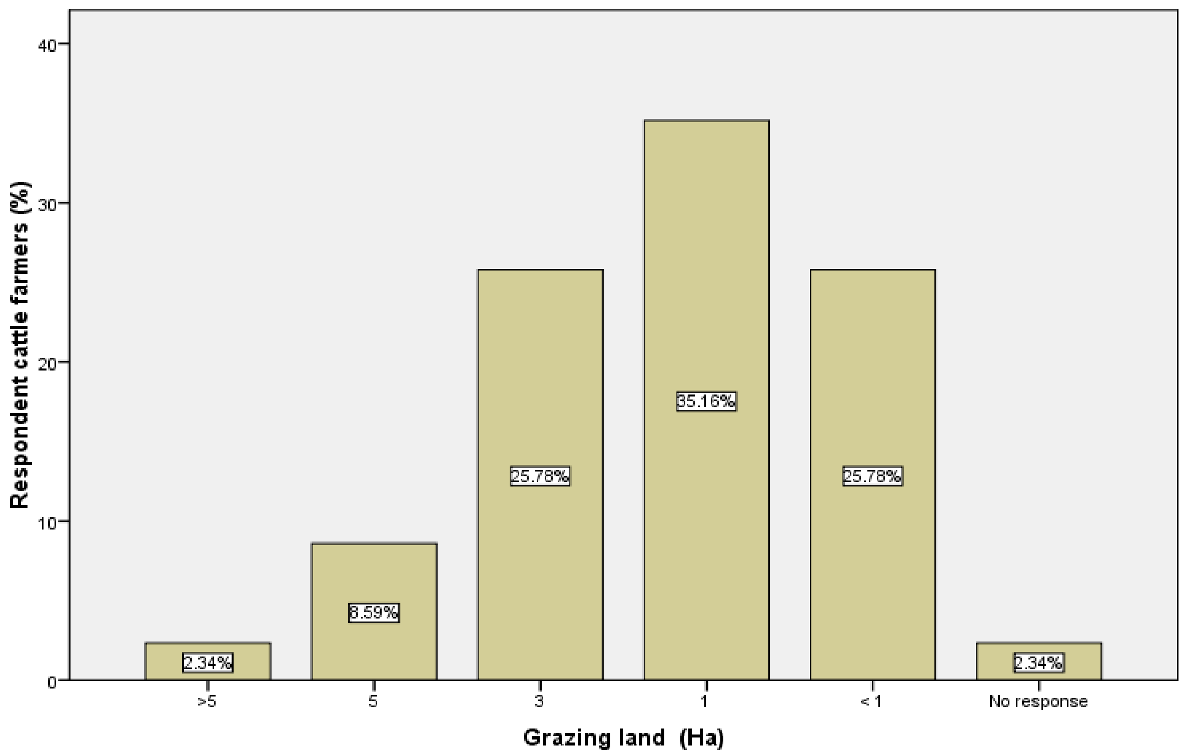

Figure 3.3 Size of grazing land

The results on figure 3.3 show that 35% of respondent cattle keepers said had grazing land size of 1 hectare while 26% of respondents said had less than 1 hectare giving a total of 61% of respondents saying had grazing land of 1 hectare and below. The majority (64%) of respondent cattle farmers possess 1-10 cattle with the least (2%) possessing 31-40 cattle. Reynolds (2006) reported that land carrying capacity for cattle in Northern Malawi is 0.7 ha per cattle which translates that majority of cattle farmers in Bolero, which this study has found to have reported possessing 1-10 cattle could have grazing land of up to 7 ha. The results indicate that 2 % of respondents had more than 5 ha of grazing land and majorities do not have adequate pastures to graze their cattle.

The stressors reported include rangeland degradation, fragmentation of grazing areas and changes in land tenure from communal towards private ownership, in-migration of non-pastoralists into grazing areas. Figure 3.4 shows the horticultural crops (vegetables) and Tobacco nurseries which are located to places close to water sources (dambos) which were originally grazing areas for cattle at first, but now taken over for Tobacco nurseries (observed in November, 2013 during orientation in Bolero, our Community of Practice). Similarly the researcher observed in most of the sections visited during data collection, and during profiling exercise.

Figure 3.4 Tobacco nurseries and vegetable crop dominance (November, 2013).

In Bolero the communal lands has turned in operating tobacco farms which has become private ownership. This study has established that 92 % of respondent cattle farmers said grazing land utilization is open access to anybody and to any place. The study has also revealed that adequate grazing routes to the grazing areas are reported to be in dry season (97%) when the land has been cleared after harvesting of crops. From August to October, there was mobility of cattle farmers to some distance to look for fresh forage in wetlands and were digging wells for cattle watering in some dry-up streams.

The results of Figure 3.5 indicate that majority of the respondents (58 %) said they rely on only 2 watering points for their cattle. Those farmers from sections which are along Rukuru River said they rely on that river during rainy season and in dry season when the river water levels drop, they rely on drawing water from secondary source such as dug-out wells or boreholes. The cattle farmers who are along Ruviri River said they rely on that river during the rainy season and they have their second water point during dry season when they draw water using buckets from boreholes or move the cattle fetching for water in the wells of the drying river. Masike and Urich (2009) observed that adequate provision of water for livestock production could become more difficult under climate change. Their study in Botswana estimated that the cost of supplying livestock water from boreholes would increase by 23% by 2050 due to increased hours of groundwater pumping (whether motorized or manual pumping) needed to meet livestock water demands under warmer and drier conditions.

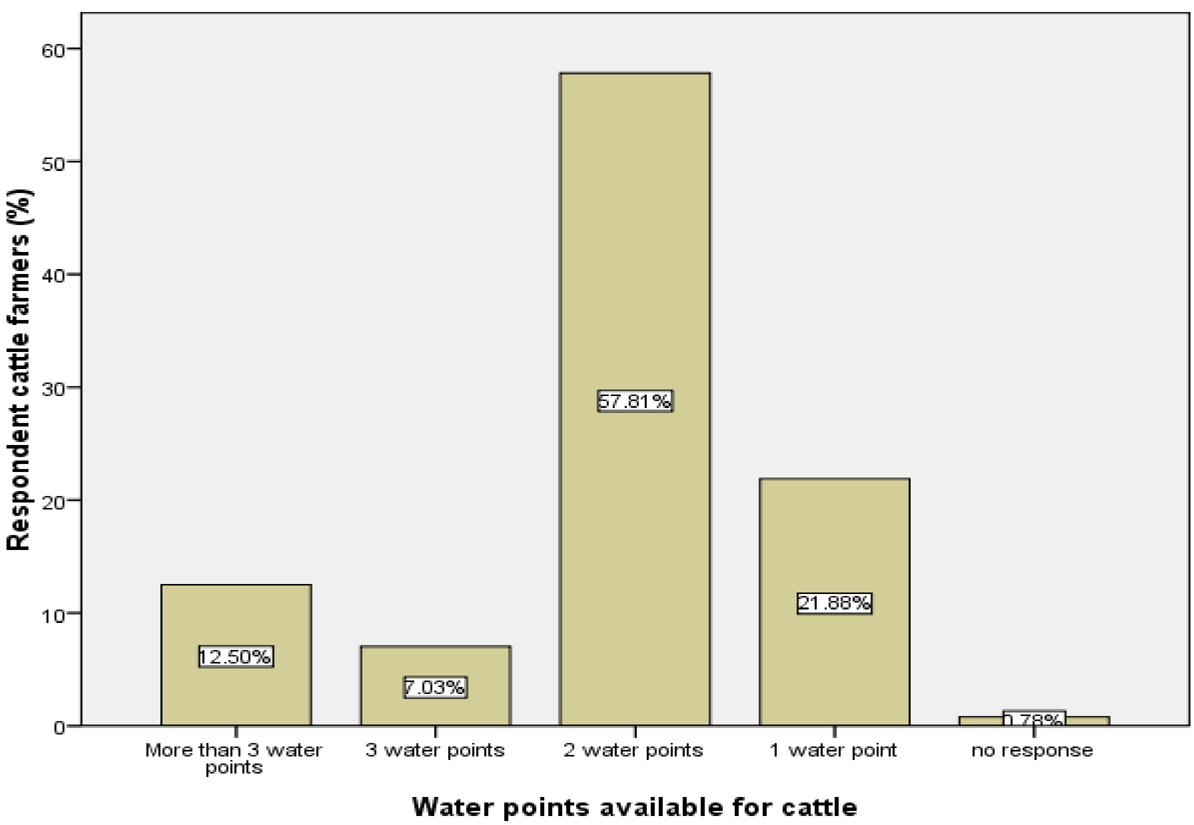

Figure 3.5 Number of water points relied upon by cattle farmers

Figures 3.6a and 3.6b show the distances cattle farmers travel with their cattle to reach water points during dry season and rainy season respectively.

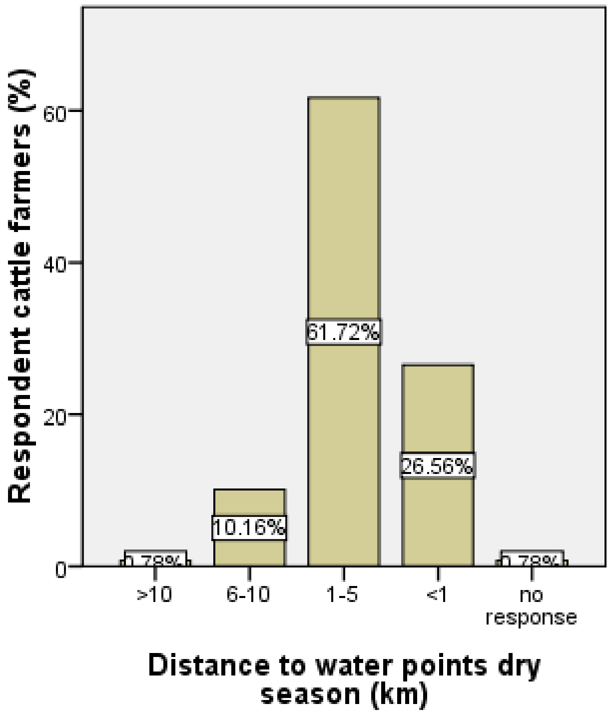

Figure 3.6 a

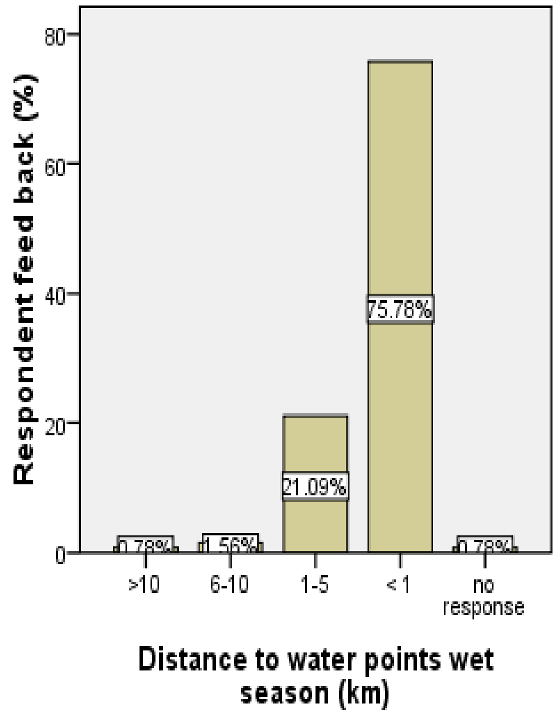

Figure 3.6 b

This study has established that majority of respondent farmers (72%) when asked about dry season distance said they travel up to 10 kilometers with their cattle to reach water points during dry season while in rainy season majority reported that they travel less than a kilometer to reach water point and they explained that it is like that because during rainy season there is water all over even in swamps.

The results of the current study agrees with the study which reported that changes in hydrological cycle, temperature balance and rainfall patterns have negative effects on cattle productivity through reduction of water and pasture (Mwiturubani, 2010).

3.6.1 How cattle farmers respond to drying up of pastures and water bodies in Bolero

The study will discuss the following variables which had been used to assess coping mechanisms of cattle framers from climate change impacts: Pastures and water supply challenges. This research revealed a range of practices that help the cattle farmers cope with drying pastures and water bodies. These are mobility, cooperation and sharing, and livelihood diversification

3.6.1.1 Responses to drying up of pastures through Mobility

The study found that the cattle farmers move distances fetching for pastures during scarcity. The researcher got similar responses from Individual interviews as well as during focus group discussions as per following conversation:

Me (Researcher): “What do you do with your cattle in times of pasture hardship during dry season when pastures dry up?”

Cattle farmer(s) – respondent(s): “We move long distances of 5 to 10 kilometers with our cattle looking for fodder (grasses) in the wetland for them to graze. This mainly takes place from August to November.

Me: “What do you do in times of grazing hardship during wet season when there are floods and wash-away?”

Cattle farmer(s): “We climb uphill with cattle or travel to further places outside the flood area looking for dry land”.

3.6.1.2 Responses to water challenges through Mobility

Me: “What do you do with your cattle when rivers dry-up during dry season?”

Cattle farmer(s): “We go to big rivers such as Lunyina and Ruviri and look for some areas where there are some wells or pockets of water where the river has not dries-up.” (Figure 3.6a).
Survey took place from November, 2014 through April, 2015

The study has established that 27 % of the cattle keepers said they move and draw water from borehole using buckets and putting in water troughs for cattle to drink.

This study also agrees with studies conducted on the Agro-pastoralists adaptive capacities and their importance in wider community in Uganda and Kenya which isolated five key areas in which some of their practices signal a degree of adaptive capacity, thus: knowledge, mobility, cooperation and sharing, culling the herd and diversification (Adano et al, 2012; Benjaminsen et al, 2009; Butler and Gates, 2012; Tembo, 2013).

3.6.1.3 Supplementation coping mechanism

Besides moving long distances looking for pastures and water in wetland when pastures and water bodies dry-up, cattle farmers also explained that during dry season, they also supplement the feeding by giving crop residues after harvesting the crop fields. Similar to this study findings, study conducted in Zimbabwe observed that cattle were turned out into the harvested fields to feed on crop residues from May to July. From August to October, there was mobility of cattle farmers to some distance to look for fresh forage in wetlands and were digging wells for cattle watering in some dry-up streams (Madzudzo and Hawkes, 1996). However, in contrast with Madzudzo and Hawkes (1996) report, the current study has reported that supplementation with crop residues and maize bran concentrate is very minimal (16 % and 29% respectively of respondents said they practice supplementation).

3.6.1.4 Land use and Livelihood diversification coping mechanism

Livelihood diversification and integrated farming as adaptive strategies on a longer time scale would improve their adaptive capacity to climate change and variability. In line with previous studies the current study has also shown that majority of respondents (63 %) agreed that there are diversification of enterprises which they are engaged in as coping mechanisms in Bolero and some enterprises being relied upon. They also grow food crops from which they sell the surplus. Majority (41 %) indicated that they are keeping and selling some other type of livestock such as goats, pigs and chickens and they also grow and sell tobacco cash crop as coping mechanisms. On occupation as coping mechanism, the study has found out that majority (59 %) of cattle farmers were doing tobacco farming before getting engaged in cattle keeping. Currently 77 % of the cattle farmers are growing tobacco as back-up coping mechanism besides cattle keeping and there were only 16 % who are solely relying on cattle keeping. From other previous studies with Boranas in Ethiopia, McCarthy et al (2001) reported of more land allocated to crops, and small portion of land allocated to pastures that are either privatized or accessible to only a small sub-group of people. The Borana people are the predominant ethnic group on the Borana Plateau in southern Ethiopia. Though traditionally transhumant pastoralists, they have recently increased their reliance on crops. This is similar to Bolero cattle keepers whose majorities (77 %) rely on Tobacco cash crop. Still on diversification and engagement with various stakeholders the current study has also reported that cattle farmers get services in various ways and from various providers such as controlling of external parasites 63 % said they use DDL pour-on dip and for internal parasites 95 % said they use deworming remedy which are provided by Vet medicine shops, Lead farmers of Total Land Care and Find Your Feet (NGOs) and other volunteers in the Community of practice. The study found that some respondent cattle farmers (5) said they are engaged in some small scale businesses.

3.6.1.5 Cooperation and sharing

Study has found that Bolero community mainly shares the resources in form of communal grazing as cattle are grazing and drinking on shared pasture and water resources. The study has noted that the dominant cattle feeding system (90 %) was extensive type and farmers have free access to the communal grazing land on natural pastures though particular cattle farming households have specific grazing areas. Respondents said that crop residues are also fed to cattle communally without restriction to owner's field.

3.6.1.6 Respondents final comments after Interviews

The study finally asked the respondent cattle farmers to give any other comment which they felt (as a feedback). Openly, the respondents expressed the following: Need for a dip tank and cattle medicine from government as was previously done, need to know aims and objective of the study, Need to have accessible livestock extension staff within their reach, and need for farmer training in various cattle husbandry practices. However majority (43%) said had nothing to comment apart from thanking for the study to take place in their area which to them gave them a lot of expectations and hope for improvement in their livelihood, indicating that there is need for transformation in the Cop.

4.0 CONCLUSION AND RECOMMENDATION

4.1 CONCLUSION

The study has assessed the climate variability impacts on cattle farming in Bolero, Malawi. It has also assessed how farmers respond to drying up of pastures and water bodies.

Climate variability impacts has resulted varying views. Cattle farmers close to Rukuru and Lunyina rivers reported that they travel shorter distances to reach the water source while those residing in sections very far from the rivers feel the pitch of exhaustive mobility. The cattle farmers, who grow maize and other food crops more than tobacco, stand better chance of having crop residues closer to their animals to feed them at shorter distance during pasture scarcity than those who rely on Tobacco as their major crop. . The study covered all the 12 sections and purposively sampled 40 % of targeted cattle keepers. It has been found that cattle farmers are felt the impact of pasture and water variability differently in the study area.

On coping mechanisms of cattle farmers with rainfall variability, the study has established that majority of cattle keepers in Bolero practice livelihood diversification. Besides keeping cattle they also grow and sell tobacco as cash crop. They also said that they grow and sell some surplus food crops and are keeping other livestock such as goats, pigs and chickens. The existence of various stakeholders providing their services in the area also fills some gap which might have occurred. However, the study has observed challenges on feeding system where extensive system dominates and there is big gap on inclusion and use of legumes in pastures and feeding systems to cope with cattle nutritional challenge where rainfall variability has impacted on feed and pastures. The study has found that cattle farmers rely on natural grasses only without mixing with leguminous agro-forestry fodder trees which withstand adverse climatic conditions and could provide nutritious supplementary feed during lean dry season.

From respondents' final remarks (feedback), the study has noted some gaps where transformation needs to be a continuous process. Majority of the respondent cattle farmers expressed that there was need for a dip tank and cattle drugs in Bolero, from government as was the case previously. But according to Malawi government Livestock Policy (2006) there are some guiding principles as follows: Demand driven livestock services delivery, pluralism of service delivery, privatization of some livestock services, cost recovery and cost sharing (Most of the services which government used to provide freely are no longer sustainable and the approach is therefore has to change and begin to engage stakeholders and beneficiaries bearing the responsibilities and cost. Participatory approach and community empowerment can play a central role to transform the way cattle farmers get involved. This guiding principle will ensure that farming communities have an opportunity to prioritise and have commitment to their activities. The approach can provide for a sense of ownership, accountability, transparency and sustainability. Thus community transformation process to do away with Dependency Theory of Development which is predominantly top-down.

4.2 RECOMMENDATION

From the results and discussion the research would like to make the following recommendations:

4.2.1 The goal of TEN-Hunger to transform the nature of the engagement between various stakeholders impacted by or concerned with climate change should be enhanced and collaboration and network development should be sustained especially with this first cohort of MTCD program – Malawi Chapter, which has students from diversity background and working in various sectors though with related outputs and outcomes.

4.2.2 There should be timely arrangement for results dissemination seminar at our communities of practice so that the community appreciate the value of our TEN – Hunger programme and our engagement in the COP so that we plan for the next step on the actions to take from the findings and observations.

4.2.3 This study finally shares the following quote from Seo & Mendelsohn (2008) observation and recommendation:

"Policy makers need to be aware that African livestock management is vulnerable to climate change. Global climate mitigation policies must reevaluate the estimated impact of climate change on agriculture. Aid programs to Africa must carefully consider how they can help African farmers adapt to climate change. Livestock farmers should know that they can substitute livestock for crops when climate gets hotter and drier. Large livestock operations must be made aware that cattle will be very sensitive to warming. Adaptation should vary across Africa depending on conditions. Government programs should help farmers adapt to the new conditions and become self-sufficient. Aid programs must be careful not to provide incentives for farmers to remain vulnerable and thus dependent on aid to survive". Cattle farmers need to be transformed, innovative and self-reliant. "Resilience-building management is flexible and open to learning. It attends to slowly-changing, fundamental variables that create memory, legacy, diversity, and the capacity to innovate in both social and ecological components of the system. It also conserves and nurtures the diverse elements that are necessary to reorganize and adapt to unexpected and transformative circumstances. Thus, it increases the range of surprises with which a socioeconomic system can cope. Building social-ecological resilience requires understanding of ecosystems that incorporates the knowledge of local users" (Folke, et al 2002).

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