DROUGHT COPING STRATEGIES BY SMALLHOLDER CATTLE FARMERS IN ZIMBABWE †

[ESTRATEGIAS DE LOS PEQUEÑOS AGRICULTORES DE GANADO EN ZIMBABWE PARA HACER FRENTE A LA SEQUÍA]

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SUMMARY

Background: The severity of drought in sub-Saharan Africa has led to crop failure and high mortalities of cattle. For decade's drought-induced losses have been a persistent struggle for herded animals on rangelands. Persistent droughts have caused significant cattle losses, yet drought warning signs are not communicated in time to prepare farmers for adaptation and or mitigation. **Objective:** To analyse the adoption of drought coping strategies by smallholder beef farmers in Zaka District. **Methodology:** The sustainable livelihood framework guided the study in assessing the community adaptive strategies. Multi-stage cluster sampling method was employed and questionnaires were used to collect data. A chi-square test was used to evaluate the association between demographic characteristics and drought copping and mitigation strategies. A logit model and maximum likelihood estimation procedure was used to analyse the factors influencing adoption. **Results:** The results indicated that age and education status influenced ($P < 0.05$) drought copping strategies. Cattle disease and droughts were the major causes of cattle loses 38 and 35% respectively. Supplementary feeding, cattle disposal and lease grazing major were the adopted strategies. It was also found that farmer education level and access to agricultural training influenced adoption ($P < 0.05$). Cattle mortality, drought experience and crop losses are driving factors to adoption. Purchase of food items and its payment of medical bills are the major ($P<0.05$) reasons for selling beef cattle. **Implications:** Given the forecasts of future drought cycles, it is imperative that farmer's establishment of drought feeding schemes, forage harvesting, investing in commercial protein supplements and communal breeding programs for drought-tolerant cattle be implemented. **Conclusion:** Cattle disposal, supplementary feeding and lease grazing are the adopted drought mitigatory strategies by beef communal farmers, yet these are only short term. Long term grazing strategies are recommended in order to reduce further cattle losses.

Key words: adoption; cattle; drought; sustainable livelihood.

RESUMEN

Antecedentes: La severidad de la sequía en el África subsahariana ha provocado la pérdida de cosechas y una alta mortalidad del ganado. Durante una década, las pérdidas inducidas por la sequía han sido una lucha persistente para los animales de pastoreo en los pastizales. Las sequías persistentes han causado pérdidas significativas de ganado, pero las señales de advertencia de sequía no se comunican a tiempo para preparar a los agricultores para la adaptación o la mitigación. **Objetivo.** Analizar la adopción de estrategias para hacer frente a la sequía por parte de los pequeños productores de carne de vacuno en el distrito de Zaka. **Metodología:** El marco de medios de vida sostenibles guió el estudio en la evaluación de las estrategias de adaptación de la comunidad. Se empleó el método de muestreo por conglomerados de etapas múltiples y se utilizaron cuestionarios para recopilar datos. Se utilizó una prueba de chi-cuadrado para evaluar la asociación entre las características demográficas y las estrategias de afrontamiento y mitigación de la sequía. Se utilizó un modelo logit y un procedimiento de estimación de máxima verosimilitud para analizar los factores que influyen en la adopción. **Resultados:** Los resultados indicaron que la edad y el nivel educativo influyeron significativamente ($P < 0.05$) en las estrategias de afrontamiento de la sequía. Las enfermedades del ganado y las sequías fueron las principales causas de las pérdidas de ganado; 38 y 35% respectivamente. Las estrategias adoptadas fueron alimentación suplementaria, enajenación de ganado y

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arrendamiento de pastoreo. También se encontró que el nivel de educación de los agricultores y el acceso a capacitación agrícola influyeron en la adopción ($P < 0.05$). La mortalidad del ganado, la experiencia de sequía y las pérdidas de cultivos son factores que impulsan la adopción. La compra de alimentos y el pago de facturas médicas son las principales razones ($P<0.05$) para vender ganado de carne. **Implicaciones:** Dados los pronósticos de futuros ciclos de sequía, es imperativo que los agricultores establezcan esquemas de alimentación de sequía, cosecha de forraje, inversión en suplementos proteicos comerciales y programas comunales de cría para ganado tolerante a la sequía. **Conclusión:** La eliminación del ganado, la alimentación suplementaria y el pastoreo arrendado son las estrategias de mitigación de la sequía adoptadas por los ganaderos comunales de carne, pero estas son solo a corto plazo. Se recomiendan estrategias a largo plazo para reducir aún más las pérdidas de ganado.
Palabras clave: adopción; vacas; sequía; sustento sostenible.

INTRODUCTION

In Zimbabwe agriculture is the backbone of the economy, contributing between15-18 percent of the gross domestic product (GDP) (World Bank, 2019). It contributes over 40 percent of national export earnings and 60 percent of raw materials to agro industries (RBZ, 2015). More than 80 percent of the population depends on agriculture for livelihood and the majority of the small scale farmers are women (RBZ, 2015). The country is endowed with diverse climatic conditions that enable farmers to grow a wide variety of food and cash crops (World Bank, 2019). The farming areas have undergone fundamental transformations over the past decades due to the structural change in the context of a shift in the political, social and economic environments (Ward *et al.,* 2012). Due to these changes the government promulgates a dual agriculture system and focuses on assisting small scale and communal farmers (the smallholder sector) through programs of subsidized inputs, conservation farming techniques, crop and animal disease control (Ward *et al.,* 2012). The beef industry in Zimbabwe is an important component of the agricultural sector which accounts for between 7 to 10 percent of agricultural contribution to national GDP (RBZ, 2013). The success of the industry is attributed to the fact that more than 70 percent of the land in Zimbabwe is best suited for ruminant livestock production (D`Hotman and Hatendi, 1998). The livestock sector has developed to cater for the domestic and export markets. The overall performance of the agricultural sector determines the living standards and the development of the national economy. The national beef cattle population was 5, 5 million with more than 90 percent of the cattle in the smallholder farming areas (RBZ, 2015). However, off take has declined from 261 424 in 2011 to 246 522 in 2014 due to a multiplicity of factors (RBZ, 2015). The 2015-16 farming season was ravaged by the El Nino weather phenomenon across the entire southern African region killing 643 000 livestock estimated to be worth USD $2 billion washing away significant potential revenue for farmers to invest in productive assets and alleviation of rural poverty in the region (ZMVAC-OCHA, 2015). Ever since then most small scale farmers never recovered from this devastating climatic variability. Furthermore, modern agriculture require a high dependency on specialization, scale increase in operations, spatial concentration in favoured areas, extension services, and centrality of capital and labour resources (Zakarevicius, 2012) most of which are quite difficult to achieve under small holder circumstances. In addition, modern agriculture has been characterised by a plethora of innovations with the sole objective of improving agriculture productivity (Maiyaki, 2010). Unfortunately for the region, there is a need to better understand how individuals are able to make a transition out of poverty through the adoption of sustainable livelihood strategies, yielding notable results (Besley and Case, 1993) especially drought. Beef cattle production is dependent on maize production because maize constitutes the largest ingredient in stock feeds (Zimbabwe Livestock Review, 2015). However, 70 % of maize production in the majority of countries in the region comes from smallholder farmers that use traditional methods of production and obtain yields of less than one tonne per hectare. Automatically this affects beef production with low productivity levels being compounded by low capital endowments and limited uptake of productive farm technologies (ZMVAC, 2009). Drought and famines across the Sub Saharan region over the past two decades have been attributed to global climate change (IPCC, 2007). A drought is defined as a deficiency in precipitation over an extended period usually a season or more resulting in a water shortage causing adverse impacts on vegetation, animals and people (Nagarajan, 2003). In terms of beef production, drought is defined as a situation in which abnormally low rainfall results in an area being unable to carry animals at the correct stocking rate for average seasons with normal supplementary feeding without severe weight loss and high mortality (Gammon and Maclaurin 1998).

The adoption of drought coping strategies has been identified as a way to mitigate the effects of poverty caused by droughts across the country over the past decade. The recurrence of droughts has significantly reduced the national beef herd among other factors (Zimbabwe Smallholder Agricultural Productivity Survey 2017). Magotsi *et al*., (2011) found that the drought management strategies among pastoral communities in non-equilibrium Kalahari ecosystem are to move livestock to areas where there is better grazing, selling livestock, providing water, adherence to vaccination programs and enrolling to drought relief livestock programs. Gammon and Maclaurin (1998) suggests that the details of coping with drought vary with different situations. According to FAO (2010), the establishment of pre drought forage reserves, astute and timely disposal of surplus stock, culling, seeking relocation (lease grazing), felling trees and supplementary feeding are potential drought management strategies. There is enough evidence that farmers fail to cope with droughts in the country and their vulnerability is a combination of physical and socio economic attributes such as drought monitoring systems and basically unpreparedness at household level (Masike and Urich, 2012). The El Niño weather event experienced in the 2015/16 agricultural season resulted in long term drought related damage in Zimbabwe leaving an estimated 2 million people food insecure and nearly 40 000 cattle deaths (ZVAC-OCHA, 2015).). Although local breeds have an adaptation feature of smaller size enabling them to cope with the nutritional constraints typically experienced in Zimbabwe, farmers continue to lose them due to the drought. Therefore, the objective of this study was to evaluate drought mitigation strategies by cattle farmers in Zaka District.

MATERIALS AND METHODS

Study site

Zaka is a district in Masvingo Province, Zimbabwe and is located 86km south East from Masvingo in the Ndanga communal lands. The district was chosen because it recorded the highest (7 000) number of cattle mortalities), during the 2015-16 season (Zim Sit RepM, 2016). The area lies on altitude, latitude -20° 20' 59.99" S and longitude: 31° 26' 59.99" E. The area is semi-arid, mountainous with erratic rainfall averaging 600 to 800 mm per year. Subsistence farming is the main economic activity. Crop husbandry is practiced across the district with the major crops grown being maize, rapoko, millet, sorghum, round and ground nuts. The rearing of livestock such as cattle, goats, sheep and donkeys is also practiced.

Sampling

According to the Zimbabwe Poverty Atlas (2015), Zaka district is divided into 34 wards. The total population for the district is 179 766 people from 39 952 households. Ward 10 is divided into 36 villages with 1295 households and a total population of 5 594 people. The Ward average household size is 4.3. A survey calculator was used to calculating the sample size set at confidence level of 80% and margin of error of 5%and gave a result of 130 participants. Multi stage cluster sampling method was employed by dividing the ward into 36 villages and purposively selecting 13 out of the 36 villages (first stage). The selected villages were the most affected by the *El Niño* drought in terms of cattle deaths. On the second stage households which own cattle from the selected villages were then listed and the total number of households was 235. Random sampling method was employed on the second stage in selecting 10 households from each village.

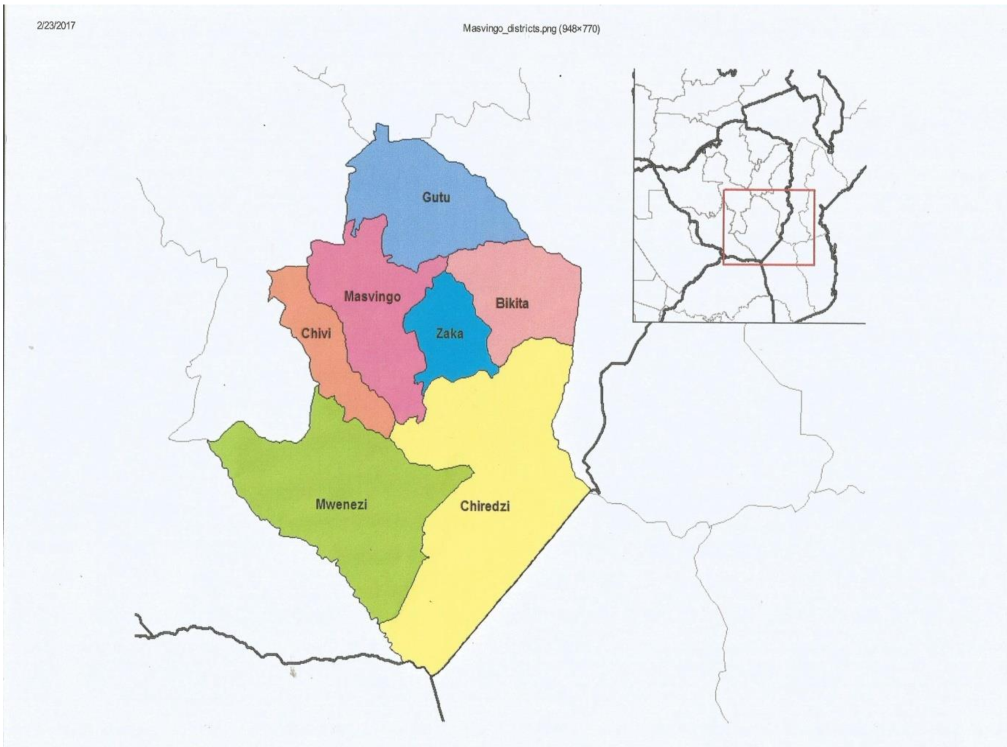

Figure 1. Map of Zaka District in Masvingo Province (Source: Rarelibra (2006)).

Data collection

Primary data was collected by use of a questionnaire from total of 130 households. Additionally, in depth interviews were conducted with officers from the department of livestock production and development (DLPD), AGRITEX to gain insights on livestock production, drought occurrence and adaptation strategies being employed by the smallholder beef farmers in the area. The triangulation of data collection methods established reliability and validation of findings in the study. Weather data of the district was obtained from the district AGRITEX Department.

The research design

A mixed methods approach was used in the current study. Both quantitative and qualitative methods were used.

Data matrix plan

The data matrix plan is shown in Table 1 where the sub questions and the nature of data expected to be generated as well as data gathering instruments employed during the process.

Statistical analysis

Descriptive statistics was used to estimate demographic characteristics of the study population. A chi-square test was used to evaluate the association between demographic characteristics and drought copping strategies. The logit model was used to analyse the significant factors hindering or stimulating the adoption of drought coping strategies by smallholder beef farmers. The logit model is used for explaining a dichotomous dependent variable with the empirical specification formulated in terms of latent response variable (Maddala, 2002). The dependent variable is a dummy that takes a value of zero or one depending on whether or not the farmer has adopted or not the drought management strategies. The independent variables are the factors which affect the adoption of drought management strategies which are discrete and continuous. The logit model assumes that there is an underlying response variable Y_i^* defined by the regression relationship expressed as:

$$Y_i^* = \beta_0 + \sum_{K=1}^{K} \beta_i X_{Ki} + \varepsilon_i \; ..... \; E(\dot{X}) = 0 \;\; E(\varepsilon) = 0 \;\; Var(\dot{X}) = 1 \; Var(\varepsilon) = 1$$

Where Y^* is the latent or unobservable variable. The observable variable is a dummy representing the adoption of drought management strategies. Y=1 if $Y^* > 0$ and Y= 0 otherwise. I is the household, X_{ki} : K=1 through k independent variables explaining the phenomenon of the household, I, β_i is the parameter that explains the effect of X_i on Y^*_i; β_o is the intercept that shows the expected value of Y^* when all X_k have a value of zero . ε_i is the stochastic error term for the household I, E is the expected value and Var is the variance, $\dot{X}$ is the mean of X.

Model Specification

i) X_1 Farmer age: It is a discrete variable measured in years given by the farmer on the day of participating in the study.

ii) X_2 Farmer sex: It is a dummy variable that assumes value of 1 if male or 0 otherwise.

iii) X_3 Farmer level of education: It is a dummy variable that assumes value of 1 if formally educated or 0 otherwise.

iv) X_4 Household size: It is a continuous variable measured in the number of people living together given by household head.

v) X_5 Agricultural training: It is a variable that assumes value of 1 if they attained training in agriculture or 0 if otherwise.

vi) X_6 Average household income: It is a dummy variable that assumes value of 1 if above the poverty datum line or 0 if otherwise.

vii) X_7 Cattle herd size: It is a discrete variable measured in the number of live cattle in the herd given by the farmer on the day of participation.

viii) X_8 Number of cattle sold annually: It is a continuous variable measured in the number of cattle sold annually given by the farmer on the day of participation.

ix) X_9 Number of cattle mortalities related to drought: It is a continuous variable measured by the cattle mortalities cases recorded in the herd due to drought.

RESULTS

Rainfall data was collected from the AGRITEX department and results are shown in Figure 2. Generally, the amount of rainfall received from 2010 to 2017 was below the national average save for the year 2014 and 2016. For such a moderate rainfall area, rainfall amounts below 400 would be regarded as a drought year. Typically, two severe droughts occurred in 2012 and 2015 within the study area. Cattle dynamics for the study area were evaluated and result are shown in Table 2. The majority (47.7 %) of the respondents had herd sizes below five cattle while 42.3 % had between five and ten. Few (9.2%) farmers had at least eleven to 20 cattle and very few (0.8%) owned above 20 cattle.

Table 1 Data matrix plan for Zaka District.

Question	Research sub question	Data needed	Analysis method
1	What are the common drought coping strategies being adopted by beef farmers?	How the strategies are implemented? Which strategies are they? Expected skill and knowledge impacted on farmers. The efficacy of the strategies and instruments.	Questionnaire and interviews were used to obtain data. Descriptive characterisation to analyse the data.
2	What are the factors affecting the adoption of drought coping strategies in Zimbabwe.	Positive factors that have enhanced the successful implementation. Negative factors that militate against strategy implementation	Questionnaire and interviews were used to obtain data. Logit regression for analysis
3	What are the benefits accrued from adopting drought coping strategies.	Household income and expenditure.	Questionnaire and Interviews for data collection and food situation analysis

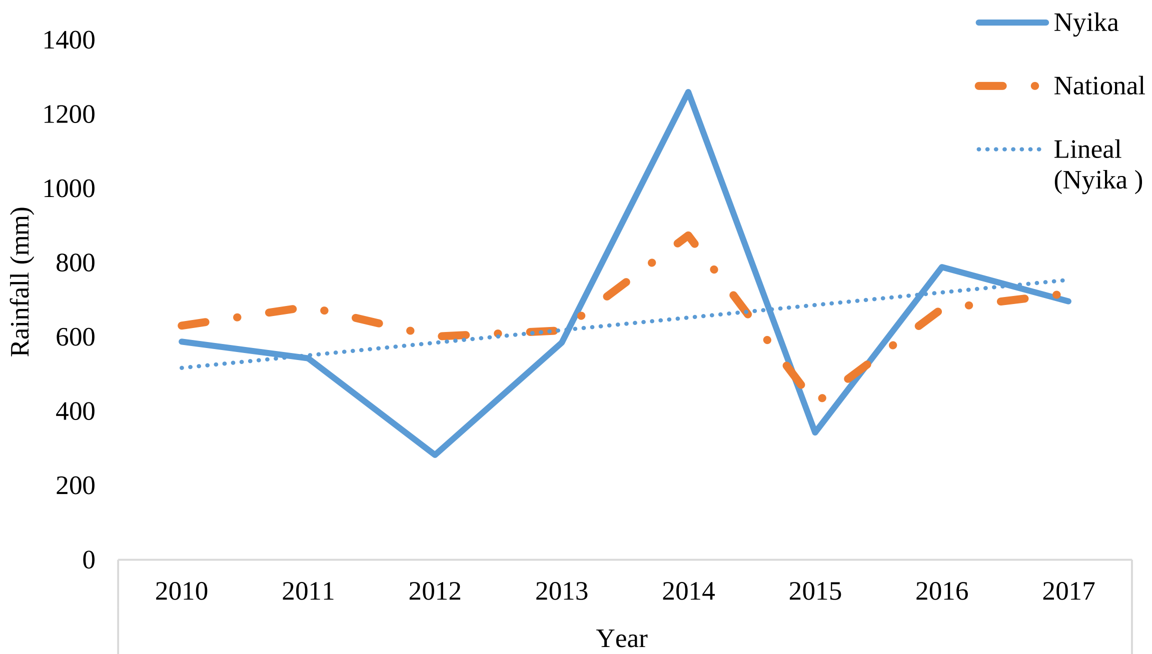

Figure 2. Rainfall distribution pattern for Zaka District (2010 - 2017).

Table 2 Cattle herd size for Zaka district.

Variable		Frequency	Percentage
Cattle herd size	0-5 cattle	62	47.7
	6-10 cattle	55	42.3
	11-20 cattle	12	9.2
	>20 cattle	1	0.8
	Total	130	100.0

Results on the drought coping strategies adopted by the smallholder beef farmers are shown in Table 3.

On average more than half (69.9%) of the respondents showed that they adopted supplementary feeding (use of maize stover) as a strategy during drought to minimise the rate of cattle losses. The other (22.3%) of the respondents have adopted cattle disposal strategy and 7.5 % prefer lease grazing. The level of adoption of any one of the strategies show that overall, farmers do not do much (66.2%) to avert the impacts of drought. Since farmers do not have any mechanisms to predict a forthcoming drought, they rely on certain cues before they engage the adoptive measures and these are shown in Table 4.

Table 3 Drought coping strategies adopted by the smallholder beef farmers.

Demographic factor	Adopted strategy		Yes	No	Chi-squares	P value
Age	Cattle disposal	18 - 30 years	8 (6.2)	0 (0)%	6.43	0.040
		31-50 years	42(44.6)	16(38.1)		
		> 50 years	38(59.4)	26 (40.6)		
	Supplementary feeding	18 - 30 years	8(6.5)	0(0)	0.429	0.807
		31-50 years	55(44.4)	3(50.0)		
		> 50 years	61(49.2)	3(50.0)		
	Lease grazing	18 - 30 years	8(6.9)	0(0)	1.966	0.374
		31-50 years	53(45.7)	5(35.7)		
		> 50 years	55(47.9)	9(64.3)		
Education status						
	Cattle disposal	No education	9(10.7)	3(6.5)	1.361	0.715
		Primary	39(46.4)	19(41.3)		
		Secondary	34(59.6)	23(40.4)		
		Tertiary	2(2.4)	1(2.1)		
	Supplementary feeding	No education	0(0)	12(9.2)	8.056	0.045
		Primary	58(46.8)	0(0)		
		Secondary	51(89.5)	6(10.5)		
		Tertiary	3(2.4)	0(0)		
	Lease grazing	No education	0 (0)	12(9.2)	2.601	0.457
		Primary	58 (44.3)	0(0)		
		Secondary	55(43.3)	2(1.5)		
		Tertiary	3(2.3)	0 (0)		

Table 4 Drivers of adoption of drought mitigation strategies amongst smallholder beef farmers.

Reasons	Responses N = 130	
	Number	Percent
High cattle mortality	118	28.5
Crop loses	87	21.0
Extension services access	43	10.4
Drought experience	104	25.1
Low productivity	30	7.2
Farmer to farmer education	32	7.7
Total	414	100

Unfortunately, farmers are only aware of a drought situation when they start to lose (28.5%) cattle and this has been cited as the main reason for the adoption of drought coping strategies. In addition, previous drought experiences (25.1%) and crop failure (21.0%) are also important cues for an impending drought which stimulate farmers to engage their adoptive strategies. Interestingly farmer to farmer education is also identified as a cue to identifying a drought. In these discussions topical clues include such factors like poor body condition and lack of reproduction by animals. The major cause of cattle deaths was also evaluated and the results are shown in Figure 3. Diseases were the major (38.0%) cause of death followed by drought (35%). Tick borne diseases for example Anaplasmosis, Babesiosis, Cowdriosis and Theileriosis were the major diseases identified. A substantial number (14%) of farmers indicated that scarcity of drinking water is a cause for concern within the study area. Besides the impacts of drought, farmers also sold their cattle for other reasons and these results are shown in Table 5. The majority (45.7%) of the households revealed that the major reason for selling cattle was to purchase food, while the other 24% cited that the frequent occurrence of health matters force many households to sell cattle to settle medical bills.

Other personal reasons such as payment of school fees, purchase of inputs lead households to sell cattle but their contribution was minimum.

The factors that influenced adoption of drought mitigatory measures by farmers were evaluated and the results are shown in Table 6.

The level of education and agricultural training significantly influenced adoption of drought mitigatory measures by farmers ($P<0.05$). An increase by one unit of education level has a positive propensity to influence 0.642 chances for adoption while agriculture training increase the chance of adoption by 0.471. The gender of the household head, marital status, age and herd size did not influence adoption ($P>0.05$).

DISCUSSION

Rainfall

The occurrence of droughts in Zimbabwe is recurring (Scoones, 1992) with about 22 droughts recorded until 2010 (Nangombe, 2012, UNDP, 2017). Eight of these have been recorded between

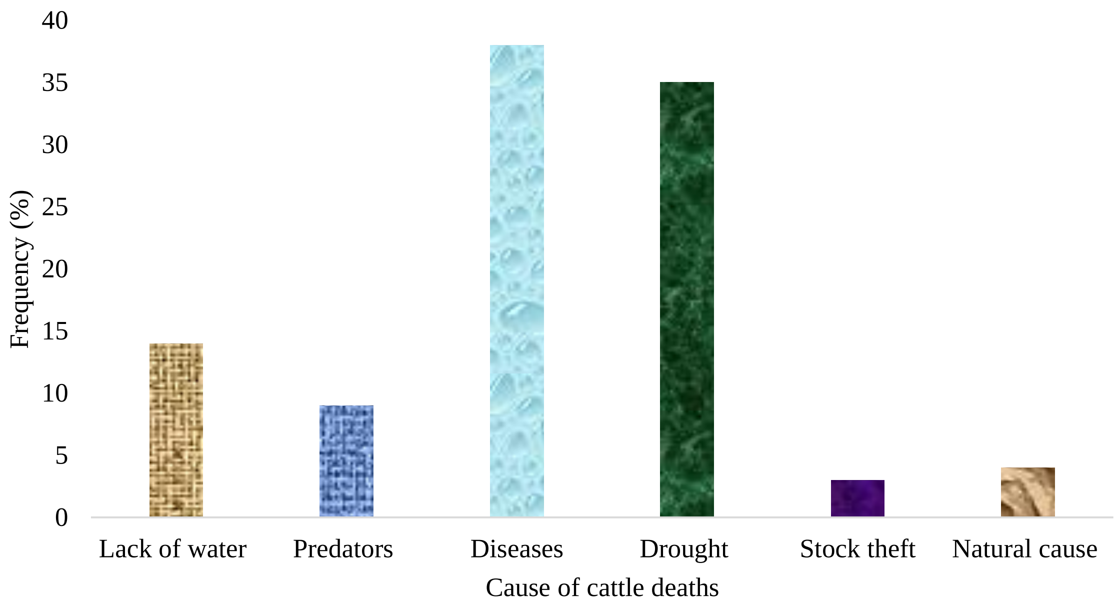

Figure 3. Causes of cattle deaths in Zaka District.

Table 5 Reasons for selling cattle in Zaka District.

Reasons	Responses	
	Number	Percent
Purchase of food	121	45.7
Pay medical bills	65	24.5
Lobola payment	19	7.2
Business investment	15	5.7
Profit	4	1.5
Other reasons	41	15.5
Total	265	100

2002 and 2010 although with different severity levels. The most intense and severe drought seasons occurred in 1991 1992, 1994–1995, 2002–2003, 2015–2016, and 2018–2019 while 2003–2004, 2006–2007, 2011–2012, and 2017-2018 showed isolated patterns of droughts (Frischen *et al.*, 2020). A report by FAO (2017) indicated that the 2015/16 rainfall season (November–April) has been the driest in the last 35 years (Thomas and Hollingsworth 2016). This consequence had grievous implications on households and national socio- economics in Zimbabwe, with particular bearing on food security as indicated by ZIMVAC, (2016). Severely reduced seasonal rains and higher-than-normal temperatures have been recently recoded in Zimbabwe (Masama, 2016, Frischen *et al.*, 2020), these were further exacerbated by the El Niño and caused approximately 12% drop in aggregate cereal production compared with the already reduced 2015 output (Ainembabazi, 2018, Frischen *et al.*, 2020). The poor rainfall performance led to widespread crop failure resulting in low production and household food availability. As a direct consequence, livestock production was also immeasurably affected by a lack of pasture and water. Results from the current study attest to this fact. Surprisingly the year 2014 is recorded to be the hottest year worldwide (OXFAM 2015), which precluded the 2015/16 EL Nino, the result from the current study are in contrast to this claim.

Herd size

Reduction of cattle herd size is a common adaptive and mitigatory measure when droughts hit communal areas (FAO, 2010, Ndlovu, 2011, Mushore *et al.*, 2013), this has been alluded to as negative coping strategies because it further exaggerates vulnerability (Frischen *et al.*, 2020), however from a livestock perspective it is a necessary measure to salvage whatever value the animals might have. Under controlled grazing, stocking rates ideally are based on forage availability and intake requirements, this is not possible under communal environments as observed in the current study. Unless robust, sustainable and resilient solutions are implemented communal farmers will continue to lose beef cattle as a result of these unfavourable climatic conditions. Results from the current study attest to this fact. Besides mitigating the effects of drought, communal farmers rely on beef cattle for many other socio-economic benefits (intrinsic value) hence droughts significantly lessons their potential, thus farmers become vulnerable. A report by Scasta et al. (2016) concluded that common drought management decisions always include reducing herd size and feeding harvested forage. However, these strategies are only short term hence livestock producers need to develop and rely on integrated long-term management strategies. Thus selection for animal traits suited for harsh and dry conditions is the most viable option especially in the face of climate change. It was generally believed that indigenous Zimbabwean breeds are hard and can survive our local conditions, but results from the current study and recent trends (Masama, 2008; Zimbabwe Agriculture Sector Disaster Risk Assessment, 2019) show that is now history and there is need to rebrand our local breeds in line with recent weather events.

Drought coping strategies

Although the government of Zimbabwe has mandated two departments; the Meteorological Services Department (MSD) and the Agriculture Research and Extension Services (AGRITEX) to monitor and report early warning signs of drought, the early warning system e at the national level is not very effective if not non-existent (Nangombe, 2012). An earlier report by Chipindu (2008) appraises that conservation is not only an essential aspect of development but a necessary requirement in drought management. As a coping strategy Nangombe (2012) alluded to the fact that livestock that is ecologically viable and such as donkeys and goats should be promoted. Evidence is brewing that smallholder farmers are increasingly troubled by unfamiliar climate dynamics (Zvigadza *et al.*, 2010), this can lead to uncertainty in this important farming sector. The research findings of lease grazing as a strategy adopted by the beef farmers in the current study concur with Magotsi *et al.* (2012) who showed that pastoral communities in non–equilibrium Kalahari ecosystems move livestock to areas where there is better grazing. Ungani (2014) found that to keep livestock alive during a drought, farmers may use commercially bought feed stocks and protein supplements (molasses and urea) to improve the palatability of the maize stover. Such practices would alleviate the impacts of drought at the same time improve nutritional status of beef animals therefore, farmers in the study area are encouraged to employ this practice. The disposal of cattle is broadly consistent with reports by Davy (2015) who coined that it is one major practise of dealing with drought because it reduces the consumption of limited forage in the communal grazing lands. This is also in agreement with Olson and Hartry (2015) who states that timely herd reduction decisions should be done and forage disaster program implementation pre-drought. In view of Masike and Urich (2012), who revealed that communal grazing

Table 6 Factors that influence adoption of drought mitigatory measures in Zaka District.

		Variables in the Equation							
		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step1[a]	Gender	-0.584	0.429	1.854	1	0.173	0.558	0.241	1.292
	Age	-0.318	0.384	0.686	1	0.408	0.727	0.342	1.545
	MS	-0.062	0.343	0.032	1	0.857	0.940	0.480	1.841
	ED	-0.627	0.304	4.255	1	0.039	0.534	0.294	0.969
	AT	-0.740	0.412	3.219	1	0.073	0.477	0.213	1.071
	HS	0.259	0.294	0.778	1	0.378	1.296	0.728	2.306
	Constant	3.534	1.650	4.586	1	0.032	34.271		
Step 2[a]	Gender	-0.611	0.401	2.317	1	0.128	0.543	0.247	1.192
	Age	-.0349	0.346	1.013	1	0.314	0.706	0.358	1.391
	ED	-0.630	0.303	4.310	1	0.038	0.533	0.294	0.965
	AT	-0.747	0.411	3.308	1	0.069	0.474	0.212	1.060
	HS	0.263	0.293	0.804	1	0.370	1.301	0.732	2.312
	Constant	3.498	1.636	4.573	1	0.032	33.037		
Step 3[a]	Gender	-0.597	0.399	2.233	1	0.135	0.551	0.252	1.204
	Age	-0.377	0.339	1.235	1	0.266	0.686	0.353	1.333
	ED	-0.628	0.304	4.270	1	0.039	0.534	0.294	0.968
	AT	-0.723	0.406	3.170	1	0.075	0.485	0.219	1.076
	HS	0.238	0.287	0.689	1	0.406	1.269	0.723	2.228
	Constant	3.245	1.507	4.638	1	0.031	25.662		
Step 4[a]	Gender	-0.605	0.398	2.309	1	0.129	0.546	0.250	1.192
	Age	-0.332	0.334	0.991	1	0.320	0.717	0.373	1.380
	ED	-0.593	0.300	3.900	1	0.048	0.552	0.307	0.996
	AT	-0.700	0.404	3.010	1	0.083	0.496	0.225	1.095
	Constant	3.426	1.492	5.272	1	0.022	30.762		
Step 5[a]	Gender	-0.576	0.396	2.113	1	0.146	0.562	0.259	1.222
	ED	-0.520	0.288	3.268	1	0.071	0.594	0.338	1.045
	AT	-0.788	0.394	3.996	1	0.046	0.455	0.210	0.985
	Constant	2.535	1.175	4.651	1	0.031	12.618		
Step 6[a]	ED	-0.443	0.279	2.517	1	0.113	0.642	0.372	1.110
	AT	-0.731	0.388	3.549	1	0.060	0.481	0.225	1.030
	Constant	1.420	0.864	2.706	1	0.100	4.139		
Step 7[a]	AT	-0.752	0.384	3.831	1	0.050	0.471	0.222	1.001
	Constant	0.406	0.570	0.508	1	0.476	1.501		

MS = marital status, ED = education status, HS = herd size, AT = agriculture training is associated uncontrolled grazing and overstocking which lead to overgrazing adoption of drought management strategies which promote individual farmer practices can be vouched for the study area. Although farmers did not confirm it, aadopting more drought tolerant livestock species like goats is a viable option for the study cite, similar conclusions have been reported by Díaz-Solís *et al.* (2009).

Drivers of adoption

Prior to the *El Niño* drought CRS (2017) reported that approximately 1.5 million rural Zimbabweans were struggling with hunger. Just after the phenomenon they reported that Zimbabwe was among the countries hardest hit by *El Niño* and that more than 2.4 million people, needed food assistance. It was noted that the respondents sometimes lack resources to get food. However other respondents stated that they can get to sleep and spend the whole day and night without food. Lack of adoption in the current study affirms earlier reports by Zvigadza, 2010, Nangombe 2012, Chitonga, 2013. Some of the reasons for this failure is attributable to fact that farmers are prone and heavily depend on relief programs and their resilience is espoused by the government's assistance which always come when a drought is looming. Such measures are reactive than proactive (Ainembabazi, 2018). Reactive responses provide short-term solutions of escaping hunger but in essence do accord farmers an opportunity to build resilience for the future. In the process reactive solutions, do not promote adoption of sustainable and adaptive technologies as indicated by Adimassu and Kessler, (2015) and, Alem and Broussard, (2016). Although the governments and NGO interventions are necessary, farmers are reluctant and discouraged from adopting risk minimizing farming practices. On the other hand, unsustainable interventions have led to this discouragement, a typical example cited by Nangombe (2012) is fodder subsidy, yet there is enough evidence that fodder production and conservation can substantially alleviate and mitigate against the adverse effects of drought.

Causes of cattle deaths

The prevalence of diseases was the major contributor to livestock loses than drought itself, these results were not expected but worrisome, however the possible reason for this could be the lack of dipping in communal areas which has become a common phenomenon (Zimbabwe Agriculture Sector Disaster Risk Assessment, 2019). In contrast ZIMVAC (2016) reported that the major cause for cattle attrition in Zimbabwe was death at 53, 46 and 42% for Matabeleland North, Manicaland and Masvingo provinces respectively. Sick animals are definitely unable to cope with a drought situation as reported by Frischen *et al.* (2020). The prevailing circumstances require imminent interventions at all levels to arrest particularly the prevalence of tick borne diseases which have been reported to cause the major cattle loses in Zimbabwe (LIMAC, 2014). Naturally cow size has a bearing on its resilience during a drought (Doy and Lamman, 2011, Scasta *et al.*, 2015), modern selection should target lower cow size which have less maintenance requirements as a long term drought mitigatory strategy (Scasta *et al.*, 2015). Although farfetched for developing countries like Zimbabwe, breeding of light-coloured animals would ameliorate the devastating effect of droughts. Similar conclusions were made by Brown-Brandle *et al.* (2006) in which black hided cattle had the greatest respiration rates, panting scores, and surface temperatures compared to red, tan, or white cattle. Furthermore, Scholtz *et al.* (2016) reported that hide texture and hair colour impacts thermal regulation leading heat stress, therefore farmers need to provide adequate water and shade. The lack of water reported in the current study was not restricted to drought only but a perennial consequence. Poor water quality plus water unavailability have been reported to hinder animal gains under rangeland management systems (Willms *et al.,* 2002).

Adoption of drought mitigatory measures

A study on the determinants of diffusion of agricultural technology results by Adensian and Zinnah (2012) concur with the study findings that traditional determinants of adoption like household size, lands size do not affect the rate of adoption but the characteristics associated with the technology do. The adoption of technologies depends on a number of factors (Chi and Yamada, 2002, Washaya *et al.*, 2016) worse still drought mitigation strategies (Ungani, 2014, UNCCD, 2019). Konje *et al*. (2015) reveals that the stimulation of agricultural growth depends on policies stimulating adoption of better agricultural production systems. Therefore, the roles played by the AGRITEX and DLPD plays a pivotal role in influencing the rate of adoption of drought coping strategies by smallholder beef farmers. Realizing the impact of droughts in the country and the increased occurrence within the past decade the Government of Zimbabwe, in collaboration with the United Nations Convention to Combat Desertification (UNCCD), has recently developed the 'National Drought Plan for Zimbabwe (UNCCD, 2019)

CONCLUSION

Cattle mortality, previous drought experience and crop losses were the main indicators of an imminent drought. Smallholder beef farmers adopted supplementary feeding, cattle disposal and lease grazing as short term mitigatory strategies against droughts. Adoption of these strategies was influenced by education status and agricultural training of the farmer and was below average. Diseases caused more cattle deaths than drought. There is need to build farmer resilience to drought situations thereby reduce their vulnerability, consequently improving their adaptive capabilities. Because rangelands are extensive, communal owned and subject to precipitation variability, individual farmer adaptations strategies, which depend on farmer circumstances, are recommended. Forage inventory prior to a drought is a practical short term recommendation for communal farmers in Zimbabwe.

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Author contribution (CRediT). P Muchaurawa – Conceptualization., **Washaya S**- Methodology, Supervision., **DD. Washaya** – Data curation,

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