

Full Length Research Paper

Pastoralist's perceptions on the impact of *Vachellia karroo* encroachment in communal rangelands of the Eastern Cape, South Africa

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The study was conducted in Alice, Eastern Cape Province, South Africa. The objective of this study was to evaluate farmers' perceptions on the impact of *Vachellia karroo* encroachment on livestock production and vegetation. Forty farmers (62% females and 38% males) were interviewed using semi-structured questionnaires. The results showed that goats and cattle were mainly kept for cash sales and sheep for wool production. Shortage of forage and lack of water points were the main constraints to livestock production, especially during the dry season. Cattle and sheep owners perceived that *V. karroo* encroachment had a negative impact on grazer production, as it reduces the grazing capacity of the veld. Goat owners viewed *V. karroo* as an acceptable tree to goats and its abundance favours browsers as compared to grazers. Although farmers have different views concerning the impact of *V. karroo* encroachment. The mean of livestock composition showed that goats (11.6±1.3) are more favoured by the veld condition compared to cattle (4.9± 1.1) and sheep (2.6±0.7). This study concludes that *V. karroo* had a negative impact on grazers' production and sheep and cattle owners observed *V. karroo* encroachment as a form of land degradation. Pastoralists recommended that veld burning and bush clearing can be used to mitigate encroachment.

Key words: Encroachment, degradation, livestock composition, *Vachellia karroo*.

INTRODUCTION

Vachellia karroo, commonly known as sweet thorn, native to Southern Africa from Angola east to Mozambique, and south to South Africa. *V. karroo* is classified as a thorn tree plant under the family of *Fabaceae*. *V. karroo* is a small to medium-sized tree and is widely distributed to

different veld types of Southern Africa (Mapiye et al., 2011). *V. karroo* has the ability to adapt to different soil types, precipitation, and temperatures (Bernes et al., 1996).

This tree becomes invasive when under disturbed,

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over, or underutilized in rangeland ecosystem, (Smet and Ward, 2005).

V. Karroo is known as one of the common encroaching woody plant in South Africa (Nyamukanza and Scogings, 2008). Numerous studies have been conducted to test various practices, which can be used to mitigate *V. karroo* encroachment. Some of these practices include the use of chemicals, bush clearing, use of fire and browsers. Use of chemical and bush clearing were reported as not economically viable because chemicals are too expensive for emerging farmers (Nyamukanza and Scogings, 2008). Use of fire in tandem with browsers was cheaper as compared to other practices, but most of the communal grazing areas have always had insufficient fuel load due to continuous grazing.

In South Africa, 80% of the land is used for agricultural purposes of which 11% is arable and 69% of the land is suitable for livestock production both commercial and communal (FAO, 2009). Communal farming in South Africa contributes 75% of agricultural output and communal farming occupies 17% of the land (FAO, 2005; Musemva et al., 2008). The transformation of vegetation from grassland to bush encroachment has resulted in a decline of livestock performance in communal areas of the Eastern Cape (Gxasheka et al., 2013). Bush encroachment has been the main constraint for livestock production in communal areas of the Eastern Cape (Solomon et al., 2014).

Smet and Ward (2006) described bush encroachment as an economic and environmental problem, which threatened livestock production and the livelihoods of farmers. Causes of bush encroachment are still poorly understood globally, but, it is linked to poor veld management practices and climate change (Ward, 2005). Bush encroachment has a negative impact on livestock production by inducing the suppressive effect on forage production and subsequently reducing the grazing capacity (Oba and Kotile, 2001; Lesoli, 2011).

V. karroo is most reported encroacher woody plant in the Eastern Cape Province (Lesoli, 2011; Solomon et al., 2014). The encroachment of *V. karroo* is gradual to such an extent that farmers could not even have noticed. Communal rangelands of Eastern Cape has no clear rangeland management practices, as a result, every community member has a free access to rangeland resources (Lesoli, 2011; Solomon et al., 2014). Lack of rangeland regulations might be one of the attributes of *V. karroo* encroachment in communal areas. Lesoli (2011) stated that poor veld management practices by pastoralists have resulted in bush encroachment (Lesoli, 2011). There is still a lack of documented information on the perceptions of pastoralists concerning the impact of *V. karroo* encroachment in communal areas. Roba and Oba (2009) believed that pastoralists have extensive indigenous knowledge on the management aspects of rangelands.

However, researchers often ignore farmers' indigenous

knowledge (Butt, 2010; Angassa and Beyene, 2003). South African government developed numerous approaches for mitigating bush encroachment, which is a form of land

degradation in communal rangelands. Some of those developments were unsuccessful because of the top-to-bottom approach used (Solomon et al., 2014). Berkes et al. (2000) also reported that the Botswana government established many programmes for addressing bush encroachment, but some of these programs were ineffective because program developers did not consider pastoralist's perceptions. Farmers are known as land users but, their understanding or perceptions on vegetation changes is often ignored by policy makers and researchers (Roba and Oba, 2009). (Roba and Oba, 2009). There are many studies, which have been conducted to assess the scientific causes and possible solutions to bush encroachment in communal areas. However, there is still lack of documented research information on the understanding of farmers' perception regarding *V. karroo* encroachment and its impact on livestock production and vegetation in communal rangelands of the Eastern Cape. The objective of this study was to evaluate farmers' perception on the impact of *V. karroo* encroachment in communal rangeland of Eastern Cape.

MATERIALS AND METHODS

Description of the study area

The study was conducted at Sheshegu village in Alice under Raymond Mhlaba Local Municipality of the Eastern Cape Province in South Africa. The area lies at 32°53 '47"58S, 26°47'8"E, and altitude of 544 m. The annual rainfall of the area ranges between 450-600mm, with February being the warmest month with an average of 25°C and July being the coldest with an average temperature of 6.3°C (Gwelo, 2012). Sheshegu village is under Bhishe thornveld vegetation type and soil parent material is that of mud-sandstone (Mucina and Rutherford, 2006) (Figure 1).

Sampling procedure and data collection methodology

Sheshegu village had about 100 (hundred) households who were livestock farmers. These households formed one farmers' association with the assistance of Extension officers. Forty households that own livestock were randomly selected for this research. Farmers' association leaders and extension officers recommended the selected households. One livestock owner (female or male) represented each household during an interview. Therefore, 40 pastoralists were interviewed using structured questionnaires (open and closed-ended). No gender restriction, both males and females were included in an interview. Farmers were interviewed based on their knowledge of rangeland vegetation and livestock production. The questionnaires were divided into four sections, namely: demographic information, livestock population, and rangeland management, rangeland condition and bush encroachment (Appendix A). The participants were interviewed separately using native language (IsiXhosa). Qualitative data for this study was collected in June 2014.

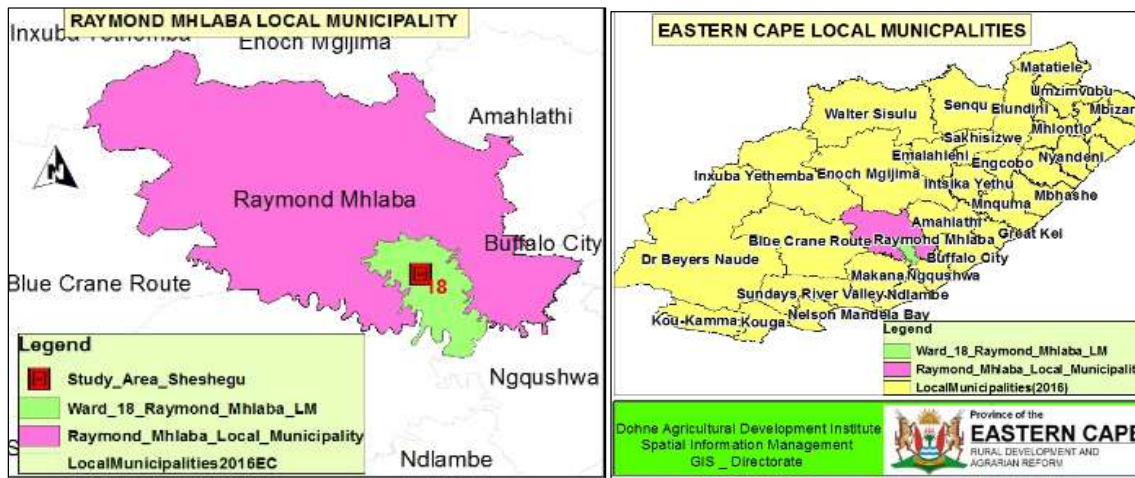


Figure 1. Map of the Eastern Cape Local Municipalities and Sheshegu indicating study area.

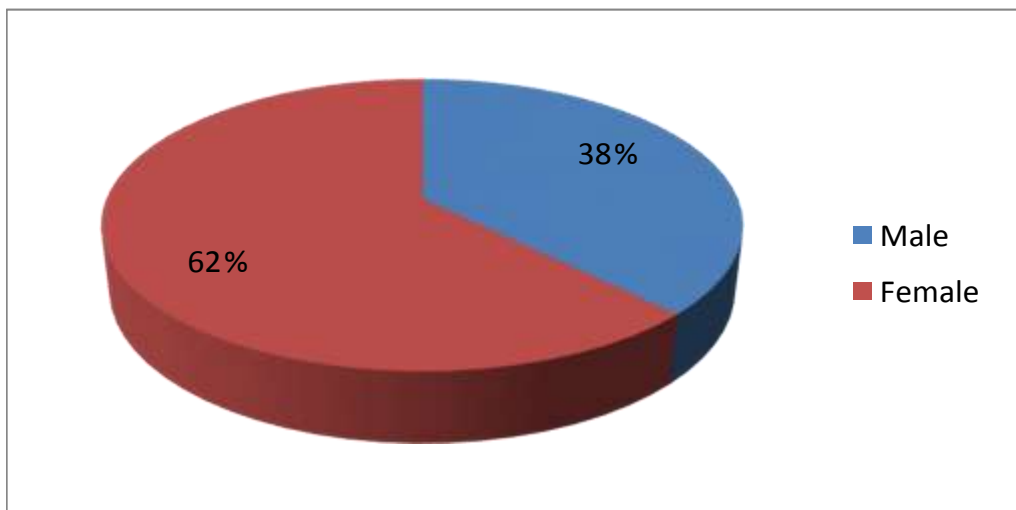


Figure 2. Proportion (%) of male and female livestock owners.

Statistical analysis

Qualitative data obtained from respondents were coded and subjected to analyses using Statistical Package of Social Science (SPSS, 2011). Descriptive statistics (frequencies, means, and percentages) were used. Friedman’s Chi-square (Steel and Torrie, 1980) test was used for ranked data. A set of sign tests for multiple comparisons of means were performed on data with significant variations. The data which Friedman’s test showed significant variation, a set of sign tests for multiple comparisons of means were performed.

RESULTS AND DISCUSSION

Demographic information of pastoralists

In this study, 62% of females participated in this study as

compared to 38% of males (Figure 2). The higher percentage of females than males was expected because some males were reported to be working during the survey. These results disagree with those published by Admasu et al. (2010) who reported less female participants as compared to males in Southern Ethiopia. Respondents in this study were mostly adults with ages ranging from 35-75 years. Lack of participation by the youth in this study could result from the fact that the majority of youth were at universities and urban areas during data collection. Baars and Aptidon (2002) reported less participation of young people in agricultural activities, but on livestock production. These results revealed that 92% of farmers attended primary and secondary schools, and 8% were illiterate (Table 1). This highlights the importance. Education as a very

Table 1. Age distribution, educational status, primary source of income and household size of respondents (n=40).

Age	Frequency	Percentage
35-45	16	40
46-55	9	22
56-65	8	20
66-75	7	18
Educational status		
Primary school	17	42
Uneducated	3	8
Secondary school	20	50
Primary source of income		
Livestock production	26	65
Work & social grant	14	35
Household size		
Adults	97	31
Youth	214	69

important tool for farming, particularly in the adoption of new technologies (Moyo et al., 2008; Katjiua Ward, 2007). Moreover, 35% of farmers depended on formal or informal jobs and social grants; whereas 65% relied on livestock farming as a primary source of income (Table 1).

Livestock composition

This study revealed that Sheshegu village had three livestock species such as goats, cattle and sheep. The mean livestock numbers owned by farmers were as follows; 11.6 goats, 4.9 cattle and 2.6 sheep (Table 1). These findings disagreed with the results of Mapiye et al. (2009) who reported 9, cattle and 7, goats; Mngomezulu (2010) also reported 12, cattle and 6, goats in the Eastern Cape. The mean of goats and sheep from this study were similar to those reported by Gwelo (2012), under Bhisho thorn veld vegetation type.

Large stock comprises of cows and heifers (9.6), calves (4.4) and bulls and oxen (0.9) respectively. The moderate proportion of bulls and oxen against high number of cows and heifers observed in this study could improve the production rate of the herd. Mating ratio per household perceived by pastoralists was 2 bulls to 20 cows. These findings were different from those reported by Solomon et al. (2014), who reported a ratio of 1 bull to 20 cows in the same province. Small stock consists of ewes (4.4), lambs (3.0), and rams and wethers (0.6); while goats comprise of doe (18.5), kids (13.7) and bucks and wethers (2.7) according to (Table 2). Farmers perceived that the control of mating ratio during the breeding is not

an easy exercise because there are no grazing camps in communal areas. Pastoralists do not care too much about the mating ratio of livestock due to the absence of grazing camps in communal areas of the Eastern Cape (Solomon et al., 2014; Mapekula, 2009).

Importance of livestock and constraints faced by farmers

Livestock plays an important role in their livelihoods of pastoralists. Pastoralists kept livestock mainly for cash sales, meat consumption and animal traction (Table 3). An income generated from livestock is used for school payments, purchase medication for livestock and household maintenance. Musemwa et al. (2010) reported that income generated from livestock through cash sales was used for households' maintenance, school fees, and food. Cash sales, meat consumption, and animal traction showed no significant difference ($P > 0.05$). Pastoralists showed less interest in animal traction because most farmers were using tractors instead of animal traction. Allsop et al. (2007) reported that animal traction has become less important because farmers rely on the government for mechanization and production inputs. Few farmers keep livestock for prestige because majority of farmers reported that they sell livestock to generate a source of income for their families. Thus, most of the pastoralists have realized that farming is a business or an investment. Mngomezulu (2010) stated that farming for prestige has declined in communal areas because most of the pastoralists are mainly farming to generating income. Most of the pastoralists stated that they sell

Table 2. Mean (\pm SE) composition of livestock species at Sheshegu village.

Livestock species	Mean (\pm SE)
Cattle	(4.9 \pm 1.1) ^b
Sheep	(2.6 \pm 0.7) ^c
Goats	(11.6 \pm 1.3) ^a
Bulls and Oxen	(0.9 \pm 0.2) ^c
Cows and Heifers	(9.6 \pm 2.2) ^a
Calves	(4.4 \pm 0.9) ^{ab}
Rams and Wethers	(0.6 \pm 0.2) ^c
Ewes	(4.4 \pm 1.2) ^a
Lambs	(3.0 \pm 0.8) ^{ab}
Bucks and Wethers	(2.7 \pm 0.4) ^c
Doe	(18.5 \pm 2.0) ^a
Kids	(13.7 \pm 1.4) ^b

Different superscripts (column) denote significant differences ($P < 0.05$) among livestock species.

livestock in local markets such as traditional ceremonies and weddings. These results are in agreement with those of Solomon et al. (2014) conducted in communal areas of the Eastern Cape.

Shortage of forage, insufficient water points, and stock theft were the most perceived challenges faced by pastoralists (Table 3). Shortage of forage, lack of water points, stock theft, and predators showed a significant difference ($P < 0.05$). Livestock diseases and the shortage of forage were most ranked (Table 3). Sheep and cattle owners indicated that an increase of *V. karroo* and prolonged drought has resulted in a shortage of feed and water for livestock. The reliance of pastoralists on native foraging methods promotes continuous grazing subsequently resulting in loss of perennial grasses (Solomon et al, 2014; Smit and Ward, 2006). Pastoralists reported scarcity of precipitation especial in winter season is a major challenge faced by pastoralist's community. Pastoralists reported that most of the boreholes, which were constructed by the government, were not maintained and some were vandalized. Dams were properly constructed, but they were reported to be dry due to prolonged drought and such as have resulted in a shortage of forage and poor performance of livestock. Shortage of feed and water due to prolonged drought or changes of weather are the most limiting factor in livestock production in the Eastern Cape (Goqwana et al., 2008; Raats, 1999). Farmers also perceived an abundance of bushes in communal areas created a very conducive environment for predators. Predators such as jackal were reported to be the serious threat to small stock most especially in encroached

areas. Kgosikoma et al. (2012) stated that sheep and goats under encroached rangelands are likely to be preyed upon by predators such as jackal.

Perceived causes and possible solutions to mitigate bush encroachment

Uncontrolled veld fires, overgrazing and climate change were perceived as causes of bush encroachment (Table 4). Uncontrolled veld fires, overgrazing, and climate change showed no significant difference ($P > 0.05$). Drought and absence of browsers were significant ($P < 0.05$) contributors compared to uncontrolled veld fires, overgrazing and climate change (Table 4). Pastoralists perceived that overgrazing, uncontrolled veld fires and climate change are the drivers of bush encroachment (Table 4). Ward (2005) reported that causes of bush encroachment are poorly understood, but bush encroachment is linked to climate change and poor management of veld management practices. Pastoralists stated that livestock were not kraaled during the winter season as result animals graze day and night. Uncontrolled grazing in communal areas promotes loss of soil cover and heavy or selective grazing in communal areas. Under heavy grazed area, grasses tend to use less water due to low photosynthesis rate and such creates a very conducive environment for the woody plant to recruit themselves (Ward, 2005; Smit and Ward, 2006). In addition, some of the pastoralists believed that the summer season has more rainfall with rapid recovery growth rate from grazing whereas winter has less rainfall

Table 3. The purpose of livestock keeping and challenges faced by farmers, (1 = most important and 6= least important), (respondents n=40).

Purpose	Mean Rank (\pm SE)	Rank
Milking purposes	3.0(0.11) ^d	3
Cash Sales	4.8 (0.13) ^a	1
Meat consumption	4.7(0.14) ^{ab}	2
Animal traction	4.3(0.24) ^{abc}	4
Prestige	3.0(0.17) ^d	5
Challenges		
Livestock diseases	1.4 (0.12) ^d	1
Predators	2.2 (0.15) ^c	4
Shortage of forage	4.7(0.09) ^a	2
Lack of water points	3.9(0.12) ^{ab}	4
Stock theft	2.8(0.14) ^{cd}	3

Different superscripts (column) denotes significant difference among the reasons and challenges at (P<0.05).

Table 4. The perceived causes of bush encroachment and possible solutions to control bush encroachment (1= Most important, 5= least important) (n=40).

Causes	Mean Rank	Rank
Drought	1.7 (0.75) ^d	5
Absence of browsers	1.4(0.39) ^d	4
Uncontrolled veld fires	4.6(08.5) ^a	2
Climate change	3.4(0.78) ^{abc}	3
overgrazing	4.0(0.72) ^{ab}	1
Possible solution to control bush encroachment		
Veld burning	2.8(0.08) ^b	3
Destocking	5.5(0.06) ^a	5
Increasing browsers	2.2(0.16) ^b	1
Increasing grazing	2.3(0.25) ^b	2
Bush clearing	3.3(0.25) ^b	4

Different superscripts denote significant difference (P<0.05) between the causes and possible solutions.

with slow regrowth rate hence their livestock were not kraaled in winter. These findings are not in agreement with the results of Moyo et al. (2008) who reported that communal farmer's kraal livestock at night in all seasons for improving forage for next grazing and preventing stock theft.

Pastoralists are aware of overgrazing of forage material because in this study they perceived that continuous grazing has resulted in the loss of perennial grass species. Loss of perennial grasses through overgrazing has resulted in a shift from grasses to bush dominated ecosystem. Gxasheka et al. (2013) stated that grazing without resting and unplanned grazing might be the

possible drivers of bush encroachment in communal areas. Lesoli (2011) argued that overgrazing, selective grazing and uncontrolled veld fires in communal areas are weakening the competitiveness of grasses against woody plants. Pastoralists have a little understanding of climate change, but, these farmers believe that uncontrolled veld fires and prolonged drought due to change in weather patterns have resulted in an occurrence of encroacher species. Tainton (1999) reported that fire can be either a good or a bad tool for controlling undesirable, therefore understanding fire behaviour and its impact on the vegetation is crucial.

Pastoralists have a different understanding concerning

bush encroachment because goat owners perceived that *V. karroo* is highly palatable to goats. Some of the Pastoralists particularly goat owners believed that the abundance of *V. karroo* favours goat production, but goats alone cannot control bush encroachment. Tainton (1999) highlighted that goats cannot completely control bush encroachment, browsers can be used to control the coppicing of woody plant, but goats cannot browse at a height of 1.5 meters. On other hand, sheep owners perceived that *V. karroo* has a negative impact on grazers because *V. karroo* reduces the grazing capacity of the veld. *V. karroo* has long spikes, therefore it causes injuries to livestock animals. Lesoli (2011) reported similar findings on the research that was conducted in the same province.

The results from this study revealed that destocking was regarded as a significant ($P < 0.05$) solution to control bush encroachment as compared to an increase of livestock (grazers and browsers), and veld burning. An increase of grazers and browsers were the most ranked solution to address to bush encroachment. Although they have different views regarding bush encroachment, farmers perceived that the spread of *V. karroo* need to be controlled because this tree is encroaching even on abandoned croplands and in open grasslands. Some Pastoralists believed that a reduction of livestock numbers (destocking), bush clearing, and veld burning might a possible solution for controlling bush encroachment. Smit (2004) stated that bush clearing, veld burning, and proper application of veld management practices can be used to mitigate the spread of encroacher species in communal areas. From a practical point of view, the application of fire (veld burning) might not work in some communal areas due to the fact fire for killing woody plants requires more fuel load for producing higher fire intensity. Grazing without resting reduces fuel, which is essential for the hot fire (Thomas et al. 2000). Application of bush clearing in an overgrazed area might lead to soil erosion. Therefore, veld resting is important because it improves biomass production and competitiveness ability of grasses against woody plants. Bille and Assefa (1983) argued that bush clearing and veld burning under overgrazed landscape cannot be recommended as control measures of bush encroachment. Smit (2004) highlighted that the phytomass of *V. Karroo* can be reduced where there is an adequate fuel load.

CONCLUSION AND RECOMMENDATIONS

This study concludes that livestock production plays a crucial role in the livelihood of pastoralists. Livestock production is constrained by bush encroachment, shortage of feed and lack of dams or drinking water points. Pastoralists have a different perception concerning the impact of *V. karroo*, but some farmers

believe that *V. karroo* needs to be controlled to a point where grazers and browsers can benefit equally from rangeland resources. The gradual spread of *V. karroo* favours goat production, at the expense of grazers.

Pastoralists have no rules and regulations on the management of rangelands resources. Poor management of veld has resulted in poor veld condition and the transformation of grassland to bush dominated ecosystem. Pastoralists believed that the use of fire (veld burning) and bush clearing could be used to mitigate bush encroachment. Therefore, more studies are still needed to evaluate the understanding of communal and commercial farmers on vegetation transformation adaptability. This study recommends that land care programmes should be implemented to restore rangelands. During the implementation of land care projects, Pastoralists should receive training and demonstrations that can complement their knowledge.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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Appendix A: Questionnaire used to interview farmers at Sheshegu village

Title: Pastoralist's perceptions on the impact of *V. karroo* encroachment in communal rangeland of the Eastern Cape, South Africa

The objective: to evaluate farmers' perception toward the impact of bush encroachment on livestock production and vegetation

Name of interviewer.....Date.....Village.....

Name of respondent.....Questionnaire reference number.....

INSTRUCTIONS: Fill in the relevant information and where possible mark with an X
DEMOGRAPHIC INFORMATION

A.1 Gender

Male		Female	
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A.2 Age

Age	15-30	30-40	40-50	Above 50
Mark with an X				

A.3 Household size

Number of adults	Number of children (<21 years)

A.4 Level of education

Levels of education	Primary school	Secondary school	Tertiary education	Other
Mark with X				

A.5. The primary source of income.

Sources of income	Mark with X
Livestock production	
Work and social grant	
Other	

LIVESTOCK POPULATION

B.1 Livestock types and numbers

Livestock type	Numbers			
Cattle	Bulls	Cows & heifers	Calves	total

Livestock type	Numbers			
Sheep	Ram	ewe	lambs	total

Livestock type	Numbers			
Goats	Buck	Boer	kids	total

B.2. Why are you keeping livestock? (In order of importance 1= most important, 5=least important)

Purposes	mark with X	Rank
Milking purposes		
Cash Sales		
Meat consumption		
Animal traction		
Prestige		

B.3 What trend do you observed from livestock population?

Trend	Increasing	Decreasing	Remain the same
Mark with X			

B.4 What challenges are you facing on livestock production? (1= most important, 5= Least important).

Challenges	mark with X	Rank
Shortage of forage		
Lack of water points/dams		
Predators		
Animal diseases		
Stock theft		

B.5. Which type of livestock do you prefer to keep? Grazers [] or browsers [] and why?

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B.6. Which type of livestock is currently increasing? Grazers [] or browsers [] and what could be the reason such an increase?

.....

B.7. Which type of livestock is currently decreasing? Grazers [] or browsers [] and what could be the reason for such a decrease?

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RANGELAND MANAGEMENT

C.1 What type of grazing systems do you practice in your rangeland?

Types of grazing systems	Continuous grazing	Rational grazing	Other
Mark with X			

C.2 What time of the year do you experience a shortage of grazing material?

Seasons	Winter	Summer	Spring	Autumn
Mark with X				

C.3. Do you practice any veld management practices in your rangeland? Yes [] or No [] If yes fill the table below

Practices	How often?	In which season(s)
Veld burning		
Veld resting		
Rotational grazing		
Other (Specify)		

RANGELAND CONDITION AND BUSH ENCROACHMENT

D.1 Which woody plant (s) species were dominant before *V. karroo* encroachment in your rangeland?

Name of woody plant species:

D.2 Which woody plant species currently dominating in your rangeland?

Name of woody species:

D.3 Which woody plant species mostly preferred by livestock in your rangeland?

Name of woody species:

D.4 Do you notice any shift from grassland to bush dominated ecosystem in your rangeland in your rangeland? Yes [] or No [] If yes what could be the reason

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D.5 Is there any problem of land degradation in your rangeland? Yes [] or No [] If yes what could be the reason

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D.6 How would you describe the rangeland condition under this encroachment of *Vachellia karroo*? Good [], Fair [], poor [], justify your answer?

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D.7 What do you utilize rangeland for?

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D.8 Does your community have grazing camps? Yes [] or No [] If yes, for what purposes?

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D.9 Do you notice bush encroachment in your rangeland? Yes [] or No []

D.10 Do you consider *V. karroo* as an encroaching woody plant in your rangeland? Yes [] or No [] and justify your answer

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D.11 From your point of view, what should be done in order to eradicate/control *V. karroo* encroaching species? (1=most important and 5=least important).

Possible solution	Mark with X	Rank
Veld burning		
Destocking		
Increasing browsers		
Increasing grazing		
Bush clearing		

D.12 What could be the causes of *V. karroo* encroachment in your rangeland? (1= most and 5=least).

Causes	Mark with X	Rank
Veld burning		
Drought		
Absence of browsers		
Uncontrolled veld fires		
Climate change		
overgrazing		

D.13 Do you think *V. karroo* encroachment has an impact on livestock production? Yes [] or No [], justify your answer?

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D.14. Do you think *V. karroo* encroachment has an impact on herbaceous vegetation? Yes [] or No [], justify your answer

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Any comment:

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