MONITORING REPORT ON INDIGENOUS ZULU SHEEP CONSERVATION PROJECT IN KWAZULU-NATAL

Directorate: Genetic Resources

Sub-directorate: Farm Animal Genetic Resources

—March 2020—

agriculture, land reform & rural development

Department:
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ACRONYMS

AnGR	Animal Genetic Resources
ARC-API	Agricultural Research Council-Animal Production Institute
DALRRD	Department of Agriculture, Land Reform and Rural Development
D:GR	Directorate: Genetic Resources
FAnGR	Farm Animal Genetic Resources
FAO	Food and Agriculture Organisation
KZNDARD	KwaZulu-Natal Department of Agriculture and Rural Development

1. Introduction

The importance of conserving farm animal genetic resources through community-based management has been highlighted in literature (Bayer et al., 2001; Dossa et al., 2009; Köhler-Rollefson, 2001; Rege, 2001; Wollny, 2001). Effective conservation of animal genetic resources (AnGR) is only possible if there is full participation of communities keeping the animals towards conservation efforts. This is because communities (individually or as a group) are responsible for making decisions for all actions involved in the management of AnGR, such that these resources are best used to meet immediate and short-term requirements for food and agriculture and remain available to meet possible longer-term needs (Rege, 2001). Furthermore, the animals are subjected to a process of genetic and/or environmental manipulation by the communities who are keeping them with the aim of sustaining, utilising, restoring, enhancing and characterising the quality and/or quantity of the AnGR and their products (e.g., meat, milk, manure, etc) (Rege, 2001).

The Department of Agriculture, Land Reform and Rural Development (DALRRD) through its Directorate: Genetic Resources (D: GR) has conducted a programme of Zulu sheep characterisation. The programme was conducted in 2012/2013 in two district municipalities (Zululand and uMkhanyakude). Activities that were undertaken included consultation with relevant stakeholders which included the KwaZulu-Natal Department of Agriculture and Rural Development (KZNDARD), the Agricultural Research Council-Animal Production Institute (ARC-API), the University of Zululand and farmers who keep Zulu sheep in the two district municipalities.

During the 2013/2014 financial year, this Zulu sheep conservation project were initiated in KwaZulu-Natal, specifically in the Zululand District Municipality under the Nongoma Local Municipality and in the uMkhanyakude District Municipality under the Jozini Local Municipality. The work was done diligently and a report on phenotypic and genetic characterisation of the Zulu sheep was shared with the district officials involved. Another flock of Zulu sheep (15 ewes and five rams) was established at the Agricultural Research Council: Animal Improvement Institute (ARC-AII) in the same financial year (2013/2014). More research was conducted which increased the population of the breed as it is standing at 110 animals.

In the current 2019/2020 financial year, DALRRD Directorate: Genetic Resources, Sub-directorate: FAnGR would be monitoring the Zulu sheep conservation project which was commissioned in the 2014/2015 financial year. This sub-directorate has developed a draft collection tool to be used during monitoring that was shared with KZNDARD officials for inputs and comments before it was called the final draft. In July 2019, the Sub-directorate: FAnGR met with the KZNDARD team and it was agreed that monitoring will be conducted in the third quarter.

In October 2019, the Sub-directorate: FAnGR together with the Zululand (Nongoma Municipality) and uMkhanyakude (Jozini Municipality) districts team monitored the indigenous Zulu sheep conservation project. The monitoring was done in order ensure to document demographics/general information, understanding to conserve and sustainably use indigenous Zulu sheep, flock composition, qualitative morphological characteristics, husbandry practices and challenges and also to ensure that indigenous Zulu sheep are conserved in situ. This report was developed in order to report back on the monitoring of the indigenous Zulu sheep conservation project in the Zululand District (Nongoma Municipality) and the uMkhanyakude District (Jozini Municipality).

2. Literature review

2.1 Characteristics and roles of Zulu sheep

The Zulu sheep breed is an indigenous sheep of South Africa. This sheep breed is characterised by either thin or fat tails, is multicoloured and has a coat of either wool or hair (Kruger, 2001). The dominant colours are brown and a brown-and-white colour combination. Brown or dark brown adult sheep are born as black lambs

and the colour gradually changes to brown or dark brown as the lambs grow (Kunene et al., 2007). There is variation in ear length: from ear buds and short prick ears to long pendulous ears (9 cm to 14 cm) (Kunene et al., 2007). Phenotypic characteristics of animals are very important and the FAO (2012) indicates that they are fundamental to the establishment of national inventories of AnGR for effective monitoring of AnGR populations and to the establishment of early-warning and response systems for AnGR.

This breed of sheep is mainly kept by the rural/communal farmers of KwaZulu-Natal. They are a source of food and income for the rural farmers of KwaZulu-Natal (Kunene & Fossey, 2006). The Zulu sheep have various adaptability traits which include the ability to reproduce in the hot and humid climate of KwaZulu-Natal and resistance to tick-borne diseases, therefore, farmers do not dip the Zulu sheep (Kunene & Fossey, 2006). Other characteristics include the ability of these animals to sustain their weight between the dry and the wet seasons without any supplements because of their foraging behaviour (Nyamukanza et al., 2009). Kunene (2010) also reports that Zulu sheep in the rural areas of KwaZulu-Natal has good meat quality and are used as a source of protein and are not used for any cultural purposes.

2.2 The importance of conservation and sustainable use of indigenous animals

Conservation, sustainable use and development are some of the strategic priority areas of the Global Plan of Action for Animal Genetic Resource which was adopted by 109 country delegations at the International Technical Conference on Animal Genetic Resources which was held in Interlaken, Switzerland, from 3 to 7 September in 2007 and South Africa through the DALRRD is part of the signatories for the plan (FAO, 2007). This conference also adopted the Interlaken Declaration on Animal Genetic Resources, which affirms countries' commitment to the implementation of the Global Plan of Action and to ensure that the worlds' livestock biodiversity is utilised to promote global food security and remains available to future generations (FAO, 2007). This implies that every country must make an effort to ensure that their diversified indigenous farm animal genetic resources are sustainably conserved and utilised for food and agriculture and also to ensure their future availability. As such, South Africa, through the DALRRD D: GR developed and implemented the National Plan for conservation and sustainable use of FAnGR from the 2015/2016 financial year to the 2018/2019 financial year and it is now in the process of finalising the developed National Strategy and Action Plan for conservation and sustainable use of FAnGR.

The main reasons for conservation and sustainable use of FAnGR are well articulated in the FAO (2007) and Gibson et al. (2005) and one of them is to prevent genetic erosion and/or extinction. The number of Zulu sheep owned by the farmers, as compared to goats and cattle, is very low (Kunene & Fossey, 2006). It has already been reported by Kruger (2001) that the Zulu sheep numbers are declining and one of the reasons is substitution with other breeds. A survey conducted by Nsahlai et al. (2009), as cited by Kunene (2010) in four districts, i.e., Uthungulu, Amajuba, Zululand and uMkhanyakude, revealed that 156 communal farmers owned a total of 4 031 Zulu goats, 2 424 cattle and 433 Zulu sheep. These surveys may be indicating that the numbers of these sheep are declining. Furthermore, several authors indicate that the population of Zulu sheep is declining due to uncontrolled and indiscriminate cross-breeding with exotic breeds for improving the body weight and frame of sheep (Kunene et al., 2014; Mavule, 2012; Mavule et al., 2013; Mavule et al., 2016). Uncontrolled and indiscriminate cross-breeding is one of the factors that leads to genetic erosion and eventually extinction of Animal Genetic Resources (AnGR) (FAO, 2007; Mavule, 2012).

2.3 Demographics of sheep farmers

To understand and know the characteristics of the group of people and/or population one is dealing or interacting with, the demographic information of the said group/population is necessary. Demographic information, among other things, include but are not limited to age, race, sex, employment, education and source of income (Abraham et al., 2017; Taye et al., 2016). Literature shows that the demographics of sheep farmers have been

studied in different parts of the country (Mavule, 2012; Kom, 2017; Fourie et al., 2018). These studies report that in terms of gender the proportion of male respondents are higher than the female respondents (Mavule, 2012; Kom, 2017; Fourie et al., 2018); a higher proportion of adults and old people are involved in farming as compared to youth (Mavule, 2012; Kom, 2017); in terms of source of income a large proportion of respondents depend on livestock production (Mavule et al., 2013) and old age pensions (Kom, 2017) and the majority of these respondents attended secondary school education (Kom, 2017; Fourie et al., 2018).

2.4 Livestock flock sizes and composition

Monitoring of changes in flock sizes is one of the factors that are important in capturing information on the productivity of sheep over seasons (Mapiliyao et al., 2012). Flock composition is the number of animals (sheep) by age and sex and it includes, among others, ewes (mature and young), rams (intact mature, intact young, castrates) and lambs. Mavule et al. (2013) reported an average sheep flock size of 39.8, with each flock consisting of 3.12 rams, 21.81 ewes, 4.98 yearlings and 9.92 lambs. The proportion of ewes/mature ewes/breeding ewes in the flocks was reported to be representing the largest class followed by other classes: suckling lambs, yearlings, castrates and rams (Mavule et al., 2013; Adimasu et al., 2019). The authors further made assumptions that the proportion of ewes was higher than those of other classes because they were kept for production and breeding purposes and other classes, particularly males (castrates and rams), were sold to generate cash or slaughtered for house consumption.

There are low numbers of indigenous Zulu sheep in the country (Kunene & Fossey, 2006), particularly because this breed is only located in KwaZulu-Natal (Kunene et al., 2014). Nsahlai et al. (2009) reported that 156 communal farmers in certain districts of KwaZulu-Natal owned a total of 4 031 Zulu goats, 2 424 cattle and 433 Zulu sheep. However, the number of smallstock in other parts of the continent as compared to other livestock species is large. A study by Abraham et al. (2017) reveals that the majority of famers in Western Tigray, North Ethiopia, owns on average 43.67 goats, 42.90 sheep, 10.19 cattle, 9.70 chickens and 0.96 donkeys.

2.5 Management of sheep

The management and production systems employed in South African sheep farming are divided into three and these include intensive, semi-intensive and extensive systems (Cloete and Olivier, 2010). It was reported by Kunene (2010) and Kunene et al. (2011) that the indigenous Zulu sheep are managed extensively. The author (Kunene, 2010) further indicated that some farmers apply indigenous knowledge as part of management practices and gave an example that they use indigenous plants as nutrient supplements for increasing the reproduction rate of these animals. The characteristics of the Zulu sheep production system in the rural communities of KwaZulu-Natal have also been reported by Mavule et al. (2013). In all three production systems, sheep farmers experience many challenges and constraints; however, the focus will be put more on the extensive production system. The limiting factors, constraints or challenges in the sheep production system, particularly the extensive system, have been studied by several researchers (Rauniyar et al., 2000; Kunene and Fossey, 2006; Fikru and Gebeyew, 2015; Fourie et al., 2018 and Mthi and Nyangiwe, 2018). The challenges or constraints reported by various authors are presented in Table 1.

Table 1. The limiting factors, constraints or challenges in extensive production systems.

The most important challenges/ constraints	Country and/or province	Authors
• poor performance of local sheep-breeds • a serious seasonal deficit of pastures and other feed • lack of an organised market for wool and meat • poor access to agricultural credit • primitive shearing equipment • inadequate supply of drinking water for sheep	Nepal	(Rauniyar et al., 2000)
• lack of extension services • theft • parasites and predators as their main constraints	South Africa, KwaZulu-Natal	(Kunene and Fossey, 2006)
• diseases and parasites • drought • feed, grazing land and water shortages • marketing problems	Ethiopia	(Fikru and Gebeyew, 2015)
• poor animal health management skills • poor animal nutritional management • inadequate support services from the government and other related stakeholders • insufficient land availability to expand production • inadequate agricultural farming equipment • lack of reproduction and production management skills • poor marketing skills	South Africa, Free State	(Fourie et al., 2018)
• diseases and parasites • shortage of feed • lack of infrastructure • organised market access • lack of water availability • high cost of drugs/vaccines • stock theft	South Africa, Eastern Cape	(Mthi and Nyangiwe; 2018)

3. Materials and method

3.1 Monitoring site

The monitoring was carried out in the Zululand (Nongoma Municipality) and uMkhanyakude (Jozini Municipality) districts in several villages. These villages included Kwa-Mabhengu, Mkhonjane, Mthelu, Makonyeni, Biva, Gedleza, Mgamunde, Ebukhaleni, Hawini, Mvulazi, Dikwe and Maphaphadwene. These villages are situated

between latitudes 27° 07' S and 29° 00' S and longitudes 29° 52' E and 32° 04' E with an altitude range of 90 m to 1 900 m above sea level and annual rainfall ranging from 600 mm to over 1 400 mm (Mavule et al., 2013).

3.2 Identification of indigenous Zulu sheep farmers

The Sub-directorate: FAnGR had a list of indigenous Zulu sheep farmers: eight from the Jozini and 10 from Nongoma Municipalities. All indigenous Zulu sheep farmers from the list were considered for visits and interviews.

3.3 Data collection

Eighteen (18) indigenous Zulu sheep farmers were visited individually at their households and were interviewed. Personal observation and counting was used to verify flock composition of each farmer. Personal observation was also used to verify the qualitative morphology of the sheep. A monitoring questionnaire was used to record information such as demographics/general information, understanding to conserve and sustainably use indigenous Zulu sheep, flock composition, qualitative morphological characteristics, husbandry practices and challenges.

3.4 Data preparation and manipulation

Fieldnames and columns for combining more than one coat colour and livestock species owned were created. Codes were allocated to age in years and education level for ease of identification and analysis.

3.5 Data analysis

Data collected were entered, manipulated, prepared and analysed using the SPSS (SPSS, 2017) and an Excel spread sheet. Means and frequency procedures of SPSS and an Excel spread sheet were used to determine descriptive statistics of variables for demographics/general information, understanding to conserve and sustainably use indigenous Zulu sheep, flock composition, qualitative morphological characteristics, husbandry practices and challenges.

4. Results and discussions

4.1 General information/demographics of goat farmers

Most of the respondent farmers were males (89%) and aged 61 to 70 years (33%) followed by farmers aged 41 to 50 years and >70 years at the same proportion (22%). These gender and age results were also most frequent in the Nongoma Municipality, but with different percentages, while the Jozini Municipality recorded the ages from 41 to 50, 61 to 70 and >70 years as the most frequent at the same proportion of 25%. The most frequent gender in both municipalities was male but with varying proportions. This result implies that the majority of indigenous Zulu sheep farmers in the Nongoma and Jozini municipalities are men and pensioners (old). Higher proportion of male respondents than female respondents and higher proportion of adults and old people are involved in farming as compared to youth were reported in Mavule (2012) and Kom (2017).

As evident by age in years, the main source of income for the majority of indigenous Zulu sheep farmers was government pensions (50%), followed by crop and/or livestock sales (28%). The pension was also recorded as the most frequent source of income for respondent farmers in both municipalities with the same proportion. As previously mentioned, this result corresponds with the age of farmers as the majority of them are old and 61 to 70 years old . Kunene and Fossey (2006) indicated that the main source of income for livestock producers in some traditional areas of Northern KwaZulu-Natal is a combination of sales (agricultural produce and cold

drinks) and work (36,8%). However, Mavule et al. (2013), who studied the characteristics of the Zulu sheep production system, reported livestock production as the major source of income identified by farmers.

The majority of the interviewed indigenous Zulu sheep farmers had acquired primary school education between grades 0 and 3 (44%). The most frequent educational level recorded in both municipalities was between grades 0 and 3 but with varying proportions. These studies by Kom (2017) under bush encroached and non-encroached areas of the Eastern Cape and Fourie et al. (2018) in the eastern Free State reported that the majority of the respondents (sheep farmers) attended secondary school education. The frequencies for demographics of indigenous Zulu sheep farmers are presented in Table 2.

Table 2. Frequencies for demographics of indigenous Zulu sheep farmers

Variables	Municipalities					
	Jozini		Nongoma		Overall	
	N	%	N	%	N	%
Gender						
Female	1	12.5	1	10.0	2	11.1
Male	7	87.5	9	90.0	16	88.9
Age in years						
≤30	0	0	0	0	0	0
31 - 40	1	12.5	1	10.0	2	11.1
41 - 50	2	25.0	2	20.0	4	22.2
51 - 60	1	12.5	1	10.0	2	11.1
61 - 70	2	25.0	4	40.0	6	33.3
>70	2	25.0	2	20.0	4	22.2
Unknown	0	0	0	0	0	0
Source of main income						
Employed	0	0	3	30.0	3	16.7
Pension	4	50.0	5	50.0	9	50.0
Social grant	1	12.5	0	0	1	5.6
Crop and/or livestock sales	3	37.5	2	20.0	5	27.8
Family member/relatives	0	0	0	0	0	0
Other	0	0	0	0	0	0
Educational level						
0 to Grade 3	3	37.5	5	50.0	8	44.4
Grade 4 – Grade 7	2	25.0	1	10.0	3	16.7
Grade 8 – Grade 10	2	25.0	0	0	2	11.1
Grade 11 – Grade 12	0	0	2	20.0	2	11.1
Post Grade 12 certificate	0	0	2	20.0	2	11.1
Diploma	1	12.5	0	0	1	5.6
Degree	0	0	0	0	0	0

4.2 Husbandry practices of indigenous Zulu sheep farmers

All the respondent farmers interviewed kept their sheep extensively (100%) on communal land. These results are in agreement with Kunene (2010), Kunene et al. (2011) and Mavule et al. (2013), who reported that the indigenous Zulu sheep are managed extensively.

Most of the respondent sheep farmers do not keep records (83%). These same results, but with varying proportions, were recorded in both municipalities. The importance of record keeping, particularly breeding records for selection of replacement breeding animals, has been reported in the study by Dossa et al. (2015).

These results showed that the majority of the respondent farmers (67%) have not sold sheep in the last 12 months. The minority of the respondents (33%) have sold sheep privately in the last 12 months. This result suggests that there is limited markets in place for farmers to sell their sheep. However, other studies reveal that the majority of farmers, particularly in a village or communal setup, sell live animals on an informal basis to consumers, traders and to a lesser extent other farmers (Tsegaye, 2009) and no sales are made at auctions, to butchers or abattoirs (Mahanjana and Cronjé, 2000). The frequencies for husbandry practices of indigenous Zulu sheep farmers are presented in Table 3.

Table 3 Frequencies for husbandry practices of indigenous Zulu sheep farmers

Variables	Municipalities					
	Jozini		Nongoma		Overall	
	N	%	N	%	N	%
Production system						
Off farm/communal extensive	8	100.0	10	100.0	18	100.0
On-farm extensive	0	0	0	0	0	0
Semi-intensive	0	0	0	0	0	0
Intensive	0	0	0	0	0	0
Do you keep records?						
Yes	1	12.5	2	20.0	3	16.7
No	7	87.5	8	80.0	15	83.3
Type of records						
Breeding record	0	0	0	0	0	0
Health record	1	12.5	1	10.0	2	11.1
Production record	1	12.5	2	20.0	3	16.7
Financial record	1	12.5	0	0	1	5.6
Other	0	0	0	0	0	0
Have you sold your indigenous Zulu sheep in the last 12 months?						
Yes	4	50.0	2	20.0	6	33.3
No	4	50.0	8	80.0	12	66.7
If yes, where did you sell?						
Auction	0	0	0	0	0	0
Butcher	0	0	0	0	0	0
Abattoir	0	0	0	0	0	0

Variables	Municipalities					
	Jozini		Nongoma		Overall	
	N	%	N	%	N	%
Privately	4	50.0	2	20.0	6	33.3
Other	0	0	0	0	0	0

4.3 Understanding of conservation and sustainable use of indigenous Zulu sheep by farmers

The overall results showed that the majority of the respondent farmers have an understanding that the indigenous Zulu sheep must be conserved and sustainably used because they provide food, meat or use for household consumption (67%); provide income (50%) and they are adapted or tolerant to environmental conditions, for example, diseases and parasites (44%). The same major understandings were recorded in both the Jozini and Nongoma Municipalities; however, the variables differed with proportions. Other variables of understanding conservation and sustainable use of indigenous Zulu sheep, such as for cultural ceremonies, treasure and pride, were indicated by the respondent farmers in Jozini Municipality only and for next or future generation, the breed is in high demand by the respondents in Nongoma Municipality only. This implies that the respondent farmers have different views in terms of the understanding of conservation and sustainable use of indigenous Zulu sheep. The understanding of conservation and sustainable use of indigenous goats by the respondent farmers is in agreement with other literatures (FAO. 1999; FAO. 2007; Wollny, 2001). The frequencies for understanding of conservation and sustainable use of indigenous Zulu sheep by farmers are presented in Table 4.

Table 4 Frequencies for understanding conservation and sustainable use of indigenous Zulu sheep by farmers

Variables	Municipalities					
	Jozini		Nongoma		Overall	
	N	%	N	%	N	%
Provide food, meat or for household consumption	7	87.5	5	50.0	12	66.7
Provide income	6	75.0	3	30.0	9	50.0
Adapted or tolerant to environmental conditions, for example, diseases and parasites	2	25.0	6	60.0	8	44.4
Cultural ceremonies	1	12.5	0	0	1	5.6
For next or future generation	0	0	2	20.0	2	11.1
Treasure	1	12.5	0	0	1	5.6
Pride	1	12.5	0	0	1	5.6
The breed is in high demand	0	0	1	10.0	1	5.6

4.4 Flock size and composition

The overall average flock size of sheep, goats, cattle, poultry and pigs in the present study was 24, 31, 38, 29 and 5 per household, respectively. The overall results reveal that the respondent farmers have a lot of cattle, which is more than any other species studied. The results for the respondents in the Jozini Municipality followed the overall and were found to have a lot more cattle than any other species while those in the Nongoma Municipality own on average more goats and poultry than any other species. These results are in agreement with a study by Mavule (2012) that reveals that the majority of famers in the rural areas of KwaZulu-Natal owns

in terms of proportion more cattle than any other species (goats and sheep). The average livestock flock sizes (N) are presented in Table 5.

The present overall findings revealed that the proportion of mature ewes (61) represents the largest class followed by suckling lambs (19) and young ewes (15) while castrates (10), young rams (9) and mature bucks (13) represent the lowest proportion. The same trends for mature ewes and suckling lambs were followed in both of the municipalities except for young ewes. This is because of that the mature rams and castrates (14) represented the third largest proportion in Nongoma while in Jozini, the mature rams only (11) were recorded as the third largest proportion. The same finding was reported for other livestock species and sheep breeds in the country and elsewhere on the continent and the world (Abraham et al., 2017; Adimasu et al., 2019; Dossa et al., 2015; Mavule, 2012). The larger proportion of mature ewes than other age groups suggests that mature females are seldom sold and slaughtered; they however remain in the flock for breeding purposes. The lowest proportion of castrates, young rams and mature rams might be due to that they are often marketed and slaughtered and also that the respondents recognised the importance of keeping only few bucks with good quality characteristics to use for breeding purposes. Average livestock flock size (N) and indigenous goat flock composition (% of total flock size per household) are presented in Table 5.

Table 5 Average livestock flock size (N) and indigenous Zulu sheep flock composition (% of total flock size per household).

Flock size (N)	Municipalities					
	Jozini		Nongoma		Overall	
	N	Mean ± SD	N	Mean ± SD	N	Mean ± SD
Sheep	299	37.38 ± 28.61	110	12.22 ± 6.67	409	24.06 ± 23.41
Goats	266	33.25 ± 4.50	199	28.43 ± 22.49	465	31.0 ± 15.26
Cattle	470	58.75 ± 64.69	207	20.7 ± 16.23	677	37.61 ± 47.34
Poultry	234	29.2 5± 10.73	287	28.7 ± 20.96	521	28.94 ± 16.73
Pigs	5	5	0	0	5	5
Flock composition (%)						
Mature ewes (more than 1 year old)	178	58.13 ± 16.18	64	63.10 ± 16.48	242	60.76 ± 16.03
Castrates (lambs, young and adults)	2	2.96 ± 1.97	10	14.00 ± 11.71	12	10.32 ± 10.75
Mature rams (more than 1 year old)	19	11.45 ± 9.98	11	14.22 ± 7.93	30	12.74 ± 8.87
Young rams (6 months – 1 year)	13	8.55 ± 8.36	2	8.70	15	8.59 ± 6.83
Young ewes (6 months – 1 year)	46	16.28 ± 8.80	7	12.81 ± 2.70	53	15.24 ± 7.49
Lambs (0 – 6 months)	41	16.31 ± 9.80	16	21.56 ± 14.80	57	18.94 ± 12.28

4.5 Livestock ownership pattern by farmers

The overall results showed that a large number of livestock owned by the interviewed farmers were cattle (33%) followed by poultry (25%) and in terms of combinations of livestock kept, most of the respondent farmers kept sheep, cattle, goats and poultry (73%). Most of the respondent farmers in Jozini were found to own large number of cattle as well followed by sheep, while those in Nongoma owned more poultry followed by cattle. The respondents in both municipalities kept the same combinations of livestock as the overall but with diversified proportions. The livestock kept and combination of livestock owned by the respondent farmers in this study was similar to research findings for studies conducted in other rural areas in the country; Northern KwaZulu-Natal (Kunene and Fossey, 2006) and other countries in Africa, i.e., the Amhara region, Ethiopia (Tsegaye, 2009) and Botswana (Monau et al., 2017). Frequencies for livestock kept and combinations owned by indigenous Zulu sheep farmers are reflected in Table 6.

Table 6 Frequencies for livestock kept and combinations owned by indigenous Zulu sheep farmers.

Livestock kept	Municipalities					
	Jozini		Nongoma		Overall	
	N	%	N	%	N	%
Sheep	299	23.47	110	13.70	409	19.69
Goats	266	20.88	199	24.78	465	22.39
Cattle	470	36.89	207	25.78	677	32.60
Poultry	234	18.37	287	35.74	521	25.08
Pigs	5	0.39	0	0	5	0.24
Combinations of livestock kept						
Sheep, cattle, goats and poultry	7	87.5	9	90.0	16	72.7
Sheep, cattle, goats, poultry and pigs	1	12.5	0	0	1	4.5
Cattle, goats and poultry	0	0	1	10.0	1	4.5

4.6 Qualitative morphological characteristics of indigenous Zulu sheep

Among the indigenous Zulu sheep studied in the Jozini and Nongoma Municipalities, the most common coat patterns and coat fibres type were multi-coloured (100%) and coarse wool (100%), respectively. The multi-coloured coat patterns and coarse wool fibres type were more frequent for the individuals in both municipalities. These results are in agreement with Kruger (2001) and van Zyl and Dugmore (2015).

The most recurring coat colour was a combination of white and black (29%) followed by a combination of black, white and brown, and white, black and brown at the same proportions (24%). The same trends of coat colours were recorded in both municipalities but with varying proportions. These results are dissimilar to the study conducted by Kunene et al. (2007) on indigenous Zulu sheep in different localities of northern KwaZulu-Natal. The authors report that the most dominant coat colour for indigenous Zulu sheep is brown, followed by combination of brown and white and black and brown. The coat colour recorded in this study may imply that the indigenous Zulu sheep might have been crossed with other sheep breeds, e.g., Dorper, as the breed's coat colour is characterised by combination of white and black. The latter might be spot on as the declining of indigenous Zulu sheep due to uncontrolled and indiscriminate cross-breeding (Kunene et al., 2014; Mavule, 2012; Mavule et al., 2013; Mavule et al., 2016), and substitution with other breeds (Kruger, 2001), have been reported.

The most frequent hair/wool size was medium (94%), ear size was medium (65%), ear orientation was lateral (94%) and tail shape was tapered (88%). The most frequent hair/wool size, ear orientation and tail shape found in the overall indigenous Zulu sheep population were also recorded for individuals in both the Nongoma and Jozini Municipalities, but with varying proportions except for ear size in the Nongoma Municipality, which was rudimentary. The overall proportion for thin and thick tail bases were the same (59%) and the same trends was followed in both municipalities. The tapered tail shape, thin and thick tail bases and medium to rudimentary ears (mouse-like ears) were also recorded in the study by Kunene et al. (2007) and van Zyl and Dugmore (2015).

Both male (53%) and female (71%) indigenous Zulu sheep had no horns and this was however varied among male individuals in the Nongoma Municipality, in which absence and presence of horns in some individuals were recorded at the same proportion (50%). These were also reported in Kunene et al. (2007) and van Zyl and Dugmore (2015). Frequencies for qualitative morphological variables of indigenous Zulu sheep are presented in Table 7.

Table 7 Frequencies for qualitative morphological characteristics of indigenous Zulu sheep

Variables	Municipalities					
	Jozini		Nongoma		Overall	
	N	%	N	%	N	%
Coat pattern						
Uniform	0	0	0	0	0	0
Multi-coloured	8	100.0	9	100.0	17	100.0
Coat fibre type						
Hair	1	12.5	0	0	1	5.9
Coarse wool	8	100.0	9	100.0	17	100.0
Fine wool	0	0	0	0	0	0
Hair/wool size						
Short	1	12.5	0	0	1	5.9
Medium	7	87.5	9	100.0	16	94.1
Long	0	0	0	0	0	0
Coat colour						
Black, red and white	0	0	1	11.1	1	5.9
Black and white	0	0	1	11.1	1	5.9
Black, white and brown	2	25.0	2	22.2	4	23.5
White	1	12.5	0	0	1	5.9
White and black	3	37.5	2	22.2	5	29.4
White, black and brown	2	25.0	2	22.2	4	23.5
White and brown	0	0	1	11.1	1	5.9
Horns in females						
Present in all	0	0	1	11.1	1	5.9
Present in some	3	37.5	1	11.1	4	23.5
Absent	5	62.5	7	77.8	12	70.6
Horns in males						
Present in all	0	0	2	22.2	2	11.8
Present in some	4	50.0	2	22.2	6	35.3
Absent	4	50.0	5	55.6	9	52.9
Ear size						
Large	0	0	0	0	0	0
Medium	8	100.0	3	33.3	11	64.7
Rudimentary	0	0	7	77.8	7	41.2
None	0	0	0	0	0	0
Ear orientation						
Erected	0	0	0	0	0	0
Drooping	2	25.0	0	0	2	11.8
Forward	0	0	0	0	0	0

Variables	Municipalities					
	Jozini		Nongoma		Overall	
	N	%	N	%	N	%
Lateral	7	87.5	9	100	16	94.1
Tail base						
Thin	5	62.5	5	55.6	10	58.8
Thick	5	62.5	5	55.6	10	58.8
Tail shape						
Tapered	7	87.5	8	88.9	15	88.2
Curled	3	37.5	1	11.1	4	23.5

4.7 General challenges faced by indigenous Zulu sheep farmers

Most of the farmers have experienced mortalities (83%) in mature females (56%) and lambs in both female (67%) and male (61%) sexes in the last 12 months. Causes and negative impact of mortality in sheep production have been studied (Kom, 2016; Mogashoa, 2016; Tibbo, 2006). Frequencies for mortality of indigenous Zulu sheep that occurred in the last 12 months are presented in Table 8.

Table 8 Frequencies for mortality of indigenous Zulu sheep occurred in the last 12 months

Variables	Municipalities					
	Jozini		Nongoma		Overall	
	N	%	N	%	N	%
Have you experience mortality in the last 12 months?						
Yes	7	87.5	8	80.0	15	83.3
No	1	12.5	2	20.0	3	16.7
If yes, which category of female sheep						
Mature (more than 1 year old)	5	62.5	5	50.0	10	55.6
Young (6 months – 1 year)	3	37.5	1	10.0	4	22.2
Lambs (0 – 6 months)	7	87.5	5	50.0	12	66.7
If yes, which category of male sheep						
Mature (more than 1 year old)	3	37.5	2	20.0	5	27.8
Young (6 months – 1 year)	3	37.5	1	10.0	4	22.2
Lambs (0 – 6 months)	7	87.5	4	40.0	11	61.1

The majority of the respondent farmers reported drought (28%) and internal parasites (28%) followed by diseases (22%) and accidents (22%) as their main challenges. Kunene and Fossey (2006) found that livestock producers in some traditional areas of Northern KwaZulu-Natal reported lack of extension services, theft, parasites and predators as their main constraints. Frequencies for general challenges experienced by indigenous Zulu sheep farmers are presented in Table 9.

Most of these farmers revealed that they would overcome the challenges of drought, internal parasites, diseases and accidents through drought relief feeds from government, deworming programmes by using medication for treatment and requesting the local municipality to construct speed humps on the road, respectively. Frequencies for plans to overcome the general challenges experienced by indigenous Zulu sheep farmers are

presented in Table 10.

Table 9 Frequencies for general challenges experienced by indigenous Zulu sheep farmers

General challenges	Municipalities					
	Nongoma		Jozini		Overall	
	N	%	N	%	N	%
Internal parasites	3	30.0	2	25.0	5	27.8
Drought	2	20.0	3	37.5	5	27.8
Diseases	1	10.0	3	37.5	4	22.2
No assistance from the state in terms of medication for prevention/control of diseases	1	10.0	0	0	1	5.6
Dogs	3	30.0	0	0	3	16.7
Car accidents	3	30.0	1	12.5	4	22.2
Poisonous plants	1	10.0	0	0	1	5.6
Expensive medication	1	10.0	0	0	1	5.6
Inbreeding	0	0	1	12.5	1	5.6
Drowning in the river	0	0	1	12.5	1	5.6
Poisoned by neighbours	0	0	1	12.5	1	5.6
Lamb mortality	0	0	1	12.5	1	5.6
Thatch is the most available grass	0	0	1	12.5	1	5.6

Table 10 Frequencies for plans to overcome each challenge experienced by indigenous Zulu sheep farmers

General challenge	Plan to overcome the challenge	Municipalities					
		Nongoma		Jozini		Overall	
		N	%	N	%	N	%
Internal parasites	Through deworming programmes and deworming	3	30.0	0	0	3	16.7
	Get assistance from government with deworming medication	0	0	2	25.0	2	11.1
Drought	Get drought relief feeds from government	1	10.0	1	12.5	2	11.1
	Drill for water, erect boreholes and plant pastures	0	0	1	12.5	1	5.6
	It is difficult to overcome it because it needs a lot of money	0	0	1	12.5	1	5.6
	No plan	1	10.0	1	12.5	2	11.1
Diseases	Prevent/control of diseases through vaccination	1	10.0	0	0	1	5.6
	Buy medication for treatment	0	0	2	25.0	2	11.1
No assistance from the state in terms of medication for prevention/control of diseases	Buy medication	1	10.0	0	0	1	5.6
Dogs	Catch and kill the dogs	1	10.0	0	0	1	5.6
	Hold the owners responsible	1	10.0	0	0	1	5.6
	Shepherd or herd the sheep	1	10.0	0	0	1	5.6
Car accidents	Shepherd/herd the sheep far away from the road	1	10.0	0	0	1	5.6
	Request municipality to erect speed humps on the road	2	20.0	0	0	2	11.1
	No plan	0	0	1	12.5	1	5.6
Poisonous plants	Eradicate the plants by deeply uprooting them	1	10.0	0	0	1	5.6
Expensive medication	Government must provide medication	1	10.0	0	0	1	5.6
Inbreeding	Government must provide/lend farmers rams	0	0	1	12.5	1	5.6
Drowning in the river	No plan	0	0	1	12.5	1	5.6
Poisoned by neighbours	Shepherd/herd the sheep	0	0	1	12.5	1	5.6
Lamb mortality	No plan	0	0	1	12.5	1	5.6
Thatch is the most available grass	No plan	0	0	1	12.5	1	5.6

5. Conclusion and recommendations

Demographic information, husbandry practices, qualitative morphological characteristics and constraints revealed in this study threaten the success of sustainable conservation of indigenous Zulu sheep in the rural communities of the Nongoma and Jozini Municipalities. Proper intervention through institutional and technical support and intensive interaction with indigenous Zulu sheep farmers are necessary for awareness on the importance of some of the husbandry/management issues and breeding strategies or programmes to maintain the characteristics of the breed. Youth and adult participation would also be beneficial toward the sustainability of the conservation project in the long run.

6. References

Abraham, H., Gizaw, S. and Urge, M. 2017. Begait Goat Production Systems and Breeding Practices in Western Tigray, North Ethiopia, *Open Journal of Animal Sciences,* 7: 198 – 212.

Adimasu, E., Alemayehu, K. and Getachew, T. 2019**.** Breeding Objective, Breeding Practices and Selection Criteria of Indigenous Sheep in Western Amhara, Ethiopia. *International Journal of Sustainable Agricultural Research*, 6(4): 172 – 182.

Bayer, W., von Lossau, A. and Feldmann, A. 2001. Smallholders and Community-Based Management of Farm Animal Genetic Resources: Proceedings of the 2001 Workshop on Community-Based management of Animal Genetic Resources, Mbabane, Swaziland, May 7 – 11, 2001. FAO.

Cloete, S.W.P. and Olivier, J.J. 2010. 'South African Industry'. In: Cottle, D.J. eds. *The International Sheep and Wool Handbook*. Nottingham, England: Nottingham University Press. 95 – 112.

Dossa, L.H., Sangaré, M., Buerkert, A. and Schlecht, E. 2015. Production objectives and breeding practices of urban goat and sheep keepers in West Africa: regional analysis and implications for the development of supportive breeding programs, *SpringerPlus* 4(281): 1 – 12.

FAO. 1999. The global strategy for the management of Farm Animal Genetic Resources. Executive brief. Rome: FAO.

FAO. 2007. Global plan of action for animal genetic resources and the Interlaken Declaration. International Technical Conference on Animal Genetic Resources for Food and Agriculture, Interlaken, Switzerland, September 3 – 7, 2007. Commission on Genetic Resources for Food and Agriculture.

FAO. 2012. *Phenotypic characterization of animal genetic resources.* Rome: FAO. Animal Production and Health Guidelines No. 11.

Fikru, S. and Gebeyew, K. 2015. Sheep and Goat Production Systems in Degehabur Zone, Eastern Ethiopia: Challenge and Opportunities, *Journal of Advances in Dairy Research* 3(2): 1 – 9.

Fourie, P.J., Mahlako, S.R. and Van der Westhuizen, C. 2018. Assessment of the management practices of emerging sheep production systems in the Eastern Free State: Can the extensionist make a difference? *South African Journal of Agricultural Extension,* 46 (2): 57 – 68.

Köhler-Rollefson, I. 2001. *Community – based management of animal genetic resources with special reference to pastoralists. Proceedings of the 2001 Workshop on Community-Based management of Animal Genetic Resources*, Mbabane, Swaziland, May 7 – 11, 2001. FAO.

Gibson, J., Gamage, S., Hanotte, O., Iñiguez, L., Maillard, J.C., Rischkowsky, B., Semambo, D. and Toll, J. 2005. *Options and Strategies for the Conservation of Farm Animal Genetic Resources. Report of an International Workshop,* Montpellier, France, November 7 – 10, 2005. CGIAR System-wide Genetic Resources Programme (SGRP)/Bioversity International.

Kruger, I. 2001. *The indigenous sheep breeds of South Africa*. Genetic Resource Department. ARC-Animal Improvement Institute (ARC-AII). Available from: <http://www.arc.agricza/home.asp?> [Accessed on: 25 April 2019].

Kunene, N.W. and Fossey, A. 2006. A survey on livestock production in some traditional areas of Northern KwaZulu-Natal in South Africa, *Livestock Research for Rural Development,* 18(8). Available at: <http://www.lrrd.org/lrrd18/8/kune18113.htm> [Accessed on: 22 February 2016].

Kunene, N.W., Nesamvuni, E.A. and Fossey, A. 2007. Characterisation of Zulu (Nguni) sheep using linear body measurements and some environmental factors affecting these measurements, *South African Journal of Animal Science,* 37: 11 – 20.

Kunene, N.W. 2010. *Characterisation of indigenous Zulu (Nguni) sheep for utilisation, improvement and conservation*, Doctor of Philosophy thesis, University of KwaZulu-Natal, Pietermaritzburg. Available at: <http://hdl.handle.net/10413/773>. [Accessed on: 26 November 2019].

Kunene, N.W., Bezuidenhout, C.C., Nsahlai, I.V. and Nesamvuni, E.A. 2011. A review of some characteristics, socio-economic aspects and utilization of Zulu sheep: implications for conservation, *Tropical Animal Health and Production*, 43: 1075–1079. doi: 10.1007/s11250-011-9823-3. [Accessed on: 22 January 2020].

Kunene, N.W., Ceccobelli, S., Di Lorenzo, P., Hlophe, S.R., Bezuidenhout, C.C. and Lasagna, E. 2014. Genetic diversity in four populations of Nguni (Zulu) sheep assessed by microsatellite analysis. *Italian Journal of Animal Science*, 13(1): 3083. doi: 10.4081/ijas.2014.3083. [Accessed on: 22 January 2020].

Kom, L. 2017. Sheep flock structure, dynamics, management practices, and wool production under bush encroached and non-encroached areas of the Eastern Cape Province, South Africa. Master of Science. University of Fort Hare, Alice. Available from: <http://hdl.handle.net/20.500.11837/795> [Accessed on: 21 January 2020].

Nsahlai, I., Udo, P., Kunene, N.W. 2009. Gabhisa Planning and Investment. Commercialisation of Goats in KwaZulu-Natal. Report Submitted to Department of Economic Development, South Africa.

Mahanjana, A.M and Cronjé, PB. 2000. Factors affecting goat production in a communal farming system in the Eastern Cape region of South Africa, *South African Journal of Animal Science,* 30(2): 149 – 154.

Mapiliyao, L., Pepe, D., Marume, U. and Muchenje, V. 2012. Flock dynamics, body condition and weight variation in sheep in two ecologically different resource-poor communal farming systems, *Small Ruminant Research*, 104: 45– 54. doi:10.1016/j.smallrumres.2011.11.006. [Accessed on: 24 January 2020].

Mavule, B.S. 2012. Phenotypic Characterization of Zulu Sheep: Implications for Conservation and Improvement. Master of Science dissertation, University of Zululand, KwaDlangezwa. Available from: <http://uzspace.uzulu.ac.za/handle/10530/1253>. [Accessed on: 22 January 2020].

Mavule, B.S., Muchenje, V. and Kunene, N.W. 2013. Characterization of Zulu sheep production system: Implications for conservation and improvement, *Scientific Research and Essays,* 8 (26): 1226 – 1238.

Mavule, B.S., Sarti, F.M., Lasagna, E. and Kunene, N.W. 2016 . Morphological differentiation amongst Zulu sheep populations in KwaZulu-Natal, South Africa, as revealed by multivariate analysis, *Small Ruminant Research,* 140: 50 – 56.

Mogashoa S.M. 2015. *Influence of socio-economic factors on sheep mortality and sales constraints faced by small-scale sheep producers in Nkangala district, Mpumalanga province, South Africa,* MSc dissertation, University of Limpopo, Turfloop. Available from: <http://hdl.handle.net/10386/1561> [Accessed on: 23 March 2020].

Monau, P.I., Visser, C., Nsoso, S.J. and Van Marle-Köster, E. 2017. A survey analysis of indigenous goat production in communal farming systems of Botswana. *Tropical Animal Health and Production* 49 (6): 1265 – 1271.

Mthi, S. and Nyangiwe, N. 2018. Farmers' perception on sheep production constraints in the communal grazing areas of the Eastern Cape Province, South Africa. *International Journal of Livestock Production,* 9(12): 334 – 339. doi: 10.5897/IJLP2018.0500. [Accessed on: 21 January 2020].

Nyamukanza, C.C., Scogings, P.F., Mbatha, K.R. and Kunene, N. W. 2010. Forage-sheep relationships in communally managed moist thornveld in Zululand, KwaZulu-Natal, South Africa, *African Journal of Range & Forage Science,* 27 (1): 11 – 19. doi: 10.2989/10220111003703443. [Accessed on: 25 February 2020].

Rauniyar, G.P., Upreti, C.R., Gavigan, R. and Parker, W.J. 2000. Constraints to sheep farming in Nepal: Development challenge for poverty alleviation. Asian Australian Journal of Animal Science, 13(8): 1162 – 1172. doi: 10.5713/ajas.2000.1162. [Accessed on: 21 January 2020].

Rege, O.E. 2001. *Defining Livestock Breeds in the Context of Community-Based Management of Farm Animal Genetic Resources. Proceedings of the 2001 Workshop on Community – Based management of Animal genetic Resources*, Mbabane Swaziland, May 7 – 11, 2001. FAO.

SPSS. 2017. IBM SPSS for Windows, Version 25.0. Armonk, New York: IBM Corp

Taye, M., Yilma M., Mengistu S., Abiso, T., Bassa, Z., Wolde, S., Rischkowsky, B., Dessie T., Okeyo M. and Haile, A. 2016. Characterization of production system and breeding practices of sheep producers in Doyogena district, Southern Ethiopia, *African Journal of agricultural Science,* 11 (52): 5192 – 5201.

Tibbo, M. 2006. *Productivity and Health of Indigenous Sheep Breeds and Crossbreds in the Central Ethiopian Highlands*, Doctoral thesis, Swedish University of Agricultural Sciences, Uppsala. Accessed on 20 March 2020

Tsegaye, T. 2009. Characterization of goat production systems and on-farm evaluation of the growth performance of grazing goats supplemented with different protein sources in Metema Woreda,

Amhara region, Ethiopia. Master of Science Thesis, Haramaya University, Haramaya. Available from: <https://hdl.handle.net/10568/707>. [Accessed on: 22 January 2019].

Van Zyl, E.A. and Dugmore, T.J. 2015. Imvu – The indigenous sheep of KwaZulu-Natal: A Zulu Heritage, KwaZulu-Natal Department of Agriculture and Rural Development.

Wollny, C.B.A. 2001. The Need to Conserve Farm Animal Genetic Resources Through Community-Based Management in Africa: Should Policy Makers Be Concerned? *Ecological Economics*, 45(3):341-351. doi: 10.1016/S0921-8009(03)00089-2. [Accessed on: 03 June 2019].

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