Basic factors influencing lamb mortality under low input production systems in the Eastern Cape Province, South Africa

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Abstract

A cross-sectional study was conducted to assess incidences of lamb mortality in low input farming systems in the Eastern Cape province. Four villages (Ndakana, Kwa-Masele, Qhugqwala and Ndindwa) and 18 households were selected. Data was collected from 399 lambing records from June 2017 to May 2018 whereby an analysis of factors affecting lamb mortalities (i.e. sex of lamb, season of birth, age of ewe and village) were investigated. With the exception of age of ewe, the variables had a significant ($P < 0.001$) effect on lamb mortality. Qhugqwala had the highest lamb mortality (28.8%) compared to the other villages. Mortality rate was higher in the male lambs (61%) compared to female lambs (39%). Lambs born in spring had higher mortality rate (58%) compared to 42.4% in lambs born in winter. This study confirmed that overall mortality rate averaged 33% from birth to yearly weaning. Season of birth, sex of a lamb and location were the major contributing factors to lamb mortality under low input farming systems.

Keywords: communal, lamb, location, mortality, season, sex, sheep

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Introduction

Sheep farming forms a major part of livestock industry in the Eastern Province of South Africa. Like other livestock species, sheep are widely kept by resource-poor farmers under low input production farming systems, where numbers and breeds vary according to production systems (Meissner *et al*., 2013). They are the important assets for resource-poor farmers in most rural communities in Africa where crop production is unreliable (Ashebir *et al.*, 2016). The contribution of smallstock (sheep and goats) to South Africa's animal product income ranges between 8-10% per annum (Cloete & Olivier, 2010). Sheep are considered advantageous compared to cattle, due to fast growth rate and having a shorter production cycle (Tibbo *et al*., 2006).

At the household level, sheep serve as a source of food, cash income, saving, fertiliser, source of employment and has the potential to play a role in poverty reduction in most rural communities (FAO, 2009; Yitayew *et al*., 2013; Bettencourt *et al.*, 2015). They are also sources of foreign currency (Berhanu *et al*., 2006; DAFF, 2016). According to Kunene and Fossey (2006) and Kosgey *et al*. (2008), sheep contribute enormously towards promotion of farmer livelihoods as an investment and insurance to cope with crop failure where mixed farming is common. It is projected that by the year 2025 sheep will account for half of the red meat production in sub-Saharan Africa (Winrock, 1992).

Reproductive efficiency is a major determinant of profit in any sheep farming enterprise. In low input farming systems, overall reproductive rates are low compared to the commercial sector (Grobler, 2008). Communal sheep farming reflects a high lambing percentage (91%), a high level of lamb mortality (±25%), which results in a low weaning percentage (±45%), low offtake (±9.9%) and poor returns to the cash economy of the province (Bembridge, 1989; Fourie *et al*., 2018). Improving the reproductive performance of breeding herd in low input farming systems is a major goal for the South African sheep industry (NDA, 2007). Such a goal can only be achieved by increasing the number of lambs successfully reared per ewe in a given lambing season (Markos *et al*., 2006; Khan *et al*., 2006).

Lamb mortality amongst rural communities is a serious problem that threatens sustainable sheep farming with a huge economic impact on farm income and genetic improvement (Bangar *et al*., 2016; Abdelqader *et al*., 2017; Herago *et al*., 2017).

The mortality rate of lambs in sub-Saharan Africa is within the range of 9% to 76% across sheep populations of mixed age, breeds and a range of production systems (Gama *et al*., 1991; Binns *et al*., 2002; Turkson, 2003; Baffuor-Awuah *et al*., 2007; Chniter *et al*., 2009).

Therefore, there is a pressing need to improve sheep production efficiency in low input farming systems by reducing lamb mortality rate.

Jeichitra *et al*. (2013), Muthukumar *et al*. (2016), Chaudhari *et al*. (2017) and Elia (2018), reported that parity, season of birth, sex of a lamb, district/village, breed, type of birth, birth weight were the major factors directly associated with high lamb mortality rate from birth to weaning. These results were heterogeneous and highly influenced by factors such as disease, shortage of feed, production system, environmental variables and poor management practices (Githiori *et al.*, 2006; Homman *et al.*, 2007; Gizaw *et al.*, 2010; Mapiliyao, 2012). In addition, poor feeding resources and disease prevalence has a significant effect on the genetic gain and breeding improvement programs of sheep (Sultana *et al*., 2017). Therefore, lambs conceived and born under poor feeding conditions and disease prevalence are at high risk of mortality (Kanani *et al.,* 2006).

Few studies were conducted to investigate how lamb mortality is influenced by fixed effects such as lamb factors (breed and sex), prenatal influences (prenatal nutrition, litter size) and ewe factors (condition score, age and parity) (Morris *et al*., 2000; Mousa-Balabel, 2010). However, to our knowledge there are few records pertaining to lamb mortality in central-western region of the Eastern Cape Province under low input farming system. Lamb mortality records are from studies conducted on commercial farms under good management practices. Therefore, the current study was designed to collect on-farm data directly from households under low input farming system where records are not properly kept. The aim of this study was to assess the incidences of mortality under low input farming system, in order to reduce lamb mortality rates through proper management programmes with subsequent improved farm income and genetic gain in sheep populations.

Materials and Methods

Study areas

A cross-sectional study was conducted from June 2017 to May 2018 in four villages situated in the Amathole District Municipality (ADM) and Buffalo City Metro (BCM) of the Eastern Cape Province namely; Ndakana, Kwa-Masele, Qhugqwala and Ndindwa. The description of the study areas are depicted in Table 1.

Table 1 Description of the survey study sites

District Municipality	Local Municipality	Villages	Description of the study sites
Amathole	Amahlathi	Ndakana	A village situated 15 km east of Stutterheim town, 32°39'15"S and 27°28'35"E with elevation of 854m. Vegetation is described as Amathole Montane Grassland and receives an average rainfall of 500-740mm.
	Raymond Mhlaba	Ndindwa	A village located 35 km east of the town of Middledrift, 32°57''47" S and 27°20'43"E with elevation of 472m above sea level. Vegetation is Bhisho Thorhveld and receives an annual average rainfall of 479-600mm.
	Ngqushwa	Qhugqwala	It is situated 50 km southeast of the town of Peddie, 32°00'18"S and 27°20'03"E with an elevation of 397m above sea level. The average annual rainfall is 500-618mm. Vegetation is classified as Buffels Thicket.
Buffalo City Metro	-	Kwa-Masele	A village located 7.5 km north of Qhugqwala, 32°56'21"S and 27°19'52"E with an elevation of 529m above sea level. Vegetation is Bhisho Thornveld and receives an average annual rainfall of 500-700mm.

Source of vegetation and dominant plant species: adapted from Mucina and Rutherford, 2006

Selection of farmers and experimental animals

The four villages (Ndakana, Kwa-Masele, Qhugqwala and Ndindwa) were purposively selected with the assistance of National Wool Growers Association (NWGA) and Department of Rural Development and Agrarian Reform (DRDAR) extension personnel. The criteria for selecting the communities was based on the accessibility (roads), and whether the community has shearing shed and involvement in communal wool sheep improvement program. The participants were selected based on their willingness to participate, have experience (more than 10 years) in farming and own 40 breeding ewes and above.

Flock management

In the four villages, sheep were kraaled at night and grazed on rangelands during the day, from 08:30 to 17:00 with *ad libitum* availability of water. A total of 636 ewes aged 2-6 years were naturally mated. Uncontrolled breeding was the dominant practice employed where rams were running with ewes throughout the year. The animals were sheared once a year during the shearing season (October) in shearing sheds. Plastic ear tags were used for the identification of animals to facilitate accurate recording. The main feed resource in the study areas is natural pastures and crop residues. During harvesting period, especially in homestead gardens, breeding ewes with the lambs had access to crop residues.

Data collection

Data comprising of 399 lambing records from 636 ewes were used in this study. The collection period was from June 2017 to May 2018. Data was collected from birth to 1 year of age for the season of birth, sex of lamb, dam age, and location.

Lambing percentage (LP) and Mortality rate (MR) were calculated, using the following equations (Olivier, 2014).

$$\text{Lambing percentage (LP)} = \frac{\text{Number of lambs born}}{\text{Number of ewes mated}} \times 100$$

$$\text{Mortality rate (MR)} = \frac{\text{Number of lambs died}}{\text{Number of lamb born alive}} \times 100$$

Statistical analysis

Data were analysed using the Statistical Analysis System (SAS, 2003) version 9.1. Frequencies were determined using the PROC FREQ procedures (SAS, 2003). The chi-square test was used to determine associations amongst the effects of village, dam age, sex and season of birth.

Results and Discussion

Lambing percentage

The lambing percentage was observed to be significantly higher in Qhugqwala (75.56%) followed by Ndindwa (64.10%), Kwa-Masele (58.23%) and low in Ndakana (56.00%), with an average of 69±10.09 across four study areas (Table 2). There were no significant differences between the latter three communities.

Table 2 Lambing percentage from the study areas

Location	Ewes mated	Lambs born	Lambing %
Ndakana	175	98	56.00
Kwa-Masele	170	99	58.23
Qhungqwala	135	102	75.56**
Ndindwa	156	100	64.10

**P<0.001

These results were similar to those reported by Fourie *et al.* (2018), who reported a high lambing percentage of 91% in ewes, which depended on conception rate and the number of ewes mated in three districts of the Free State province, South Africa. On the other hand, Lakew *et al*. (2017) reported a 34.4% lambing in the Wolayita zone of Southern Ethiopia. The differences in lambing percentage might be ascribed to variation in environment, type of breed, nutrition and management prevailing at the different locations.

Table 3 Effect of location, ewe age, sex of a lamb and season of birth on lamb mortality

Factors	**Mortality**
Location	0.0019**
Ewe age	0.5443^{NS}
Sex of a lamb	0.0001**
Season	0.0001**

**P<0.001 and NS not significant at P>0.05

Sex of a lamb

Sex of a lamb had a significant effect (P < 0.001) on lamb mortality. The mortality rate was higher in male lambs (60.6%) than in female lambs (39.4%) (Figure 1). The higher mortality in male lambs compared to female lambs has been reported in previous studies (Ahmed *et al*., 2010; Abdelqader *et al*., 2017; Abecia and Palacios, 2018). However, Mengistie *et al*. (2011) and Lamesegn *et al*. (2018) in Ethiopia reported higher mortality for female lambs.

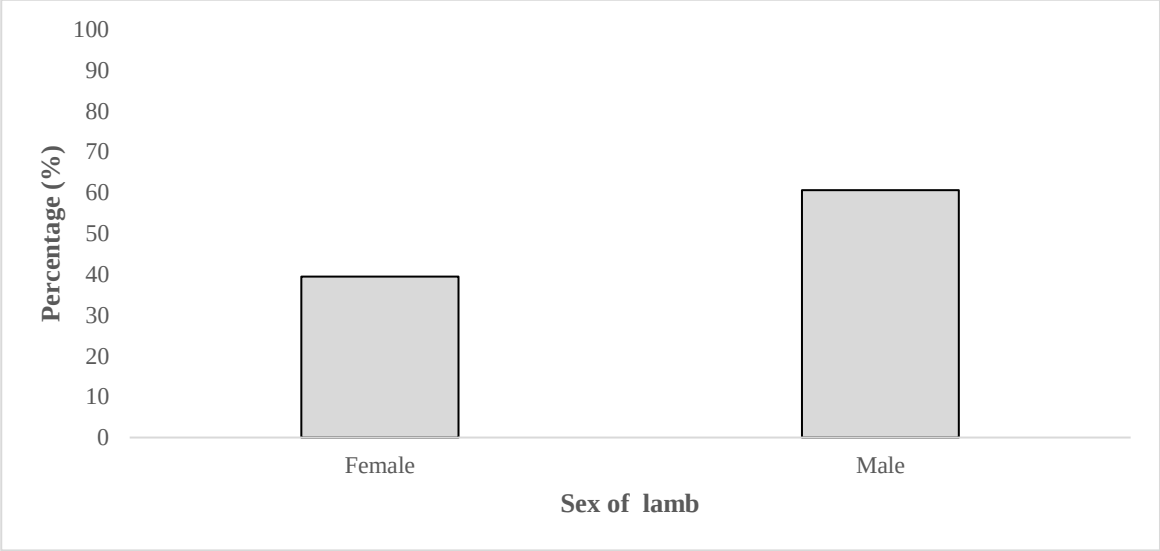

Figure 1 Mortality of different sex lambs

Gardner *et al*. (2007) and Gökce *et al*. (2013) reported that male lambs had higher resistance to gastro-intestinal parasites compared to female lambs, but this depended on the amount of colostrum produced by ewes. Abecia and Palacios (2018) reported that ewes giving birth to female lambs produce more milk than those giving birth to male lambs, and females had an advantage to be able to stand and suck soon after birth compared to male offspring (Riley *et al*., 2004). According to Mysterud *et a*l. (2000), Markos (2006) and Mandal *et al*. (2007), sex differences in lamb mortality may be attributed to independent lamb behaviour, horminal effect on immune function and sex linked deteminants which are yet to be identified.

Location

Location had a significant effect (P <0.001) on lamb mortality. Lamb mortality was the highest in Qhugqwala (28.8%) followed by both Ndindwa and Kwa-Masele areas with the same rate (26.5%) and the lowest being in Ndakana (18.2%) (Figure 3).

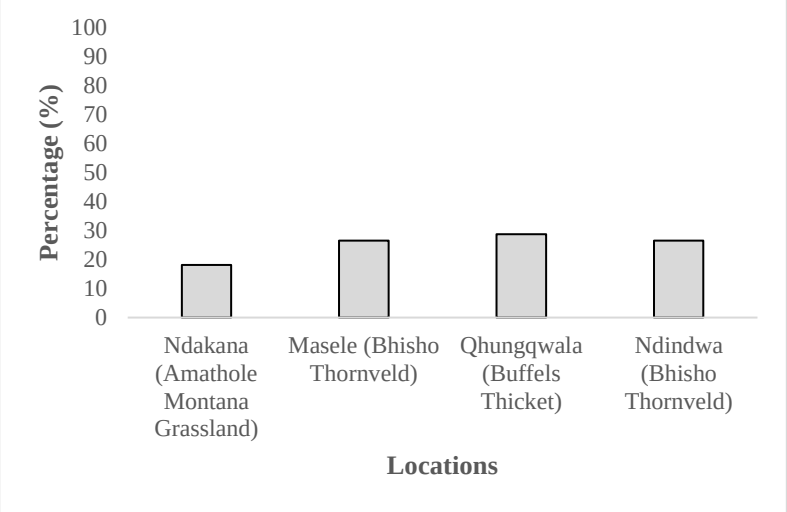

Figure 2 Lamb mortality in the four study areas

During this study, the average lamb mortality from birth to yearling age of 33% was observed. This is in agreement with the research conducted by Belay and Haile (2011), who reported high lamb mortality in lambs born in Dedo district than lamb born Seka district. The difference in mortality could be ascribed to management practices and nutritional factors with respect to geographical distribution of a particular location. Alternatively, it might be due to low feed supply for both lactating ewes and lambs. Genetic difference that existed among sheep kept in different location might also cause variation in lamb mortality.

Ewe age

In the current study age of the ewe had no significant effect (P > 0.05) on lamb mortality in the four locations, however, lamb mortality tended to be higher in younger ewes (2-tooth) compared to other age groups. Lamb mortality was 27.3%, 25%, 24.2% and 23.5% in 2, 4, 6 and full tooth ewes respectively (Figure 3). Similar results were also expressed by Morri *et al*. (2000) and Southey *et al*. (2004) in other sheep breeds

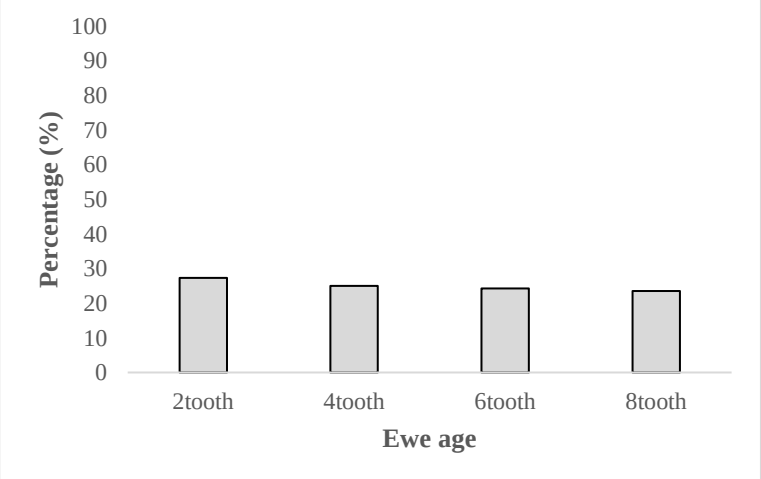

Figure 3 Mortality rate of lambs born from different age group of ewes

This could be due to the fact that most of the feed consumed by young ewes is mainly partitioned for maintenance and growth and not for the production of milk. Number of investigation supported the notion that, lambs born from ewes giving birth for the first time are slower to attempt to stand and suck after birth (Owens *et al*., 1985; Dwyer and Lawrence, 2005; Cloete *et al*., 2005) this could be due to the immaturity of the uterine environment in these younger ewes (Plush, 2013). Alternatively, it could be due to low quantity of colostrum/milk and poor mothering ability due to inexperience from young ewes (Woolliams *et al*., 1983; Southey *et al*., 2001; Sawalhe *et al*., 2007). Delaying the first mating of young ewes (parity 1-2) until they reach their optimum reproductive age (18 months) can reduce lamb mortality. Provision of supplementary feeding for both ewes and lambs at critical periods during pregnancy and after lambing is crucial to reduce lamb mortality.

Season

Season had a significant effect ($P < 0.001$) on lamb mortality. The majority of mortality occurred in lambs born in spring (58%) compared to the lambs born in winter (42%) (Table 4). The higher lamb mortality during spring could be due to onset of the rainy season, which favours high incidence of pathogens. This result is also confirmatory with the findings of Woldemeriam (2009), Belay and Haile (2011), Meissner *et al*. (2013), Bangar *et al*. (2016) and Sawyer and Narayan (2017) reported high mortality during spring season.

Table 4 Season of birth on lamb mortality rates

Season	Number	Mortality (%)
Winter (May-July)	56	42.2
Spring (August-October)	76	57.6
Total	132	100

Additionally, high lamb mortality in spring might be due to poor nutritional management and prolonged dry period resulting in poor body condition of ewes with subsequent poor with production. Improving management practices such controlling the mating and lambing season, provision of shelter and supplementary feeding of ewes is of paramount important to curb high lamb mortality.

Conclusions and recommendations

Factors affecting mortality rate of lambs are important components of total flock profitability. The study revealed that lamb sex, village and season of birth were the major factors affecting mortality rate in lambs from birth to yearling age. It was observed that lamb mortality rate varies from one location to another and this might cause by varied animal husbandry practices in different villages. Further detailed investigation on the effect of genetic and non-genetic factors on pre and post weaning lamb mortality should be done at provincial level with representing different agro-ecological zones and farming systems.

Authors' contribution

SM, JR and VM designed the study. SM, JR, WJG and ZM assisted in data collection. SM analysed the data and write the manuscript. JR and CTM revised the manuscript. All authors read and approved the final manuscript.

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