

Appraisal of the management practices of goat farmers in selected districts of the KwaZulu-Natal province: can the extensionist play a role to improve?

Ntuli, L.¹ and Fourie, P.J.²

Correspondence author: P.J. Fourie. Email: pfourie@cut.ac.za

ABSTRACT

The study was conducted to assess management practices by goat farmers in uMgungundlovu of the KwaZulu-Natal province. A total of 70 farmers were interviewed using structured questionnaires. A considerable number of respondents had low-level education (40%) n=28. Management activities performed by respondents included control of internal and external parasites, which was done by 94% and 96%, respectively. The most vaccinated for diseases were Pulpy kidney (61.54%) and Pasteurella (51.92%). Fifty-five respondents (78.57%) grazed their animals on the veld, while an insubstantial percentage of respondents had cultivated pastures (15.71%) n=11. Respondents provided winter and summer supplementary feed (46%) and supplementary lick (83%). A total of 17 farmers (24.29%) had a specific breeding season. Breeding management activities were done by farmers, and 5.71% of respondents tested bucks for fertility, while 18.57% provided flush feeding, and 11.43% performed pregnancy diagnosis. Most farmers who applied sound management practices reported elevated production levels.

Keywords: Management practices, goat farmers, KwaZulu-Natal

1. INTRODUCTION

Livestock contributes to food security and plays a role in the economy and social life in South Africa (Meissner, Scholtz & Palmer, 2013:282). Reynolds, Wulster-Radcliffe, Aaron & Davis (2015:1377) stated that livestock plays a major role in supplying protein to people in the form of meat and milk. South Africa has a thriving goat industry which consists of fibre, meat and dairy-producing goat breeds (Visser & Van Marle-Koster, 2017:19). According to Stewart (2000:134), KwaZulu-Natal has a goat population of one million, almost all of which are in communal areas. Goats are important in the improvement of rural livelihood (Peacock, 2005:179); they also ensure food security through aiding seasonal food variability and availability (Dube, 2015:2). Goats are also relatively cheap to acquire and reproduce quickly, which is why they have a faster population recovery in the event of severe losses (Peacock, 2005:180). Dube (2015:3) stated that although some research has been done on goats, most of it lacked farmer participation as it was mainly researcher-driven, resulting in a lack of adoption

¹ Master of Agriculture Student, Central University of Technology, Free State, Private Bag X20539, Bloemfontein, 9300, South Africa. Email: lawndeka@gmail.com

² Head of Department: Agriculture, Central University of Technology, Free State, Private Bag X20539, Bloemfontein, 9300, South Africa. Email: pfourie@cut.ac.za

of technologies. The current study was carried out to appraise management practices by goat farmers. Furthermore, the contribution that agricultural extension can make in the development of these farmers.

2. MATERIALS AND METHODS

The study was conducted in the KwaZulu-Natal province, in the uMgungundlovu district. Seven municipalities were selected with ten respondents each, therefore seventy respondents in total. Farmers were selected using the simple random sampling method where every farmer had an equal chance of being selected, and farmers participated voluntarily in the survey. A well-designed questionnaire was used to gather data from respondents individually. Factors that were probed included financial management and record keeping, health management, nutritional management, veld management, breeding management, and biographical details. All raw data was captured and coded in Microsoft Office, Excel®. Analysis was completed using Statistical Package for Social Science (SPSS) Software.

3. RESULTS AND DISCUSSION

3.1. Educational level

The majority of respondents, (n=28) 40%, which consists of (n=27) males and (n=1) females, had levels of education lower than grade 12, while 1.43% of respondents, all females, had a degree in Animal Science (Table 1), which is the highest level of education obtained for this study. Oduro-Ofori, Aboagye & Acquaye (2014:1951) stated that the returns on agricultural productivity increase as the educational level increases. According to Lubambo (2011:30), the level of education influences the ability to make decisions and is directly related to the success of a farm. In this study, 38.57% of respondents were in the age group 51 to 70+ years. STATSSA (2011:42) reported that most elderly people in South Africa have no formal education. Katikati (2017:56) stated that this might have been influenced by the fact that older people grew up when education was not easily accessed.

TABLE 1: Education level and gender of respondents in the uMgungundlovu district

Level of education	Female	Male	Total	Total %
No matric	1	27	28	40
Grade 12	2	17	19	27.14
Diploma in Agriculture	1	3	4	5.71
Degree in Animal Science	1	-	1	1.43
Masters' degree in Agriculture	-	-	-	-
Doctorate in Agriculture	-	-	-	-
Other qualifications	4	14	18	25.71
Total	9	61	70	100

3.2. Herd particulars

According to Bester, Ramsay, & Scholtz (2009:9), herds in the communal sector were small, with 56.8% of keepers owning less than ten goats as against 10% in the emerging sector. Ngqangweni & Delgado (2002:5) stated that various factors could affect the size of the herd; these include socio-economic factors such as farm assets, access to finance or credit institution and household head characteristics, that is; age, gender, marital status and educational level. The average farm herd in this study consisted of 79.87 animals. The respondents in this district were mainly faced with stock theft. A total of 28.57% respondents had poor fencing (figure 1).

TABLE 2: Mean±Standard deviation (SD) of herd numbers (bucks, does, kids and weaners) in the uMgungundlovu district

Herd combination	Bucks	Does	Kids	Weaners
Mean±SD	3.37±3.47	49.96±73.89	15.59±22.15	10.96±20.38

More than 39% of farmers were farming with cattle, 50% were farming with chicken, and 10.3% had sheep. The different species play important roles in food production and income generation from different animals (FAO, 2017).

3.3. Farm infrastructure

Figure 1 illustrates infrastructure and its condition as given by the respondents, of which 28.57% of respondents had poor fencing, 68.57% had no handling facilities, and 34.29% had farm housing in moderate condition. During the course of the study, farmers with no handling facilities stated that health management was mostly affected by this as it is a challenge to vaccinate, dose and dip animals without handling facilities. This may result in stock losses. According to Fungo, Krygsman, & Nel (2017:94), adequate infrastructure raises farm productivity and lowers farming costs. Farm infrastructure provides assurance for the supply of agricultural inputs and facilitates the delivery of farm outputs to the markets. All respondents (100%) had access to roads.

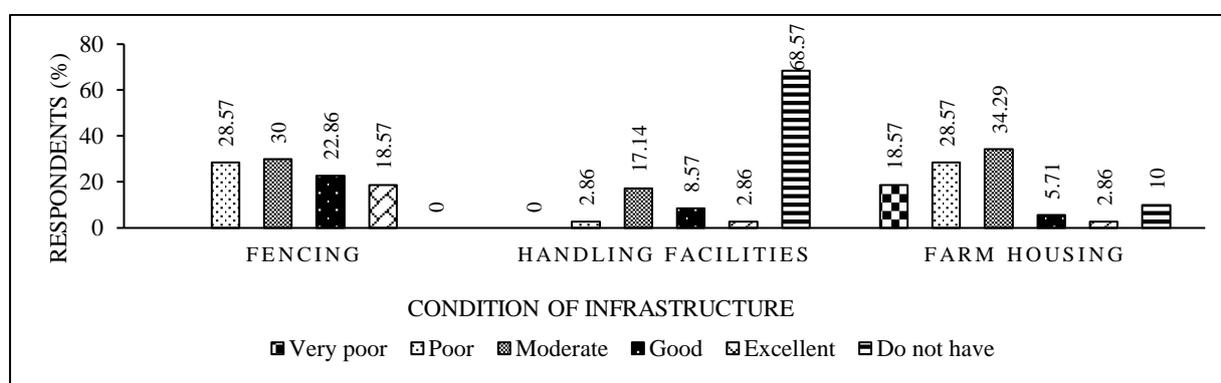


FIGURE 1: Farm infrastructure and condition in the uMgungundlovu district

3.4. Animal health

3.4.1. Internal parasites

Sixty-six respondents control parasites, 51.51 % use the oral dosing method, 12.12% injecting, and those who use both the dosing and injection method accounts for 36.36% (Figure 2). Villarroel (2013:4) stated that the best prevention is to reduce animals' exposure to parasites by providing a clean environment and avoiding overcrowding of pens. In this study, it was discovered that some older farmers do not buy deworming remedies since they still believe in homemade remedies.

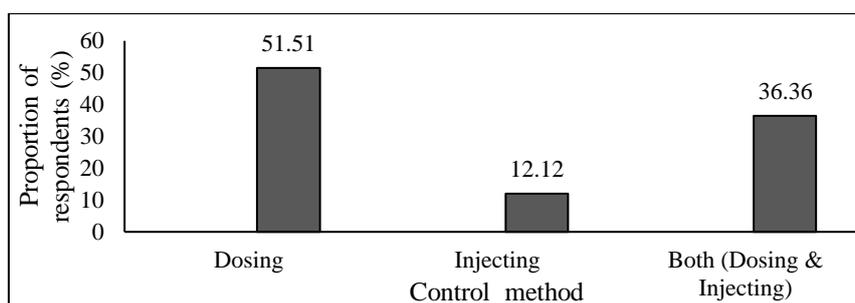


FIGURE 2: Respondents' method of controlling internal parasite

3.4.2. External parasites

A considerable proportion of respondents (95.71%) were controlling external parasites, while 4.29% were not (Table 3). Ticks were a major problem, resulting in heartwater disease (also known as Ehrlichiosis). Heartwater disease can be fatal and usually begin with fever and may involve neurological signs and respiratory distress (Yunker, 1996:159). Respondents use different methods of controlling external parasites, with most farmers using spot treatment method (n=31) and the least used method is the injectable method (n=12). Lack of knowledge has some farmers using wound aerosols to control ticks. Through non-formal education, extension services could facilitate these farmers on how livestock vaccination should be done based on recommended practises for KwaZulu-Natal and season of the year. In an extension approach, companies selling animal health products could be mobilised to eventually become more involved in rural communities.

TABLE 3: Respondents' method of controlling external parasites

Control method	No. of farmers district	Total %
Plunge/Spray dip	24	34.29
Injection	12	17.14
Spot treatment	31	44.29
Other	-	-
Do not control at all	3	4.29
Total	70	100

3.4.3. Vaccination

A total of 18 (25.71%) farmers do not vaccinate at all, while 74.29% (n=52) vaccinated at least against one disease. The highest proportion of respondents vaccinated goats against Pulpy kidney (61.54%). According to Rowe (2016:1), prevention is better than cure, and it is therefore important that any goats introduced to an existing flock be disease-free and healthy. It is important to have a strict vaccination programme to control common diseases. It was noted during this study that some farmers still rely on government schemes to have their flock vaccinated.

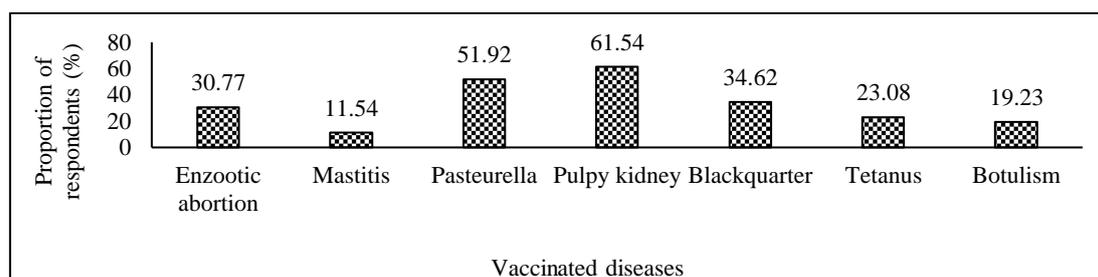


FIGURE 3: Vaccinated diseases by respondents

4. ANIMAL NUTRITION

Vatta, Devilliers, Gumede, Harrison, Krecek, Letty, Mapeyi & Pearson (2015) stated that goats obtain most of the nutrients it needs from grazing. In the dry season, the quality of available vegetation deteriorates, and it becomes important to provide supplementary licks or feed to the flock. However, according to Economides (1986:61), it is difficult to describe the feeding and management of the sheep and goat industry around the world because of many interacting factors such as the production system and genetic potential of breeds.

Figure 4-A shows that 46% of respondents provide supplementary feed while 54% do not provide supplementary feed. Some of the respondents stated that feed is expensive, therefore they graze animals on veld without the provision of additional supplementary feed, and figure 4-C shows that 77% of the farmers graze their animals. Most of the farmers (83%) provided supplementary licks (Figure 4-B). Some stated they did not have knowledge of supplementary licks and did not see the need for it as it is expensive. Figure 4-D shows that 47% of respondents had forage reserved while 53% did not reserve forage. Those that reserved forage were reserving it in the form of hay (69.70%), silage (15.15%) and in both silage and hay form (15.15%).

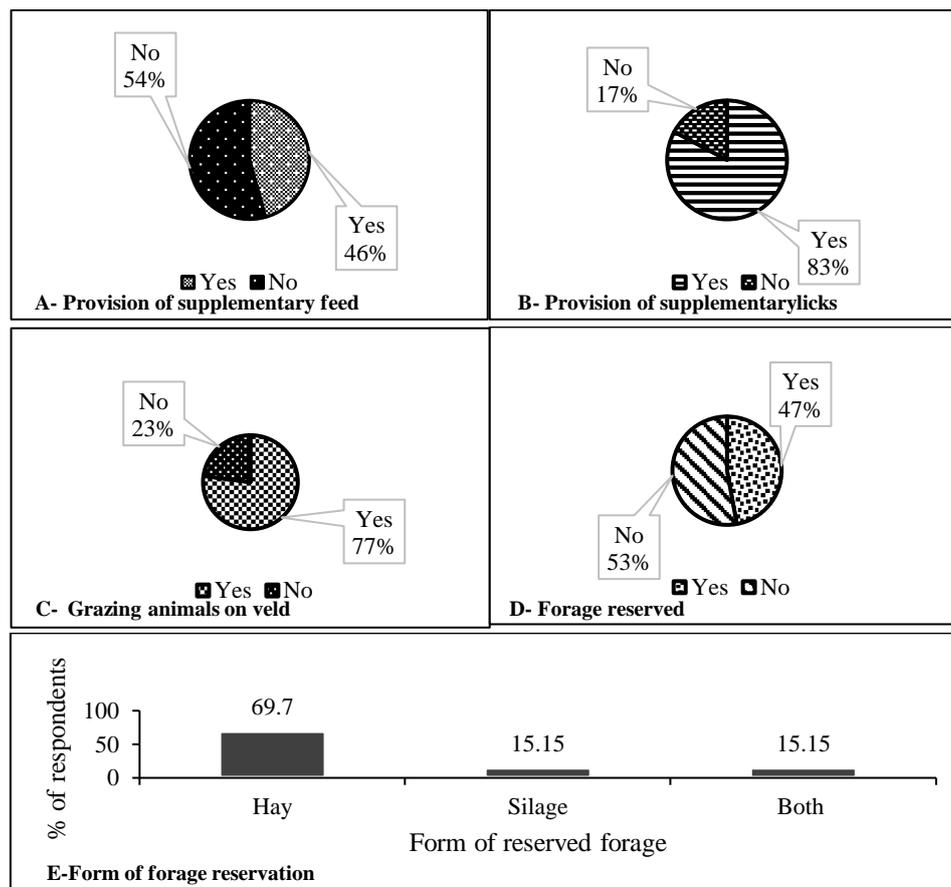


FIGURE 4: *A*-Provision of supplementary feed (Winter/Summer) by respondents'; *B*-Provision of supplementary lick by respondents; *C*-Grazing animals on veld; *D*-Forage reservation by respondents; *E*-Form of forage reservation by farmers.

5. GENERAL MANAGEMENT

5.1. Castration

Table 4 shows general management practices by farmers; castration, tagging and hoof trimming. In this study, 58.57% of respondents castrate their bucks with most farmers (27.14%) using the elastrator method, while 24.29% used a burdizzo. Yami (2009:1) stated that castration is important to control and maintain the breeding programme. A percentage of 41.43 of farmers did not castrate at all. Only 8.6% of respondents were using the knife method, which according to Yami (2009:12), has the greatest potential of infection and fly infestation. This is another example where extension services can not only educate farmers in using more effective methods but also reduce possible losses.

5.2. Animal identification

Stuart (2016:1) stated that being able to identify individual animals on the farm is critical to good farm management. Table 4 shows that 67.14% of farmers used the ear tag application method to identify livestock, while 10% used ear notching and 2.86% ear tattooing. Most farmers in this study find the ear tag application method the quickest and easiest procedure.

5.3. Hoof trimming

Table 4 shows that 38.57% of the respondents trim hooves while 61.43% do not trim hooves. Animals with overgrown hooves are susceptible to joints and tendon problems. According to Nix (2014:1), the amount of time between trimmings depend on factors such as the goat's age, level of activity, nutritional level and even the type of breed.

TABLE 4: General management practices by respondents (Castration, animal identification and hoof trimming)

General management activity	Method	Number of respondents	Percentage of respondents
Castration	Burdizzo	17	24.29%
	Elastrator	19	27.14%
	Knife	6	8.57%
Animal identification	Ear notch	7	10%
	Ear tag	47	67.14%
	None	14	20%
	Other (Tattoo)	2	2.86%
Hoof trimming	Yes	27	38.57%
	No	43	61.43%

6. BREEDING MANAGEMENT

A total of 17 farmers (24.29%) had a specific breeding season, while 75.71% (n=53) had no breeding season. All 17 farmers (24.29%) were practising the group mating system. Four (5.71%) respondents were testing their breeding bucks for fertility, and 18.57% were flush feeding does prior to breeding. This could be because of a lack of knowledge, as some of the interviewees stated that they were not aware of this management practice. Eight farmers (11.43%) were making a pregnancy diagnosis, and 88.57% (n=62) were not making pregnancy diagnoses. Karadaev (2015:184) stated that pregnancy diagnosis is essential for better efficacy and management of reproduction.



FIGURE 5: Goat breeding practices

7. REPRODUCTION PERFORMANCE

The district had a total of 3 497 does, of which 63.25% (n= 2 212) of the does were bred during the years 2017/2018. For this study, the conception rate, which is used to express the proportion of does that kidded compared to the does that were mated, was 71.70%. Davila (2017:95) stated that factors that affect conception rate include nutritional management and body condition of goats. Figure 4-A show that 54% of respondents did not provide winter and summer supplementary feed, and only 18.57% of farmers were flush feeding their does (Figure 5). In relation to this study, the conception rate could have been influenced by knowledge, and thus the nutrition management. The effect of reduced fertility due to inadequate nutrition was also reported in communal goats by Chikwanda (2004:75). Mellado (2020) stated that goat reproductive management should aim at attaining a greater than 90 % kidding rate. The kidding rate, used to express the number of kids born compared to the number of does mated, was 84.81% in this study. This is relatively poor for goats, and this gap should be bridged by agricultural extension in collaboration with agricultural research, the breeders' society and industry. Even commercial farmers have recently become more willing to assist in the development of emerging farmers. Does with poor body condition scores will display reduced reproductive performance as opposed to those with better body condition scores (Kenyon, Maloney & Blache, 2014:45). The farmer has the ability to control or manipulate factors that influence the reproductive performance of livestock by having a strict selection of breeding animals; providing correct nutrition, and having a strategic and suitable deworming and vaccination programme (Petrovic, Petrovic, Muslic, Maskimovic, Ilic, Milosevic, & Stojkovic, 2012:519).

The weaning percentage was 77.89%. Weaning percentage is used to express the proportion of kids weaned compared to the number of does who lambed. This is an important parameter that assists in identifying problems during the breeding season, especially with regard to the ability of does to successfully rear good quality kids (Olivier, 2014:2). The mortality rate, which measures the number of deaths, was 10.71%. Snyman (2010:54) reported that the leading cause of death was known to be predators and small kids abandoned by does. Similarly, this study found the main cause of mortality was predation (64.5%), followed by diseases with 45.2%, inclement weather (35.5%), and poor mothering abilities (17.7% %), while twelve respondents had problems with theft. Sound reproduction rates are paramount in maintaining the viability of a herd. Hlatshwayo & Worth (2019:18) supports the view that extension in collaboration

with other organisations, non-governmental organisations and Institutions of Higher Learning should play a role on the ground level.

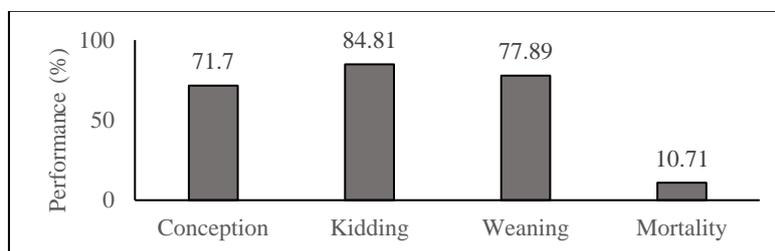


FIGURE 6: Reproductive performance of goat flock in the uMgungundlovu district

8. VELD MANAGEMENT

8.1. Veld division

A single farm may have veld types differing with regard to the nature of the vegetation, the palatability of plants and accessibility of certain parts of veld (Roux & Skinner, 2012). It is therefore important that veld should be separated by fencing off. Veld separation allows the utilisation of different plant communities (Van de Pol & Jordaan, 2008:40). Thirty-one percent of farmers were dividing veld into camps, while 67% were not dividing veld into camps. Hewett (2008:146) stated that the separation of different types of veld on a farm helps to keep the grazing inside each camp fairly uniform. In this study, some farmers stated that they did not have big enough land to divide into camps. Even in this situation, extension could serve as a valuable link between academic institutions and farmers since universities frequently search for sites where practical demonstrations and training can be presented. In this way, both students and farmers can benefit.

8.2. Cultivated pastures

Eleven farmers (15.71%) had cultivated pastures. *Pennisetum clandestinum* (Kikuyu) was listed by most farmers (n=4). Kikuyu is one of the most important dryland summer pastures species in KwaZulu-Natal (Househam, 2011:72). The major role of cultivated pastures is to satisfy the forage requirements of animals when there is low quality and quantity of forage produced by rangelands (Aucamp, 2008:22). Two farmers were cultivating *Eragrostis tef* (Teff) and *Digitaria eriantha*, respectively. Two farmers were cultivating *Medicago sativa* (Alfalfa), while one farmer had Mooi mix.

9. MARKETING CHANNELS

The marketing channel that was used the least by the farmers was abattoirs with 4%, auctions (14%), butchers (10%) and speculators (12%). The majority of meat goats marketed in South Africa are sold privately in the informal market to be slaughtered for religious or traditional purposes. The choice of marketing channel depends on a number of issues, including the

availability of the markets, prices offered in the market and the distance to the market (Sehar, 2018:9).

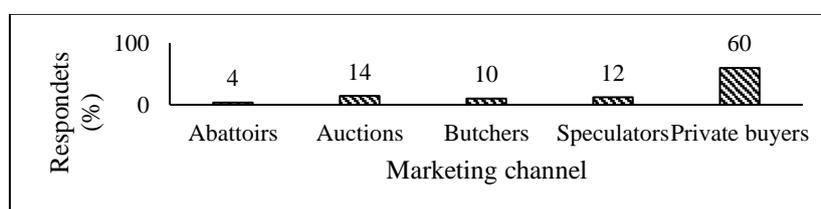


FIGURE 7: Marketing channels

10. CONCLUSION

The impact of the growing interest in goat farming in KwaZulu-Natal may prove to be beneficial in the creation of employment opportunities, eradication of poverty and local food security. Goat farming in the uMgungundlovu district is dominated by males, where most of the farmers have acquired at least a primary level of education. The majority of the farmers were controlling internal and external parasites, and they were also vaccinating goats for diseases. The most vaccinated disease was Pulpy kidney, followed by Pasteurella and Black quarter. There was a provision of supplementary feeding by some farmers. Farmers are aware of management practices such as control of internal and external parasites, vaccination, the importance of nutrition and general management of goats. However, the execution is outdated, and there is a great lack of knowledge. Farmers relied greatly on other farmers for information, in which case the information may be inaccurate, one-sided or obsolete.

This study reiterated that there is still a role that needs to be played by the agricultural extension services for the developing farmers. In order to improve these farmers' management practises, extensionists also need to assist them through training in improved farming methods and techniques. Currently, support programs to farmers are merely fragmented and need to be well-coordinated. Agricultural extension specialists in the field of animal production could render the much-needed momentum towards economic goat production. In addition, agricultural bodies such as the Red Meat Producers Organisation (RPO) and the various goat breeders' societies in South Africa could also play a consequential role in the training of these farmers. Finally, the study recommends that focussed workshops for farmers be conducted in order to equip them with relevant knowledge.

11. ACKNOWLEDGEMENTS

The KwaZulu- Natal Indigenous Veld Goat club and financial assistance from Central University of Technology are gratefully acknowledged.

REFERENCES

- AUCAMP, A.J. 2008. Linking cultivated pastures with rangelands. *Grassroots: Newsletter of the Grassland Society of Southern Africa*, Vol 8. No 8, 19-25.
- BESTER, J., RAMSAY, K.A. & SCHOLTZ, M.M. 2009. Goat farming in South Africa: Findings of a national livestock survey. *Applied Animal Husbandry and Rural Development*, Vol 2: 9–13.
- CHIKWANDA, A.T. 2004. Characterisation of goat production systems and productivity in Rushinga communal area. M.Phil. Thesis, University of Zimbabwe, Harare, Zimbabwe, pp. 1-87.
- DAVILA, F.S. 2017. Reproduction in Goats. *Goat Science*. [Online] Retrieved from: <https://www.intechopen.com/books/goat-science/reproduction-in-goats/> Chapter 5, pp. 87-105. Accessed: 10 October 2019.
- DUBE, K. 2015. Characterisation of goat production systems in selected Coastal areas of the Eastern Cape province, South Africa. Master of Science in Agriculture, University of Fort Hare, South Africa.
- ECONOMIDES, S. 1986. Nutrition and Management of sheep and goats. Small ruminant production in the developing countries. Food and Agriculture Organization, pp. 61-73.
- FAO-FOOD AND AGRICULTURE ORGANIZATION. 2017. Animal Production [Online] Retrieved from: <http://www.fao.org/animl-production/en/> Accessed: 12 October 2019.
- FUNGO, E., KRYGSMAN, S & NEL, H. 2017. The Role of Road Infrastructure in Agricultural Production, Stellenbosch University, South Africa, pp.94 -108.
- HEWETT, G. 2008. Veld conditions. Selecting and classifying grazing camps. *FCS Anim. Prod. L3* pp 146-150.
- HLATSHWAYO, P. P. K. & WORTH, S. H. 2019. Agricultural extension: criteria to determine its visibility and accountability in resource poor communities. *S. Afr. J. Agric. Ext.* Vol. 47 No. 2, 2019: 13 – 20.
- HOUSEHAM, S. D. 2011. Forage systems for goat production in South Africa. Master of Science in Agriculture Thesis. University of KwaZulu-Natal, South Africa.
- KARADAEV, M. 2015. Pregnancy diagnosis techniques in goats. *Bulgarian J. of Vet. Med.*, vol 18, pp. 183 -193.
- KATIKATI, A. 2017. Assessment of production practices of emerging cattle farmers in the selected districts of the Eastern Cape Province, South Africa. M.Tech Thesis, Central University of Technology, South Africa.
- KENYON, P.R., MALONEY, S.K., & BLACHE, D. 2014. Review of sheep body condition score in relation to production characteristics. *New Zealand J. of Agric. res.* Vol 57 pp.38-64.
- LUBAMBO P.T. 2011. An appraisal of post-transfer production trends of selected land reform projects in the North-West Province, South Africa MSc Thesis, University of Pretoria.

- MEISSNER, H.H., SCHOLTZ, M.M. & PALMER, A. 2013. Sustainability of the South African livestock sector towards 2050. Part 1: Worth and impact of the sector. *S. Afr. J. of Anim. Sci.*, 43(3) 282-297.
- MELLADO, M. 2020. Goat Husbandry: Reproductive Management. Food Science [Online] Retrieved from: <https://www.sciencedirect.com/science/article/pii/B9780081005965008234> Accessed: 11May 2021.
- NGQANGWENI, S. & DELGADO, C. 2002. Decision on livestock keeping in the semi-arid areas of Limpopo province pp.1-8.
- NIX, J. 2014. Hoof Trimming in Goats. [Online] Retrieved from: <https://www.thesheepsite.com/articles/11/hoof-trimming-in-goats> Accessed: 03 October 2019.
- ODURO-OFORI, E., ABOAGYE, A. & ACQUAYE, N. 2014. Effects of Education on the Agricultural Productivity of Farmers in the Offinso Municipality. *International Journal of Development Research*. Vol 6, pp 1951 -1960.
- OLIVIER, W.J. 2014. Calculation of reproduction parameters. Info pack: AP 2014/032 Grootfontein Agricultural Development Institute.
- PEACOCK, C. 2005. Goats: A pathway out of poverty. *Small Ruminant Research*, 60:179–186.
- PETROVIC, M., PETROVIC, C., MUSLIC, R., MASKIMOVIC, N., ILIC, Z., MILOSEVIC, B. & STOJKOVIC, J. 2012. Some important factors affecting fertility in sheep. *Biotech. in Anim. Husb.* vol 28, pp.517-528.
- REYNOLDS, L.P., WULSTER-RADCLIFFE, M.C., AARON, D.K. & DAVIS, T.A. 2015. Importance of Animals in Agricultural Sustainability and Food Security. *J. of Nut.*, (145) 1377-1379. [Online] Retrieved from: <https://academic.oup.com/jn/article-abstract/145/7/1377/4590010> Accessed: 28 February 2020.
- ROUX, P.W. & SKINNER, T.E. 2012. The group camp system. *Farming in South Africa* 45 (10) [Online] Retrieved from: <https://gdi.agric.za/articles/Agric/groupcamp.php> Accessed: 18 January 2019.
- ROWE, A. 2016. Basic goat health management: all you need to know. [Online] Retrieved from: <https://www.farmersweekly.co.za/animals/sheep-goats-health-management-all-you-need-to-know/> Accessed: 20 May 2019.
- SEHAR, M. 2018. Factors influencing market access and livestock marketing inefficiency in Mpumalanga Province, South Africa. Master of Science thesis. University of South Africa, pp. 1-93.
- SNYMAN, G. 2010. Factors affecting pre-weaning kid mortality in South African Angora goats. *S. Afr. J. of Anim. Sci.*, 40, pp. 54 -64.
- STATSSA - Statistics South Africa. 2011. Profile of older persons in South Africa. Report-03-01-602011.pdf pp.41-48.
- STEWART, I.B. 2000. Zulu Goats in KwaZulu Natal. *S. Afr. J. of Anim. Sci.*, (30) 134-135.

- STUART, B. 2016. Ear tagging livestock important for identification. *The Weekly Times*.
- VAN DE POL, R. & JORDAAN, J.J. 2008. The fodder bank system: its current place in veld management. *Grassroots: Newsletter of the Grassland Society of Southern Africa*. Vol 8. No1, 36-44.
- VATTA, M., DEVILLIERS, JF. GUMEDE, S., HARRISON, L.J.S., KRECEK, LETTY, B.A., MAPEYI, N & PEARSON, RA. 2015. Feeding goats [Online] Retrieved from: <https://www.farmersweekly.co.za/farm-basics/how-to-livestock/basic-goat-management-and-feeding/> Accessed: 28 May 2019.
- VILLARROEL, A. 2013. Internal Parasites in Sheep and Goats. *Extension Veterinarian, Oregon State University* pp.1-4.
- VISSER, C. & VAN MARLE-KOSTER, E. 2017. The development and Genetic Improvement of South African Goats. *Intech Open*, pp 19-36. [Online] Retrieved from: <http://dx.doi.org/10.5772/intechoprn.70065> Accessed: 28 February 2020.
- YAMI, A. 2009. Castration of sheep and goats. *Technical Bulletin No.18. Ethiopia Sheep and Goat productivity Improvement Program*. R.C Merkel 12Pp.
- YUNKER, C.E. 1996. Heartwater in sheep and goats: A review. *Onderstepoort J Vet Res*. 1996 Jun; 63(2): 159-170.