



Farmers' Perceptions and Knowledge of Cattle Adaptation to Heat Stress and Tick Resistance in the Eastern Cape, South Africa

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ABSTRACT: The objective of this study was to determine the perceptions and knowledge of farmers of heat stress and tick resistance in cattle. A cross-sectional survey was conducted and 110 farmers in four villages in the sour and sweet velds of the Eastern Cape Province, South Africa were interviewed. The associations among area (municipality), gender, age, level of education, employment and religion were computed using Chi-square tests. The majority of the respondents had on average 4 bulls, 4 cows, 4 heifers, 4 calves, and 4 oxen. Milk was considered as the major (28.3%) reason for keeping cattle. Most farmers owned non-descript (72.6%), and Nguni (45.3%) cattle because of their heat tolerance (54.7%), tick resistance (54.7%), and milking ability (28.2%) traits. Excessive panting (56.6%) and disease transmission (76%) were regarded as the major effects of heat stress and tick infestation in cattle, respectively. About 50% of the respondents agreed that hair length influences tick resistance and 47.17% considered coat colour when acquiring cattle. In the sampled areas, ticks were prevalent in the summer season (93%), and 77.36% of the respondents use acaricides every fortnight. Gall sickness was reported to be a major problem in the cattle herds by 36.79% of the respondents. Our results showed that farmers in the two municipalities had knowledge of cattle adaptation to heat stress and tick resistance. (**Key Words:** Herd Composition, Nguni, Non-descript Genotype, Season, Socio-demography)

INTRODUCTION

Sustainable livestock production is very important to the livelihoods of people and therefore there is need to improve it (Lamy et al., 2012). According to Thornton (2010), about 600 million farmers in the communal areas have their livelihoods largely supported by livestock production. It is of great importance for farmers to keep animals that are well adapted to their environmental conditions in order to maximize production. Farmers are keen on keeping animals that provide them with good returns. Cattle, goats, sheep and chickens kept by farmers in the communal areas allow them to have a source of income, draught power, manure and other socio-economic activities to cater for their day to day needs (Mapiye et al., 2009a; Nqeno et al., 2011). These functions and roles differ with the socio-economic factors,

cultural and biological attributes of a community.

Communal areas are largely dominated by small scale and resource-limited farmers. These areas have vast arable and grazing lands suitable for indigenous breeds. The Nguni cattle breed is ideal because it is indigenous and is known for its ability to adapt well in low grazing communal areas (Muchenje et al., 2008a; Musemwa et al., 2010). The breed's remarkable attributes have seen its popularity increasing in the South African rural communities. Musemwa et al. (2010) described the Nguni breed as being environmentally friendly since it requires low management and maintenance inputs. As a result, the Nguni cattle development project in the Eastern Cape Province, South Africa has contributed towards the introduction of this breed in many communities thus contributing to poverty alleviation from the benefits of keeping the breed (Mapiye et al., 2007). Variations in climatic and environmental conditions have a major influence on cattle performance and play a big role in determining productivity.

Climatic conditions differ from one area to the other and rainfall and temperature variations determine the

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availability of suitable grazing areas for the cattle (Mapiye et al., 2010). High temperatures and humidity favour the breeding of parasites with high tick loads seen after heavy rains (Muchenje et al., 2008b; Lorusso et al., 2013). Such temperature conditions contribute to heat stress incidence whose effects may be deleterious if precautions measures are not undertaken. There is therefore need for farmers to equip themselves with the necessary knowledge, skills and management tactics to boost the performance of their animals in any environment.

Farmers are the key players in agricultural production and their knowledge on sustainable agriculture is essential (Chunyan et al., 2013). The perceptions and knowledge they have on animal production are likely to influence how best they will breed their animals. These will also aid in the development of strategic methods and policies that can be implemented to control the devastating effects of problems such as heat stress, ticks and tick-borne diseases. This will in turn enhance production potentials of their animals in the livestock industry. Therefore, the objective of this study was to determine the perceptions and knowledge of farmers' livelihoods and cattle adaptation to heat stress and tick infestation.

MATERIALS AND METHODS

Description of study sites

The study was conducted in four communities (Khayamnandi, Nselamanzi, Thanga, and Zazulwana) in the Eastern Cape Province, the second largest in South Africa. The province experiences varied climatic conditions as it has inland and coastal areas. Khayamnandi and Nselamanzi are fall under Nkonkobe municipality while Thanga and Zazulwana form part of the Mquma municipality. Khayamnandi and Nselamanzi are inland areas characterised by a semi-intensive cattle production system in the sweetveld. They are situated at an altitude of 450 to 500 m with mean annual rainfall of 480 mm and 18.7°C mean annual temperature. Thanga and Zazulwana villages are coastal areas mainly characterised by extensive (communal) cattle production on sourveld land. It receives mean rainfall of 596 mm, mainly in summer with mean summer temperature of 25.6°C and mean winter temperature of 19.2°C (South African Explorer, 2014). The villages are located at 700 to 900 m above sea level and under the Grassland biome.

Data collection

A total of 36, 19, 19, and 36 respondents in Zazulwana, Thanga, Khayamnandi and Nselamanzi communities, respectively, participated in the survey. Informal interviews were done with the extension officers to obtain more data

and information required that aided in the quality of the survey and identifying the necessary farmers for the study. A structured questionnaire was used to collect information from the farmers about their perceptions and knowledge on adaptation of cattle to heat and tick resistance. Respondents were selected from the communities based on the number of cattle owned and preference was made for those with 4 or more cattle per household. Trained enumerators aided in interviewing the farmers using isiXhosa, the vernacular language of the area. To eliminate bias, open-ended and closed questions were used to acquire information on household, farmers' livelihood and socio-economic status and respective cattle production.

Statistical analysis

The PROC FREQ procedures of Statistical Analyses Systems (SAS) (2003) were used to determine the frequencies of gender, age, level of education, employment and religion of the farmers. The Chi-square tests of SAS (2003) were used to determine associations between demographic information and reasons for keeping cattle and perceptions on ticks and heat stress.

RESULTS

Farmers' social demographic information

The municipality with the highest number of farmer participants was Nkonkobe (54%) while Mquma municipality had 46%. Table 1 shows the socio-economic dynamics of the 110 farmers who participated in the study. The majority of the farmers (64%) were males. The highest numbers of farmers were above 51 years of age (67%). Most of the farmers (43%) had gone through secondary education (Grade 8 to 12) as their highest level of education and depended on grants/pensions (34%) for income. Most of the farmers (75%) were Christians.

Herd composition and uses of cattle

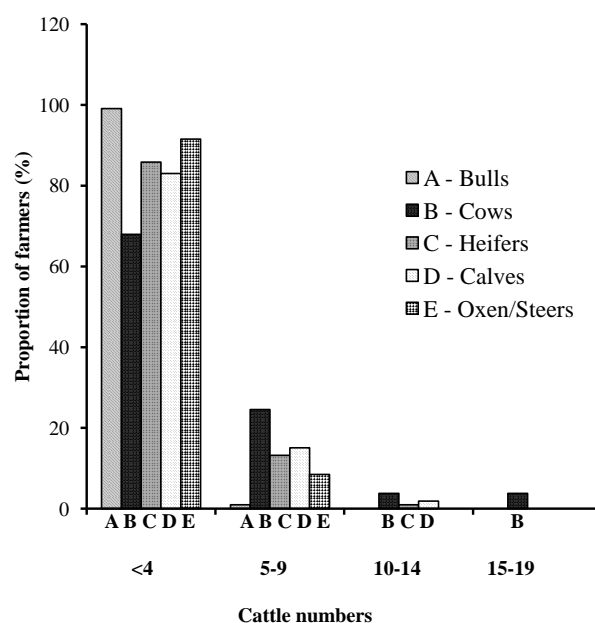
The proportion of farmers, herd size and cattle numbers per composition are represented in Figure 1. The proportion of farmers who had ≤ 4 bulls, cows, heifers, oxen and calves in their herds was 99%, 68%, 86%, 92%, 83%, respectively. Only 4% of the farmers had 15 to 19 cows. Most farmers revealed that, they kept cattle for milk (28%), sales (26%) and ceremonies (11%) as shown in Table 2. The breed(s) and reasons for keeping them are highlighted in Table 3. Some of the farmers kept more than one type of cattle breed. The non-descript cattle (72.6%) were commonly kept by the farmers, followed by the Nguni (45.3%). The majority of the farmers (55%) claimed that tick resistance and heat tolerance attributes were the reasons why they kept certain cattle breeds.

Table 1. Demography of cattle farmers in the Nkonkobe and Mquma municipalities in the Eastern Cape Province

Items	Proportion (%)
Gender	
Male	64.15
Female	35.85
Total	100
Age	
20-29	6.60
30-50	26.42
51-60	30.19
>60	36.79
Total	100
Level of education	
Tertiary	16.04
Secondary	43.40
Primary	35.85
No formal education	4.72
Total	100
Employment	
Farming	27.36
Employed	13.21
Self employed	25.47
Grant/ pension receiver	33.96
Total	100
Religion	
Christianity	74.53
Traditionalism	24.53
Other	0.94
Total	100

Farmers' perceptions and knowledge on coat characteristics, heat stress and tick infestation in cattle

The perceptions of farmers on the effects of heat stress on cattle production are shown in Figure 2. A total of 57% of the farmers perceived that heat stress causes excessive panting in cattle, while 48% and 46% reported loss of weight and reduced milk production, respectively. About 70% of the cattle farmers perceived reduced feed intake and death effects of heat stress. The least perceived notion on the effects of heat stress was said to be reduced breeding efficiency stated by 26.42% of the farmers. The perceptions and knowledge of farmers on the effects of ticks is highlighted in Figure 3. Most farmers (76%) reported that ticks cause the transmission of tick-borne diseases. The results show that 33.02% of the farmers consider tick worry, 30.19% consider undesired meat quality and 21.7% reported death to be effects of ticks in cattle. As indicated in Figure 4, a total of 47.17% of the farmers consider coat colour when acquiring their cattle and 38.68% have knowledge on cattle adaptation to heat stress. About 50% of the farmers agreed that hair allow ticks to attach easily to the skin of cattle and 33.96% highlighted dark coat colour

**Figure 1.** Farmers' herd compositions and sizes (percentages).

relates to more tick loads in cattle. Only 30.19% were positive that cattle with long hairs experience heat stress less often and 21.7% mentioned that darker colours absorb more heat allowing the cattle to be prone to effects of heat stress.

Farmers' perceptions and knowledge on seasonal tick prevalence, tick-borne diseases, and tick control methods and practices

The responses of farmers to seasons of tick prevalence are shown in Figure 5. The majority of farmers (93%) reported summer as the season when tick infestation is highest in cattle. Most of the farmers (77%) use acaricides, (12%) make use of ethno-veterinary medicines and (11%) use both acaricides and ethno-veterinary medicines to control ticks in their herds of cattle (Figure 6). The frequency of tick dipping on a yearly basis (Figure 7) was every fortnight in summer and once a month in winter as reported by 62% of the farmers. About 29% of the farmers dip their cattle monthly throughout the year. The tick-borne

Table 2. Proportion (%) of various uses of cattle in the Eastern Cape Province, South Africa

Socio-economic purpose	Frequency	Proportion (%)
Skin	2	1.89
Manure	4	3.77
Draught	8	7.55
Meat	10	9.43
Milk	30	28.3
Status quo	7	6.6
Dowry (lobola)	5	4.72
Ceremonies	12	11.32
Sales	28	26.42

Table 3. Cattle breeds kept by farmers and reasons for keeping the specific breeds

Breed ¹	Frequency	Percentage
Brahman	22	18.8
Bonsmara	5	4.7
Angus	1	0.9
Nguni	48	45.3
Shorthorn	5	4.7
Non-descript	77	72.6
Reason for keeping specific breed(s)		
Heat tolerance	58	54.7
Milking ability	33	28.2
Tick resistance	58	54.7
Meat quality	25	23.6
Temperament	23	21.7
Fertility	28	26.4
Traditionalism (ugqirha)	1	0.9

¹ Means some of the farmers kept more than one cattle breed.

diseases' prevalence is shown in Figure 8. About 37% and 26% of the farmers reported that their cattle had suffered from gall sickness and red water, respectively. A total of (20.75%) farmers had their cattle suffer from heart water. Of all the farmers (16.04%) never experienced tick-borne disease problems in their animals.

Association of farmers' demography, reasons for keeping cattle and their perceptions and knowledge on heat stress and ticks

The association between demographic information of the farmers and reasons for keeping certain cattle breeds are shown in Table 4. Area, gender and religion of the farmers influenced their perceptions on heat tolerance. Tick

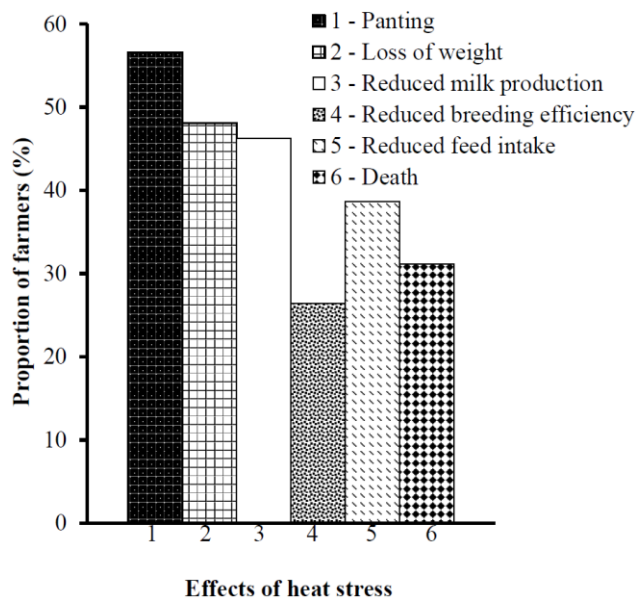


Figure 2. Farmers' perceptions and knowledge on heat stress and its implications on cattle.

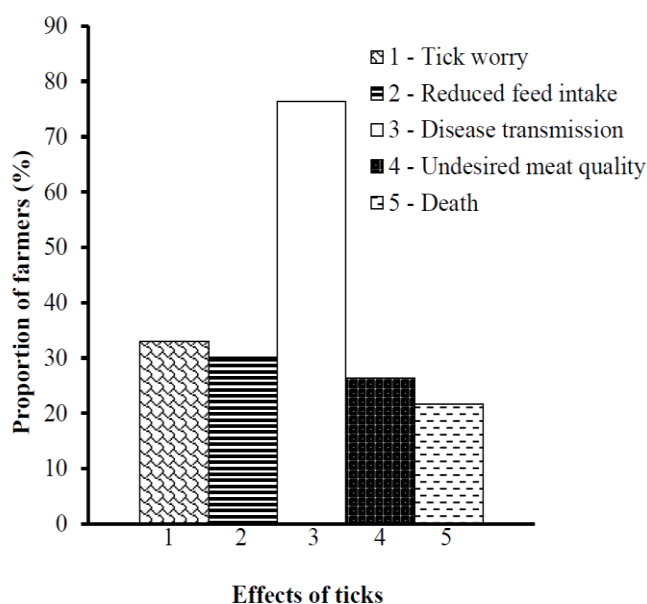


Figure 3. Farmers' perceptions and knowledge on ticks and their implications on cattle.

tolerance perception was associated with area. On the other hand, level of education and employment played a role in the meat quality views of the farmers. The perception on fertility was associated with area, while the level of education influenced the farmers' knowledge on cattle adaptation to heat stress. The results highlighted in Table 5 show that location of farm significantly ($p < 0.05$) influenced the perceptions on excessive panting, death and coat colour in heat stressed cattle. The opinions of the farmers on coat colour were different ($p < 0.05$) for gender. Hair length perceptions were determined by the farmers' level of education. The association of the demographic information of the farmers with the knowledge on effects of ticks in cattle is indicated in Table 6. Location of farm was associated with the perception that, ticks cause reduced feed intake, disease transmission and that coat colour plays a role in the extent of infestation. Perceptions and knowledge on ticks was influenced by gender as more males than females

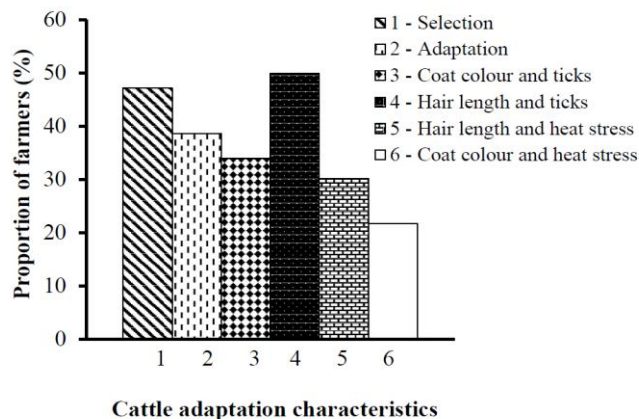


Figure 4. Farmers' perceptions on coat characteristics and their relation to heat stress and ticks.

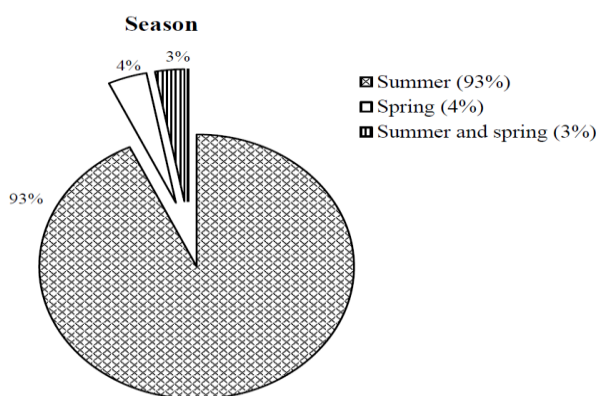


Figure 5. Farmers' perceptions and knowledge of seasonal tick prevalence.

revealed that, tick infestation causes tick worry and reduced feed intake in cattle.

DISCUSSION

From this study, men owned more cattle as compared to women. This concurs with Mapiye et al. (2009a) and Tada et al. (2013) who reported that men are usually the owners of large stock such as cattle. Similar findings were observed in Nigeria and Tanzania by Kristjanson et al. (2010) and Covarrubias et al. (2012) where men dominated the livestock industry in rural areas as they were in possession of more cattle than women. This indicates that, there are other responsibilities for women that may not be associated with livestock production such as household chores (Musemwa et al., 2010; Fayemi and Muchenje, 2013). These results further influence the number of cattle in areas that may be having more women than men. Over the years, women have been encouraged to participate actively even in male dominated industries to enable their empowerment and development of communities and these

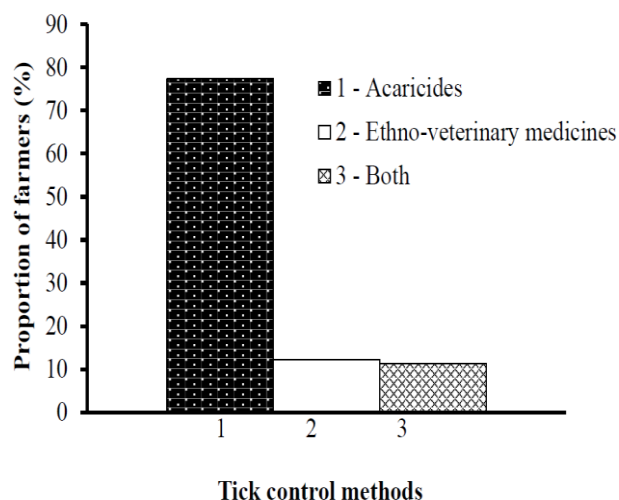


Figure 6. Methods used by farmers to control tick infestation in cattle.

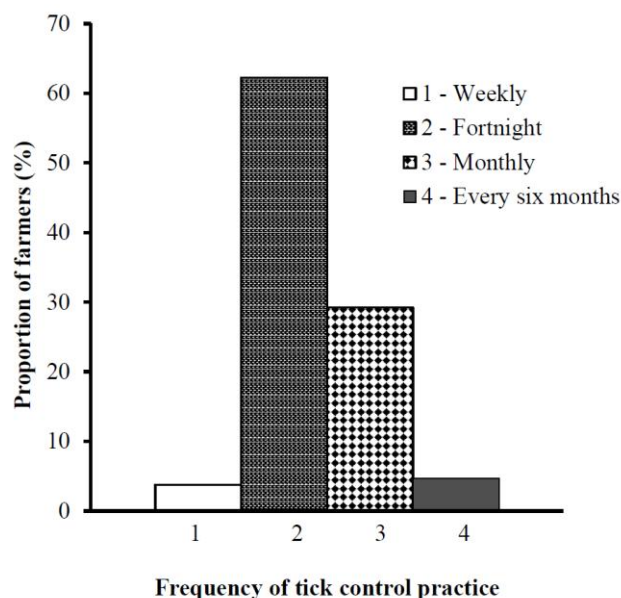


Figure 7. Farmers' response to how often they practice tick control on their cattle.

results are not advantageous in that regard. Most of the farmers interviewed were 51 years of age or older (≥ 51 years) and their source of income was in form of grants or pensions. Comparable findings by Scholtz et al. (2008) showed that rural/urban migration of the youth in search for greener pastures contributed to the higher proportion of rural farmers who were 60 years. This was also observed by Tada et al. (2012) who reported that young people usually go to urban areas to pursue their tertiary aspirations and secure better paying jobs.

There were low cattle numbers per household herd and these findings are in agreement with Mapiye et al. (2009b) whose study revealed herd sizes of five to ten possibly due to unavailability of good quality rangelands. The unavailability of palatable and nutritious grazing land could

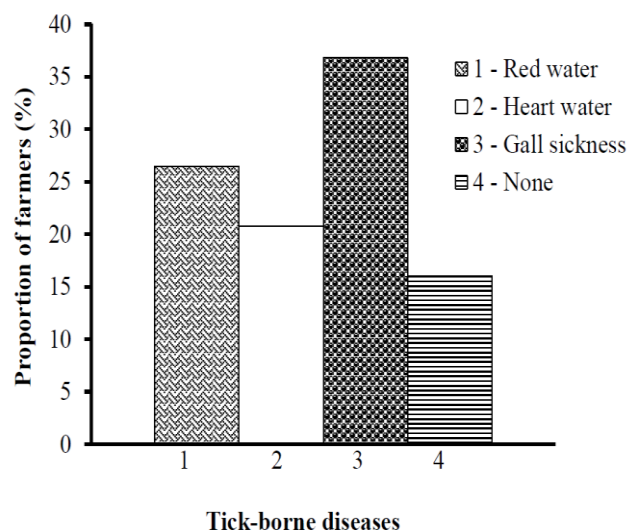


Figure 8. Farmer's response on tick-borne disease prevalence.

Table 4. Association between demographic information and reasons for keeping specific cattle breeds

Demographic factor	Heat tolerance	Milking ability	Tick tolerance	Meat quality	Temperament	Fertility	Traditionalism	Knowledge on adaptation
Area	**	NS	**	NS	NS	*	NS	NS
Gender	**	NS	NS	NS	NS	NS	NS	NS
Level of education	NS	NS	NS	*	NS	NS	NS	*
Employment	NS	NS	NS	*	NS	NS	NS	NS

Significant at * $p \leq 0.05$, ** $p \leq 0.01$, but NS not significant at $p \geq 0.05$.

have contributed to the low numbers since the areas have different rainfall patterns which in turn influence vegetation growth (Mapiye et al., 2009a). There were more cows than heifers and this could have been due to the long calving intervals or mortality of calves causing low calf numbers on the other hand as observed in a study by Nqeno et al. (2011). Most of the farmers had at least one bull to use for breeding purposes though high oxen numbers were observed. These findings concurred with a study by Chimonyo et al. (1999) who mentioned that farmers tend to castrate their bulls in order to have oxen for draught power purposes.

In contrast to a previous study by Tada et al. (2012) and Enkono et al. (2013) where cattle were mainly used for sales to obtain money, the farmers in the Eastern Cape Province considered milk as the major purpose for keeping cattle and on the other hand this finding was also reported by Musemwa et al. (2010). However, the farmers in the current study also kept cattle for ceremonies, meat, draught, manure, lobola and status quo as observed in similar studies by Mapiye et al. (2009a) and Nqeno et al. (2011). This indicated that there are variations from one farmer to another in the way they utilize cattle and their produce.

Nguni and non-descript cattle were kept by the majority of the farmers as they reported that these were easily accessible and available animals in their communities. Several studies (Muchenje et al., 2008b) reported similar

findings arguing that communal areas are characterized by harsh environments that require the raising of hardy breeds such as the Nguni. The non-descript cattle arose from the indiscriminate crossing of the Nguni with exotic (*Bos taurus*) breeds. The farmers did not regard the milking ability of the breeds as the major reason for keeping cattle. This was a contradiction since their general reason for cattle production was for milk purposes. Results from the study suggest that these breeds have good heat and tick tolerance abilities. Heat stress indicators perceived by the farmers showed that they had knowledge on heat regulation in cattle. Further reports were made that cattle usually graze in camps populated with canopy trees to provide shade as well and local dams for additional drinking water. In addition, some of the farmers provide additional drinking water in water points. Nienaber and Hahn (2007) postulated that shades aid in masking the animals from solar radiation.

Farmers reported a higher prevalence of ticks during the summer season and these results were similar to the ones observed by Muchenje et al. (2008b) and Marufu et al. (2011) whose findings showed high tick prevalence in the rainy season. This has a negative impact on the productivity of the cattle leading to great economic losses. The farmers in the current study were concerned about the transmission of heartwater, redwater and gall sickness and similar findings in the Eastern Cape Province were highlighted by

Table 5. Association between demographic information and effects of heats stress in cattle

Demographic factor	Excessive panting	Loss of weight	Reduced milk production	Reduced breeding efficiency	Reduced feed intake	Death	Coat colour	Hair length
Area	**	NS	NS	NS	NS	**	**	NS
Gender	NS	NS	NS	NS	NS	NS	*	NS
Age	NS	NS	NS	NS	NS	**	NS	NS
Level of education	NS	NS	NS	NS	NS	NS	NS	*

Significant at * $p \leq 0.05$, ** $p \leq 0.01$, but NS not significant at $p \geq 0.05$.

Table 6. Association of demographic information and effects of ticks on cattle

Demographic factor	Tick worry	Reduced feed intake	Disease transmission	Undesired meat quality	Death	Coat colour	Hair length
Area	NS	*	***	NS	NS	*	NS
Gender	*	*	NS	NS	NS	NS	NS
Level of education	NS	NS	**	NS	NS	NS	NS
Employment	NS	NS	NS	NS	*	NS	NS

Significant at * $p \leq 0.05$, ** $p \leq 0.01$, but NS not significant at $p \geq 0.05$.

Mapiye et al. (2009a,b) and Nqeno et al. (2011). Hence, the farmers had resorted to the use of acaricides and ethno-veterinary medicines to control ticks and tick-borne diseases. The results are also comparable to findings by Ndebele et al. (2007) in Zimbabwe where 50% of the communal farmers used ethno-veterinary medicines and 90% made use of veterinary medicines provided by extension officers and government. For maximum efficiency, some used both control measures and dipped their cattle every fortnight in the dry season. Findings by Masika et al. (1997) also showed that farmers prefer to use ethno-veterinary medicines in addition to acaricides. This was because they perceived that ticks were now resistant to the acaricides provided by the state and they also wanted to completely eradicate tick problems in their cattle. Some of the farmers complained that the acaricides provided by the government were no longer as effective as the ones they used in the past years.

The association of area with the perceptions on heat tolerance and fertility as reasons for keeping specific breeds may be due to the fact that, heat affects the productivity of cattle. Some areas experience higher environmental temperatures which may lead to stressful conditions when the heat lost by an animal is less than heat gained as postulated by Bernabucci et al. (2010). Hansen (2009) also found that heat stress affects fertility by disrupting spermatogenesis and oocyte development, oocyte maturation, early embryonic development, foetal and placental growth and lactation. Area was also associated with perceptions on excessive panting, death and coat colour. This was probably because animals tend to pant increasingly as a cooling mechanism and death results when the animal fails to release more heat than gained to the environment.

The perceived findings that coat colour influences tick infestation in cattle were also reported by Bernabucci et al. (2010) who revealed that dark coat colours absorb more heat energy causing animals in areas with high ambient temperatures to be at risk. The ticks attach more often on dark coloured animals which make it difficult for predators to locate them. Studies by Ibelli et al. (2012) showed similar findings on coat characteristics and tick infestation. However, a study by Tada et al. (2013) revealed that farmers preferred certain coat colours based on culture, ceremonial significance and ritual activities.

Gender was associated with the perceptions that non-descript and Nguni cattle are heat tolerant and that coat colour influence heat stress susceptibility in cattle. Most men also perceived that ticks cause tick worry and reduced feed intake in cattle. On the other hand, the level of education was associated with the perception that farmers chose specific cattle breeds because of their excellent meat quality attributes and that they had knowledge on cattle

adaptation mechanisms under differing environmental conditions. The meat quality perception was similar to findings by Rani et al. (2013) who revealed that educated and employed people prefer lean meat for health reasons. This indicates that farmers know that the sustainable production of cattle has a contribution to the resulting beneficial meat quality attributes to people. Others perceived that hair lengths enhanced the heat tolerance ability of cattle while ticks can transmit tick-borne diseases. According to the farmers, some receive awareness and training from extension officers and this greatly contributed to their knowledge on cattle production and diseases as older farmers feared their animals were prone to death due to heat stress and ticks.

CONCLUSION

Results from the present study indicated that the most important reason for keeping cattle was for milk consumption. Nguni and non-descript cattle were reported to be the common breeds kept because of their heat resistance and tick tolerance abilities. The farmers perceived that ticks and heat stress can result in undesired meat quality, infertility and reduced weights of cattle. Coat colour and hair lengths were reported to have an influence on tick loads and heat stress in the summer seasons. The farmers commonly used acaricides and ethno-veterinary medicines to prevent tick infestations. Generally, the farmers had knowledge on cattle adaptation to heat stress and tick infestation in cattle. However, it is important to establish the tick load and heat stress attributes of Nguni cows by determining their coat characteristics, cortisol levels, temperature humidity index and haematological parameters.

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