EXPLORING CATTLE TICK INFESTATIONS, FARMERS' KNOWLEDGE, ATTITUDES AND CONTROL PRACTICES IN SELECTED VILLAGES OF COLLINS CHABANE LOCAL MUNICIPALITY, LIMPOPO PROVINCE

By

MOSERI UHONE BUDI PRINCESS

Student number: 19018667

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Department of Animal Science

Faculty of Science, Engineering & Agriculture

University of Venda

Thohoyandou, Limpopo

South Africa

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Student: ________________________ **Date:** __**15/02/2026**___

Miss UBP Moseri

Supervisor: ________________________ **Date:** __**19-04-2026**__

Dr E Bhebhe

CO-Supervisor: __ __________ **Date:** ___19/04/2026_____

Dr T Chitura

DECLARATION

I, Uhone Budi Princess Moseri (Student number: 19018667), hereby declare that this dissertation submitted in fulfilment of the requirements for the Master of Science in Agriculture in Animal Science (AGMAAS) in the Department of Animal Science, Faculty of Science, Engineering and Agriculture, at the University of Venda has not been submitted previously for any degree at this or any other university. It is original in design and in execution, and all reference material contained therein has been duly acknowledged.

Signature: ______________________ **Date:** 15/02/2026

Uhone Budi Princess Moseri

DEDICATION

Firstly, I would like to dedicate this work to myself, for the unwavering resilience, determination, and perseverance that saw me through the toughest times. I acknowledge the late nights, early mornings, and every moment in between, recognising the hard work and energy invested along the way. As Romans 8:18 reminds us, "For I consider that the sufferings of this present time are not worth comparing with the glory that is to be revealed to us." This verse has shaped my life by reminding me that every struggle and every hardship is temporary yet purposeful, fuelling my hope in the greater reward that lies ahead. Moreover, I give thanks to God, whose unfailing grace and strength sustained me through it all, rewarding my diligence, as Proverbs 14:23 states: "In all labour there is profit, but mere talk leads only to poverty," a testament to the power of steadfast faith and hard work. Furthermore, I would like to dedicate this work to my family, who have been my rock and inspiration. To my father (Mr Maumela Prince Moseri) and mother (Mrs Constance Moseri), whose unwavering support, love, and sacrifice have been the foundation of my educational journey. Your respect for me and investment in my future have fuelled my passion to push forward. To my late Aunt (Miss Livhuwani Mutengwe), your wisdom and encouragement to aim high and prioritise education left an indelible mark on my life. To my siblings (Mukanea, Khuthadzo, Tshifularo and Rabelani), this is a testament to the fact that the impossible is possible. I hope this work paves a path for you to dream even bigger. To my nieces (Kharendwe, Arehone, Akonaho and Otondwa), nephew (Blessing) and grandson (Unarine), I dedicate this work as a beacon of hope. May this work inspire you to appreciate the value of education and pursue your dreams fearlessly.

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ABSTRACT

Tick infestations remain a significant constraint to cattle health and productivity in communal farming systems of South Africa. A cross-sectional mixed-methods approach was employed, combining tick surveys, clinical examinations of cattle, and a farmer's knowledge, attitudes and perceptions (KAP) survey conducted during routine dipping days. Adult ticks were systematically collected from cattle, preserved in 70% ethanol and identified morphologically using standard taxonomic keys. A clinical evaluation checklist was used to record tick burden, species composition, attachment sites, tick-induced lesions, and body condition scores. Cattle farmers' data was collected through face-to-face interviews using a structured questionnaire administered in Xitsonga language. A total of 967 adult ticks were identified, comprising eight species, with *Amblyomma hebraeum* and *Rhipicephalus decoloratus* being the most prevalent across both villages. Ntlhaveni village exhibited a higher overall tick burden and greater abundance of *Rhipicephalus microplus* and *Hyalomma rufipes* than Matiyani village, suggesting that environmental conditions, grazing patterns, and management practices likely influenced spatial variation. High tick burdens were observed in both villages, with mixed-species infestations being common. Age and physiological status significantly influenced tick burden and tick-induced lesion severity, with growing and pregnant cattle more severely affected. Tick lesions, hair loss and skin thickening were prevalent, and most cattle displayed low to moderate body condition scores, suggesting negative implications for productivity. Despite limited formal livestock training, most farmers demonstrated practical knowledge of tick identification and inspection. However, nearly half of the respondents reported year-round high tick infestations and perceived a decline in acaricide effectiveness, suggesting potential acaricide resistance. Tick infestations were associated with reduced milk production, poor body condition, increased calf mortality, and higher treatment costs. Overall, the study highlights the substantial health and economic burden of ticks in communal cattle systems, underscoring the need for location-specific, integrated, and sustainable tick control strategies supported by strengthened veterinary extension services.

Keywords*: Cattle ticks, Communal farming systems, Tick diversity, Tick burden, Tick control practices*

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ABBREVIATIONS AND ACRONYMS

AEBREC	Animal Environmental and Biosafety Research Ethics Committee
LPREC	Limpopo Provincial Research Ethics Committee
CCLM	Collins Chabane Local Municipality
KAP	Knowledge, Attitude and Practices
SAWS	South African Weather Service
TTBDs	Ticks and tick-borne diseases
FMD	Foot and Mouth disease
BCS	Body condition score
Stats SA	Statistics South Africa
KNP	Kruger National Park
TBD	Tick-borne diseases
NS	Not significant
S	Significance
%	Percentage
Av	Average
MT	Matiyani
NT	Ntlhaveni

CHAPTER 1: INTRODUCTION AND BACKGROUND

1.1 Background

In South Africa, cattle farming provides an essential source of protein, employment, animal draught power, and income for most communal farmers (Jongejan *et al*., 2020; Mapholi *et al*., 2022). However, Nyangiwe & Matthee (2025) reported that communal farming systems are vulnerable to tick infestations due to extensive grazing, limited infrastructure, and constrained veterinary support. In addition, Hurtado & Giraldo-Ríos (2018) indicated that tick infestations have detrimental effects on animals' immune systems, resulting from blood loss, pathogen transmission, stress, and irritation. Tick infestations also threaten the viability of communal cattle farming enterprises. A study by Strydom *et al*. (2023) reported that parasitism challenges profitable production by reducing feed efficiency, immune function, reproductive efficiency, live weight, milk yield, calf yield, and carcass weight. In South Africa, provinces such as Limpopo and the Eastern Cape are particularly affected, with dominant tick species, namely *Rhipicephalus microplus*, *Rhipicephalus appendiculatus*, and *Amblyomma hebraeum,* persisting across diverse ecological zones (Makwarela *et al.*, 2023; Nyangiwe & Matthee, 2025). Environmental factors such as temperature, humidity, vegetation cover, and climate variability further influence tick survival and seasonal abundance, often intensifying infestation pressure in rural areas (Kgopa *et al*., 2025).

Farmers' knowledge, attitudes, and practices regarding tick infestations and tick control have a significant influence on the effectiveness of control programs. However, a study by Gaorekwe *et al*. (2025) shows that many communal cattle owners are knowledgeable about the presence of ticks and tick-borne diseases in their herds. Yet, they still lack detailed knowledge of tick species, disease mechanisms, or optimal control strategies. In agreement, a study by Malgwi *et al*. (2025) reveals a persistent knowledge gap among farmers regarding tick disease transmission, zoonotic risks, and effective tick preventive measures. Furthermore, Gaorekwe *et al*. (2025) reported that farmers respond to tick infestations only when animals exhibit severe clinical signs, allowing tick populations to increase unchecked and elevating the risk of tick-borne disease outbreaks. Control of cattle ticks in communal systems primarily relies on chemical acaricides applied through dipping or hand-spraying. However, a study by Nyangiwe & Matthee (2025) indicates that improper mixing, irregular application, limited access to veterinary extension services, and rising acaricide resistance have reduced the effectiveness of these measures. Githaka *et al*. (2022) and Makwarela *et al*. (2025) stated that acaricide resistance has emerged as a significant threat to sustainable tick control, leading to increased treatment costs and eroding farmer confidence in conventional methods. In addition, Malgwi *et al*. (2025) reported that socioeconomic factors such as education level, access to information, and institutional support further shape farmers' attitudes and control practices. Understanding the dynamics of cattle tick infestations alongside farmers' knowledge, attitudes, and practices is essential for developing effective, context-specific, and sustainable control strategies. Therefore, a study that combines field assessments of tick species diversity and burden with a knowledge, attitudes, and practices (KAP) survey of farmers will provide locally relevant evidence. This evidence can underpin integrated, sustainable control measures tailored to the conditions and needs of communal farming areas in Collins Chabane Local Municipality, Limpopo Province. Ultimately, this will help reduce tick-related losses, deter the development of acaricide resistance, and strengthen livestock health and productivity.

1.2 Statement of the research problem

Cattle production plays a vital role in rural communities, specifically in Collins Chabane Local Municipality, where cattle are a critical asset that supports household livelihoods and economic stability (Kone *et al*., 2025). Despite their importance, cattle in rural areas are highly susceptible to parasitism due to the widespread reliance on extensive farming systems. The majority of farmers in Collins Chabane Local Municipality allow cattle to graze freely on communal rangelands. While this system reduces feeding costs, it exposes cattle to disease-causing organisms, such as ticks, that are present in the natural environment. Ticks are particularly prevalent in such grazing systems, as they thrive in bushy vegetation and favourable climatic conditions commonly found in communal rangelands. Tick infestation has serious direct and indirect effects on cattle production and animal husbandry practices. Direct effects include blood loss, skin damage, irritation, stress, reduced weight gain, decreased milk production, and death. Furthermore, Indirect effects arise through the transmission of tick-borne diseases, increased treatment costs, reduced market value of animals, and disruptions to routine livestock management practices such as grazing, breeding, housing, and herd movement. These impacts result in substantial productivity and economic losses for communal farmers (Gaorekwe *et al*., 2025). The proximity of Collins Chabane Local Municipality to wildlife conservation areas, such as the Kruger National Park, further increases the risk of tick infestations and tick-borne diseases. Wildlife species serve as natural reservoirs for diverse tick species and pathogens, which can be transmitted to cattle at the wildlife–livestock interface. However, it is reported that the wildlife-livestock interface has often been neglected and that disease spillover is consequently largely underreported (Vercauteren *et al*., 2021). In addition, sharing grazing areas or close contact between wildlife and communal cattle facilitates the spillover of ticks and the introduction of new tick-borne diseases into local herds, posing serious challenges for farmers with limited access to veterinary services. Equally important in cattle production is the role of farmers' knowledge, attitudes, and practices regarding ticks and tick control. Farmers' level of awareness of tick biology, seasonal occurrence, disease risks, and available control methods directly influences the effectiveness of tick management. Positive attitudes toward prevention and timely treatment can improve herd health, while poor knowledge, misconceptions, irregular acaricide use, incorrect dosing, and inadequate herd management practices may contribute to persistent tick infestations, acaricide resistance, disease outbreaks, and poor livestock productivity. Farmers' practices therefore have both direct implications for cattle health and indirect implications for the sustainability of broader animal husbandry systems. However, there is limited information specifically describing cattle tick infestations and farmers' knowledge, attitudes, and practices regarding tick control in Collins Chabane Local Municipality and other similar communities located near the Kruger National Park. Therefore, the study aimed at providing critical insights into tick diversity, disease transmission dynamics, and farmers' knowledge, attitudes, and practices regarding ticks and tick control, which are necessary for developing targeted and sustainable tick control strategies for communal farming systems.

1.3 Justification

This study is justified by the lack of information on the dynamics of tick infestations and the distribution of tick species in the Collins Chabane Local Municipality, located near the Kruger National Park. This lack of information consequently puts cattle farmers at risk because their current knowledge, attitudes, and practices of tick control methods are poorly understood, and the range of tick species and their transmission routes remain unclear (Katswara & Mukaratirwa *et al*. 2021). Therefore, this study will inform the development of integrated tick management (ITM) strategies that consider the local context, including the potential role of wildlife reservoirs, the need to address acaricide resistance, and the need to reduce reliance on potentially ineffective or misused chemicals. Furthermore, the findings of this study will benefit the Limpopo Department of Agriculture and Rural Development (LDARD), animal health technicians, and agricultural extension officers by helping them better understand local tick problems and farmer practices, enabling them to provide more appropriate advice and targeted animal health interventions. Additionally, the findings will benefit the national Department of Agriculture (DOA) in making informed decisions on policies, planning, and resource allocation for tick control in communal farming areas. The study will also add to existing knowledge on tick ecology and management in communal livestock systems, thereby guiding future research and tick control programmes. Ultimately, the results of this study are expected to support the development of practical and locally suitable integrated tick management strategies that improve cattle health and productivity. As a result, communal farmers who depend on cattle for income, food, and cultural purposes may benefit through healthier animals, improved household food security, and more sustainable farming systems. Healthier cattle will also produce more organic manure for crop production, thereby improving soil fertility and overall agricultural productivity.

1.4 Research objectives

1.4.1 Main objective

To explore and compare cattle tick infestations, farmers' knowledge, attitudes, and control practices in Ntlhaveni and Matiyani villages, Collins Chabane Local Municipality, Limpopo Province.

1.4.2 Specific objectives

i) To identify the tick species infesting cattle in the selected villages using morphological keys.

ii) To determine and compare the levels of tick infestations in the selected villages using a clinical evaluation checklist.

iii) To evaluate the effects of tick infestations on cattle health in the selected villages using a clinical evaluation checklist.

iv) To determine the relationship between tick infestations and animal factors such as age, sex, and physiological status in the selected villages using a clinical evaluation checklist.

v) To conduct a face-to-face interview and gather farmers’ knowledge, attitudes, and control practices in the selected villages.

1.5 Research questions

i) Which tick species are infesting cattle in the selected villages?
ii) How do tick infestation levels compare among the selected villages?
iii) What are the effects of tick infestations on cattle health in the selected villages?
iv) What is the relationship between tick infestation and animal factors, such as age, sex, and physiological status in the selected villages?
v) What are the farmers' knowledge, attitudes, and control practices in the selected villages?

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CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

Cattle farming plays a significant role in the agricultural sector and the livelihoods of many communities in South Africa, particularly in communal farming systems (Monkwe *et al*., 2023). In South Africa, environmental conditions such as warm temperatures and high humidity create an ideal environment for tick proliferation, with several economically important species, including *Amblyomma hebraeum*, *Hyalomma spp,* and *Rhipicephalus (Boophilus) decoloratus*, being widely distributed across cattle-rearing provinces. Understanding the biology of ticks, as well as farmers' knowledge, attitudes, and control practices (KAP), is therefore essential for designing effective and sustainable tick management strategies. Effective control must be informed by awareness of species-specific behaviour, seasonal dynamics and socio-economic contexts that influence farmer decisions. Despite this, studies have identified persistent gaps in farmers' knowledge and practices that undermine control efforts, underscoring the urgent need for tailored education, extension services, and integrated approaches in rural cattle production systems.

2.2 Cattle production in communal farming systems of South Africa

Cattle production refers to the breeding, raising and finishing of bovine animals to obtain products such as meat, milk and other products for human consumption (Mahmud *et al*., 2021). Communal cattle production is the most practised farming system in rural areas of South Africa, particularly in provinces such as the Eastern Cape, KwaZulu-Natal, and Limpopo (Mmbengwa *et al.*, 2015; Rust *et al*., 2019R; Mapiye *et al*., 2020). These systems are characterised by communal grazing, low external inputs, limited veterinary services, and multifunctional roles of cattle such as draught power, milk, meat, cultural value, and financial security (Nengovhela *et al.*, 2021). In Addition, Monkwe *et al.* (2023) defined communal cattle production in the Limpopo province as collective, cooperative farming in which farmers share grazing land, resources, and labour. The Department of Agriculture, Forestry and Fisheries (DAFF) (2018) reported that 40% of cattle produced in South Africa are from communal and emerging farms.

Furthermore, studies by Nyangiwe & Matthee (2025) and Slayi & Mpisana (2025) reported that cattle productivity in communal systems is limited by disease pressure, poor nutrition, and inadequate animal health management. In addition, Monkwe *et al*. (2023) identified climate stress, land tenure management issues, limited resources, and tick-borne diseases among the several challenges that hinder cattle production in communal farming systems. Furthermore, studies conducted in the Limpopo and Mpumalanga provinces have consistently reported higher tick burdens in communal herds than in commercial systems, with consequent devastating effects on animal health and productivity (Makgabo, 2023; Monakale *et al*., 2024).

Moreover, recent work has increasingly highlighted animal health challenges, particularly those posed by ectoparasites such as ticks, as a critical bottleneck in communal cattle production systems (Mapholi *et al*., 2022; Kgopa *et al*., 2025). Furthermore, Mthi *et al*. (2020) reported that communal cattle farming systems in the Eastern Cape Province of South Africa face significant constraints due to ticks and tick-borne diseases, resulting in lower reproductive rates, lower calf weaning percentages, and higher mortality. Makwarela *et al.* (2023) reported that tick infestations and tick-borne diseases result in annual losses of approximately 500 million Rand to livestock producers in South Africa. Tavirimirwa *et al*. (2019) identified the need to improve communal grazing land to reduce the spread of ticks and tick-borne diseases by preventing livestock from continuously grazing in the same area.

Additionally, few studies integrate ecological variables, such as vegetation type and proximity to wildlife, which limits their explanatory power in high-risk interface areas. Therefore, this study builds on the existing knowledge gap by focusing on communal cattle production near the Kruger National Park (KNP), where ecological and disease pressures are likely intensified. By incorporating tick species diversity, infestation levels, and farmer knowledge, the study addresses a gap in location-specific evidence for Collins Chabane Local Municipality.

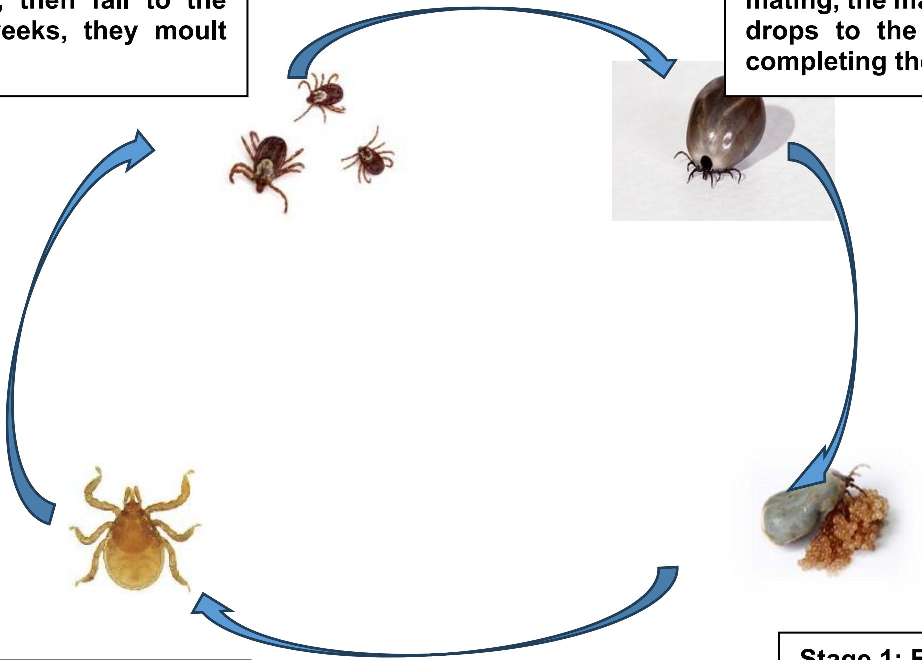
2.3 Biology of ticks

Ticks are obligate haematophagous ectoparasites that belong to the class Arachnida and are grouped into two families, namely hard ticks (Ixodidae) and soft ticks (Argasidae). Gilbert (2021) reported that there are approximately 800 tick species, of which about 650 belong to the Ixodidae family and 150 to the Argasidae family. In addition, hard ticks can be distinguished from soft ticks morphologically by having a scutum, whereas soft ticks have a flexible body that lacks a scutum. Makwarela *et al. (*2023) stated that, over time, ticks have developed traits that influence their vectorial capacity for tick-borne diseases. Furthermore, Bolek *et al*. (2024) noted that ticks can live on one or more hosts, and their life cycles are classified as either simple (direct), in which a parasite infects a single host, or complex (indirect), in which it utilises multiple hosts. Additionally, ticks have a complex life cycle that comprises four stages: egg, larva, nymph, and adult (Johnson, 2023).

(Figure 2)

Stage 3: Nymph
Nymphs are immature ticks, smaller than adults, with 8 legs. They are tiny and hard to spot, which helps them attach to a host unnoticed. Once they feed, they stay on the host for 4-9 days until fully engorged, then fall to the ground. After 2-4 weeks, they moult into adult ticks.

Stage 4: Adult
At this stage, they have eight legs and are larger than nymphs. Adult ticks feed on larger hosts, including cattle and humans. They feed more than 24 hours before mating. After mating, the male dies and the female drops to the ground to lay eggs, completing the life cycle.



Stage 2: Larva
Once the eggs hatch, they develop into larvae with six legs. They resemble adult ticks but are difficult to spot. They feed on small hosts such as lizards or birds. After feeding, they drop to the ground and moults into a nymph after 1 to 3 weeks.

Stage 1: Eggs
Female ticks lay thousands of eggs in the soil or leaf litter. These eggs incubate for several weeks to months. This stage marks the beginning of the tick life cycle and lays the foundation for the next stages.

Figure 2: General life cycle of a tick

Sourced from: https://share.google/EAIbb6GNQNLsAyEoO

Tick species infesting cattle are generally classified into one-host, two-host, and three-host ticks based on their host utilisation strategy. This biological distinction influences their epidemiology, control, and interaction with livestock and wildlife.

2.3.1 One-host ticks

One-host ticks complete their larval, nymphal, and adult stages on a single host individual, detaching only to lay eggs in the environment (Leal *et al*., 2020). The approximate time to complete the cycle is one to three months (1-3 months). A study by Khoza (2024) found that *Rhipicephalus (Boophilus) decoloratus* and *Rhipicephalus microplus* are the most prominent one-host ticks infesting cattle in southern Africa. These species are particularly efficient parasites because they experience minimal exposure to environmental hazards and host-seeking risks across life stages. Furthermore, studies by MA (2025) and Makwarela *et al*. (2025) indicate that one-host ticks are strongly associated with severe blood loss, hide damage, and the transmission of *Babesia bigemina* and *Anaplasma marginale*. A study by Dzemo *et al*. (2023) reported that their biology makes them highly responsive to acaricide-based control but also prone to rapid acaricide resistance development, particularly in communal farming systems with inconsistent treatment regimes.

2.3.2 Two-host ticks

Two-host ticks complete their larval and nymphal stages and then drop off and moult into an adult before seeking out a second host to feed on and mate (Apanaskevich *et al*., 2014). The approximate time to complete the cycle is six to twelve months (6-12 months). Furthermore, a study by Zhou *et al.* (2025) identified *Hyalomma rufipes* as a notable two-host tick affecting cattle in semi-arid regions of southern Africa. Additionally, Nyangiwe & Matthee. (2025) reported *Rhipicephalus evertsi* as a common two-host tick, which requires two host animals to complete their life cycle. A review by Kgopa *et al*. (2025) of studies from southern Africa highlights the role of two-host ticks in the transmission of pathogens, such as *Theileria spp*. and *Rickettsia spp*. The immature stages often utilise small mammals or birds, thereby facilitating pathogen circulation across ecosystems. A study by Alasmari *et al*. (2025) reported that their partial dependence on the environment increases exposure to climatic variability, which directly affects infestation dynamics.

2.3.3 Three-host ticks

Three-host ticks exhibit one of the most complex life cycle patterns among ixodid ticks, requiring a separate host for each feeding stage: larva, nymph, and adult, with the tick detaching and moulting in the environment between each stage (CDC, 2025). In this cycle, larvae typically feed on smaller vertebrates, nymphs on medium-sized hosts, and adults on larger vertebrates, completing development only after sequential blood meals on three different hosts (Khoza, 2024). Once mated and engorged, the female detaches from the final host to oviposit in the environment, whereas males often remain attached to continue seeking mates across feeding events (CDC, 2025). Among cattle ticks of southern and eastern Africa, *Amblyomma hebraeum* and *Rhipicephalus appendiculatus* are consistently reported as dominant species infesting livestock in systems where cattle and wildlife interact (Alasmari *et al*., 2025; Makwarela *et al*., 2025). These ticks frequently exploit multiple host species, including wild ungulates and domestic cattle, at various life-cycle stages, thereby enhancing opportunities for cross-species parasite transmission at the wildlife–livestock interface (Makwarela et al., 2025). *Rhipicephalus appendiculatus* is recognised as the main vector of *Theileria parva*, the protozoan parasite responsible for East Coast fever, a disease with high mortality in susceptible cattle populations in sub-Saharan Africa (Gabriel *et al*., 2025). This vector–host–pathogen dynamic poses a serious threat to communal cattle herds adjacent to protected areas, where wildlife reservoirs and livestock come into regular contact, thereby increasing the risk of disease spillover (Makwarela *et al*., 2025). Importantly, there is a notable lack of village-level comparative studies examining how proximity to protected wildlife areas influences the distribution of one, two, and three-host ticks in communal cattle systems. In addition, existing studies rarely integrate tick biology with farmer knowledge, attitudes, and practices, particularly at the wildlife–livestock interface.

2.4 Common ticks in South Africa

Accurate identification of tick species is essential for understanding infestation dynamics, disease transmission, and the design of effective control strategies, particularly at the wildlife–livestock interface.

2.4.1 Predominant tick species infesting cattle in South Africa

Amblyomma hebraeum is a three-host tick characterised by long mouthparts and a distinctly ornate scutum in males, and a plain scutum in females. This tick species is typically found in warm, humid bushveld and savanna regions, particularly near wildlife where ungulates are abundant (Horak *et al*., 2017; Khoza, 2024). While wildlife reservoirs play a crucial role in sustaining tick populations, cattle in communal areas are often heavily parasitised (Makwarela *et al*., 2023). Studies conducted in the Limpopo Province, Mpumalanga Province, and Eastern Cape Province of South Africa have reported *A. hebraeum* as either the most prevalent or the second most prevalent tick species infesting cattle, accounting for a higher percentage of the overall tick burden compared to other species on communal cattle (Horak *et al*., 2017; Nyangiwe *et al*., 2017; Makwarela *et al*., 2023; Khoza, 2024). Notably, this tick is most prevalent in cattle during summer and spring, when humidity supports the survival of its off-host stages. Adult *Amblyomma hebraeum* preferentially attach to the belly, groin, sternum and upper-lower perineum on cattle (Makwarela *et al*., 2023). Moreover, this tick serves as a primary vector for heartwater, a highly fatal disease that affects cattle.

Rhipicephalus (Boophilus) decoloratus is a one-host tick characterised by its uniform blue-brown colouration, absence of festoons, and short mouthparts. This tick thrives in regions with moderate rainfall and continuous host availability, especially in savanna and grassland ecosystems within communal and smallholder cattle farming systems (Horak *et al*., 2017; Nyangiwe *et al*., 2017; Makwarela *et al*., 2023). Studies conducted in the Limpopo and Mpumalanga Provinces have identified *R. decoloratus* as the second-most prevalent species, comprising a significant proportion of total tick collections (Mandara *et al*., 2018; Monakale *et al*., 2024; Makwarela *et al*., 2023). This tick is active year-round, with peak activity in summer and winter. Its persistence during Autumn and Winter is facilitated by the continuous presence of cattle (Mandara *et al*., 2018; Monakale *et al*., 2024). *Rhipicephalus decoloratus* typically attaches to areas where the skin is thinner, and the blood supply is rich, such as the neck, dewlap, brisket, shoulders and flanks. Lastly, it is a vector of bovine babesiosis and anaplasmosis, making it one of the most economically important cattle ticks in South Africa.

Rhipicephalus microplus is a one-host tick characterised by a rounded body shape, deeper palpal segments, and a distinct dorsal scutal texture. This tick is commonly found in warm, humid regions of South Africa. *Rhipicephalus microplus* is increasingly dominant in the total tick burden, with increasing prevalence in previously unaffected areas (Monakale *et al*., 2024; Makwarela *et al*., 2024). It thrives in warm, wet conditions, peaking in population during the summer. Furthermore, a study by Shege (2025) states that *R. microplus* has a strong preference for cattle and attaches to the neck, dewlap, shoulders, brisket, and flanks. *Rhipicephalus microplus* serves as a vector of bovine babesiosis and anaplasmosis, posing a serious threat as it displaces indigenous tick species.

Rhipicephalus evertsi evertsi is a two-host tick with distinctive red legs, elongated mouthparts, and the presence of festoons. It is distributed across savanna, bushveld and mixed farming systems, including areas with wildlife-livestock interfaces. Studies conducted in the Eastern Cape, Limpopo, and Mpumalanga Provinces have reported *R. evertsi evertsi* as the second and third most prevalent species, accounting for approximately half of the ticks collected (Horak *et al*., 2017; Nyangiwe *et al*., 2017; Mandara *et al*., 2018; Monakale *et al*.,2024; Makwarela *et al*., 2023; Mapholi *et al*., 2022). This tick infests both livestock and wildlife, although cattle remain an important host in communal systems (Nyangiwe *et al*., 2017; Monakale *et al*., 2024). In cattle, the preferred attachment sites are the perineum, anus, udder, scrotum, and tail. It is highly active during spring and summer. It is a known vector of anaplasmosis and equine piroplasmosis, hence its increased veterinary importance.

Hyalomma rufipes is a two-host tick species known as the brown-legged tick with long, shiny and banded legs, elongated mouthparts, and a dark brown scutum (Estrada-Peña *et al*., 2023). It is widely distributed in semi-arid and arid regions. Furthermore, Mandara *et al*. (2018) and Monakale *et al*. (2024) reported it in areas with extensive grazing and wildlife presence. This species parasites both cattle and large wild ungulates. Studies have documented *H. rufipes* primarily on extensively grazed cattle, accounting for a lesser percentage of tick collections (Mandara *et al*., 2018). Monakale *et al*. (2024) and Mapholi *et al*. (2022) ranked it third- or fourth-most prevalent among cattle. It was reported to be attached to the legs, brisket, udder, scrotum and perineal regions of cattle. It is an important vector of Crimean-Congo haemorrhagic fever virus (CCHFV) and Theileria species, making it significant for both veterinary and public health (Estrada-Peña, 2023).

Hyalomma truncatum is a two-host tick with long mouthparts, dark brown bodies, beady eyes, and lengthy, red and white ringed legs. It is associated with semi-arid and arid grazing systems, particularly in extensive livestock farming (Mandara *et al*., 2018). This tick species parasitises both cattle and wildlife animals (Monakale *et al*., 2024). According to reports, it is the third- or fourth-most prevalent tick species, and its peak infestation in cattle occurs during hot seasons, when competing tick species are less abundant (Mandara *et al*., 2018; Monakale *et al*., 2024; Mapholi *et al.,* 2022). It often attaches to the legs, belly, brisket and tail region. Lastly, Khan *et al*. (2022) reported that it transmits *Anaplasma marginale* in the livestock host.

2.4.2 Tick distribution and diversity of tick species infesting communal cattle

Tick distribution refers to the geographical and seasonal occurrence of tick species across different ecological zones. In contrast, tick diversity refers to the variety, richness, and relative abundance of tick species within a specific area or host population. In South Africa, ambient temperature variation is a significant factor in determining the distribution and diversity of tick species that infest cattle. Temperature directly affects tick survival, development rates, and seasonal activity (Alasmari *et al*., 2025). In agreement, Makwarela *et al*. (2025) reported that South Africa's climatic heterogeneity supports distinct tick assemblages, with warmer eastern regions favouring species such as *Amblyomma hebraeum* and *Rhipicephalus appendiculatus*. Several studies conducted in communal cattle farming systems in the Limpopo Province have consistently reported high tick burdens during warm and wet seasons, reflecting the role of temperature in accelerating tick life cycles and increasing population densities (Mapholi *et al*., 2017; Nengovhela *et al*., 2021; Mapholi *et al*., 2022). Furthermore, rising temperatures have facilitated the expansion of thermophilic species such as *Rhipicephalus (Boophilus) microplus*, which has become increasingly dominant in communal grazing systems due to its adaptability and acaricide resistance (Nyangiwe *et al*., 2017; Nemaungwe *et al*., 2023). However, extreme temperatures, particularly when combined with low moisture availability, may increase tick mortality through desiccation, thereby influencing seasonal and spatial distribution patterns (Nielebeck *et al*., 2023; Eisen & Eisen, 2024).

Relative humidity further shapes tick distribution and diversity, particularly in communal grazing environments where cattle are continuously exposed to environmental stages of ticks. Ticks are highly susceptible to desiccation when off-host, making humidity a critical factor for survival, questing behaviour, and reproduction (Ostfeld & Brunner, 2015; Leal *et al*., 2020). Furthermore, studies in the Limpopo Province by Makwarela *et al*. (2024) and Gaorekwe *et al*. (2025) indicate that communal areas characterised by warm temperatures and high relative humidity support higher tick abundance and species diversity compared to drier regions. In these environments, shaded and humid microhabitats enable moisture-sensitive species, such as *Amblyomma hebraeum* and *Rhipicephalus appendiculatus,* to persist across seasons. Conversely, low humidity limits the establishment of tick species regardless of temperature suitability, leading to shifts in community composition towards more xeric-adapted ticks. This ecological filtering partly explains the consistent dominance of *Rhipicephalus microplus* reported in communal cattle systems, where its physiological tolerance and resistance to commonly used acaricides provide a competitive advantage (Nyangiwe *et al*., 2018; Slayi & Mpisana, 2025).

Vegetation structure and land use further mediate the effects of temperature and humidity on tick distribution and diversity by influencing microclimatic conditions and host availability. Yawa *et al.* (2018) articulate that tick occurrence in South Africa is strongly associated with vegetation type and seasonal changes in grazing landscapes. Furthermore, studies by Mapholi *et al*. (2022) and Gaorekwe *et al*. (2024) show that the dense bushveld vegetation typical of many communal areas in the Limpopo Province provides shade, higher humidity, and suitable questing substrates, thereby promoting higher tick richness and abundance. In contrast, overgrazing, land fragmentation, and agricultural expansion reduce vegetation complexity and may lower overall tick diversity while favouring a few dominant pest species. Makwarela *et al*. (2023) reported that South Africa harbours seven ixodid tick genera infesting cattle, namely *Amblyomma*, *Boophilus*, *Dermacentor*, *Haemaphysalis*, *Hyalomma*, *Ixodes*, *and Rhipicephalus*, with a varying species composition across provinces and vegetation zones. In communal areas, particularly in the Limpopo province, *Amblyomma hebraeum*, *Rhipicephalus evertsi evertsi*, *Rhipicephalus (Boophilus) spp*., *and Hyalomma spp*. are frequently reported, reflecting adaptation to bushy savanna and semi-arid environments (Mapholi *et al*., 2022; Makwarela *et al*., 2024). These patterns demonstrate how vegetation, in interaction with climate and management practices, shapes tick assemblages on cattle.

Despite extensive research on cattle ticks, most studies focus solely on livestock populations and fail to adequately account for the wildlife–livestock interface. This represents a critical gap, particularly in provinces such as Limpopo, where communal grazing areas often overlap with wildlife habitats and conservation areas. Wildlife hosts may act as reservoirs for ticks and tick-borne pathogens, influencing tick diversity, distribution, and infestation pressure on cattle. Therefore, investigating tick species composition and abundance at the wildlife–livestock interface is necessary to improve understanding of tick ecology, disease transmission dynamics, and the development of integrated tick control strategies.

2.5 Effects of tick infestations on cattle health and productivity

Ticks are external parasites that infest vertebrate animals and depend on blood feeding for survival (Hurtado & Giraldo-Ríos, 2018). In cattle, tick infestations result in substantial health and productivity losses, even in the absence of pathogen transmission. Ticks affect cattle health and productivity both directly, through blood loss, skin damage, anaemia, and indirectly by weakening immune responses, which increases disease susceptibility and elevates farm treatment costs (Strydom *et al*., 2023; Yadav & Upadhyay, 2024). Therefore, tick infestations are widely recognised as one of the most significant biological constraints to cattle productivity in tropical and subtropical regions such as South Africa (Heylen *et al*., 2023). Direct tick feeding activities on cattle cause open wounds that are highly susceptible to secondary bacterial infections and myiasis, which further induce irritation and pain, thereby compromising animal welfare and productivity (Islam *et al*., 2015; Melo *et al*., 2024).

Additionally, Nyangiwe *et al*. (2017) and Monakale *et al*. (2024) reported that intense and prolonged tick infestations can lead to local skin damage, dermatitis, and hide downgrading, which reduces the market value of cattle products. Furthermore, studies have highlighted that cattle productivity is affected by ticks attached to sensitive anatomical sites, such as the udder and teats, which are associated with udder lesions, reduced milk yields, and an increased risk of mastitis in lactating cows (Heylen *et al*., 2023; Makwarela *et al*., 2024). Chronic and heavy tick infestations have also been shown to increase physiological stress, reduce grazing time, impair feed conversion efficiency, and lower body condition scores, ultimately diminishing weight gain and overall productivity (Heylen *et al*., 2023; Monakale *et al*., 2024). Notably, ticks also serve as vectors for a range of tick-borne diseases that significantly impact cattle health and productivity. A study by Nyangiwe & Matthee (2025) reported babesiosis, heartwater, and anaplasmosis as common tick-borne diseases that significantly affect the health and productivity of communal cattle in South Africa. Bovine babesiosis is caused by Babesia species, which are transmitted mainly by *Rhipicephalus spp*. (Jabbar *et al*., 2015; Kasaija *et al*., 2021). Ali & Marif. (2023) reported that bovine babesiosis affects cattle health and productivity by causing digestive disorders, abortion and calf death after birth. Furthermore, disease symptoms noted in previous studies included fever, haemoglobinuria, and severe anaemia, which collectively reduced weight gain, milk yield, and survival (Pfeffer *et al*., 2018; Garcia *et al*., 2022; Strydom *et al*., 2023). Heartwater is a fatal tick-borne disease of cattle, primarily transmitted by ticks of the genus *Amblyomma*. It is transmitted biologically by ticks, such as *Rhipicephalus decoloratus,* and mechanically by biting flies, causing severe anaemia, weight loss, depression, reduced milk output, and reproductive failure, which further compromises productivity in communal systems (Khoza, 2024; Monakale *et al*., 2024). Furthermore, previous studies by van den Heever *et al*. (2022) and Makwarela *et al*. (2023) reported that heartwater disease affected cattle health and productivity by causing high mortality rates in susceptible breeds, increasing the risk of secondary infections, reducing weight gain, and decreasing fertility and reproductive performance. Additionally, this disease leads to nervous signs, hydropericardium and sudden death, and is common in bushveld and wildlife interface areas, where it can cause catastrophic production losses in susceptible herds (Makwarela *et al*., 2025). Anaplasmosis is a common tick-borne disease of cattle in South Africa, caused by *Anaplasma marginale* and transmitted by ixodid ticks (Jabbar *et al*., 2015). This disease has been reported by Pfeffer *et al*. (2018), Ziam *et al.* (2020), Makgabo *et al.* (2023), and Fatima *et al*. (2025) as having a significant impact on cattle health and productivity. It is worth noting that the reported clinical signs on cattle associated with this disease include anaemia, fever (pyrexia), jaundice, loss of appetite (anorexia), decreased growth rates, reduced milk yield, and impaired fertility and reproductive performance.

A systematic review by Monakale *et al*. (2024) in South Africa confirmed that multiple TBDs agents, including *Babesia bigemina*, *Babesia bovis* and *Anaplasma marginale*, are prevalent across provinces and contribute to reduced cattle performance and disease burden in communal herds. Furthermore, a study by Gaorekwe *et al*. (2025) in the Limpopo Province reported that farmers recognised heartwater and redwater as major tick-borne diseases affecting cattle health. However, majority of the farmers lacked adequate knowledge of disease control, which contributes to ongoing productivity losses due to poor prevention and treatment practices. The same study highlights that communal cattle remain highly exposed to tick-borne pathogens due to inadequate biosecurity and acaricide resistance, exacerbating health and productivity constraints. Furthermore, a systematic review of tick infestations and associated risk factors in South Africa confirmed that tick infestations are widespread among communal cattle and that multiple tick species, including *Amblyomma hebraeum* and *Rhipicephalus spp*., are common vectors of pathogenic agents that reduce animal health and productivity (Monakale *et al*., 2024). Similarly, cross-sectional research in the Eastern Cape Province of South Africa found that communal farmers perceive ticks and TBDs, particularly redwater, gall sickness (anaplasmosis) and heartwater, as significant constraints to cattle health and productivity (Nyangiwe & Matthee, 2025). These disease effects, combined with direct tick damage, produce measurable production losses. Studies have reported that increased tick burdens are significantly associated with lower body condition scores, reduced growth rates, diminished reproductive performance and lower milk yields in communal cattle (Salih *et al*., 2023; Gaorekwe *et al*., 2025). Moreover, limited access to veterinary services, poor tick control practices, and knowledge gaps among farmers exacerbate these impacts, resulting in higher morbidity and mortality than in commercial herds.

The interplay of direct harm and transmitted diseases thus forms a compounded constraint on communal cattle health and productivity in South Africa. Although existing literature clearly demonstrates that tick infestations and tick-borne diseases adversely affect cattle health and productivity, significant gaps remain in understanding how infestation intensity, disease occurrence and management practices interact within communal cattle systems in South Africa. Many studies rely on indirect indicators such as body condition scoring and provide limited village-level. This study is therefore relevant as it integrates measured tick infestation levels with observable cattle health indicators and farmer management practices in communal herds from Ntlhaveni and Matiyani villages in Collins Chabane Local Municipality. By comparing communities that differ in proximity to the Kruger National Park, the study generates context-specific evidence that strengthens understanding of tick-related health and productivity impacts and supports the development of targeted, practical tick-control and livestock-management interventions in communal settings.

2.6 Factors influencing cattle tick infestations and species distribution in communal farms

Cattle tick infestations remain one of the most significant constraints to livestock productivity and health in communal cattle farming systems globally and in South Africa. Ticks of economic and veterinary importance, particularly those belonging to the genera *Amblyomma, Rhipicephalus* and *Hyalomma*, negatively affect cattle through blood loss, skin damage and the transmission of tick-borne diseases such as heartwater, anaplasmosis and babesiosis (Chitura *et al*., 2025; Makwarela *et al*., 2025). In communal farming systems, where cattle are often managed under extensive grazing conditions with limited veterinary support, the burden of tick infestations is particularly pronounced. Previous studies have highlighted that cattle tick infestations are influenced by complex interactions among environmental conditions, animal-related factors, and management practices (Peralbo-Moreno *et al*., 2022; Nyangiwe & Matthee, 2025).

2.6.1 Environmental factors and climatic conditions

Environmental and climatic conditions are widely recognised as primary determinants of tick survival, reproduction and spatial distribution. A systematic review by Kgopa *et al*. (2025) reported that temperature, rainfall, and vegetation structure strongly influence tick abundance and species composition in South African communal farming systems. Notably, Nyangiwe & Matthee (2025) found that communal cattle grazing in bushy, humid environments in the Eastern Cape Province led to higher infestations of *Amblyomma hebraeum* and *Rhipicephalus species*. Furthermore, Makwarela *et al*. (2024) surveyed six provinces of South Africa and found high tick prevalence across the provinces, suggesting that the warm temperatures (up to 35 °C) and moderate humidity (40-65%) created a favourable microhabitat for tick survival and proliferation, particularly during warm and wet seasons. Globally, Estrada-Peña (2025) reported a similar finding, stating that climatic variability and climate change have expanded tick habitats, thereby increasing the risk of infestation in extensive livestock systems. However, Peralbo-Moreno *et al*. (2022) argued that climatic factors alone cannot fully explain tick infestation patterns, emphasising the roles of host exposure and management practices. This suggests that while environmental conditions create ecological suitability for ticks, their actual impact on cattle infestation is mediated by grazing behaviour and farmer management decisions. This observation is particularly relevant to the Collins Chabane Local Municipality, where communal grazing occurs in heterogeneous landscapes that border wildlife areas.

2.6.2 Animal factors

Tick infestations in animals are strongly influenced by intrinsic host characteristics such as age, sex, breed, and physiological status. However, animals that are resistant to tick infestation prevent ticks from feeding effectively, leading to reduced engorgement, lower egg production, and decreased larval development, ultimately resulting in a lower tick population (Makwarela *et al*., 2023). Furthermore, a study by Mapholi *et al. (*2017) found that there is a well-recognised genetic variation in tick resistance among different breeds. In South Africa, various exotic cattle breeds are prone to ticks and tick-borne diseases. Indigenous Bos indicus breeds or crossbreds typically exhibit greater resistance to tick attachment and feeding than exotic Bos taurus breeds. In contrast, indigenous breeds and some locally developed breeds have adapted well to survive in harsh tropical conditions. Additionally, Rodriguez-Vivas *et al*. (2018) and Heylen *et al*. (2023) both report that genetic factors, such as skin thickness, glandular secretion, and immunological traits, contribute to breed-level tolerance. Numerous field studies have demonstrated that older cattle generally harbour more ticks than calves, due to cumulative exposure and larger body surface area. A higher tick infestation was observed in the adult age group, with a prevalence of 76.2%, compared to 49.5% in the young age group (Belete & Mekuria, 2023). Furthermore, Heylen *et al*. (2023) reported significantly higher mean tick burdens in adult cattle than in calves across rural smallholder systems, and similar findings were reported by Addo *et al*. (2024) in Ghana.

Age has consistently been identified as a significant risk factor for tick infestation. A study by Fesseha *et al*. (2022) in Ethiopia reported significantly higher tick prevalence in adult and older cattle compared to calves, attributing this to prolonged exposure to tick-infested grazing areas and larger body surface areas. In agreement, Sharma *et al*. (2024) in India found that adult cattle harboured higher tick burdens than younger animals across extensive production systems. Within South Africa, Katswara & Mukaratirwa (2021) in the Eastern Cape Province noted that calves often remained near homesteads, where tick pressure was lower, while adults grazed in bushy communal rangelands, thereby increasing exposure. Moreover, Nyangiwe & Matthee (2025) observed that adult cattle in communal systems were more frequently and heavily infested than calves, a pattern attributed to differential grazing ranges. Nevertheless, Heylen *et al*. (2023) reported no significant age-related differences in tick infestation, suggesting uniform exposure under extensive systems. This contrast indicates that age-related infestation risk is context-specific and strongly influenced by grazing behaviour and management, underscoring the need to assess age as a risk factor within local communal systems such as Collins Chabane.

Sex-related differences in tick infestation have been reported, although findings remain inconsistent. For example, Heylen *et al*. (2023) found that female cattle in communal husbandry systems in sub-Saharan Africa carried significantly lower tick loads than males for several tick species, suggesting real biological differences in infestation patterns. In contrast, a recent study in Ethiopia by Rebuma *et al*. (2024) reported no significant difference in overall tick prevalence between male and female cattle, highlighting the variability in sex effects across different settings. Furthermore, a study by Dzemo *et al*. (2024) in South African communal systems suggests that uniform management approaches may hinder the detection of subtle sex-related differences in natural tick burdens, particularly when acaricide control is ineffective or inconsistently applied. These findings highlight the need for context-specific evaluation of sex as a risk factor in communal cattle production.

Physiological status and body condition are important determinants of host susceptibility to tick infestation in cattle.

A study by Silva *et al*. 2021 demonstrates that lactating and peripartum cows carry higher tick burdens than dry cows, likely due to hormonal, reproductive, and immunological stresses associated with lactation. However, poor body condition has also been consistently associated with higher tick prevalence and intensity, reflecting the role of nutritional stress in reducing host resilience to ectoparasites (Rehman *et al*., 2017). In addition, host characteristics such as sex and age modulate infestation patterns, with females often carrying more ticks than males under similar exposure conditions, suggesting that physiological and behavioural factors interact to influence vulnerability (Rehman *et al*., 2017). A review highlights the complex interplay of animal physiological traits, management, and environmental factors that affect tick infestations, although quantitative studies remain limited (Kgopa *et al*., 2025). This gap is particularly relevant in communal systems where nutritional stress and disease are common, underscoring the need to include physiological factors in the current study

2.6.3 Wildlife–livestock interactions

Wildlife–livestock interfaces have been increasingly recognised as important drivers of tick infestation and species diversity (Raboloko *et al*., 2020). Furthermore, studies conducted near the Kruger National Park indicate that wildlife species, such as buffalo and antelope, serve as reservoirs for ticks of veterinary importance (Horak *et al*., 2017; Sisson *et al*., 2023; Cossu *et al*., 2024, 2025). Notably, Monakale *et al*. (2024) documented *Amblyomma hebraeum*, *Hyalomma rufipes,* and *Hyalomma truncatum* in cattle grazing near wildlife–livestock interfaces in Limpopo Province, confirming a shared tick fauna between wildlife and livestock. Similarly, a systematic review by Makwarela *et al*. (2025) highlighted that wildlife–livestock interactions facilitate the persistence of ticks and the circulation of tick-borne pathogens across shared landscapes. In contrast, Nyangiwe & Matthee *et al*. (2025) argued that wildlife presence alone does not inevitably lead to increased tick infestation unless accompanied by poor livestock management. This suggests that wildlife-associated risk is amplified in communal systems lacking effective control measures, as is the case in many villages bordering protected areas such as Collins Chabane Local Municipality.

2.6.4 Management-related factors

Management practices have a significant influence on the level of tick exposure and the effectiveness of control measures within a farm. Grazing management has a strong impact on animals' exposure to tick habitats. Furthermore, Inadequate grazing management practices, such as overgrazing, can increase the risk of tick infestations by creating environments favourable to tick survival and reproduction. Kgopa *et al*. (2025) indicate that poor grazing management and a lack of rotation promote sustained tick exposure and survival. Furthermore, grazing near bushy areas and wildlife corridors increases exposure to questing ticks, thereby intensifying the risk of infestation (Ledger *et al*., 2019). These findings are particularly relevant to communal grazing systems in Limpopo Province, where cattle frequently graze near wildlife boundaries.

Acaricides remain the primary method of tick control; however, their effectiveness depends heavily on management practices. Furthermore, irregular dipping is far less effective than weekly or biweekly regimens under tropical conditions (Kazungu *et al*., 2015). However, a study by Makwarela *et al*. (2025) reported that frequent dipping without rotation of acaricides can accelerate resistance development, emphasising the need for integrated approaches combining management, biological, and genetic control. A study by Nyangiwe and Horak (2018) reported widespread misuse of acaricides in communal farms, including underdosing and irregular application. Furthermore, Dzemo *et al*. (2023) documented acaricide resistance in *Rhipicephalus microplus* populations, linking its development to poor management and a lack of acaricide rotation. In contrast, Thononda (2023) demonstrated improved tick control outcomes in areas with effective veterinary extension services, highlighting the importance of farmer knowledge and institutional support.

While numerous studies reveal clear associations between risk factors and cattle tick infestations, many rely on cross-sectional designs that limit causal inference. Animal host factors, such as physiological phase and immune status, remain under-researched in South African contexts, despite strong evidence from other regions. Furthermore, the integration of ecological, animal, and socio-behavioural data is limited, leaving gaps in understanding how husbandry, wildlife exposure, and host biology interact over time. Therefore, the present study in Collins Chabane Local Municipality is critically important because it will bridge existing knowledge gaps by quantifying animal-level risk factors alongside ecological and management drivers. In addition, this study examines the dynamics of the wildlife-livestock tick interface, particularly in areas where shared tick species are present, addressing a significant research gap in South Africa. Furthermore, it evaluates farmer practices and acaricide use, critically linking them to infestation outcomes and control effectiveness.

2.7 Economic impact of cattle ticks and farmers' knowledge, attitude and practices on ticks, tick control, and acaricide resistance

2.7.1 Economic effects of tick infestations on cattle farming systems

Communal livestock farmers in both tropical and subtropical regions are particularly affected by ticks and tick-borne diseases due to their heavy reliance on cattle for their livelihoods (Gaorekwe *et al*., 2025). A study by Makwarela *et al.* (2023) indicated that ticks infest approximately 80% of the global cattle population, resulting in annual economic losses of USD 20–30 billion, thereby highlighting their substantial impact on the livestock economy. Furthermore, Heylen *et al*. (2023) reported that ticks cause both direct and indirect economic losses, including mortality, reduced milk and meat production, poor weight gain and decreased working efficiency, which collectively undermine cattle productivity. Additionally, Kasaija *et al*. (2021) found that tick feeding leads to irritation, allergic reactions and anaemia, consequently lowering production performance and farm profitability. Moreover, cattle farmers incur additional losses from tick paralysis, reduced fertility, and hide damage, which diminish the market value and overall income from cattle enterprises (Heylen *et al*., 2023). Indirectly, a study by Heylen *et al*. (2023) noted that farmers incur substantial costs for acaricides, tick-control equipment, and treatment for tick-borne diseases, such as anaplasmosis, babesiosis, theileriosis, East Coast fever, and heartwater. Monakale *et al*. (2024) further reported that treatment costs are often prohibitive in rural areas with limited veterinary services. Henceforth, reduced genetic improvement, restrictions on livestock movement and restricted access to markets further exacerbate economic losses, particularly in communal systems (Kasaija *et al.*, 2021).

2.7.2 Farmers' knowledge, attitude and practices on ticks, tick control and acaricide resistance

Communal cattle farmers are especially vulnerable to tick impacts due to limited resources and restricted access to veterinary and extension services. Gaorekwe *et al*. (2025) indicated that these constraints increase farmers' susceptibility to severe tick infestations and tick-borne diseases. Additionally, the social and cultural significance of cattle in communal settings means that tick-related losses extend beyond economic considerations, affecting not only household food security but also social status and prestige. Therefore, strengthening farmer knowledge and improving access to veterinary services have been identified as critical interventions to reduce the financial and social burden of tick infestations

(Heylen *et al*., 2023). Farmers' knowledge, attitudes and practices (KAP) are central to the effectiveness of tick control strategies in communal cattle systems. In addition, a study by Monakale *et al*. (2024) found that Farmers' understanding of tick biology, disease transmission and appropriate control methods strongly influences the success of control interventions.

Furthermore, Yawa *et al*. (2020) and Nyangiwe & Matthee (2025) reported that farmer attitudes shape the consistency and sustainability of tick control efforts, particularly under resource-limited conditions common in rural South Africa. Previous studies have reported that communal cattle farmers generally possess basic knowledge of ticks and their harmful effects. For example, a study by Monakale *et al*. (2024) indicated that most farmers can visually identify ticks and associate heavy infestations with poor body condition, skin damage and reduced productivity. Furthermore, Gaorekwe *et al*. (2025) found that farmers commonly recognise tick-borne diseases such as redwater and heartwater, although they often lack understanding of the specific tick species involved. In addition, Namgyal *et al*. (2021) noted that farmers' experiential knowledge was derived from daily interactions with cattle and served as the foundation for recognising ticks. However, despite this awareness, studies consistently indicate a limited understanding of tick life cycles, disease epidemiology, and acaricide resistance, suggesting variability in depth of knowledge rather than a complete absence of knowledge about ticks and tick-borne diseases (Monakale *et al*., 2024). This is because most KAP studies rely on self-reported data, which may overestimate actual knowledge due to social desirability bias, thereby limiting the accuracy of reported findings (Yawa *et al*., 2020; Monakale *et al*., 2024). Overall, there is still limited knowledge among farmers living near wildlife reserves, despite their frequent exposure and recurring disease outbreaks.

Farmers' attitudes towards ticks significantly influence their willingness to adopt and sustain control measures. Several authors have indicated that ticks are perceived as a serious yet unavoidable problem in communal grazing systems (Nyangiwe & Matthee, 2025). Monakale *et al*. (2024) reported that many farmers regard tick infestations as usual and respond only when infestations become severe. Furthermore, Katswara & Mukaratirwa *et al*. (2021) found that farmers near wildlife–livestock interfaces often feel powerless due to continuous reinfestation from wildlife reservoirs. Consequently, negative attitudes towards the effectiveness of tick control undermine consistent management practices. Jamra *et al*. (2024) reported that farmers with better knowledge and positive perceptions of acaricide efficacy were more likely to use them appropriately and consistently, whereas those with poor perceptions used them irregularly or employed ineffective practices. Furthermore, Sungirai *et al*. (2016) reported that farmers' confidence in acaricides was high, with 75% of farmers perceiving commercial acaricides as more effective at controlling ticks than traditional practices.

In contrast, Monakale *et al*. (2024) found a preference for conventional remedies driven by cost, accessibility and cultural beliefs. Tick control practices in communal systems are diverse and include chemical acaricides, traditional remedies and manual tick removal. Furthermore, a study by Murapa (2018) in the Mpumalanga province of South Africa reported that plunge dipping and spraying are the most used tick control methods for communal cattle. Additionally, Dzemo *et al*. (2023) found that improper acaricide use, including underdosing and irregular application, is widespread and contributes to the persistence of infestations and the development of acaricide resistance. Furthermore, Monakale *et al*. (2024) noted the frequent use of ethnoveterinary remedies, particularly in areas with limited veterinary support. Therefore, there is a need for an integrated tick management approach that combines chemical, environmental, and traditional methods for sustainable control. Despite the proven efficacy of acaricides, their use is often inconsistent. According to Yawa *et al*. (2020), communal farmers apply acaricides only after heavy infestations are observed, rather than preventively. Furthermore, limited awareness of acaricide resistance leads to repeated use of the same products, henceforth reducing long-term effectiveness (Dzemo *et al*., 2023). However, most studies assessing tick control practices rely on farmer knowledge, which may not accurately reflect application frequency or dosage, and few evaluate the effectiveness of traditional methods under field conditions (Monakale *et al*., 2024). Overall, the literature demonstrates that the Farmer's knowledge, access to veterinary advice, and socioeconomic conditions influence the effectiveness of tick control strategies. Paucar *et al.* (2022) observed that a poor understanding of acaricide dilution and resistance leads to higher tick prevalence, while Rodríguez-Vivas *et al*. (2018) emphasise the importance of education and coordinated community dipping programs as cost-effective ways to reduce infestation rates. Together, these studies demonstrate that improved farmer capacity and adherence to integrated tick management principles can significantly reduce infestation intensity. However, limited village-level evidence exists linking farmer KAP, tick burden and proximity to wildlife conservation areas in South Africa. Therefore, this study addresses these gaps by comparing farmers in Ntlhaveni and Matiyani villages, which differ in their distance from the Kruger National Park, thereby contributing to the development of locally appropriate, sustainable, and context-specific tick control strategies for communal cattle systems in Collins Chabane Local Municipality.

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CHAPTER 3: IDENTIFICATION OF TICK SPECIES AND COMPARISON OF CATTLE TICK INFESTATIONS IN MATIYANI AND NTLHAVENI VILLAGES

ABSTRACT

Tick infestations remain a major constraint to cattle production in communal farming systems in South Africa, where environmental and management conditions favour the proliferation of diverse tick species. This study aimed to identify the tick species infesting cattle and to compare infestation levels between the villages of Matiyani and Ntlhaveni in the Limpopo Province. A total of 967 adult ticks were collected from cattle using a systematic hand-picking method during routine livestock dipping. Ticks were preserved in 70% ethanol and identified to the species level via stereomicroscopy, following standard taxonomic keys. The identified species were *Amblyomma hebraeum* (31.3%), *Rhipicephalus decoloratus* (22.3%), *R. microplus* (13.1%), *R. evertsi* (11.2%), *R. appendiculatus* (6.1%), *Hyalomma rufipes* (6.8 %), *Amblyomma variegatum* (5.4%), and *H. truncatum* (2.9%). The clinical evaluation checklist, including tick infestation parameters, was entered and processed in Microsoft Excel before analysis. Tick infestation levels and their frequencies were analysed using SPSS version 28, and percentage compositions were calculated to compare the infestation levels between the two villages using cross-tabulations. Results showed that Ntlhaveni had a higher overall tick burden, dominated by *Amblyomma hebraeum* (34.4%) and *Rhipicephalus decoloratus* (24.1%), while Matiyani had a lower proportion, with *A. hebraeum* (26.3%) and *R. decoloratus* (19.5%) being the most prevalent tick species. Notable differences were observed in the distribution of *R. microplus* and *H. rufipes*, which were more abundant in Ntlhaveni. These variations suggest that local environmental conditions, grazing patterns and management practices may influence species composition and infestation intensity. In conclusion, the study highlights significant spatial variation in tick species distribution between the two communal villages, emphasising the need for location-specific tick control strategies. The findings contribute valuable baseline data for future surveillance and support improved management of tick-borne diseases in communal cattle production systems.

Key words: Cattle farming, cattle Infestations, Tick control methods, Tick burden, Tick abundance

3.1 Introduction

Cattle ticks are distributed worldwide, with varying species and prevalence rates across regions, including tropical and subtropical areas (de la Fuente *et al*., 2023). Nyangiwe *et al*. (2018) reported that these ticks affect approximately 80% of the world's cattle population, posing a significant risk of tick-borne diseases and resulting in substantial annual global losses. In South Africa, livestock production systems are particularly vulnerable to tick infestations (Mapholi *et al*., 2022). This is mainly caused by free-grazing practices, inconsistent dipping routines, and limited access to veterinary support, all of which increase the risk of heavy tick burdens and associated tick-borne diseases. In addition, these factors enable multiple tick species to coexist and move freely between animals, creating ideal conditions for the maintenance and spread of vector-borne diseases that affect livestock health and productivity. Accurate identification of tick species occurring on cattle is crucial because each species differs in its ecological preferences, host associations and vectorial capacity.

Matiyani and Ntlhaveni villages represent typical communal cattle farming systems in Collins Chabane Local Municipality (CCLM), where environmental conditions, vegetation structure, and grazing practices may influence tick abundance and species distribution. Although both villages are located within the same broad agro-ecological zone, there is limited published information on tick species composition and infestation levels. Establishing such comparisons is essential because spatial variation in tick communities can affect disease risk, emerging vector populations and the effectiveness of tick control programmes. Therefore, this study aimed to identify the tick species infesting cattle in Matiyani and Ntlhaveni villages and to compare the infestation patterns between the two areas. By examining species diversity, abundance, and potential ecological drivers, the findings will contribute to improved tick surveillance, more targeted control strategies, and a more comprehensive understanding of tick ecology in communal livestock systems within the Collins Chabane Local Municipality, Limpopo Province.

3.2 Materials and methods

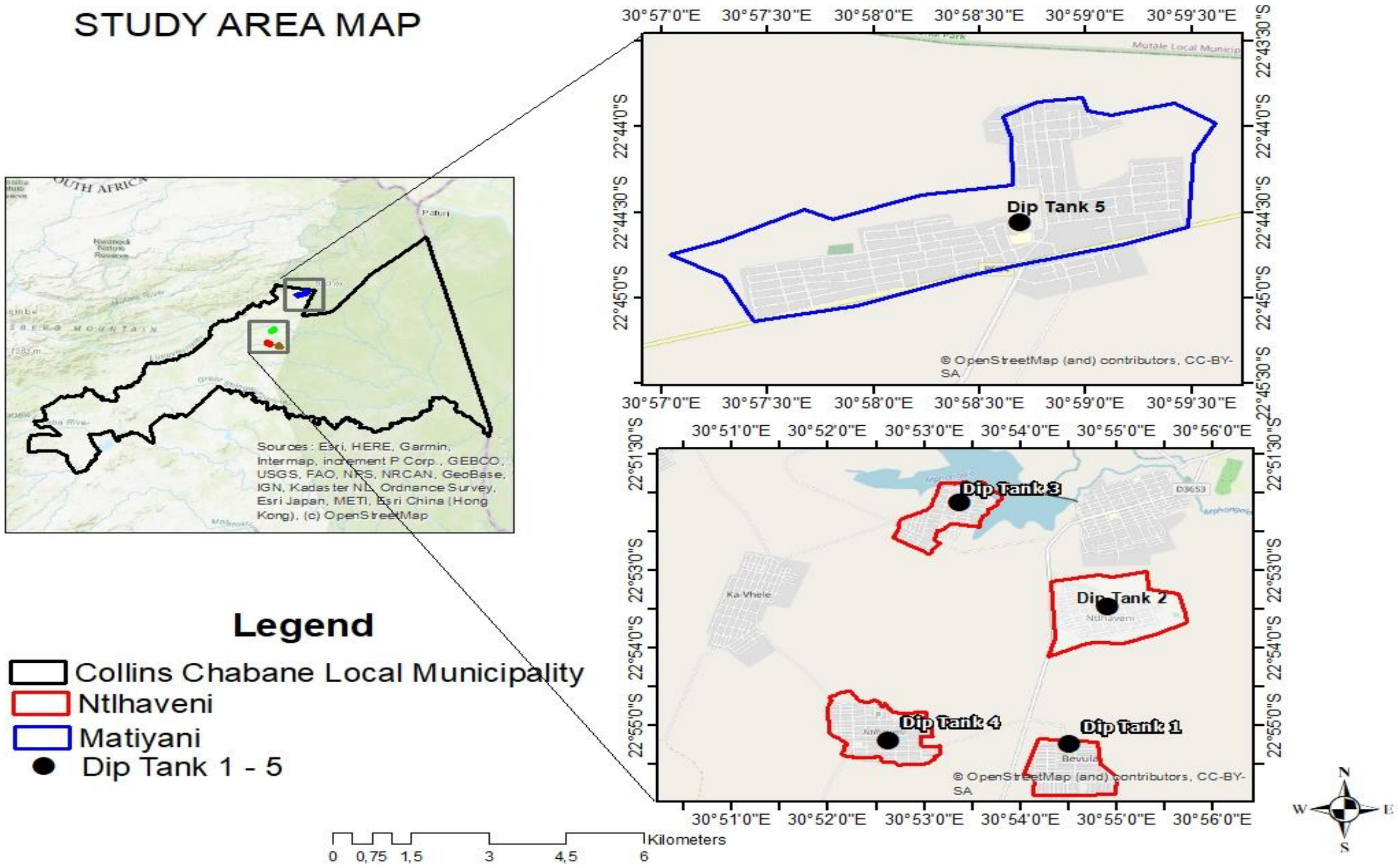
3.2.1 Ethical approval

The Animal, Environmental, and Biosafety Research Ethics Committee (AEBREC), University of Venda, approved the study under reference number **FSEA/24/ANS/09/1302.** The Limpopo Provincial Research Ethics Committee (LPREC), a unit of the Limpopo Provincial Government's Office of the Premier, approved the interviews with farmers and the collection of tick samples, under project number **LPREC/157/2025.**

3.2.2 Description of the study area

The study was conducted in Collins Chabane Local Municipality (CCLM) in the Vhembe District of Limpopo Province, South Africa (22° 35´ S 30° 40´ E). Collins Chabane Local Municipality (CCLM) covers an area of approximately 5.835 km^2, with a human population of 443,798 and a population density of 66/km^2 (STATS SA, 2022). It is a semi-arid environment with a mean annual rainfall of 800 mm. Summer temperatures range from 25°C to 35°C, and winter temperatures range from 10°C to 20°C (South African Weather Service, 2022). Collins Chabane Local Municipality is situated within the Savanna biome and comprises a mixed veld featuring both sweet veld (palatable year-round and high in nutritive value) and sour veld (unpalatable during winter and low in nutritive value) pastures

Figure 3: Map showing the study area



Developed using ArcMap V10.8

Data collection was conducted in two selected villages, namely Ntlhaveni and Matiyani. These villages are under intensive surveillance and disease control measures by the Limpopo Department of Veterinary Services, through regular cattle inspections and weekly dipping. Matiyani (MT) village was specifically chosen for this study because it is located 4.7 kilometres (km) from the Kruger National Park (KNP), at coordinates 22°43'52.6"S 30°59'03.2"E. This proximity to KNP makes MT village a high-exposure site, where cattle are at risk of sharing grazing land with wildlife from the KNP and of interacting with wildlife from the KNP. The village presented an ideal location to investigate the potential spillover of novel tick species from wildlife to domestic cattle, thereby highlighting the direct impact of wildlife-livestock interactions. The village had 146 cattle farmers and one dip tank.

On the other hand, Ntlhaveni (NT) village is situated 29.2 km from the KNP and served as a comparative site (22°53'28.8"S, 30°55'00.1"E). It was chosen because it had the highest free-ranging cattle population in the municipality, totalling two thousand and four hundred (2,400), which made it a suitable study area for cattle farming practices in the region. The village is home to two hundred and ninety-one (291) cattle farmers and features four dip tanks identified as A, B, C, and D. Both villages are within the FMD red-line zone and under constant veterinary supervision.

3.2.3 Study design

A cross-sectional study design was conducted for 1 month (October 2025) in Matiyani and Ntlhaveni villages. This design was essential for the mixed-methods study on tick infestations in cattle, as it provided an efficient, cost-effective means to collect both quantitative and qualitative data at a single point in time (Creswell & Creswell, 2017). This approach allowed concurrent collection of tick samples to further identify tick species and complete a clinical evaluation checklist. It also enabled the researcher to conduct interviews with farmers about their knowledge, perceptions, and management practices. The integration of these complementary datasets provided a comprehensive snapshot of the situation, revealing not only the extent of the tick challenges but also the socio-cultural factors that influenced it, such as local beliefs and economic constraints on the effective use of acaricides. This enabled the study to explore associations and generate findings that were crucial for possibly developing relevant and effective control strategies and for informing future longitudinal research. However, it is worth noting that this design could not establish a definitive cause-and-effect relationship between variables, nor could it track changes over time.

3.2.4 Clinical examination of cattle for tick infestations and tick collection

Clinical evaluation of cattle for tick infestations and subsequent tick collections were performed during routine dipping days in Matiyani and Ntlhaveni villages. These evaluations utilised a specific checklist to provide a standardised score regarding the effects of ticks on cattle health. The process involved a systematic sampling strategy in which every fifth animal entering the crush pen was selected for examination, and its identity was documented regardless of sex, age, or physiological phase.The clinical evaluation checklist used a scoring system for observations, with a score of 0 indicating no effect, 1 indicating mild effects, 2 indicating moderate effects, and 3 indicating severe effects. This applied to tick infestation parameters, including tick burden, identified tick species, tick distribution on the animal's body, tick-induced lesions, and the dominant tick species. Additionally, the checklist included a section to record the presence (P) or absence (NP) of specific clinical signs, such as jaundice, general skin lesions, hair loss, discharge from the eyes or nose, skin thickening, and the overall body condition score (Appendix 5). Animal handling procedures were carried out under the direct supervision of qualified Animal Health Technicians. Following the clinical assessment, five ticks were systematically collected from various predilection sites on the same animal, including the genital area, ears, neck, belly, rectum, legs, and tail, using forceps, as described by Gäumann *et al*. (2010). To maintain ethical standards and ensure data anonymity, each animal was assigned a unique identification code consisting of the first three letters of the village name, followed by its unique number. After collection, each tick was placed into a separate specimen container filled with 10 mL of 70% ethanol for preservation. The container label included the collection site coordinates, the unique animal ID, and the collection date. The collected samples were then transported to the Animal Science Laboratory, Faculty of Science, Engineering, and Agriculture, University of Venda, where ticks were counted and their genus and species levels identified using a stereomicroscope, according to standard identification keys provided by Walker *et al. (*2003) and Makwarela *et al*. (2023). During transportation, the cooler box containing the vials was sealed tightly with biohazard tape and kept cool using ice packs. The samples were refrigerated at - 20°C.

3.2.5 Tick counting

On collection days at the dip tanks, tick species were initially grouped based on appearance. Trained field interns from the University of Venda, Department of Animal Science, carried out the tick collection activities at the study sites. Two interns were assigned to tick collection, while one counted the cattle during the roundup. The researcher was responsible for overseeing the entire project, sorting, counting, and preparing the ticks for further analysis by placing them in vials.

3.2.6 Statistical analysis

Clinical evaluation data and field observations from both villages were entered into a Microsoft Excel database and analysed using the Statistical Package for the Social Sciences (SPSS), version 29.0. The software was used to determine the frequencies of tick species occurrence and the distribution of tick infestation parameters within each village. The chi-square ($\chi 2$) test was used to determine possible associations between animal factors, clinical signs and symptoms, tick infestation parameters and the villages.

3.3 Results

3.3.1 Distribution of cattle tick species in Matiyani and Ntlhaveni villages in CCLM, Limpopo Province

The distribution of tick species showed noticeable variations between the two study sites (Table 3.1). In Matiyani village, *Amblyomma hebraeum* (26%) and *Rhipicephalus decoloratus* (20%) were the most dominant species, followed by *Rhipicephalus evertsi evertsi* (16%) and *Rhipicephalus microplus* (13%). Other species contributed smaller proportions, with Amblyomma *variegatum, Rhipicephalus appendiculatus, Hyalomma truncatum, and Hyalomma rufipes* showing the lowest percentages at 8%, 8%, 4%, and 5%, respectively. In contrast, Ntlhaveni village had a higher overall tick burden, with *Amblyomma hebraeum* being dominant (34%), followed by *Rhipicephalus decoloratus* (24%), *Rhipicephalus microplus* (13%), *Rhipicephalus evertsi evertsi* (10%), *Hyalomma rufipes* (8%), *Rhipicephalus appendiculatus* (5%), Amblyomma *variegatum* (4%) and *Hyalomma truncatum* (2%).

Table 3.1 The proportion of cattle tick species collected from Matiyani and Ntlhaveni villages, Collins Chabane Local Municipality, Limpopo Province

Tick species	Matiyani village n= 369	Ntlhaveni village n= 598	Total % of tick species from both village
Amblyomma hebraeum	97 (26 %)	206 (34 %)	60
Amblyomma variegatum	30 (8 %)	22 (4 %)	12
Hyalomma rufipes	20 (5 %)	46 (8 %)	13
Hyalomma truncatum	15 (4 %)	13 (2 %)	6
Rhipicephalus appendiculatus	28 (8 %)	31 (5 %)	13
Rhipicephalus evertsi	59 (16 %)	57 (10 %)	26
Rhipicephalus decolarutus	72 (20 %)	144 (24 %)	44
Rhipicephalus microplus	48 (13 %)	79 (13 %)	26

3.3.2 Association between villages and cattle tick infestation parameters

Table 3.2 shows a non-significant association ($p > 0.05$) between tick burden and the villages, with both villages showing similar results of 88%. The distribution of ticks on cattle differed significantly between villages ($p < 0.05$). Cattle owned by farmers from MT village were more infested with ticks in multiple areas (74%), while cattle owned by farmers from NT village had widespread infestation across their bodies (26%). There was no significant difference ($p > 0.05$) between tick-bite lesions and villages; the majority of cattle in both villages had a high percentage of a few tick bite lesions, with 82% in the MT village and 76% in the NT village. The abundance of tick species differed significantly between the villages ($p < 0.05$). Matiyani village had a high proportion of one dominant species and 2–3 co-dominant species (45% and 48%, respectively), while NT village had a higher proportion of 2–3 co-dominant species and multiple dominant species (69% and 19%, respectively).

Table 3. 2 Frequency and percentage of tick infestation parameters in Matiyani and Ntlhaveni villages, Collins Chabane Local Municipality, Limpopo Province

Parameter	Matiyani village		Ntlhaveni village		Significance
	Frequency (85)	Percentage (%)	Frequency (167)	Percentage (%)	
Tick burden					
1 – 5 ticks	0	0	**2**	**1**	
6 – 9 ticks	10	12	19	11	N
≥10 ticks	75	88	146	88	
Tick distribution					

Limited to one area	14	17	26	16	
Multiple areas	63	74	98	59	S
Widespread	8	9	43	26	
Tick- bite lesions					
Few bite lesions	70	82	126	76	
None	5	6	12	7	N
Numerous tick bite lesions	10	12	29	17	
Tick species abundance					
1 dominant specie	38	45	20	12	
2 - 3 co-dominant species	41	48	115	69	S
Multiple dominant species	6	7	32	19	

*N=Not significance (p>0.05), S= Significance (p<0.05)

3.4 Discussion

A total of 967 ticks were collected from the study area and identified using a stereomicroscope (AmScope SM-1TB Trinocular stereomicroscope, 7X–45X Magnification, on a pillar stand with an extra-large plate). Table 3.1 lists the identified ticks belonging to three (3) genera: *Amblyomma, Hyalomma and Rhipicephalus*. Studies by Horak *et al*. (2017) and Makwarela *et al*. (2023) reported that ticks from these genera are native to South African ecosystems and affect both wild and livestock animals. The most prevalent tick species observed in this study were *Amblyomma hebraeum* (31%) and *Rhipicephalus decoloratus* (22%), which were found in both villages. In contrast, a study conducted by Monakale *et al*. (2024) in the Limpopo Province, South Africa, reported that the most prevalent tick species were *Rhipicephalus microplus* and *Amblyomma hebraeum.* These findings suggest that environmental or management conditions in the study area, such as warmer microclimates, higher vegetation cover, or greater host availability, favour the proliferation of these species (*A. hebraeum* and *R. decoloratus*). In addition, Mandara *et al*. (2018) reported that *A. hebraeum* is typically found in warm and hot, dry, harsh areas, and is more commonly found in cattle. Horak *et al*. (2017) observed that wild animals, such as Kudu, Giraffe, Buffalo, Warthogs, and Rhinoceros, are hosts for *A. hebraeum*, possibly explaining its prevalence in cattle grazing near game reserves.

The dominance of *A. hebraeum* in both villages aligns with findings from surveys of cattle-associated ticks, which consistently show this species to be highly prevalent in savannah and bushveld ecosystems, as well as at wildlife–livestock interfaces (Makwarela *et al*., 2023; Smit *et al.,* 2024). In the present study, *A. hebraeum* was more abundant in Ntlhaveni village, despite Matiyani village being the one closer to the KNP. While the distance from the KNP is typically associated with higher *Amblyomma* densities, Makwarela *et al.* (2024) reported that abiotic conditions, particularly temperature, humidity, rainfall, and vegetation structure, can strongly influence tick survival and questing behaviour. These factors may therefore have created microclimatic pockets in Ntlhaveni village that were more favourable for *A. hebraeum* development than in Matiyani village, demonstrating that local habitat characteristics can override simple distance-based expectations. The findings also align with observations by Mapholi *et al*. (2022), who demonstrated that tick loads in Nguni cattle vary across environmental conditions, reinforcing the role of environmental heterogeneity in shaping tick abundance.

Rhipicephalus decoloratus was the second-most-abundant species in both villages. Its dominance has long been associated with communal cattle farming systems; however, Yawa *et al*. (2018) and Makwarela *et al*. (2023) indicated that its abundance is also influenced by climatic variables and livestock density. In this study, *R. decoloratus* was more abundant in Ntlhaveni village, possibly reflecting higher cattle densities or grazing practices that favour its life cycle. Makwarela *et al*. (2024) stated that *R. decoloratus* abundance responds strongly to favourable abiotic conditions, particularly warm temperatures and moderate humidity, which sustain off-host development. This suggests that the local environmental conditions in Ntlhaveni village may have been more suitable for *R. decoloratus* than those in Matiyani village. Mapholi *et al*. (2022) similarly reported that cattle in certain environmental zones experience heavier infestations of Rhipicephalus species, supporting the interpretation that the distribution of *R. decoloratus* is environmentally mediated rather than solely host driven. *Rhipicephalus microplus* showed relatively similar abundance in both villages. This is consistent with contemporary reports of the species' rapid expansion across South Africa, where *R. microplus* has steadily displaced *R. decoloratus* in several provinces, including the Eastern Cape, Northern Cape, Western Cape, and Free State (Nyangiwe *et al*., 2017; Makwarela *et al.*, 2025). The presence of *R. microplus* in both villages mirrors findings by Makwarela *et al.* (2024), who showed that its establishment is closely tied to local abiotic factors and cattle management practices. These studies demonstrate that *R. microplus* thrives under warm and moderately humid conditions and can persist where cattle movements facilitate its spread, making the uniform presence of this species across both study sites ecologically plausible

Rhipicephalus evertsi was the third most prevalent species in Matiyani village and fourth in Ntlhaveni village, which is further away from the KNP. *R. evertsi* was more abundant in Matiyani, a pattern consistent with that of general tick species that thrive in open grazing landscapes, as noted by Mandara (2018) and Monakale *et al*. (2024). However, Mapholi *et al*. (2022) reported that *Rhipicephalus evertsi* was the second most dominant tick species across the Eastern Cape Province, Gauteng Province, KwaZulu-Natal Province, and Limpopo Province in South Africa. This difference in findings between villages could have been due to spillover of novel tick species from wildlife to domestic cattle, as *R. evertsi* is reported to be a dominant tick species on both domestic and wild animals in South Africa (Booysen *et al*., 2017). *Rhipicephalus appendiculatus* was the fourth most prevalent tick species infesting cattle in both villages. These results align with those of Mapholi *et al*. (2022), who identified *R. appendiculatus* as the fourth-most dominant species across four provinces in South Africa. On the contrary, Makwarela *et al*. (2024) found that among the collected ticks across six provinces, Limpopo Province, Gauteng Province, and Mpumalanga Province had 0% of *R. appendiculatus.* The present study observed that severe infestations of *R. appendiculatus* caused substantial damage to the calves' ears. *Hyalomma rufipes* and *Hyalomma truncatum* were the least prevalent species in both villages. These species exhibited patterns that reflect interactions among environmental conditions, host availability, and vegetation structure. For instance, the abundance of *Hyalomma rufipes* in Ntlhaveni village suggests that local environmental and management factors may outweigh simple distance effects.

The findings in Table 3.2 show a non-significant difference ($p > 0.05$) relationship between tick burden and villages, with 88% of sampled cattle in Matiyani and Ntlhaveni carrying ≥10 ticks. These observations suggest that the two villages are exposed to similar tick infestation pressures, resulting in a substantial risk to cattle production. Furthermore, studies by

Makwarela *et al*. (2023) and Heylen *et al.* (2023) reported high tick prevalence and heavy mean loads in communal and smallholder systems. Additionally, high tick burdens of this magnitude (≥10 ticks) are frequently reported in communal grazing systems and are commonly linked to unrestricted grazing, seasonal peaks in tick activity, and incomplete or ineffective acaricide application (Mandara 2018; Mapholi *et al*., 2022). Makwarela *et al*. (2024) reported that warm, moist months are associated with increased off-host survival and questing activity, leading to high herd-level burdens during peak seasons. Moreover, a study by Yawa *et al*. (2020) reported that persistent heavy infestations despite control efforts can also reflect acaricide resistance or poor application practices, a point supported by regional surveys that document inadequate dosages and emerging resistance in Boophilids and other genera (Monakale *et al*., 2024). Thus, the high proportion of ≥10 ticks is consistent with recent field studies in Limpopo and neighbouring provinces (Mapholi *et al*., 2022; Makwarela *et al*., 2024), indicating elevated risks to animal health and production. Therefore, this study noted that communal grazing practices have limited resources for tick control, and favourable climatic conditions commonly result in uniformly high tick burdens across neighbouring communities. Heavy infestations were observed in most cattle, having direct effects such as irritation, blood loss, hide damage, udder lesions, reduced weight gain and low milk yield. This predisposed animals to secondary bacterial infections. These impacts are well documented in a review of ticks and tick-borne diseases affecting livestock in southern Africa and similar settings (Shahzad *et al*., 2025).

The distribution of ticks across the body of host animals significantly differed ($p < 0.05$) between villages. Matiyani village had the most cattle with ticks in multiple areas (74%) and very few widespread infestations (9%), whereas Ntlhaveni village had a larger fraction showing widespread distribution (26%) and fewer limited-area infestations. This significant shift toward more widespread attachment in Ntlhaveni village suggests more generalised exposure, such as higher contact with a greater diversity of questing ticks across multiple body regions and higher mobility of infested hosts. During observations in the study area, ticks showed a preference for attachment sites, such as the perineum, udder, inside the ears, and under the tail. However, the degree of tick spread in this study was observed to be dependent solely on species composition, host grooming, and acaricide application methods. Farmers from the two villages utilised different acaricide application techniques: farmers in Matiyani village relied more on the pour-on method, while those in Ntlhaveni village relied more on the plunge-dip method, which may have contributed to differences in dominant species and distribution. In addition, Monakale *et al*. (2024) noted that differences in species composition and behaviour, with some species favouring restricted sites, while others account for much of the variation in body distribution. Furthermore, a study by Jaca. (2017) reported that udder and under-tail areas are often not attended to when controlling ticks and therefore can harbour more ticks. Nyangiwe *et al*. (2017) and Makwarela *et al*. (2024) reported that landscape heterogeneity and host movement patterns, including shared grazing, market trade, and seasonal transhumance, strongly influence tick distribution on animals; where hosts move through multiple microhabitats, they encounter a wider array of questing species and life-stages, producing more widespread attachment patterns. Alternatively, areas with denser bushes and more wildlife encounters can lead to concentrated populations of ticks, often found in their preferred feeding sites. Therefore, the pattern observed in Matiyani village, with multiple but not widespread occurrences, might indicate localised hotspots or specific attachment sites influenced by species composition.

Tick-induced lesion counts did not significantly differ ($p>0.05$) between villages despite differences in distribution and tick species. Despite the large tick burdens, most animals in both villages had a high percentage of few visible tick bite lesions (Matiyani, 82%; Ntlhaveni, 76%), with only a minority showing a lower percentage of visible tick bite lesions. These findings could be due to several reasons, such as lesion scoring being similar and missing smaller differences, as well as different tick species producing different lesion types and severities. Mapholi *et al*. (2022) reported that the Nguni and other indigenous cattle breeds frequently tolerate higher tick loads with relatively less severe lesions and clinical signs than exotic breeds, due to acquired resistance and skin characteristics. The findings suggest that in these villages, where breed composition is dominated by indigenous cattle, lesion frequency could be reduced despite heavy loads. Additionally, early acaricide use may reduce tick attachment duration and lesion severity, but it does not fully prevent infestation (Yawa *et al*., 2020; Monakale *et al*., 2024). Conversely, lesion counts can underestimate subclinical damage, such as anaemia, reduced weight gain, or pathogen transmission. Therefore, the presence of a few visible lesions should not be taken as evidence of low impact. This variation was emphasised in fieldwork that paired visual lesion scoring with productivity and pathogen testing (Makwarela *et al*., 2024).

3.5 Conclusion

The study on the Collins Chabane Local Municipality revealed that cattle in Matiyani and Ntlhaveni villages are exposed to substantial tick burdens, dominated by *Amblyomma* *hebraeum, Rhipicephalus decoloratus,* and *Rhipicephalus microplus*. Notably, tick species dominance and abundance showed marked variation between villages, suggesting that local environmental conditions, grazing practices, and cattle movement patterns exert a more significant influence on tick ecology than mere proximity to wildlife. The higher abundance of *A. hebraeum* and greater co-dominance of tick species in Ntlhaveni village imply more favourable microclimatic conditions and potentially wider host mixing. Conversely, the pronounced single-species dominance in Matiyani village may indicate a more uniform ecological setting or acaricide selective pressure favouring specific species. Although tick loads were considerable, visible lesion severity remained low, reflecting the relatively high tolerance of locally adapted cattle breeds and possibly periodic tick-control interventions. Nonetheless, the widespread occurrence of tick infestations underscores the persistent exposure to multiple tick species and the elevated risk of tick-borne diseases. These findings underscore the need for location-specific, integrated tick management strategies informed by local abiotic conditions, cattle movement patterns, herd composition, and the evolving distribution of tick species. Additionally, strengthened surveillance, improved acaricide use practices, and seasonal control strategies tailored to local tick ecology are essential to mitigating infestation levels and enhancing cattle health and productivity in these communities.

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CHAPTER 4: IMPACT OF TICK INFESTATIONS ON CATTLE: RELATIONSHIP WITH ANIMAL FACTORS AND EFFECTS ON HEALTH IN MATIYANI AND NTLHAVENI VILLAGES

ABSTRACT

Tick infestations are a major constraint to cattle health and productivity in communal farming systems of South Africa. This study assessed the impact of tick infestations on cattle health, focusing on associations with animal factors, clinical health effects, and farmer management practices in Matiyani and Ntlhaveni villages. A cross-sectional, mixed-methods design was employed, allowing for the concurrent collection of parasitological samples and clinical evaluation data. Clinical examinations were conducted during routine dipping days using a standardised checklist, with every fifth animal entering the crush pen systematically selected. Tick burden, tick species composition, attachment distribution, tick-induced lesions, clinical signs and body condition scores were recorded. Tick samples were collected from predilection sites, preserved in ethanol, and identified morphologically to the genus and species levels. Data were analysed using SPSS (version 29.0), and associations between animal factors, tick infestation parameters, clinical signs and villages were evaluated using chi-square tests. High tick burdens were observed across both villages, with no significant differences between male and female cattle. However, age and physiological status significantly influenced tick burden, distribution, lesion severity and species abundance, with adult and pregnant cattle being more severely affected. Most cattle harboured mixed-tick species infestations, and dermatological signs, such as hair loss and skin thickening, were highly prevalent. Significant village-level differences were detected for hair loss and skin thickening, both of which were more common in Matiyani. Most cattle exhibited low to moderate body condition scores, indicating potential impacts on productivity. Overall, the findings highlight the substantial health burden posed by ticks in communal cattle systems and underscore the need for targeted and sustainable tick control strategies that prioritise high-risk animal groups.

Keywords: Body condition score, Communal farming, Clinical evaluation, Ticks, Tick burden

4.1 Introduction

Tick infestations are a significant constraint to cattle production in communal grazing areas of South Africa, particularly in communal areas such as Matiyani and Ntlhaveni villages. Furthermore, in communal cattle production systems, animals are continuously exposed to tick-infested environments and access to veterinary services is often limited; consequently, tick infestations persist and are difficult to control (Nyangiwe & Matthee, 2025; Mollong *et al*., 2025). As a result, cattle in such systems frequently experience chronic infestations that compromise welfare and productivity. Additionally, the economic impact of cattle tick infestations is substantial, with smallholder farmers facing reduced livestock productivity, increased veterinary costs, and income losses. Despite the use of acaricides and other control measures, tick infestations remain prevalent, highlighting the need for improved management strategies tailored to local conditions.

Ticks cause a wide range of clinical and pathological effects that directly impact cattle health. Furthermore, their repeated attachment can result in hair loss, skin thickening, wounds, and secondary bacterial infections. Tiba *et al*. (2023) and Melo *et al*. (2024) reported that heavy tick infestations are associated with clinical signs, such as anaemia and jaundice, particularly in areas where tick-borne haemoparasites are endemic. In addition, ticks frequently exhibit a predilection for sensitive anatomical sites, such as the udder and perineum, where lesions may interfere with suckling and calf growth, further compounding production losses (Jaca *et al*., 2017). The cumulative effects of tick infestations and tick-borne diseases are often reflected in poor body condition and reduced productivity. Studies across smallholder systems have demonstrated associations between high tick burdens, pathogen exposure, and lower body condition scores, driven by chronic blood loss, immune activation, and reduced feed efficiency (Heylen *et al*., 2023). Consequently, these impacts translate into measurable economic losses, including reduced growth rates, fertility impairment, and increased mortality, making tick infestation a major constraint to sustainable cattle production (Hurtado *et al*., 2018; Strydom *et al*., 2023). Therefore, this study aimed to investigate the impact of tick infestations on cattle health, with specific emphasis on the relationship between animal factors and health effects in Matiyani and Ntlhaveni villages. The findings aim to inform targeted interventions that mitigate tick-related losses and enhance livestock health in these communities.

4.2 Materials and methods

4.2.1 Ethical approval

Described in 3.2.1

4.2.2 Description of study area

Described in 3.2.2

4.2.3 Study design

Described in 3.2.3

4.2.4 Clinical examination of cattle tick and clinical signs of tick infestations

Described in 3.2.4

4.2.5 Statistical analysis

Described in 3.2.5

4.3 Results

4.3.1 Relationship between cattle sex, age, physiological phase and tick burden, tick distribution, tick-induced lesions, and tick species abundance

Table 4.1 shows that most cattle across all categories carried heavy tick burdens (≥10 ticks), with females (88%; 140/159) and males (87%; 81/93) exhibiting similarly high infestation levels; the sex-related difference was not statistically significant ($p > 0.05$). However, age had a significant effect on tick burden ($p < 0.05$), with adult cattle (>2 years) having the highest proportion of heavy infestations (91%; 139/152) compared to calves (69%; 9/13) and growing cattle (84%; 73/87). Tick distribution across the body also did not differ significantly by sex ($p > 0.05$), but did vary significantly by physiological status and age ($p < 0.05$), with older cattle showing more widespread or multi-area attachment. A similar pattern was observed for tick-induced lesions, which showed no significant difference between males and females ($p > 0.05$) but did vary significantly across age groups ($p < 0.05$), with adults showing a higher number of lesions. Physiological status did not significantly influence total tick burden ($p > 0.05$) but had strong associations with tick distribution ($p < 0.05$), lesion severity ($p < 0.05$) and species abundance ($p < 0.05$), where mature and pregnant cattle exhibited greater lesion frequency and more complex mixed-species infestations. Across all groups, most cattle harboured 2–3 co-dominant tick species, and the lack of sex-based differences in species abundance ($p > 0.05$) contrasted with highly significant variations across age ($p < 0.05$) and physiological categories ($p < 0.05$). Overall, the results indicate that age and physiological status, rather than sex, are key factors determining tick burden, attachment patterns, lesion development and species composition.

Table 4.1 Distribution of tick burden, attachment sites, bite lesions and species abundance among cattle by sex, age, and physiological status

Parameter	Sex		Age			Physiological status			
	F (159)	M (93)	≤ 6 months (13)	7 months – 2 years (87)	> 2 years (152)	Growing (88)	Lactating (38)	Matured (39)	Pregnant (87)
Tick burden									
1 – 5 ticks	0	2	1	1	0	2	0	0	0
6 – 9 ticks	19	10	3	13	13	15	4	2	8
≥10 ticks	140	81	9	73	139	71	34	37	79
Significance	N. S			S				N. S	
Tick attachment sites									
Limited to one area	21	19	6	19	15	25	1	4	10
Multiple areas	104	57	5	55	101	50	25	27	59
Widespread	34	17	2	13	36	13	12	8	18
Significance	N. S			S				S	
Tick-bite lesions									
No lesions	11	6	4	7	6	10	1	1	5
Few lesions	126	70	8	71	117	69	27	28	72
Many lesions	22	17	1	9	29	9	10	10	10
Significance	N. S			S				S	
Tick species abundance									
1 dominant specie	31	27	6	31	21	36	4	6	12
2 – 3 co-dominant species	106	50	7	44	105	41	28	25	62
Multiple dominant species	22	16	0	12	26	11	6	8	13
Significance	N. S			S				S	

*F= Female, M= Male N=Not significance (p>0.05), S= Significance (p<0.05)

4.3.2 Prevalence of clinical signs in cattle infested with ticks in Matiyani and Ntlhaveni villages

Table 4.2 compares the prevalence of clinical signs between Matiyani (MT) and Ntlhaveni (NT) villages. Hair loss was highly prevalent in both villages (MT, 100%; NT, 93%) and differed significantly between villages ($p < 0.05$), while skin thickening was significantly more common in MT (91%) than in NT (59%) ($p < 0.05$). In contrast, jaundice, discharge or crusting, and skin wounds or irritation showed no statistically significant differences between villages ($p > 0.05$), despite minor variations in prevalence.

Table 4.2 Observed clinical signs associated with tick infestations in cattle in Matiyani and Ntlhaveni villages, Limpopo Province

Parameter	Matiyani village		Ntlhaveni village		Significance
	N (85)	Percentage (%)	N (167)	Percentage (%)	
Jaundice					
None	0	0	2	**1**	
Not present	13	15	43	26	N. S
Present	72	85	122	73	
Hair loss					
Not present	0	0	12	7	
Present	85	100	155	93	S
Skin thickening					
Not present	8	9	68	41	
Present	77	91	99	59	S
Discharge or crusting					
Not present	55	65	94	56	
Present	30	35	73	44	N. S
Skin wounds and irritation	6	7	32	19	
Not present	23	27	30	18	N. S
Present	62	73	137	82	

* N= Total number of observations, N.S=Not significance (p>0.05), S= Significance (p<0.05)

4.3.3 Body condition score of cattle in Matiyani and Ntlhaveni villages

Figure 4.1 shows the observed cattle body condition scores in MT and NT villages. Most cattle have body condition scores of 1.5 (35%) and 2 (39%), indicating a moderate body condition. Fewer cattle have scores of 1 (13%), 2.5 (11%), and 3 (3%), suggesting that some cattle in these villages are in lower body condition, with very few in moderate body score (score 3).

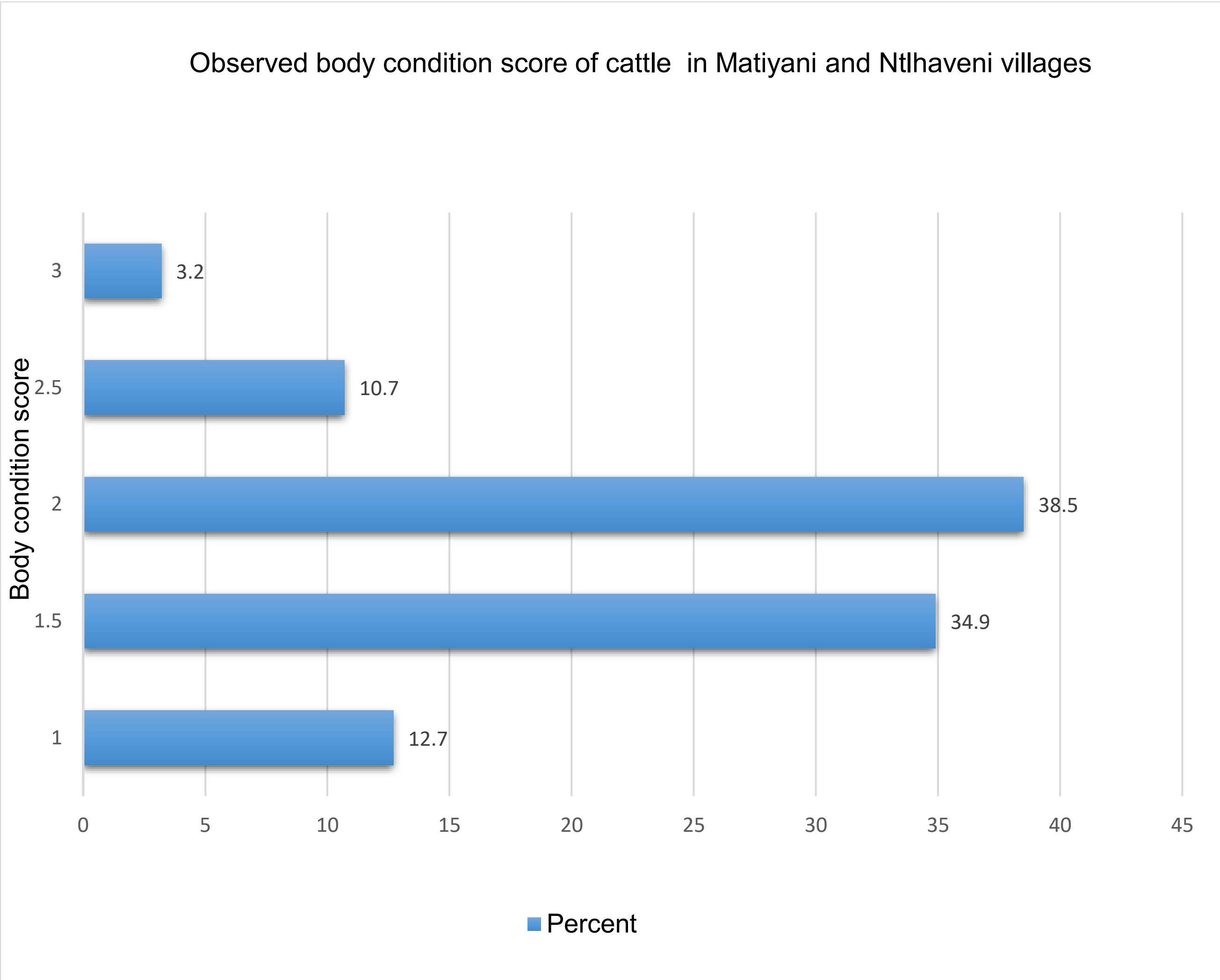

Figure 4.1 Body condition score of cattle in Matiyani and Ntlhaveni villages, Collins Chabane Local Municipality, Limpopo Province

4.4 Discussion

This study revealed that tick burdens and associated clinical signs are prevalent in Matiyani and Ntlhaveni villages, with most cattle exhibiting heavy infestations (≥10 ticks). The lack of a statistically significant difference ($p > 0.05$) in total tick burden between male and female cattle is consistent with findings reported in diverse communal and smallholder systems, where grazing behaviour and exposure to tick habitats are largely similar between sexes (Debbarma *et al*., 2018; Chepkwony *et al*., 2021; Tsolo *et al*., 2024). Furthermore, Tsolo *et al*. (2024) confirmed that sex often plays a minor role compared to environmental exposure and host age. In this study, age had a strong and significant influence on tick burden, with cattle (over 2 years old) exhibiting the highest levels of infestation, greater tick distribution across the body, and more severe tick-induced skin wounds. This finding aligns with numerous studies indicating that older cattle accumulate higher tick loads due to prolonged exposure to infested pastures, increased body surface area and behavioural factors such as wider ranging during grazing (Debbarma *et al.*, 2018; Chepkwony *et al*., 2021; Mapholi *et al*., 2022). Additionally, Abduch *et al.* (2024) demonstrated that resistance to natural tick infestation varies with age, coat type, and hair traits, suggesting that morphological changes associated with maturity may reduce innate resistance in some cattle populations.

The predominance of mixed-species infestations (2–3 co-dominant species) observed in cattle in this study is consistent with regional findings from smallholder systems in sub-Saharan Africa, where cattle are exposed to heterogeneous tick communities throughout the year (Heylen *et al*., 2023; Nyangiwe *et al*., 2025). A genetic study by Mapholi *et al*. (2017) in South African Nguni cattle further supports these findings, showing that tick counts vary by anatomical location and month, with adult cattle consistently harbouring higher numbers of multiple tick species. These results highlight that tick burden should not be interpreted solely in terms of tick counts, but rather as a dynamic interaction between host age, exposure history, and tick ecology. Physiological status also significantly influenced tick distribution, lesion severity and species abundance, with mature and pregnant cattle presenting more extensive lesions and more complex infestations. This observation corroborates earlier reports that pregnancy is associated with immunological modulation, which can increase susceptibility to ectoparasites and exacerbate tissue damage (Katiyatiya *et al*., 2015; Abduch *et* al., 2024). However, the lack of a statistically significant effect of physiological status on total tick burden suggests that physiological stress may intensify pathological outcomes rather than increase tick numbers, reinforcing the importance of assessing clinical impact alongside infestation intensity.

Clinical signs associated with tick infestation were highly prevalent in both Matiyani and Ntlhaveni villages, indicating a substantial health burden across the study area. The significantly higher occurrence of hair loss and skin thickening in Matiyani village suggests differences in infestation chronicity, tick species composition, or management practices between villages. Chronic tick attachment is well-documented to induce alopecia, hyperkeratosis, and dermal fibrosis through prolonged inflammatory responses (Melo *et al.*, 2024). Although jaundice, skin lesions and irritation were common in both villages, differences were not statistically significant. This may reflect similar exposure to tick-borne pathogens across villages, as haemoparasitic infections such as babesiosis and anaplasmosis are widespread in communal cattle systems (Tiba *et al.*, 2023; Nyangiwe *et al.*, 2025). Furthermore, Heylen *et al.* (2023) reported that clinical manifestations of tick infestation often vary more with pathogen diversity and host immunity than with tick abundance alone, which may explain the comparable prevalence of clinical signs between villages.

This study found a slightly higher prevalence of discharge and crusting in Ntlhaveni village, which may indicate secondary bacterial infections arising from repeated tick bites and poor wound healing, although the difference was not statistically significant. Similar observations have been reported in smallholder systems where limited veterinary intervention allows minor tick lesions to progress into chronic dermatological conditions (Hurtado *et al.*, 2018; Mollong *et al.*, 2025). Overall, the widespread presence of skin lesions and irritation reinforces the idea that ticks exert both direct mechanical damage and indirect pathological effects, even when infestation levels appear comparable. However, the predominance of cattle with low to moderate body condition scores (BCS) ranging from 1 –3 across both villages suggests a potential cumulative impact of tick infestation on animal productivity. The majority of recording scores of 1.5 (35%) and 2 (39%) are similar to Nyangiwe & Matthee (2025), who also indicated that moderate BCS ranges are due to the combined effects of tick infestations, limited supplementary feeding, and seasonal forage fluctuations from communal cattle systems across South Africa. Furthermore, the relatively low proportion of cattle with deplorable body condition (BCS 1 = 12.7%) aligns with a study by Gaorekwe *et al*. (2025), who reported that in the Limpopo Province, only a small percentage of severely thin cattle were observed when grazing conditions were moderately stable. Additionally, Heylen *et al*. (2023) reported that cattle in poor body condition were more likely to harbour diverse tick communities and tick-borne pathogens, supporting the patterns observed in the present study.

However, it is essential to recognise that body condition is influenced by multiple interacting factors, including nutrition, seasonal feed availability, and concurrent parasitic infections. Studies conducted in Nguni cattle under varying environmental conditions have shown that tick load interacts with heat stress and nutritional status to influence body condition and physiological stress indicators (Katiyatiya *et al*., 2015; Mapholi *et al*., 2022). Therefore, while tick infestation likely contributes to reduced body condition in Matiyani and Ntlhaveni villages, its effects are best interpreted within a broader ecological and management context.

4.5 Conclusion

The findings of this study have important implications for cattle productivity and tick management in communal systems. The high prevalence of mixed-species infestations observed in this study further complicates control efforts, as different tick species may respond differently to acaricides. Additionally, in this study area, sustainable tick control strategies should be implemented and prioritise both growing and pregnant cattle, which have been shown to experience the most severe tick effects. Integrated approaches combining strategic acaricide use, farmer education and breed-based resistance are increasingly advocated as viable solutions in tropical systems. Such targeted interventions could substantially reduce tick-induced lesions and improve body condition, thereby enhancing cattle health and productivity in villages such as Matiyani and Ntlhaveni.

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CHAPTER 5 FARMERS' KNOWLEDGE, ATTITUDE AND PERCEPTIONS ON CATTLE TICKS, TICK CONTROL METHODS, AND ECONOMIC IMPACT OF TICKS IN MATIYANI AND NTLHAVENI VILLAGES

ABSTRACT

Cattle ticks pose a significant challenge to communal cattle production, particularly in rural areas with limited access to veterinary support. This study assessed farmers' knowledge, attitudes and perceptions (KAP) regarding cattle ticks, tick infestations, control practices, and associated economic impacts in Matiyani and Ntlhaveni villages. A cross-sectional survey was conducted among seventy-three (73) purposively selected cattle farmers owning five or more cattle, using face-to-face interviews during routine dipping days. The data on farmers' demographics, tick inspection practices, knowledge of tick species, seasonal infestation patterns, control methods, and perceived economic consequences were collected using a pre-tested, structured questionnaire administered in Xitsonga. Furthermore, the data was analysed using ATLAS.ti version 8.4 through thematic analysis. The results showed that most farmers were male, over 60 years old, and had more than 10 years of experience in cattle farming. Although 96% of the cattle farmers had no formal livestock training, they were able to perform regular tick inspections and identify multiple tick species on their cattle. The identified tick species were *Amblyomma hebraeum* (51%), *Rhipicephalus decolarutus* (22%), *Rhipicephalus microplus* (17%), *Rhipicephalus appendiculatus* (11%), *Rhipicephalus evertsi* (12%) and *Hyalomma truncatum* (4%). Nearly half of the respondents (47%) reported high tick infestations throughout the year, while 32% observed peak infestations during summer. Although all farmers practised routine dipping, a substantial proportion reported a decline in acaricide effectiveness, suggesting possible acaricide resistance and an increased reliance on supplementary tick control measures, including spraying and rotational grazing. Tick infestations in this study were associated with reduced milk yield, poor body condition score, calf mortality, and increased treatment costs. The findings highlight the need for integrated tick management strategies and strengthened extension services in communal farming systems.

Keywords*: Acaricide resistance, Cattle ticks, Communal farming.*

5.1 Introduction

Cattle farming is a key socio-economic and cultural activity in many communal areas of South Africa. In the Limpopo Province, communal cattle are mainly reared under extensive grazing systems characterised by limited resources, low access to veterinary services, and high exposure to parasites, particularly ticks and tick-borne diseases (Monakale *et al*., 2024). Consequently, communal grazing systems expose cattle to continuous contact with tick-infested pastures, wildlife reservoirs, and shared watering points, thereby increasing the risk of tick infestation and reinfestation. Furthermore, ticks negatively affect cattle health through blood loss, skin damage, irritation, and transmission of pathogens such as heartwater, redwater, and gall sickness, resulting in economic losses due to reduced milk yield, poor body condition, calf mortality, increased treatment costs, and forced livestock sales (de la Fuente *et al*., 2023; Khoza, 2024). Additionally, climatic factors further influence tick survival, abundance, and distribution, increasing infestation pressure (Makwarela *et al*., 2024). Farmers' knowledge, attitudes, and perceptions (KAP) are central to effective tick management. Studies in southern Africa by Gaorekwe *et al*. (2025) and Nyangiwe & Matthee (2025) have demonstrated that communal farmers heavily rely on experiential knowledge, such as visual inspection and long-term observation, to identify tick species, assess infestation levels, and recognise clinical signs in cattle. While practical knowledge is valuable, limited formal training and poor access to extension services often result in suboptimal tick control practices, including inconsistent acaricide application, improper dosing, and lack of rotation between chemical classes. Consequently, farmers increasingly perceive acaricides as ineffective and have adopted supplementary strategies, including manual removal, ethnoveterinary remedies, rotational grazing, and the use of poultry (Yawa *et al*., 2020; Phaala *et al*., 2025).

Control of ticks in communal areas primarily relies on chemical acaricides administered through communal dip tanks. However, overreliance on a limited range of chemicals has contributed to acaricide resistance in species such as *Rhipicephalus microplus* and *Rhipicephalus decoloratus* (Nyangiwe & Matthee, 2025). Wildlife–livestock interfaces further complicate control efforts, as wildlife hosts serve as continuous reservoirs of ticks, leading to higher infestation pressure and reinfestation after treatment (Mapholi *et al*., 2022; Makwarela *et al*., 2025). Therefore, communities near Kruger National Park, such as Matiyani and Ntlhaveni, face challenges due to these interface dynamics, combined with extensive grazing practices and favourable climatic conditions.

Despite recognition of the importance of farmers' KAP in tick management, few studies have examined how farmers perceive ticks, assess control effectiveness, and experience the economic impacts of infestations in rural areas, which are wildlife-livestock interface areas in Limpopo Province. Understanding these perceptions is crucial for designing sustainable, context-specific tick control strategies that integrate farmers' knowledge with scientific approaches. Therefore, this study aimed to assess the knowledge, attitudes, and perceptions of communal farmers regarding cattle ticks, tick control practices, and the economic impacts of tick infestations in Matiyani and Ntlhaveni villages. The findings will provide insights into the interactions between farmer practices, ecological pressures, and cattle health, informing extension services, policy development, and integrated tick management strategies in communal farming systems.

5.2 Materials and methods

5.2.1 Ethical approval

Described in 3.2.1

5.2.2 Description of study area

Described in 3.2.2

5.2.3 Study design

Described in 3.2.3

5.2.4 Population and sampling size

The survey was conducted on a sample of seventy-three (73) farmers out of 397 farmers, who owned five or more cattle from both villages (Matiyani and Ntlhaveni). Furthermore, the respondents from Matiyani village were 28, and from Ntlhaveni village were 45. The imbalance in the number of respondents between the villages was due to Ntlhaveni having more cattle farmers with over five cattle, while Matiyani had fewer. Additionally, the recruitment process firmly adhered to ethical principles. For example, before administering the questionnaire, a proper introduction was provided by explaining the purpose and objectives of the study and how the farmers' responses would contribute to its outcomes. This initial explanation was crucial to ensure voluntary participation; only those farmers who expressed a willingness to participate and met the selection criteria of owning more than five cattle were provided with a consent form to read and sign as a formal agreement. Participants were explicitly informed of their right to withdraw from the study at any point without penalty, ensuring the absence of coercion or undue incentives.

5.2.5 Sampling procedure and data collection

The purposive sampling technique was employed to select 73 farmers from both villages for Face-to-face interviews during routine cattle dipping days at the study sites, using a structured questionnaire. The questionnaire interviews were pre-tested during dipping days in the Xitsonga vernacular before use in the survey to verify their validity, determine the time required, gather input from cattle farmers to aid in redesigning the questions, and identify any information that might be useful in the study. The questionnaire consisted of three sections, labelled as A, B, and C. Section A captured demographic information about the communal farmers. Sections B and C focused explicitly on the farmers' knowledge and attitudes regarding cattle tick diversity, tick infestations, tick control measures, and their perceptions of dip tank effectiveness, cattle health during high infestations, and the economic impact of ticks on their farms. The questionnaire included a supplementary paper with pictures of tick species to help respondents identify the one they had observed in their cattle.

5.2.6 Statistical analysis

The data were analysed using ATLAS.ti version 8.4, employing a thematic analysis approach. The data were coded and categorised into themes, and relationships between codes were explored using network views. The analysis focused on identifying patterns and trends in participants' knowledge, attitudes, and perceptions regarding cattle ticks, tick control methods, animal health, and economic impact.

5.3 Results

5.3.1 Cattle farmers' demographic information

Table 5.1 presents the demographic profiles of seventy-three (73) communal farmers who took part in the study. The results show that the majority of respondents came from Ntlhaveni (NT), with 62%, followed by Matiyani (MT) at 38%. In MT and NT, the dominant respondents were male (93% and 82%), and females accounted for 7% and 18%, respectively. The highest number of farmers in MT and NT were over 60 years (68% and 63%, respectively). In both villages, 96% of the respondents had no basic livestock training, with each of them owning over five (5) cattle. Those who had training (4%) in MT and NT reported attending a livestock training workshop organised by the Limpopo Department of Agriculture and Rural Development (LDARD). The majority of farmers had more than ten (10) years of cattle farming experience (79% and 84%), with a minority having less than five (5) years of farming experience (4% and 5%) in MT and NT, respectively.

Table 5.1 Demographic information of cattle farmers in Matiyani and Ntlhaveni villages in Collins Chabane Municipality, Limpopo province, South Africa

Category	**Matiyani**		**Ntlhaveni**	
	Count	**Proportion (%)**	**Count**	**Proportion (%)**
Gender				
Female	2	7	8	18
Male	26	93	37	82
Total	28	100	45	100
Age				
20 – 39	1	4	4	9
40 – 59	8	28	13	29
≥ 60	19	68	28	62
Total	28	100	45	100
Basic livestock training				
Yes, workshop	1	4	2	4
No	27	96	43	96
Total	28	100	45	100
Cattle farming experience				
1 – 5 years	1	4	2	5
6 – 10 years	5	17	5	11
≥ 10 years	22	79	38	84
Total	28	100	45	100
Herd size				
5 – 10	18	64	23	51
11 – 20	7	24	14	31
21 – 30	1	4	4	9
31 – 40	0	0	1	2
41 – 50	1	4	2	4
≥ 51	1	4	1	3
Total	28	100	45	100

5.3.2 Farmers' knowledge of ticks through observation and cattle examination

Table 5.2 shows that, in both study sites, most farmers reported examining their cattle for ticks (MT, 96%; NT, 82%) and a majority had observed ticks on their animals (MT, 96%; NT, 87%). Inspection frequency varied between weekly, monthly, and fortnightly schedules, with weekly inspections being the most common (MT, 33%, NT, 60%). Farmers predominantly identified multiple host-level factors (age, sex, physiological status) as influencing tick burdens (MT, 86%, NT, 69%). These findings show reasonable baseline surveillance at the household level but also heterogeneity in inspection intensity that may leave animals vulnerable during seasonal tick peaks.

Table 5.2 Farmers' knowledge of ticks on their farms

Farmers' knowledge on ticks	Matiyani		Ntlhaveni	
	Counts	Proportion (%)	Counts	Proportion (%)
Do you examine cattle for ticks?				
No	1	4	8	8
Yes,	27	96	37	82
After rainy days	0	0	1	3
Everyday	2	7	3	8
Fortnight	4	15	1	3
Monthly	7	26	7	19
Thrice a week	0	0	1	3
Twice a month	3	11	1	3
Twice a week	2	7	1	3
Weekly	9	33	22	60
Total	28		45	
Have you ever observed your cattle for ticks?				
No	1	4	6	13
Yes,	27	96	39	87
Frequently	8	30	17	44
Rarely	19	70	22	56
Total	28		45	
Animal factors that influence tick infestations				
Age	0	0	2	4
Sex	3	11	10	22
Physiological status	0	0	0	0
All the above	24	86	31	69
Age & sex	3	11	2	4
Total	28		45	

5.3.3 Farmers' knowledge of cattle tick species infesting their cattle

Fig. 5.1 illustrates the farmers' knowledge of tick diversity in their herd. 51% of farmers reported *Amblyomma hebraeum* as the most prevalent tick species, followed by *Rhipicephalus decolarutus* (22%), *Rhipicephalus microplus* (17%), *Rhipicephalus appendiculatus* (11%), *Rhipicephalus evertsi* (12%) and *Hyalomma truncatum* (4%).

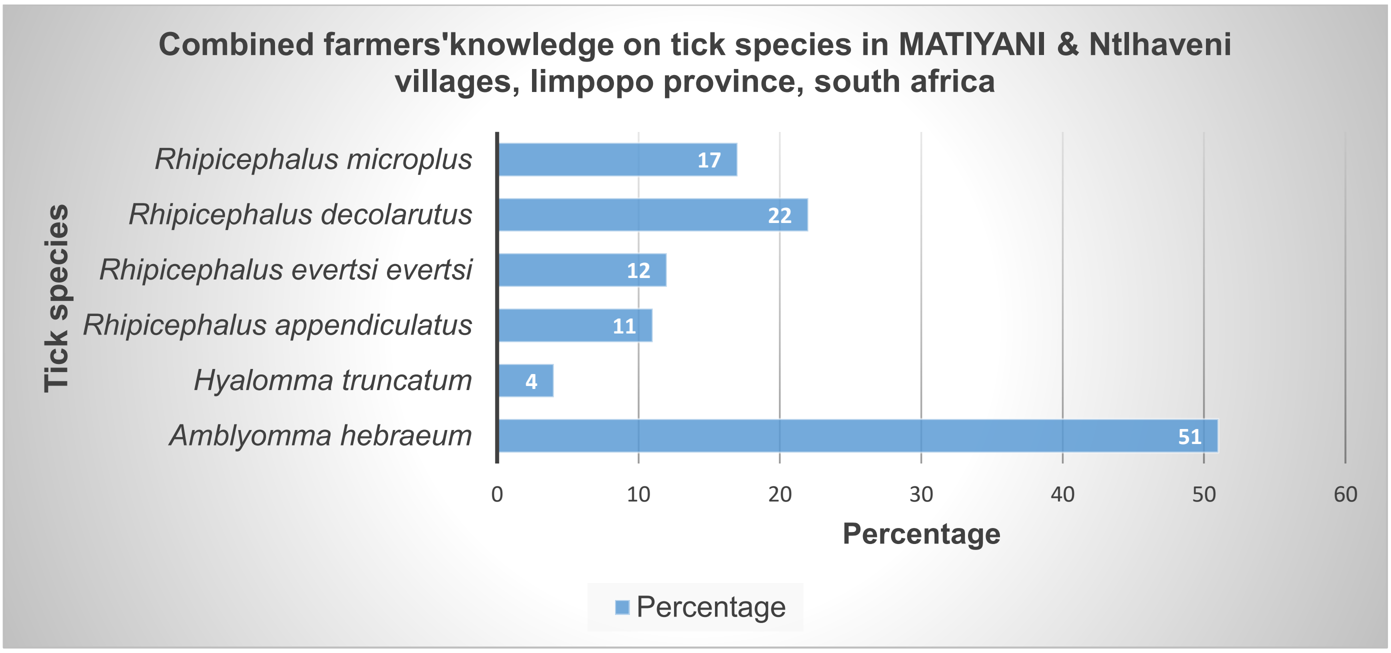

Figure 5.1 Combined farmers' knowledge on tick species in Matiyani & Ntlhaveni villages, Limpopo province, South Africa

5.3.4 Farmers' perceptions on the effects of seasonal variation on tick infestations

Fig 5.2 shows a total of 47% of farmers in both the MT and NT villages reported experiencing high tick infestations throughout the year, across all seasons. The highest percentage of farmers observed high tick infestations during summer (32%), followed by spring (8%). Other combinations reported included Winter, Spring and Summer (6%); Winter and Summer (3%); Autumn (1%); Summer and Autumn (1%); Spring and Summer (1%); and Spring, Summer, and Autumn (1%).

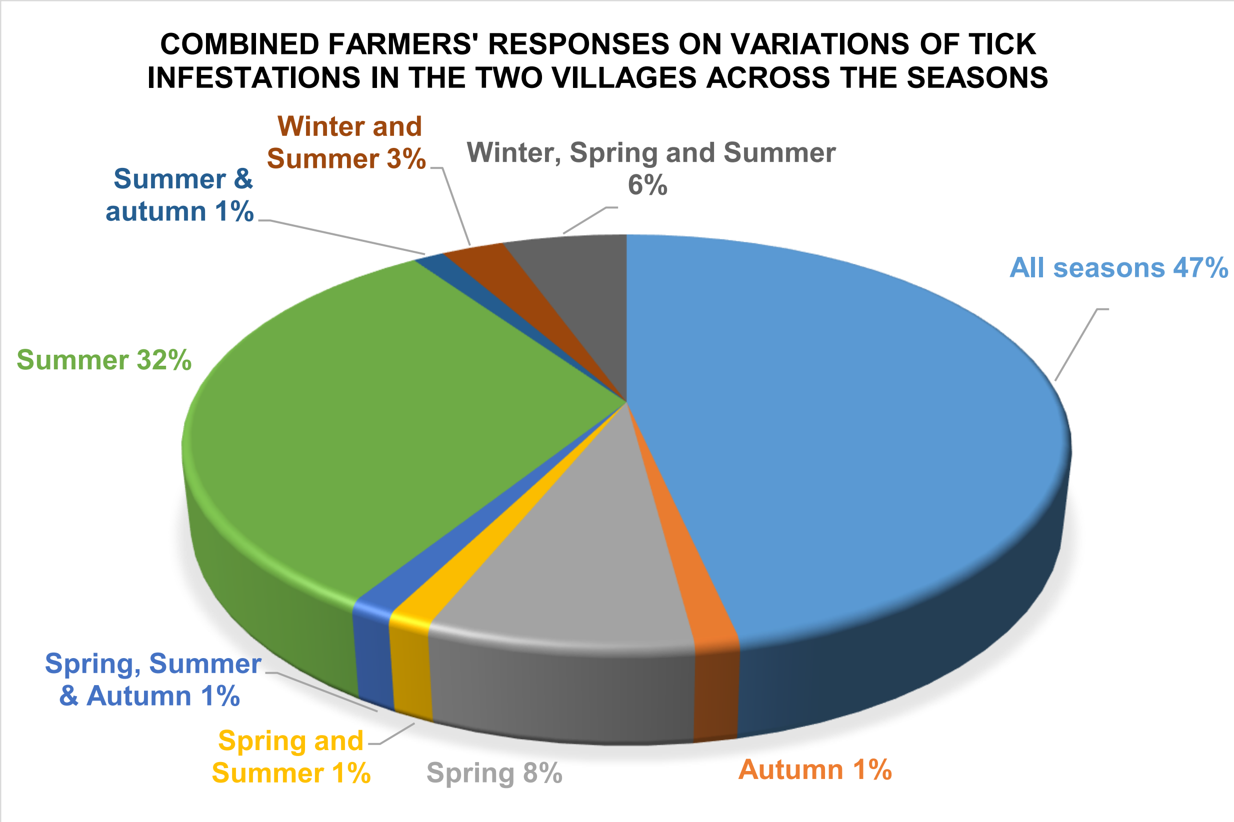

Figure 5.2 Combined farmers' perceptions on the effects of seasonal variation on tick infestations in the two selected villages in Collins Chabane Local Municipality, Limpopo Province

5.3.5 Farmers' attitude towards tick treatment intervals and their perceptions on the effectiveness of various tick control methods

The data in Table 5.3 indicate differences in tick-treatment intervals and perceptions of tick-control efficacy between Matiyani and Ntlhaveni villages. In Matiyani village, 8% of farmers attend the communal dip weekly, and 93% visit fortnightly. In contrast, in Ntlhaveni village, 98% of farmers dip weekly, and 2% dip fortnightly. The proportion of farmers who consider the dip effective is 75% in Matiyani and 78% in Ntlhaveni, while 25% in Matiyani and 22% in Ntlhaveni deem the dip ineffective. Regarding tick control methods, 75% of Matiyani farmers used a combination of pour-on treatment and spraying, while 21% relied solely on pour-on treatment. Additionally, 3.6% employed a combination of pour-on, spraying, and rotational grazing. In contrast, Ntlhaveni farmers rely on plunge dipping alone for 57.8 %, plunge dip with spraying for 28.9 %, plunge dip with rotational grazing for 4.4 %, plunge dip with hand picking for 4.4 %, plunge dip with injection and spray for 2.2 %, plunge dip with rotational grazing and spraying for 2.2 %, and biological control for 2.2 %.

Table 5. 3 Farmers' attitude towards tick treatment intervals and their perceptions on the effectiveness of various tick control methods

	Matiyani village		Ntlhaveni village	
Dip visitation	**Number**	**Proportion (%)**	**Number**	**Proportion (%)**
Weekly	2	7	44	98
Fortnight	26	93	1	2
Dip effectiveness				
Effective	21	75	35	78
Not effective	7	25	10	22
Tick control methods				
Plunge dipping	0	0	26	58
Plunge dip & rotational grazing	0	0	2	4
Plunge dip & Spraying	0	0	13	29
Plunge dip & Hand picking	0	0	2	4
Plunge dip, injection & spray	0	0	1	2
Plunge dip, rotational grazing & spraying	0	0	1	2
Biological (Chickens)	0	0	1	2
Pour on	6	21	0	0
Pour on and Spraying	21	75	0	0
Pour on, Spraying & rotational grazing	1	4	0	0

5.3.6 Farmers' knowledge of clinical signs related to tick infestations on cattle and their economic impact

Figure 5.3 depicts cattle farmers' knowledge of multiple clinical signs and production problems associated with tick infestations (abortion, calf mortality, crusting around eyes and nose, death, damaged teat, low milk yield, lameness, limping, fever, jaundice, lesions and wounds, hair loss, reduced body weight, infested udder) in their farms during periods of high infestations.

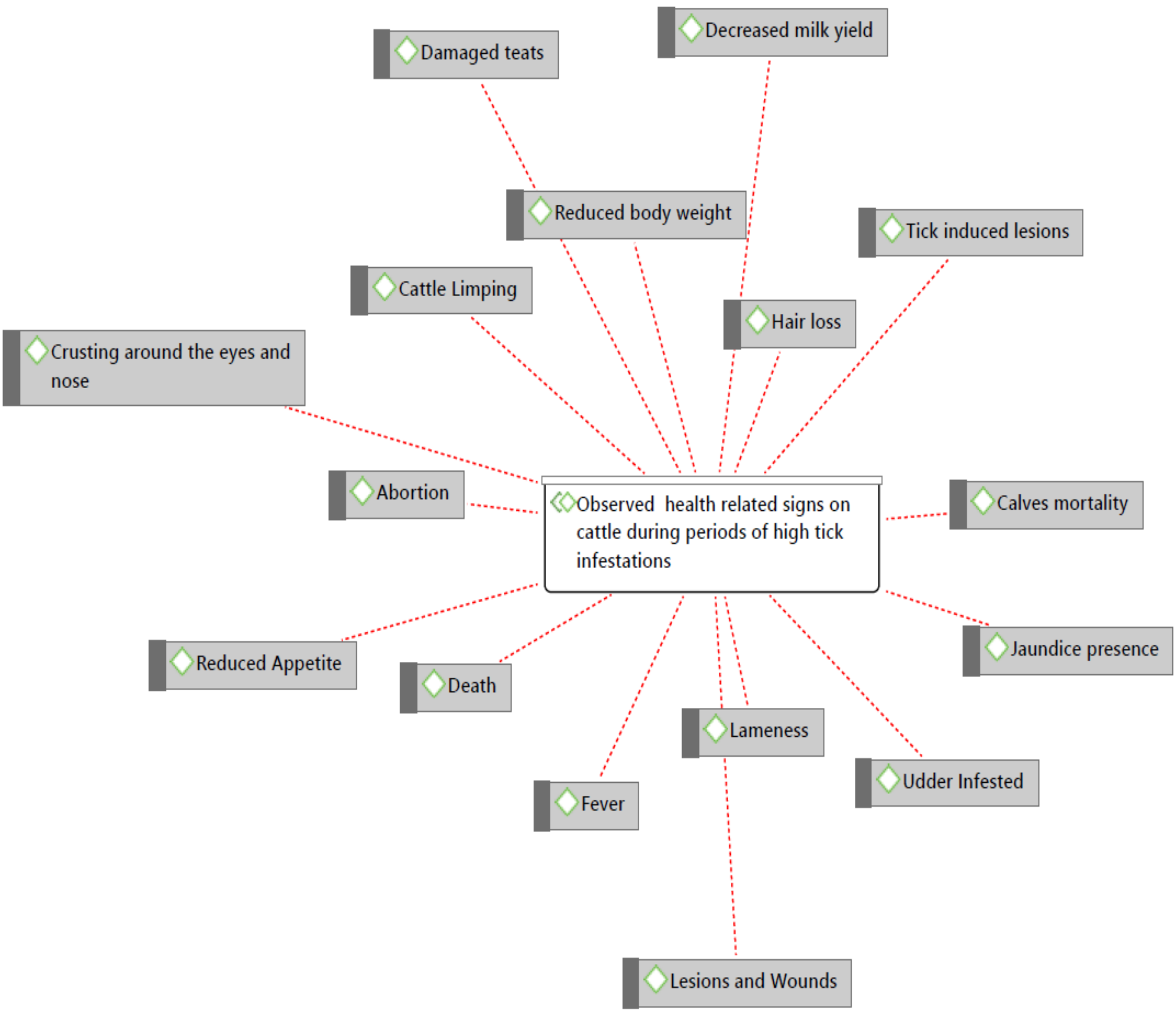

Figure 5.3 Cattle farmers' knowledge on health signs associated with tick infestations in Matiyani and Ntlhaveni villages, Collins Chabane Local Municipality, Limpopo Province

Figure 5.4 highlights the economic and welfare consequences of tick problems experienced by farmers and their cattle. According to the farmers' knowledge in this study, high tick infestation is 75 characterized by debilitated animals, limping/irritation, wounds, infested udders, damaged testicles, depressed libido, body parts inflammation, death, damaged skin and hides and paralysis. The above problems affect farmers by increasing costs and reducing farm profit. For example, farmers sell their cattle at a lower price due to reduced body weight, purchase milk for calves because of an infested udder, purchase acaricides, have no market access due to unfit cattle, and incur no profit due to mortality.

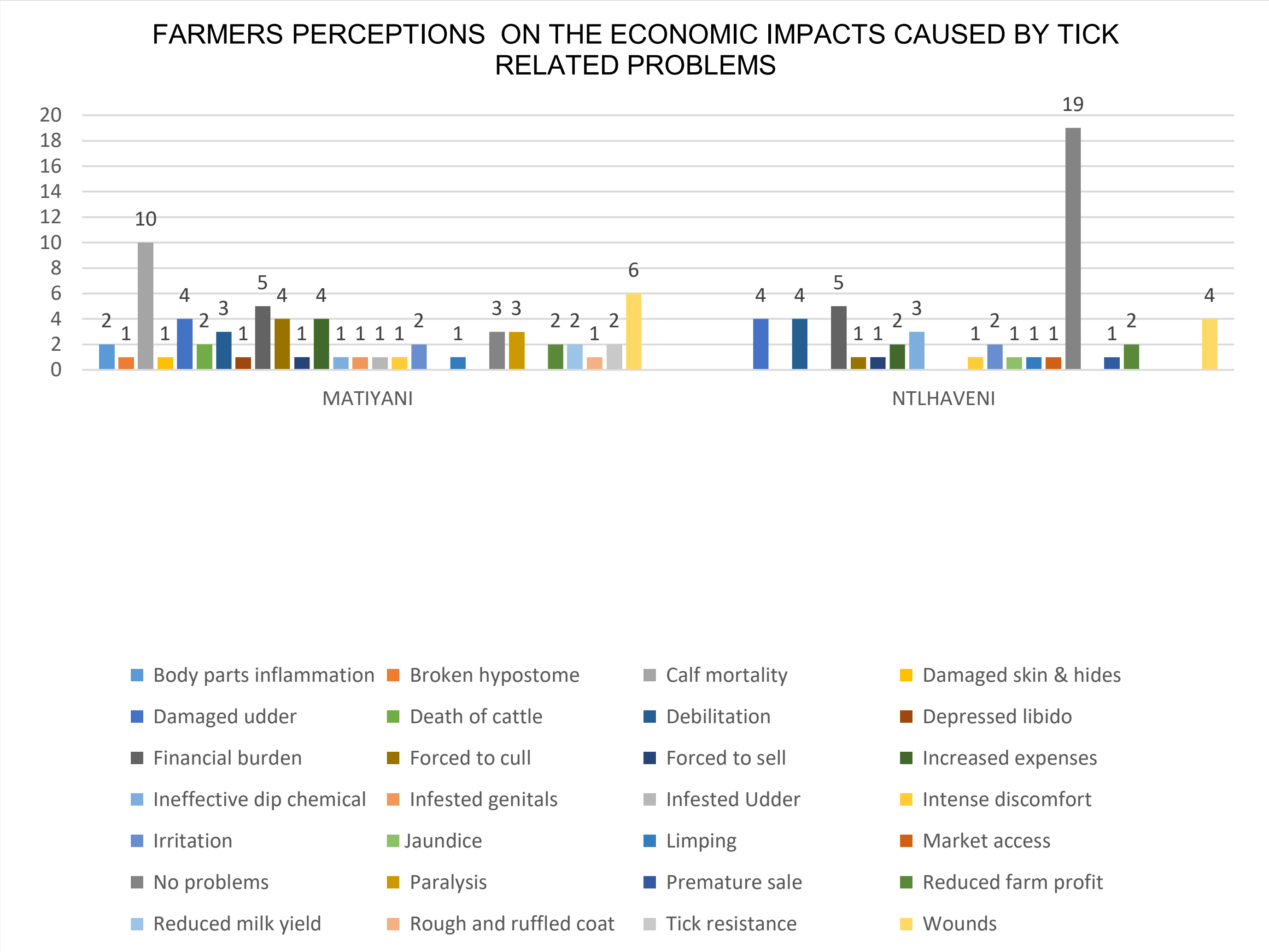

Figure 5.4 Farmers' perceived economic effects of tick-related problems on cattle production

5.4 Discussion

The predominance of male cattle owners in Matiyani and Ntlhaveni villages confirms that cattle ownership in communal systems remains largely male-dominated. Similar patterns were reported in communal farming systems of Limpopo Province by Monkwe *et al.* (2023) in Ga-Matlala and by Gaorekwe *et al*. (2025) in selected Limpopo villages, where men were primarily responsible for cattle management decisions, including tick control. Therefore, the male dominance has been attributed to the physical demands of cattle handling and the cultural significance of cattle ownership. However, in contrast, Phaala *et al*. (2025) observed a gradual involvement of women in ethnoveterinary tick control practices in Sekhukhune District, Limpopo, particularly in household-level treatments, suggesting a potential shift in gender roles under resource-limited conditions. The ageing structure of farmers observed in this study is consistent with the findings of Monkwe *et al.* (2023), who reported that more than 60% of communal cattle farmers in Ga-Matlala were aged 55 or older. Gaorekwe *et al*. (2025) similarly noted that elderly farmers dominate communal cattle farming in Limpopo Province due to youth migration to urban centres. Henceforth, the advanced age of farmers, coupled with limited formal livestock training, may reduce the uptake of modern tick control strategies and resistance management approaches.

Farmers in this study demonstrated strong experiential knowledge through regular cattle inspections and recognition of host-related factors influencing tick burden. These findings align with those of Gaorekwe *et al*. (2025), who reported that most communal farmers in the Limpopo Province relied on visual inspection to identify ticks and assess the severity of infestations. Similarly, Namgyal *et al.* (2021) reported that farmers in Bhutan possessed good observational knowledge but had limited scientific understanding of tick species and their epidemiological significance. The dominance of *Amblyomma hebraeum* and multiple *Rhipicephalus spp*. The results reported in this study align closely with national tick surveys conducted by Makwarela *et al*. (2023), who documented the wide distribution of *A. hebraeum*, *R. microplus,* and *R. decoloratus* across South Africa, with higher diversity in warmer provinces such as Limpopo. Furthermore, Mapholi *et al*. (2022) reported significantly higher tick loads in Nguni cattle reared in warmer, humid environments, supporting farmers' observations of heavy infestations in wildlife-adjacent grazing areas.

The perception among nearly half of the farmers that tick infestations occur year-round strongly correlates with findings by Makwarela *et al*. (2024), who demonstrated that temperature, rainfall, and vegetation cover significantly influence tick abundance across six provinces of South Africa, with the Limpopo province showing sustained tick activity even during winter. Additionally, Makwarela *et al*. (2025) emphasised that climate variability has reduced traditional seasonal boundaries for tick control, necessitating year-round management strategies. In contrast, Namgyal *et al*. (2021) reported more pronounced seasonal peaks in Bhutan, suggesting that the persistent infestations observed in this study are likely exacerbated by the wildlife–livestock interface, particularly in areas such as Kruger National Park, where wildlife hosts act as continuous reservoirs for ticks.

Communal dipping remains the primary tick control strategy. However, most cattle farmers in this study reported that the communal dip was effective, typically limiting its use to a 1–2-day protection window. They also observed a decline in the effectiveness of dip chemicals, prompting them to resort to home spraying and other supplementary tick-control methods. Thereby acknowledging a temporal limitation to the efficacy of dip. This observation aligns with Makwarela *et al*. (2025), who demonstrated that short-term acaricide efficacy requires integrated management to prevent re-infestation. Furthermore, a minority of cattle farmers who classified the dip tank as ineffective were predominantly those who did not apply additional home spraying, associating the lack of supplementary treatment with increased economic burden due to repeated purchases of acaricides and loss of productivity. Their perception is consistent with findings by Nyangiwe & Matthee (2025) in the Eastern Cape province, who reported widespread dissatisfaction with communal dip tanks due to rapid reinfestation and suspected acaricide resistance. Similarly, Yawa *et al*. (2020) observed that communal farmers in South Africa often supplement dipping with home spraying due to perceived failures of dipping. In this study, farmers in Matiyani village, closer to the Kruger National Park, relied on pour-on solutions provided in the dip tank, while those in Ntlhaveni village used plunge dipping. This variation aligns with findings by Gaorekwe *et al*. (2025), who reported that dipping frequency and method vary according to accessibility, perceived tick pressure, and environmental exposure. However, Makwarela *et al*. (2025) cautioned that inconsistent application and overreliance on chemical control without rotation accelerate acaricide resistance. In this study, the limited use of ethnoveterinary practices is observed, which contrasts with the findings by Phaala *et al*. (2025) in the Sekhukhune District, Limpopo Province, who documented the extensive use of plant-based remedies, ash, and manual removal as alternative tick control methods. This difference may be attributed to farmers' greater dependence on government-supported dipping schemes. However, Makwarela *et al*. (2025) emphasised that integrated tick management, combining chemical, biological, physical, and ethnoveterinary approaches, is critical for sustainable control, especially in communal systems facing acaricide resistance and ecological pressure from wildlife.

Cattle farmers in this study demonstrated substantial awareness of tick-associated clinical signs, including reduced milk yield, poor body condition, calf mortality and forced cattle sales, which are consistent with findings by Nyangiwe & Matthee (2025), who reported significant productivity losses and increased treatment costs among communal farmers in the Eastern Cape. Gaorekwe *et al*. (2025) similarly highlighted that economic losses associated with tick infestations disproportionately affect elderly farmers with limited income sources. Mapholi *et al*. (2022) further demonstrated that cattle with higher tick loads exhibit reduced growth performance, corroborating farmers' observations of weight loss and poor body condition in heavily infested animals.

5.5 Conclusion

Despite widespread suspicion of acaricide resistance among cattle farmers, most farmers lacked formal knowledge of the mechanisms. The farmers in the present study focused primarily on the health impacts of livestock, with minimal consideration of zoonotic risks, highlighting a critical public health knowledge gap in wildlife-adjacent communities. Collectively, these findings demonstrate that communal cattle farmers possess substantial experiential knowledge of ticks, but face compounding challenges related to ageing demographics, limited training, acaricide resistance, climate variability and wildlife–livestock interactions. Henceforth, sustainable tick control in the Limpopo Province requires strengthened extension services, promotion of integrated tick management and improved awareness of both livestock and zoonotic tick-borne diseases.

Overall, the findings demonstrate that communal farmers in Matiyani and Ntlhaveni possess substantial experiential knowledge of ticks and their impacts. However, this knowledge exists alongside gaps in formal training, limited understanding of acaricide resistance, and structural constraints within communal dipping systems. In agreement with regional and international studies, the persistence of tick infestations despite routine dipping highlights the urgent need for integrated, context-specific tick control strategies. Henceforth, strengthening extension services, promoting acaricide rotation, and incorporating farmer knowledge into surveillance systems could significantly enhance tick management and reduce economic losses.

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CHAPTER 6: OVERALL CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

The study highlights the significant impact of tick infestations on communal cattle in Matiyani and Ntlhaveni villages, with age and physiological status emerging as key factors influencing tick burden, lesion severity, and species distribution. Furthermore, adult and pregnant cattle are disproportionately affected, experiencing mixed-species infestations that lead to prevalent dermatological signs and generally low to moderate body condition scores. Notably, the dominant tick species identified in this study were *Amblyomma hebraeum* (31%) and *Rhipicephalus decoloratus* (22%), which indicates a high risk of tick-borne diseases such as heartwater, babesiosis, and theileriosis. Additionally, the tick species composition underscores the need for targeted disease surveillance and control strategies focusing on vectors of economically important pathogens, particularly in high-risk animal groups.

Farmers demonstrated moderate knowledge of tick diversity, with 51% correctly identifying *Amblyomma hebraeum* as a prevalent species. However, there is a gap in understanding the link between ticks and specific diseases, suggesting a need for enhanced extension services. This study reveals that most farmers (47%) reported year-round high tick infestations, with peak periods in summer, consistent with observed tick activity patterns. Furthermore, farmers' attitudes toward tick control were proactive, with 96% in Matiyani and 82% in Ntlhaveni regularly inspecting their cattle. However, practices varied, with weekly inspections more common in Ntlhaveni (60%) than Matiyani (33%). Dip tank effectiveness was perceived positively (75-78%), though reliance on acaricides remains high, risking resistance. Alternative methods, such as rotational grazing, were rarely used, indicating opportunities to promote integrated tick management.

6.2 Recommendations

The study reveals that tick infestations impose a substantial health and productivity burden on communal cattle. Therefore, targeted tick control programmes should be implemented in Matiyani and Ntlhaveni villages, with particular emphasis on the dominant tick species, *Amblyomma hebraeum* and *Rhipicephalus decoloratus*. Control efforts should prioritise high-risk cattle groups, such as adult and pregnant animals, which were found to carry heavier tick burdens and more severe lesions. Furthermore, disease surveillance systems for tick-borne diseases such as heartwater, babesiosis, and theileriosis should be strengthened through regular herd monitoring, early diagnosis, and timely veterinary intervention, particularly during summer when infestations are highest. Integrated tick management strategies should also be promoted to reduce dependence on chemical acaricides; therefore, farmers should be encouraged to combine strategic dipping with non-chemical approaches such as rotational grazing, pasture management, bush clearing, manual tick removal, and quarantine of newly introduced animals.

Proper acaricide use should be emphasised through training on correct product selection, recommended dosages, application intervals, and rotation of active ingredients, as this will help delay the development of resistance. In addition, regular maintenance and monitoring of communal dip tanks should be ensured to sustain their effectiveness. Farmer education and extension services should be strengthened to improve knowledge of tick species identification, seasonal tick activity, disease risks, and effective control practices; hence, particular attention should be given to improving farmers' understanding of the relationship between ticks and tick-borne diseases.

Routine cattle inspection practices should be standardised and encouraged across both villages, and weekly inspections should be promoted as a minimum standard for early detection and treatment. Moreover, special support should be provided to vulnerable cattle groups, such as pregnant, lactating, weak, or otherwise poorly conditioned animals, through regular monitoring, improved nutrition, and timely treatment. Capacity-building programmes for animal health technicians and extension officers are also necessary to strengthen expertise in species-specific tick control, resistance monitoring, and farmer advisory services suited to communal systems. Further research should investigate seasonal tick dynamics, economic losses associated with infestations, acaricide resistance, and the effectiveness of alternative control measures. Future studies should also incorporate molecular characterisation of ticks using techniques such as PCR and DNA sequencing to complement morphological identification, improve species accuracy, detect tick-borne pathogens, and enhance understanding of resistance patterns and disease transmission dynamics. Finally, community-based tick control initiatives should be promoted through coordinated dipping schedules, collective grazing management, and awareness campaigns, because communal tick control is likely to be more effective when implemented collectively rather than by individual farmers acting alone.

APPENDICES

Annexure 1: Questionnaire survey

Understanding cattle tick infestations in Collins Chabane Local Municipality: A questionnaire survey of farmers' experience, knowledge and practice

Section 1: Farmer demographics

1. Demographic profile of a farmer

   - Participant number………, Age (20-39, 40-59, 60>) …………
   - Gender: (Male/Female) ………………………………………….
   - Do you have any basic training in livestock agriculture? Yes/No

   If yes, specify………………………………………………………...

   - Herd size……………………………………………………………
   - Experience in cattle farming (1-5yrs; 5-10yrs, >10 years) ……...

Section 2: Tick infestations, control and animal health assessment

1. Have you ever observed tick infestations on your cattle? (Yes/No) ……

If yes, specify…………………………………………………….……

2. What time of the year do you experience the highest tick infestation? (Month)………………………………………………………………………
3. Are you familiar with the different types of ticks that can infest your cattle? (Yes/No) ……………………………………………………………………….
4. Can you identify different types of ticks in your local names? (Yes/No) …

If yes, which local name do you use to identify ticks species……………...

5. Which of the following tick species have you observed on your cattle? Common names

a. Brown tick

b. Blue tick

c. Red tick

d. Yellow tick

e. If other, specify……………………………………………………………………

6. Which of the following do you regard as animal factors that influence the level of infestation on your farm?

a. Age

b. Sex

c. Physiological status

d. All of the above

e. None of the above

7. Do you control ticks? (Yes/No) ………………………………………………

8. Which method do you currently use to control tick infestation?

a. Rotational gazing

b. Dipping

c. Hand-picking

d. Spraying

e. If other, specify………………………………………………………………....

9. How effective do you think your methods of controlling tick infestations are?

…………………………………………………………………………………….

10. Have you noticed any changes in the health of your cattle during periods of high tik infestation? (Yes/No) ……………………………………………………………...

11. If yes, which of the following signs related to cattle health have you noticed during periods of high tick infestation?

a. Abortion

b. Fever

c. Jaundice

d. Reduced appetite

e. If other, specify…………………………………………………………………...

Annexure 2: Clinical evaluation checklist for tick infestations

Animal ID ………………………………………………………………..

Physiological status…………………………………………………..

Age………………………………………………………………………..

Sex……………………………………………………………….………

Breed……………………………………………………………………..

Score 1-3 for each category will be

-1 = Low

- 2 = Moderate

- 3 = Severe

1.Tick burden (Number of the ticks per animal) Andreotti et al., 2018

-1 – 5 ticks: 1

- 6 – 10 ticks: 2

- > 10 ticks: 3

2. Tick distribution (location and spread of ticks on the body)

- Limited to one area (e. g. ears): 1

- multiple areas (e. g. ears, neck, legs): 2

- widespread (e. g. entire body): 3

3. tick-induced lesions (presence and severity of lesions or wounds)

- None: 1

- Moderate (small, few, lesions): 2

- High (large, numerous lesions): 3

4. Tick species identified on an animal

- *Amblyomma hebraeum*

- *hyalomma truncatum*

- *hyalomma rufipes*

- *Rhipicephalus decoloratus*

If other, specify……………………………………………………………...……..

5. Tick species abundance (relative abundance of each species)

- Dominant species: 1

- 2 – 3 co-dominant species: 2

- Multiple species with similar abundance: 3

6. Clinical signs that indicate the effects of the tick infestations on animal health

- Jaundice

- Weight loss

- Skin lesions and irritation

- Fever

- Swelling and lymph nodes

- Pale gums

- Tick worry

- Hair loss and thinning

- Discharge or crusting around the eyes and nose

Total score =

Annexure 3: University of Venda ethics certificate

ETHICS APPROVAL CERTIFICATE

RESEARCH AND INNOVATION
OFFICE OF THE DIRECTOR

NAME OF RESEARCHER/INVESTIGATOR:

Ms UBP Moseri

STUDENT NO:
19018667

PROJECT TITLE: **Determination of the occurrence of tick infestations and molecular characteristics of tick species isolated from cattle in some villages located in Collins Chabane local municipality.**

ETHICAL CLEARANCE NO: **FSEA/24/ANS/09/1302**

SUPERVISORS/ CO-RESEARCHERS/ CO-INVESTIGATORS

NAME	INSTITUTION & DEPARTMENT	ROLE
Dr T Chitura	UNIVEN, Animal Science	Supervisor
Dr E Bhebhe	UNIVEN, Animal Science	Co-Supervisor
Ms UBP Moseri	UNIVEN, Animal Science	Investigator-student

Type: **Masters Research**
Risk: **Minimal risk to humans, animals or environment (Category 2)**
Approval Period: **February 2025 – February 2026**

The Research Ethics Social Sciences Committee (AEBREC) hereby approves your project as indicated above.

General Conditions
While this ethics approval is subject to all declarations, undertakings and agreements incorporated and signed in the application form, please note the following.

- The project leader (principal investigator) must report in the prescribed format to the REC:
  - Annually (or as otherwise requested) on the progress of the project, and upon completion of the project.
  - Within 48hrs in case of any adverse event (or any matter that interrupts sound ethical principles) during the course of the project.
  - Annually a number of projects may be randomly selected for an external audit.
- The approval applies strictly to the protocol as stipulated in the application form. Would any changes to the protocol be deemed necessary during the course of the project, the project leader must apply for approval of these changes at the REC. Would there be deviated from the project protocol without the necessary approval of such changes, the ethics approval is immediately and automatically forfeited.
- The date of approval indicates the first date that the project may be started. Would the project have to continue after the expiry date; a new application must be made to the REC and new approval received before or on the expiry date.
- In the interest of ethical responsibility, the REC retains the right to:
  - Request access to any information or data at any time during the course or after completion of the project,
  - To ask further questions; Seek additional information; Require further modification or monitor the conduct of your research or the informed consent process.
  - withdraw or postpone approval if:
  - Any unethical principles or practices of the project are revealed or suspected.
  - It becomes apparent that any relevant information was withheld from the REC or that information has been false or misrepresented.
  - The required annual report and reporting of adverse events was not done timely and accurately,
  - New institutional rules, national legislation or international conventions deem it necessary.

ISSUED BY:
UNIVERSITY OF VENDA, RESEARCH ETHICS COMMITTEE
Date Considered: February 2025

Name of the AEBREC Chairperson of the Committee Prof IEJ Barnhoorn

Signature

UNIVERSITY OF VENDA
OFFICE OF THE DIRECTOR
RESEARCH AND INNOVATION
2025 -02- 17
Private Bag X5050
Thohoyandou 0950

University of Venda
PRIVATE BAG X5050, THOHOYANDOU, 0950, LIMPOPO PROVINCE, SOUTH AFRICA
TELEPHONE (015) 962 8504/8313 FAX (015) 962 9060
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Annexure 4: Department of Agriculture and Rural development ethics clearance

LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF
AGRICULTURE AND RURAL DEVELOPMENT

Ref: 12R
Enquiries: Dr T. Raphulu

03 March 2025

Moseri Uhone Budi Princess
Student no. (19018667)
University of Venda

RE: APPLICATION TO CARRY OUT RESEARCH UNDER THE DEPARTMENT OF AGRICULTURE & RURAL DEVELOPMENT: COLLINS CHABANE LOCAL MUNICIPALITY

1. Kindly take note that your request to conduct research titled "***Determination of the occurrence of tick infestations and molecular characteristics of tick species isolated from cattle in some villages located in Collins Chabane local municipality, LIMPOPO PROVINCE***", has been granted.

2. The permission entails clinical examination of cattle for tick infestations and tick collection in Ntlhaveni and Xigalo villages located in Collins Chabane municipality. **Please note that you are not allowed to conduct face-to-face interviews with farmers (pending ethics clearance from Limpopo Provincial Research Ethics Committee).**

3. You are required to contact the office of the Deputy Director: Vhembe East to brief them on the study, to request up-to-date database of cattle farmers at Ntlhaveni and Xigalo villages.

4. Kindly take note that you will be expected to hand over a copy of your final report to the Department for record purposes. You may also be invited to share your findings in the Departmental Research Forum.

5. Hoping that you will find this in order.

Kind regards

Dr. T. Raphulu
Chairperson: Research Committee

03/03/2025
Date

67/69 Biccard Street, POLOKWANE, 0700, Private Bag X9487, Polokwane, 0700

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Annexure 5: Limpopo Provincial Government Ethics certificate

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LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

OFFICE OF THE PREMIER

TO: DR. T RAPHULU

FROM: PROF I SWARTS

CHAIRPERSON: LIMPOPO PROVINCIAL RESEARCH ETHICS COMMITTEE (LPREC)

REVIEW DATE: 06 AUGUST 2025

SUBJECT: DETERMINATION OF THE OCCURRENCE OF TICK INFESTATIONS AND MOLECULAR CHARACTERISTICS OF TICK SPECIES ISOLATED FROM CATTLE IN SOME VILLAGES LOCATED IN COLLINS CHABANE LOCAL MUNICIPALITY

RESEARCHER: UBP MOSERI

Dear Colleague

The above researcher's research proposal served at the Limpopo Provincial Research Ethics Committee (LPREC). The committee is satisfied with the methodological and ethical soundness of the proposed study.

Decision: The proposal is granted full approval.

Regards

Chairpersonson: Prof I Swarts

Swarts

Secretariat: Ms. J Mokobi

Date: 14/08/2025

Annexure 6: Turn-it in front page report

MOSERI edited THESIS 2026.pdf

by Nevuwari Tshengedzeni

Submission date: 15-Feb-2026 04:16PM (UTC+0200)
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