Determination and validation of ethno-veterinary practices used as alternatives in controlling cattle ticks by resource-limited farmers in the Eastern Cape Province, South Africa.

By

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DECLARATION

I, Busani Moyo, hereby declare that this work has not previously been submitted at this or any other university, and it is my own work in design and execution and that all references contained herein have been duly acknowledged.

BUSANI MOYO

Signature of the Candidate……………………………………

Date………………………………………………………………
ABSTRACT

Ticks are the most common external parasites of economic importance in the livestock farming sector of Southern Africa. They are vectors of tick-borne diseases and are commonly controlled using conventional acaricides, which are expensive and not readily available to resource-limited farmers. As a result many resource-limited farmers resort to use of alternative materials to control ticks on their livestock. Tick resistance to acaricide is an increasing problem in Southern Africa and poses a real economic threat to livestock and veterinary pharmaceutical industries.

The objective of this study was to document and validate the ethno-veterinary remedies used as alternative methods of controlling cattle ticks by resource-limited farmers. A questionnaire survey was conducted in May 2007, at Qolora by-Sea and Nontshinga in Centane district, to determine tick control methods used by resource limited farmers in the Amathole District Municipality of the Eastern Cape Province, South Africa. Furthermore, in vitro and in vivo experiments were done to validate the acaricidal properties of ethno-veterinary remedies used by resource-limited farmers.

Ticks were reported to be a major problem, transmitting diseases like anaplasmosis (89.8%), babesiosis (55.9%) and ehrlichiosis (16.9%), they also cause wounds that predispose cattle to screwworm infestation, tick worry and teat damage. All farmers used acaricides and dipping tanks provided by the government to control ticks, as the main tick control method. However, the majority (94.9%) were of the opinion that the dip wash was not effective in controlling ticks. As a result, farmers complemented the government dipping service with use of own initiatives like spraying with conventional acaricides (22%), household disinfectants such as Jeyes fluid (18.6%), used engine oil (10.2%), chickens feeding on ticks (5.1%), manual
removal (5.1%), and pouricides (1.7%). In addition, some farmers also use plants (6.8%), mainly the leaf of *Aloe ferox* and the bark of *Ptaeroxylon obliquum*.

The *in vitro* repellency models showed Jeyes fluid (76.8 and 100% concentrations) and *P. obliquum* (40%) had repellent properties that lasted 6 hours and 40 minutes respectively while that of, Tabard (35% diethyltoluamide) positive control, lasted for 4 hours when applied against nymphal stages of *Rhipicephalus sanguineus* ticks. In the contact bio-assay, undiluted used engine oil, *T. minuta* oil (50%), Ektoban® (Cymiazol 17.5% and cypermethrin 2.5%) and Jeyes fluid (76.8%) caused higher tick mortality of more than 86%. Other materials (*A. ferox, Lantana camara* and *Tagetes minuta*) had no repellence and acaricidal properties.

In the *in vivo* study, Jeyes fluid at a concentration of 76.8% and used engine oil displayed efficacy of 71 and 76.4% respectively which was similar to that of the positive control Ektoban® at 97.8% tick load reduction. Among plant materials *L. camara* at 40% concentrations had an efficacy of 57% while *A. ferox, P. obliquum* and *T. minuta* were not effective at all. The remedies used by resource-limited farmers to control ticks vary in efficacy. Their ability to reduce tick load on cattle appears to be promising and a welcome development as their use could probably reduce tick burdens in cattle with less expenditure. However, further investigations need to be done before they are recommended for use. Despite being effective some of the materials have potential toxic effects in animals and also cause environmental contamination and I recommend used engine oil, Jeyes fluid and *L. camara* for further testing as they showed some efficacy compared to other remedies.

**Key words:** acaricides, ethno-veterinary remedies, tick load reduction, validate
I genuinely dedicate the success of this research study to God for regulating me to live and become a believing scholar.

To my wife, Sipho Moyo and my sons, Busiso and Bukhosi for their continued support.

To my parents who understood the importance of education.

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<td>TBDs</td>
<td>Tick borne diseases</td>
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<td>DBSA</td>
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PUBLICATIONS

Full articles prepared from the thesis

a) Published:


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Conference presentations from the thesis:

a) Regional

b) **International**

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CHAPTER 1

1 GENERAL INTRODUCTION

The cattle industry plays an important role in the agricultural sector and the national economy of South Africa. Cattle production contributes about 25-30% to the total agricultural output per annum (Musemwa et al., 2008). South Africa’s cattle population is approximately 14 million with the Eastern Cape Province contributing 3.171 million, which represents 22% of the country’s total cattle population (FAO, 2006; National livestock statistics, 2006). It is estimated that 52% of cattle in South Africa are found in the communal farming areas (National Department of Agriculture, 1999). Possession of cattle contributes significantly to the farming family’s income and food security base. The Nguni, Sotho and Tswana people equate cattle with life and they have many uses (Owen, et al., 2005). They are a source of meat, milk, hides and cash (FAO, 1998). The dung is used as source of soil nutrients (Devendra and Chantlalakhana, 2002), while other uses include payment as bride price (lobola) and also for ceremonial purposes (Owen, et al., 2005). Cattle are also used for draught purposes since draught cattle permit more land to be cultivated in a timely manner and less human drudgery.

Although majority of cattle in South Africa are found in communal farming areas, farmers in these regions are faced with many constraints, limiting the productivity of the animals. One of the major constraints faced by resource-limited cattle farmers in the region is the prevalence of parasites and diseases particularly in the wet season (Masiga, 1996). High mortalities are reported due to the parasites and the diseases associated with ticks and tick borne diseases (Muchenje et al., 2008).

The economic importance of ticks has long been recognized (de Waal, 2000). They transmit diseases such as anaplasmosis, babesiosis and ehrlichiosis, all of which cause
morbidity and mortality of animals. It is reported that anaplasmosis is most widespread in South Africa with more than 99% of the total cattle production at risk (de Waal, 2000). Other negative impacts of ticks include: sweating sickness a diseases which mainly affect calves. The *Hyalomma* spp of ticks release toxins into the animal which is manifested by ulceration of the mouth, sweating of the body and alopecia (Norval, 1983). Ticks also cause tick worry, whereby an animal looses condition, becomes weak and has a reduced immunity to diseases, which results in a general economic loss because the animal does not grow and produce as it should (Drummond, 1983). In addition, ticks cause blood loss and damage to skin, hides, teats leading to formation of wounds, which predispose animals to secondary bacterial infection and the development of abscesses (Peter et al., 2005).

Ticks are the most common external parasites of economic importance in the small-holder farming areas of Southern Africa (Hlatshwayo and Mbati, 2005). Ticks parasitize a wide range of vertebrate hosts, and transmit a wide variety of pathogenic agents than other groups of arthropods (Oliver, 1989). In general the favorite hosts of ticks are cattle but game and other small animals such as hares and birds are alternative hosts (Peter et al., 2005).

Ticks are commonly controlled using conventional acaricides which has been considered as the best method of controlling ticks, however it has certain shortcomings. Conventional acaricides are expensive or unaffordable to rural farmers. According to United States Department of Agriculture (1967) conventional acaricides can be toxic to livestock and humans; they can also create residues in animal tissues and may be destructive to the environment if they are not used in a safe and correct manner. In some studies done by Garcia-Garcia et al. (2000) and Laffont et al. (2001), residues of conventional acaricides were noticed in meat and dairy products and also caused contamination of environment via the cattle dung. Some reports have shown that ticks have developed resistance against a range of conventional acaricides (Nolan, 1990; Martins et al., 1995; George, 2000). In most areas
of the world, ticks have become resistant to arsenic and organophosphorus acaricides (Matthewson and Baker, 1975; Wharton, 1983; Drummond, 1983). Chlorinated hydrocarbons acaricides have also been withdrawn from the market (Graham and Hourrigan, 1977; Spickett, 1998), because of their high toxicity and long residual (lifespan). Carbamates are little more toxic than organophosphates for mammals and are much more expensive (Spickett, 1998).

Due to shortcomings of the conventional acaricides, resource-limited farmers are resorting to alternative methods and remedies that fall within ethno-veterinary medicine. Ethno-veterinary medicine is community based local or indigenous knowledge and methods of caring for healing and managing livestock. This also includes social practices and the ways in which livestock are incorporated into farming systems. It consists of local people’s knowledge dealing with folk beliefs, skills, methods and practices pertaining to animal healthcare and production (Mathias-Mundy and McCorkle, 1989). Ethno-veterinary medicine provides valuable alternatives to and complements conventional veterinary medicine. This is increasingly evident in the West where herbal medicine and other alternative approaches are becoming the mainstream practices. It is of specific value in developing countries where allopathic veterinary medicines are often beyond the reach of livestock producers. It can play an important role in grassroots development which seeks to empower people by enhancing the use of their own knowledge and resources (Bizimana, 1997). Livestock producers combine ethno-veterinary practices to reduce reliance on acaricides; Masika et al. (1997) showed that 39 percent of small scale farmers in the central Eastern Cape Province used complementary treatments, including hand picking, application of used motor oil or household disinfectants, diesel fuel, paraffin and Jeyes fluid.
1.1 Description of the materials used in the study

*Tagetes minuta*

*Tagetes minuta* L is an annual herb that belongs to the Asteraceae family. It is commonly known as Khaki weed/ Mexican marigold. It has a very strong and sharp smell. The plant is a branch erect herb, 1-2m tall with yellow-orange ray florets and 10 to 15 yellow-orange disk florets per capitula. Leaves are slightly glossy green and pinnately dissected into 4 to 6 pairs of pinnae. Leaf margins are finely serrate. The undersurface of the leaves bear a number of small, punctuate, multicellular glands, orangish in clour, which exudates a licorice-like aroma when ruptured (Prakaso *et al.*, 1999). *T. minuta* possesses insecticidal activities (Tomova *et al.*, 2005).

![Figure 1.1: *Tagetes minuta* plant](image)
*Aloe ferox*

*Aloe ferox* belongs to the Asphodelaceae family and is commonly known as Bitter aloe/ Red aloe. It is a palmlike succulent with a single (1.8-3.1m) upright unbranched woody stem crowned with a dense rosette of 0.9m long thick and fleshy leaves. The leaves have sharp reddish brown spines on the margins and smaller spines on their top and bottom surfaces. They are dull green, usually with reddish tinge. The leaves are arranged in a rosette, and as the leaves age and die, they remain attached to the plant, forming a petticoat of dried leaves around the base of the stem. The inflorescence is a candelabra of tubular orange red flowers standing 0.6 to 1.2 m above the leaves. The flower stalk may have 5-10 branches and individual flowers are about 2.5 cm long and densely packed in thick brushlike clusters on the stalks. It is known to posses medicinal properties (Ayurvedavaridhi and Ayurvedavaridhi, 2008).

![Aloe ferox plant](image)

*Figure 1.2: Aloe ferox plant*
**Lantana camara**

It belongs to Vervain (Verbenaceae) family. Lantana is a weed shrub with square stems that may grow up to 1.45 m high. It has opposite, round aromatic leaves that smell strongly when crushed. The stems are covered with hairs and sharp, recurved prickles. The flowers are borne in flat-topped clusters and their colour (which varies in different areas) may be white, yellow, orange, pink, or red. The fruit (berry) is a cluster of one-seeded drupes that are at first glossy green but turn purplish black when ripe (Henderson, 2001). The essential oil of *L. camara* is reported to have insecticidal properties on insects (Abdel-Hady *et al.*, 2005).

![Figure 1.3: Lantana camara plant](image)

**Ptaeroxylon obliquum**

*Ptaeroxylon obliquum* (Sneeze wood) is a tree in the family Rutaceae. It is native to Southern and Tropical Africa. This species varies in form from shrub to a large tree (up to 20 m tall). It is dioecious and the flowers are borne in panicles. The fruit is capsule and the seeds are winged. The strong and durable wood contains an aromatic resin that causes violent sneezing. It is used as moth repellent. The resin is used to treat against warts and the powdered bark controls ticks (Archer and Reynolds, 2001).
Jeyes fluid

It is a multi-purpose disinfectant that can be used to disinfect, clean and remove grease while killing germs. It is black in colour and contains mainly tar acids-13% m/m (carbolic acid) and sodium hydroxide (1%). The carbolic acid is destructive to low forms of life and lethal to aquatic life (Chem Alert report, 2006).
Used engine oil

Used engine oil is generated during the normal periodic preventative maintenance services conducted on internal combustion engines. The majority of engine oils are derived from petroleum. It mostly consists of hydrocarbons, organic compounds entirely of hydrogen and carbon. Polycyclic aromatic hydrocarbons (PAHs) are the major constituent of used engine oil. The chemical composition of engine oil changes with use, and in general used engine oil is considered more toxic than the original oil. It is a dangerous polluting product (Ssempembwa et al., 2004).

Figure 1.6: Used engine oil

Ektoban ® (cymiazol 17.5% w/v and cypermethrin 2.5% w/v - Novartis South Africa)

It is a commercial registered acaricide (Reg. No G0598 Act 36/1947). In cattle, it controls ticks, lice, flies and protect against screw-worm infestations (Novarties, South Africa (Pty) Ltd, personal communication 2008).
Several other plants have been evaluated and shown to possess some acaricidal properties; *Azadirachta indica* (Williams, 1993; Kalakumar et al., 2000), *Ocimum suave* (Mwangi et al., 1995b), *Gynandropsis gynandra* (Lwande et al., 1999), *Stylosanthes scabra* (Khudrathulla and Jagannath, 2000), *Tephrosia vogelii* (United States Environmental Protection Agency, 2002; Kaposhi, 1992) *Solanum dasyphyllum*, and *Neorautanenia mitis* (Kalakumar et al., 2000). However, some of their efficacy in controlling ticks is comparatively lower than the conventional acaricides while others are as efficient as the conventional acaricides. However, some of the plants have dermal irritation effects on animals, but their continuous use by cattle farmers do indicate their preparedness to use alternative means to conventional acaricides (Regassa, 2000). Ethno-veterinary medicines, on the other hand, are cheap, familiar, and locally available and therefore can be an alternative to conventional medicine.

Ethno-veterinary medicine is also affected by cultural and religious beliefs and this affects its use by resource-limited farmers. Much of this valuable ethno-veterinary medicine knowledge, like other forms of tradition knowledge, is transmitted orally from generation to
generation and hence is in danger of extinction or being adulterated because of the current rapid changes in communities all over the world (Njoroge and Bussmann, 2006).

1.2 Justification of the study

Cattle ticks are commonly controlled using conventional acaricides, which are expensive, not easily accessible and unaffordable to the resource-limited farmers like those in Centane district, which is in the coastal region of Eastern Cape Province of South Africa, where there is extreme poverty (Mushi et al., 2000; Dold and Cocks, 2002). This has caused them to resort to use of ethno-veterinary remedies to control cattle ticks that reduce cattle productivity. Unfortunately, the local ethno-veterinary practices and remedies in the area are poorly documented. This necessitates the documentation and validation of the potential acaricidal properties of these remedies. This will assist to preserve the local knowledge for future generations and other communities in the region (Mathias, 2001).

1.3 Main Objective

The main objective of this study was to determine, document and validate the ethno-veterinary remedies used as alternative methods of controlling cattle ticks by smallholder farmers in the Eastern Cape Province, South Africa.

1.4 Specific objectives

- To determine and document the ethno-veterinary practices used by farmers to control ticks in cattle.
- To validate the acaricidal properties of selected ethno-veterinary remedies in vitro.
- To assess the dermal irritation effects of the identified ethno-veterinary remedies to animals.
- To validate the acaricidal properties of selected ethno-veterinary remedies in vivo.
1.5 Hypothesis

- Farmers use ethno-veterinary remedies to control cattle ticks.
- Ethno-veterinary remedies have the same acaricidal properties as conventional acaricides \textit{in vitro}.
- Ethno-veterinary remedies have the same dermal irritation effects on animals as conventional acaricides.
- Ethno-veterinary remedies have the same acaricidal properties as conventional acaricides \textit{in vivo}.
CHAPTER 2

2 Literature review

2.1 Cattle Ticks

They are approximately 120 tick species that occur in Southern Africa. About 35 species of ticks are normally found on domestic animals in Southern Africa and of these only 15 species are of economic importance (Spickett et al., 1991). Several surveys on cattle tick have been conducted in South Africa, four tick species were found to be of major economic importance as vectors of tick-borne diseases that affect cattle. These were *Amblyomma hebraeum*, *Rhipicephalus (Boophilus) decolaratus*, *Rhipicephalus (Boophilus) microplus*, *Rhipicephalus appendiculatus* and *Rhipicephalus evertsi evertsi* (Bryson et al., 2002; Nyangiwe and Horak, 2007) while *Hyalomma marginatum rufipes*, *Hyalomma truncatum*, *Ixodes rubicundus*, *R. evertsi evertsi* and *Rhipicephalus warburtoni* were found in the Free State Province (Fourie and Horak., 1990; Fourie et al., 1996; Nyangiwe and Horak., 2007). Ticks parasitise a wide range of vertebrate hosts, and transmit a wide variety of pathogens which are *Ehrlichia (cowdria) ruminantium*, *Babesia bigemina*, *B. bovis* and *Theileria parva* (Allsopp et al., 2004; de Vos et al., 2004; Lawrence et al., 2004)

Ticks cause great economic losses to livestock in the world and have adverse effects on livestock hosts in several ways (Sanelson, 1975). Ticks and tick-borne diseases cause a lot of mortalities and their control in cattle cost a lot of money to many countries. In Brazil it cost about USD 2 billion per year in 2000 (Grisi et al., 2002) while in 2007 the Department of
Agriculture in Eastern Cape Province, South Africa spent R 200 million per year to dip cattle (Ntwayi, Department of Agriculture–Veterinary section, personal communication 2007).

2.2 Effects of ticks on cattle

Ticks have different effects in cattle, including being a vector of tick-borne diseases (theileriosis, babesiosis and ehrlichiosis), cause tick worry, suck blood, and cause teat, ear and hide damage (FAO, 1998; CRC-VT, 2001). They predispose the animal to abscesses, foot rot and screwworm infection. Ticks also have an indirect effect on cattle in terms of milk production (damage of the teats) and reduced weight gain (L’Hostis and Seeger, 2002; Peter et al., 2005). These effects seriously limit livestock production and improvement (Latif and Jongejan, 2002). Therefore ticks need to be controlled if livestock production is to meet world needs for animal protein.

2.3 Tick control methods

2.3.1 Conventional methods

Ticks are generally controlled with the use of conventional acaricides that are applied by dipping, spraying or pour-on which is considered as one of the best methods (Martins et al., 1995). Their application to cattle has been simple and widely accepted by farming communities, governments and donor agencies (Latif and Jongejan, 2002). However there are some problems associated with their wide use. Some reports show that ticks are developing some acaricidal resistance in many African countries where cattle have been treated with conventional acaricides to control tick infestations (Martins et al., 1995; Latif and Jongejan, 2002).
Conventional acaricides tend to contaminate the environment and indiscriminately kill beneficial insects (parasitoids), birds (oxpecker) and have harmful effects on the food chain (United States Department of Agriculture, 1967; Laffont et al., 2001; Latif and Jogejan, 2002; Uilenberg, 2005). They are also expensive and unaffordable to resource-limited farmers; as a result the farmers have resorted to ethno-veterinary practices and remedies (Laffont et al., 2001).

2.3.2 Use of ethno-veterinary practices / remedies to control ticks

Ethno-veterinary medicine covers people’s knowledge, skills, methods, practices and beliefs about the care of their animals (McCorkle et al., 1996). In view of the rising costs of conventional drugs, ethno-veterinary remedies are gaining importance in the management of livestock diseases in African countries (Njoroge and Bussmann, 2006). This has generated a lot of research and farmers perceive that they are as effective, in controlling ticks as conventional acaricides (Tabuti et al., 2003; Githiori, 2004). In Kenya ethno-veterinary remedies are used among pastoral and farming communities in marginal areas (Njoroge and Bussmann, 2006). They are locally available and affordable to the farming communities (Field and Simpkin, 2004). However in ethno-veterinary medicine most research has been limited to finding out which plants are used for which purposes (Bizimana, 1997).

Ethno-veterinary medicine provides valuable alternatives to and compliments the conventional acaricides especially where the later is unavailable, unaffordable or inappropriate. Ethno-veterinary remedies can provide low cost health care for simple animal health issues. It is generally based on local knowledge and tradition. Some of the ethno-veterinary remedies have been documented and some have been validated for their acaricidal
properties. For example, certain plants have been found to possess strong acaricidal and/or tick repellent properties. These include: *Nicotiana tabacum*, *Vernonia amygdalina*, *Tephrosia vogelii*, *Chrysanthemum cinerariaefolium* (Nash, 2008). On the other hand, some plants have been found not to have any significant acaricidal effect, these include the leaves of *Aloe morlothi* (Spickett et al., 2007) and powdered *Aloe ferox* (Fourie et al., 2005). According to Sutherst et al. (1982) and Kaaya, (2000), *Stylosanthes scabra* and *Stylosanthes viscose* produce toxins that kill *R. (B). microplus* larvae. Subsequent work in Puerto Rico confirmed that *S. scabra* and *S. viscose* were the *Stylosanthes* species that yielded the fewest live larvae of *R. (B). microplus* and larvae and nymphs of *A. varegatum* (Zimmerman et al., 1984). The *in vitro* work in India has shown the secretion of *S. scabra* kill larval and nymphal stages of *Rhipicephalus sanguineus*, *R. (B). microplus* and *Haemaphysalis intermedia*, (Khudrathulla and Jagannath, 2000).

In their studies Thompson et al., (1978) found that *Melinis minutiflora* plots yielded fewer *R. (B). microplus* larvae compared with *Hyparrhenia rufa*, *Brachiaria decumbens* and *Cynodon dactylon*. *M. minutiflora* grown in monoculture plots was highly lethal and repellent to the larvae of *R (B). microplus* as found by de Barros and Evans (1989). Also the repellent effects of *M. minutiflora* were demonstrated against *R. appendiculatus* ticks by Mwangi et al. (1995a). They conducted *in vitro* studies on adults, nymphs and larvae and concluded from olfactometer studies that the repellent effect was a result of a strong volatile chemical. Also the long trichomes on the stems and leaves of the grass also impede the movement of larvae upwards.
Acalypha fruticosa, is valued in India and Africa for its medicinal properties and its leaves have shown to attract larvae, particularly of R. appendiculatus (Alasbahi et al., 1999; Nadanakunjidam, 2003; Hassan et al., 1994). In the bush surrounding grazing paddocks, it was noted that ticks were consistently found on the underside of leaves of the shrub. It was proposed that the plant might be planted in pastures to attract ticks and ticks could be controlled by selectively destroying tick infested leaves.

In vitro studies have shown that the whole plant material of Gynandropsis gynandra has repellent and acaricidal properties on ticks (Lwande et al., 1999; Songsak and Lockwood, 2002). There was total absence of ticks in paddocks where the plant was present in high numbers compared with the neighbouring paddocks where the plant was absent (Malonza et al., 1992). Oil from seeds of the A. indica (neem) tree has shown to have inhibitory effects on vitellogenin during oogenesis of arthropods (Williams, 1993). Several studies on the effect of neem extracts on cattle ticks have been conducted on different tick species such as A. hebraeum, R. evertsi, H. truncatum and R. (B). decoloratus (Williams, 1993; Kalakumar et al., 2000; Benavids et al., 2001; Webb and David, 2002. Overall it reduced tick load burden in cattle significantly. Work done by Benavides et al. (2001) on R. (B). microplus, using a 5 percent soapy aqueous extract on naturally infested animals treated every 21 days showed similar efficacy to an amitraz-based commercial acaricides in two field trials. They also demonstrated high efficacy (100% control of reproduction) in vitro, when using an ether extract, while alcohol extracts resulted in 70% reduction of reproduction by the tick. Ethanol extracts of neem were found by Williams (1993) to be effective at inhibiting oviposition.
Abdel-Shafy and Zayed (2002) also concluded that neem can be used for tick control at economic concentrations of 1.6% to 3.2%.

The ethno-veterinary remedies of tick control practiced in western Ethiopia have been examined by a survey of farmers, followed by *in vitro* and *in vivo* testing of treatments that appeared to have potential to control ticks (Regassa, 2000). Commonly used treatments included *Capsicum* spp; commercial spice mixed with butter fat; the juice of crushed leaves and bark of *Calpurnia aurea*; crushed seeds of *Lepidium sativa* mixed with fresh cattle feces; juice of *Solanum incanum*; juice of crushed leaves of *Phytollaca dodecandra* and the latex of *Ficus brachypoda*. Of these, *Capsicum* spp., *Europhorbia obovalifolia*, *S. incanum* and *F. brachypoda* were the more effective treatments when used *in vitro*, causing 100, 92, 42 and 83% mortality of *R. (B). decoloratus*, respectively after 20 minutes of exposure.

In Kenya, the most used plants for tick control were: *Tithonia diversifolia* (Hemsl) and *Tagetes minuta* (Njoroge and Bussmann, 2006). These are important exotic weeds in the area but have become important medicinal plants such that they are allowed to grow along farm edges. In Cameroon, *Ageratum houstonium*, a wild plant of asteracae family; abundantly available in Cameroon has acaricidal properties (Pamo et al., 2005). Essential oils from the plant were toxic to *Rhipicephalus lunulatus* both *in vitro* and *in vivo*. The efficacy of the roots of *Dahlstedia pentaphylla* plant against infestations of *R. (B). microplus* was shown to be 76.10 % three days after application (Pereira and Famadas, 2006). Some plants like *S. incanum*, *Ocimum species* and *V. amygdalina* are capable of reducing tick feeding, molting, fecundity and viability of eggs (Kaaya, 2000). A number of plants with repellent or toxic effects on ticks have been identified and there is a strong evidence of the field efficacy of
some. Some of the studies on potentially useful plants have been restricted to in vitro bioassays in which the active chemicals are often not known and the yield is not stated, preventing an evaluation of their potential as tick control agents. Some plants with acaricidal properties have some side effects on animals for example application of latexes of *Euphorbia obovalifolia* caused alopecia in areas of skin smeared with the latex (Regassa, 2000).

In Kenya, farmers are reported to mix 100 ml of nicotine with about 1 L of used engine oil to make an oil dressing to kill ticks (Forse, 1999). Also in Zimbabwe resource-limited farmers uses supplementary tick control methods such as hand removal and application of home made acaricides (eg used engine oil, insecticide mixed with used engine oil (Chamboko *et al*. (1999). While in South Africa surveys done by Dreyer, 1997; Mbati *et al*., 2002 and Masika *et al*., 1997 in the Free State Province and in central Eastern Cape Province showed wide use of used engine oil, household disinfectant (Jeyes fluid), diesel fuel, paraffin, chickens and manual removal to control ticks.

Despite the use of Jeyes fluid and used engine oil as acaricide they have some detrimental effects both on animals and the environment. Used engine oil contains heavy metals such as lead, arsenic, cadmium or chromium which can be toxic or leave residues in meat, on skins and milk (Turkson, 2001; Villarino *et al*., 2003). Farmers are advised to exercise caution when using petrochemicals, such as used engine or diesel, in back rubbers or other self treatment devices for control of external parasites to avoid contamination of meat and milk (Food Safety Control Points, 2007). Used engine oil is known to have toxic environmental contaminants that alter soil biochemistry, which include alteration on soil microbial properties, pH, oxygen, poor aeration and nutrient availability (Odjegba and Sadiq, 2002;
Osubar and Anoliefo, 2003; Dominguez-Rosado and Pitchtel, 2004; Achuba and Peretiemo-Clarke, 2008). Kerosene has been recorded as an acaricide mixed with salt to control ticks, however it should not be used very often as it has adverse effect on the skin Mohammed, (1993). In Lesotho Jeyes fluid or soapy water are used to control ticks in horses (Melissa, 2008). The Jeyes fluid contains carbolic acid as the active ingredient, some years back carbolic dip was used to control ticks. However its use had some limitations (Linklater et al., 1982). In another incidence 14 outbreaks of pneumonia in sheep following dipping in carbolic dip were reported. Deaths commonly occurred between 1 and 3 days after dipping. Also 2 out of 3 lambs dipped in twice the recommended strength became ill with severe pneumonia apparently following skin absorption (Linklater et al., 1982). Prolonged contact of Jeyes fluid and skin cause redness and irritation to the skin (Safety Data Sheet, 2007). Jeyes fluid is also reported to have an effect on the environment, it turns water alkaline which tends to be lethal to aquatic life (Adcock Ingram, 2008).

Domestic chickens are well known to consume ticks in their diet (Hassan and Dipeolu, 1993; Kohn and Norval, 1994). Indigenous chickens are effective predators of A. hebraem, R. evertsi evertsi, Hyalomma spp and R. (B). decolaratus (Kohn and Norval, 1994). Scavenging village chickens remove ticks from recumbent cattle as well as ingesting unfed adults that have dropped on the ground. Cattle allow chickens to feed on attached ticks and feeding was easier for chickens when cattle were recumbent in the mornings (Dreyer, 1997). Kraaling of cattle makes it easier for chickens to feed on ticks. An average of 100 ticks can be consumed by one bird per day (Hassan et al., 1991; Dreyer, 1997; Johnson, 2005). It can be concluded that chickens could be incorporated into integrated control programmes for livestock ticks in
townships and rural villages in South Africa, where cattle are kept and milked in backyards, provided that chicken-friendly acaricides are used (Dreyer, 1997; Johnson, 2005).

Uses of ethno-veterinary remedies probably reduce tick-burdens while maintaining endemic stability to tick-borne diseases (Regassa, 2000). However little work has been done to document and validate these ethno-veterinary remedies in South Africa.
CHAPTER 3

3  Tick control methods used by resource-limited farmers and the effect of ticks on cattle in rural areas of the Eastern Cape Province, South Africa

3.1  Introduction

Ticks are the most common external parasites of economic importance in the small holder farming areas of the southern region of Africa (Soneshine, 1991). They parasitize a wide range of vertebrate hosts, and transmit a wide variety of pathogenic agents than other groups of arthropods (Oliver, 1989). In general, the favourite hosts for ticks are; cattle, but game and other small animals such as hares and birds are alternative hosts (Oliver, 1989). Ticks and tick-borne diseases (TBDs) can have a devastating effect on livestock production. They transmit diseases such as anaplasmosis, babesiosis and ehrlichiosis that cause morbidity and high mortalities in animals. It is reported that anaplasmosis is the most widely spread disease in South Africa, with more than 99% of the total cattle being at risk (de Wall, 2000).

Ticks also affect cattle by causing tick worry, whereby an animal loses condition, becomes weak; and has a reduced immunity to diseases, this results in general economic loss because the animal does not grow and produce as expected (Drummond, 1983). Tick bites also lead to blood loss and damage to skin and teats resulting in development of wounds, which predispose animals to secondary bacterial infection and development of diseases (Peter et al., 2005; Muchenje et al., 2008).

Over the last hundred years tick control has been based on the regular application of acaricides (George, 2000) but this is possible only if livestock producers can afford the cost of drugs. Also the use of conventional drugs has resulted in other implicit drawbacks such as
the presence of residues in the milk and meat, and the development of chemical resistant tick strains (Willadsen and Kemp, 1988; Nolan, 1990; George, 2000).

In most areas of the world, ticks have become resistant to arsenic and organo-phosphorus acaricides (Matthewson and Baker, 1975; Drummond, 1983; Wharton, 1983). Chlorinated hydrocarbons acaricides have been withdrawn from the market (Grahman and Hourrigan, 1977; Spickett, 1998) because of their high toxicity and long residual effect (lifespan) on cattle products. Carbamates are a little more toxic than the organophosphates for mammals and are much more expensive (Spickett, 1998). For livestock producers in more affluent regions of the world, there is a trend towards minimizing acaricides and other drugs for the safety of consumers, workers in the animal industry, animals, and the environment (Garcia-Garcia, et al., 2000).

In addition, conventional acaricides are poisonous to the environment and their use is complicated especially for resource-limited farmers. Also the costs of conventional veterinary medicines are escalating and becoming unaffordable to many resource-limited livestock farmers in most African countries. On the other hand ethno-veterinary medicines are gaining recognition at the expense of conventional drugs especially because of their greater accessibility, lower costs and apparent effectiveness (Mwale, et al., 2005). There is lack of documentation on alternative tick control methods used by smallholder farmers. The objective of the study was, therefore to assess the effect of ticks in cattle in the study area, as well as to document the alternative methods used by the small-holder farmers to control ticks on cattle in the Centane District of the Eastern Cape Province.
3.2 Materials and methods

3.2.1 The study Area

A survey was conducted to determine the various tick control methods used by resource-limited farmers in two villages; Qolora by-Sea (32° 38.63 S and 028° 24.36 E; Elevation 50 m) and Nontshinga (32° 29.65 S and 028° 17.80 E; Elevation 476 m); in the Centane district of Umnquma local municipality, in the Amathole District Municipality. It is situated in the Coastal forest and False Thornveld of the Eastern Cape. A subtropical climate prevails, with rainfall peaking in summer with a range of between 601-800mm. Most rain is from November to end of April. The average summer minimum temperature is 21°C and a maximum of 29°C. In winter, the average minimum temperature is 7°C while the maximum temperature is 24°C. The topography of the area is undulating with many steep slopes. Smallholder farmers in this area keep cattle, goats, chickens and horses.

3.2.2 Sampling procedure

The Centane district was stratified into wards and villages, after which two villages Qolora-by sea and Nontshinga were selected randomly from the two wards (wards1 and 29). Subsequently, households with cattle were randomly selected from the two villages and interviews conducted with 59 cattle farmers from the two villages: 29 in Qolora by sea and 30 in Nontshinga.

3.2.3 Data collection

The data collected was basically on the effect of ticks in cattle and the tick control methods used by farmers. Farmers identified the ticks using their colour and other morphological features. The field team further confirmed the identity of the ticks during dipping days. Three of the respondents were herbalists, two from Qolora by sea and one from Nontshinga village.
Plant samples were collected, pressed, identified by their scientific names and preserved. Voucher specimen numbers BMO1-037/2007 and BMO1-038/2007 were prepared and deposited in the Giffen herbarium at the University of Fort Hare.

### 3.3 Results

All respondents (100%) acknowledged ticks to be the major problematic external parasites, they encountered in cattle rearing. All the farmers interviewed, reported *Amblyomma hebraeum* to be the most common tick species in the area. *Boophilus* spp. and *Rhipicephalus appendiculatus* were considered to be important by 98.3% and 94.9% of farmers respectively. Other ticks perceived to be of minor importance were *Rhipicephalus evertsi evertsi* (8.5%) and *Hyalomma marginatum rufipes* (3.4%). All respondents (100%) considered ticks to be vectors of TBDs, and that they also cause tick worry (52.5%), predispose cattle to screw worm infestation (96.6%), lead to wounds (100%), cause teat damage (94.9%) and predispose animals to abscesses (78%). Teat damage results in cows failing to produce milk and as a result calves do not get colostrum necessary for immunity. The highest tick burdens were experienced between spring and summer.

The most common TBDs reported to be prevalent in the study area were: anaplasmosis (89.9%), babesiosis (55.9%) and ehrlichiosis (16.9%). Farmers with the guidance of a retired government veterinary services employee, were able to describe the diseases using clinical signs exhibited by the animal which further assisted in providing proper treatment.

The government provides a dipping service where acaricide Triatix 500 TR® (Amitraz 50%) is provided for use in communal dip tanks, once a week in summer and fortnightly during winter. The community selects one member of the community to mix the acaricide in the dip tank. Dipping of cattle is not compulsory and small ruminants like goats are not
dipped. About 95% of the respondents claimed that the acaricides (dip wash) were not effective in killing ticks. As a result farmers complemented the dipping service provided by buying their own acaricides (23%), others used alternative methods (ethno-veterinary practices) (45.8%) and a proportion of 30.5% relied only on government dipping service (Table 1). Of those who used commercial acaricides, 22% applied Triatix 125® (Amitraz 12.5%) when spraying and 1.7% used pouricides. Of the respondents using commercial acaricides, 18.6% belonged to the working class.

### Table 3.1. Complementary Dipping Methods

<table>
<thead>
<tr>
<th>Methods</th>
<th>Material used</th>
<th>% of farmers using the method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional acaricides</td>
<td>Spraying</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>Pouricides</td>
<td>1.7</td>
</tr>
<tr>
<td>Alternative method</td>
<td>Jeyes fluid</td>
<td>18.6</td>
</tr>
<tr>
<td></td>
<td>Used engine oil</td>
<td>10.2</td>
</tr>
<tr>
<td></td>
<td>Plant use</td>
<td>6.8</td>
</tr>
<tr>
<td></td>
<td>Chickens</td>
<td>5.1</td>
</tr>
<tr>
<td></td>
<td>Manual removal</td>
<td>5.1</td>
</tr>
</tbody>
</table>

Several alternative tick control methods recorded were: use of used engine oil (10.2%), chickens pecking on the cattle (5.1%), manual removal by cutting and pulling the ticks (5.1%), Jeyes fluid (18.6%) and medicinal plants (6.8%). The majority of respondents used Aloe
ferox (75%) and Ptaeroxylon obliquum (25%) in the control of ticks (Table 2). Farmers in this survey crushed fresh leaves of A. ferox and P. obliquum, soaked them in water overnight, strained the mixture and then sprayed the cattle. The way the plants are prepared and used is shown in Table 2. Used engine oil was brushed on livestock without being diluted. The Jeyes fluid was diluted according to the manufacturer’s instructions and sprayed on livestock especially when they were heavily tick-infested.
**Table 3.2** Plants used for the control of cattle ticks in the Eastern Cape, South Africa

<table>
<thead>
<tr>
<th>Family name</th>
<th>scientific name</th>
<th>Local Name</th>
<th>Common Name</th>
<th>Part</th>
<th>Preparation method</th>
<th>Route of application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rutaceae</td>
<td><em>Ptaeroxylon</em> obliquum</td>
<td>uBhaqa&lt;sup&gt;X&lt;/sup&gt;</td>
<td>Sneezewood&lt;sup&gt;E&lt;/sup&gt;</td>
<td>Bark</td>
<td>Crushed and soaked in cold water (infusion)</td>
<td>Topical spraying</td>
</tr>
<tr>
<td></td>
<td></td>
<td>uMthati&lt;sup&gt;Z&lt;/sup&gt;</td>
<td>Nieshout&lt;sup&gt;A&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asphodelaceae</td>
<td><em>Aloe ferox</em></td>
<td>IKhala&lt;sup&gt;X&lt;/sup&gt;</td>
<td>Cape aloe</td>
<td>Leaves</td>
<td>Crushed and soaked in cold water (infusion)</td>
<td>Topical spraying</td>
</tr>
<tr>
<td></td>
<td></td>
<td>INhlabaa&lt;sup&gt;Z&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Key**

<sup>X</sup>-Xhosa name

<sup>Z</sup>-Zulu name

<sup>E</sup>-English name

<sup>A</sup>-Afrikaner name
3.4 Discussion

The highest tick burdens were experienced between spring and summer when conditions were conducive for tick multiplication. The principal ticks that infested cattle in the study area were *R. (B). decoloratus*, *R. appendiculatus*, *Amblyomma hebraeum*, *R. evertsi evertsi*, and *H. marginatum rufipes*. This is in agreement with similar studies of Mbati *et al.*, (2002), who reported that in the Eastern Free State of South Africa, *R. (B). decoloratus* and *R. evertsi evertsi* were the predominant tick species. Generally, small ruminants like goats were rarely dipped by rural farming communities, this was also observed by Kunene and Fossey, (2006). Small ruminants and un-dipped cattle become reservoirs of ticks, ultimately re-infesting the dipped animals. Farmers reported high incidence of tick-related problems; with anaplasmosis, babesiosis and ehrlichiosis being the common TBDs. Mbati *et al.*, (2002) in their study in the Eastern Free Estate found that cattle were sero-positive for babesiosis and anaplasmosis. The *R. (B). decoloratus* is strongly associated with bovine babesiosis and anaplasmosis while *R. evertsi evertsi* is associated with babesiosis and anaplasmosis (Mbati *et al.*, 2002).

The farmers obtained some of the knowledge from the extension officers and also from other farmers who have worked on the farms or in the Department of Veterinary services. This made it easier for them to distinguish the tick species and diagnose the diseases. Of all the known blood sucking arthropods, ticks transmit the widest variety of pathogens that include rickettsiae, protozoa and viruses. *R. (B). decoloratus* a vector of anaplasmosis was the most common tick in the survey area.

Tick bites were reported to predispose animals to abscesses, screwworm infestation and wounds. These conditions were found to be very common in the area and had a strong association with high tick infestation levels. The long mouth parts of the genera *Amblyomma* and
Hyalomma penetrate deeper into the tissues than those of ticks with short mouth parts such as the genera Boophilus. They tear the muscles inflicting some small wounds which result in tissue necrosis (Sonenshine, 1991). The tick bite wounds, when contaminated with pathogens, result in abscesses which later rupture to become open wounds. The wounds may later be infested with screwworm. Teat damage results in cows failing to produce milk culminating in the newly born calves not getting the necessary colostrum that is its first line of immunity. The consequences could be high calf mortalities which were also reported in the survey.

Some farmers perceived the dip to be weak in strength as a tick control measure, and as a result they complemented government dipping by buying their own commercial acaricides, while others used alternatives. Ineffectiveness of the dip wash was perceived to be due to incorrect dilution; attributed to the people responsible for mixing the acaricide having a low numeracy and low literacy levels. Farmers could be using the incorrect concentrations of the acaricide resulting in use of under-strength dip wash. This is due to farmers mixing the acaricide without following instructions on the acaricide package.

In addition, the dips do not have foot baths, which results into a lot of mud entering in the dip tank, thus reducing the efficacy of the target dip wash. Also sediments reduce the capacity of the plunge causing cattle not to be completely submerged. During dipping the dip chemicals tend to bind to particles of dirt, hair and dung that enter the dip thus weakening the strength of the dip wash increasing the stripping rate. Excessive pollution in the dip adversely affects the efficiency of the dip (Purdie et al., 2006; Shumba and Choga, 2003). Cleaning of the plunge dip is recommended if the pollution level is higher than 20% (Purdie et al., 2006). Periodic cleaning out of the plunge dip is very important so as to remove the accumulated sediments (Moyo and
Masika, 2008). Therefore, periodic testing of acaricides needs to be done to ascertain the efficacy and rule out resistance.

Previous studies, Masika et al., (1997) and Mbati et al., (2002) reported similar findings of farmers complementing dipping using old motor oil, household disinfectant, pour-on acaricides and manual removal of ticks. Chickens remove ticks from recumbent cattle in the morning hours as well as ingesting engorged adult ticks that have dropped off to the ground and this is in agreement with the findings of Kohn and Norval (1994) and Dreyer et al., (1997). There have been proposals that chickens be incorporated into integrated tick control programmes for livestock in rural villages in South Africa, on the condition that chicken friendly acaricides are used (Dreyer et al., 1997). However, use of chickens can not be the major control method because their consumption rate is minimal considering the size of their crop and some of the farmers do not have enough chickens to feed on ticks.

Use of used engine oil is said to be effective in controlling cattle ticks Mbati et al., (2002) and Masika et al., 1997), however its safety to animals and meat consumers has not been assessed. There is need for safety assessment because used oil is a highly complex mixture, containing compounds distilled from petroleum for example, aliphatic hydrocarbons, aromatic hydrocarbons, polycyclic aromatic hydrocarbons [PAHs]), as well as metals such as aluminium, chromium, lead, manganese and others which are toxic (Delistraty and Stone, 2007). They increase after the oil is used (COEJL, 2004).

Toxic components in used engine oil, such as lead chromium, copper and zinc, can directly kill some plants and animals or become concentrated in plant and animal tissues. Concentrations of toxic compounds in plants and animal tissues consumed by humans may be toxic to them.
Also it can cause lead poisoning in livestock (Environmental services, 2007) and contaminate the environment (Delistraty and Stone, 2007). Continuous contact with used motor oil has caused skin cancer in laboratory animals and swallowing may cause stomach cramps and diarrhoea (Household product database, 2007). Therefore, the use of old engine oil is not a practice that should be promoted. However, because of the socio-economic situation of farmers in the Eastern Cape Province, many of whom depend on government pensions, they cannot afford to buy conventional acaricides. Therefore, they resort to using old engine oil to control ticks on their cattle.

Jeyes fluid is a commercial product, used as a household disinfectant. It contains mainly tar acids-13% m/m (carbolic acid) and sodium hydroxide (1%). The use of Jeyes fluid as an acaricide probably dates back to the use of carbolic dip for tick control more than 50 years ago (Malesela, 2004). Veterinarians do not recommend its use, however farmers maintain that it is cheaper than dips and also kills ticks. Jeyes fluid is a corrosive product that has the potential to cause adverse effects on skin and eyes. With prolonged and repeated skin contact it may result in irritation, skin dermatitis, blisters and burns (Chem. Alert Report, 2005). Exposure can further cause pathology to various body organs and systems (Chem. Alert Report, 2005). It has an effect on the environment, it turns water alkaline, which tends to be lethal to aquatic life (Chem. Alert Report, 2005). The safety of Jeyes fluid to animals and the environment, together with its residual effect to consumers are not known; therefore caution needs to be taken when using it.

Manual removal of ticks is widely practiced in smallholder farming systems in the developing world. Masika et al., (1997) reported that 10% of livestock owners in the central region of the Eastern Cape Province of South Africa either cut ticks off with blades, scissors or pulled them from their animals; whereas Chamboko et al., (1999) reported 6.9% of Lowveld smallholder
farmers and 28.3% of Highveld farmers in Zimbabwe removed ticks from their cattle by hand. Manual removal of ticks could be an alternative to complement the main tick control method. However, it is laborious and pulling off the ticks damages the animal tissues especially for ticks with long mouth parts.

Two plants were found to be used in the control of ticks; *A. ferox* and *P. obliquum*. The plant *A. ferox* is widely distributed in the Eastern parts of South Africa (van Wyk *et al.*, 2002), where it is generally referred to as the Cape Aloe. It belongs to the Asphodelaceae family. *A. ferox* is a broad spectrum medicinal plant known as “A pharmacy in a plant”, it is reported to have a laxative effect, due to the glycoside aloin it is also reported to be an insect repellent (Marvelous *Aloe ferox*, 2002) and has also been used in the treatment of gall sickness and heart water (van Wyk *et al.*, 2002, Masika and Afolayan, 2003.)

The plant *P. obliquum* belongs to the Rutaceace family. Pieces of wood can be placed in cupboards to repel moths. The bark of *P. obliquum* has been reported to contain; saptaeroxylon (an acid saponin), pyrogall, resins and an alkaloid (Archer and Reynolds, 2001). Resins were reported to possess essential oils which had acaricidal activities in a study by Pontes *et al.*, (2007). Oils of resins showed fumigant toxicity and the aged resin oil induced repellence (Pontes *et al.*, 2007). In this study, the bark was crushed and soaked in cold water overnight, strained and sprayed on the cattle. Archer and Reynolds (2001) reported that the powder of the bark added to water kills cattle ticks.

Despite plants having been used to treat various ailments for a very long time world wide, only a small proportion (6.8%) of the respondents used plants in the study area. The reason for the low percentage of plant use is that knowledge of plants used to treat various ailments, resides
with certain people, for example herbalists and old-aged people. Therefore most of the farmers were ignorant about the plants used, not only for tick control but even for many other livestock ailments. Considering that only 18.6% of the interviewed farmers were employed, it is evident that the majority do not have money to buy acaricides and other forms of tick control agents. Therefore use of plants could provide a better alternative because they are locally available at no cost, and they are generally acceptable to the communities. Various plants for example *Stylosanthes scabra* (Khudrathulla and Jagannath, 2000); *Azadirachta indica* (Webb and David, 2002); *Tephrosia vogelii* (Kaposhi, 1992) have been found to possess acaricidal properties.

### 3.5 Conclusion

Knowledge of plants used in the treatment and/or control of certain ailments is transmitted orally from generation to generation, however there is danger of extinction of this indigenous knowledge as older people die and younger generations fail to learn the traditional way of life (Tabuti *et al*., 2003). Since the results reflected low knowledge on plant use, there is an urgent need to document and validate information on use of ethno-veterinary remedies as acaricides for the benefit of the new generation, so that the knowledge can be preserved, plants conserved and sustainably managed. The *in vitro* validation of the ethno-veterinary remedies is discussed in chapter 4.
4  *In vitro* validation of the acaricidal properties of materials used in ethno-veterinary control of cattle ticks

4.1  Introduction

The survey results reported earlier (Chapter 3) indicate that ticks are one of the major contributors to animal health problems and exert the greatest limitation in cattle production, by causing Tick-borne diseases and production losses in cattle. These ticks are commonly controlled using conventional acaricides which are applied as dips or sprays and pour-on at various frequencies. Unfortunately, these conventional acaricides are expensive, not readily available to the rural farmers, the undegradable residues contained may pollute the products (milk and meat) and the environment, and ticks have developed resistance to them (Okello-Onen and Rutagwenda, 1997). This has caused resource-limited farmers to turn to low cost alternatives such as ethno-veterinary medicine as reported earlier (Chapter 3), which is the folk or traditional beliefs, knowledge, skills and practices relating to health-care of animals (McCorkle, 1986).

The purpose of this study was to validate the acaricidal properties of selected ethno-veterinary materials used by rural farmers in the control of cattle ticks.

4.2  Materials and Methods

4.2.1  Study site

The study was conducted at the Animal Science laboratory, University of Fort Hare. It is 520 m above sea level and is located 32.8° latitude and 26.9° longitude.
4.2.2 Plant material collection

The leaves of *Aloe ferox* Mill, Voucher number BM01-037/2007, *Lantana camara* L Voucher No. BM01-039/2007, *Tagetes minuta* L Voucher No. BM01-040/2007 and the bark of *Ptaeroxylon obliquum* (Thunb) Radlk Voucher No. BM01-038/2007 were collected within Amathole District Municipality (30°15’ S and 30°15’E), South Africa. They were authenticated in Albany herbarium, Rhodes University. Although the questionnaire survey was conducted in Centane (Chapter 3), the materials were collected around Amathole District Municipality, from area with similar agro-ecological and climatic conditions with that of Centane. Due to the collection sites being in close proximity to the University of Fort Hare, it enabled the plant material to be collected and soon extracted with minimal delay. The area has mean annual temperature of 21.7˚C and an average rainfall of 580-800mm (ISCW, 2008). Most of the soils are of the Glenrosa and Mayo form. They are moderate fertile soils which are medium textured shallow with limited water storage capacities (SCWG, 1991). The area is situated in the false thorn veld. The vegetation is composed of several trees, shrubs and grass species. The dominant species are *Acacia karoo*, *Ptaeronxylon obliquum*, *Aloe ferox*, *Themeda triandra*, *Digitaria erientha*, *Eragrostis spp.*, *Cynodon dactylon*, *Pennisetum clandestinum* and *Sporobolus* species (Muchenje., 2008).

4.2.3 Preparation of the plant materials

4.2.3.1 Aqueous extraction of dried plant material

Fresh plant material (leaves of *L. camara*, *T. minuta*, *A. ferox*, and the fresh bark of *P. obliquum*) were collected, air dried under shade for six weeks and then milled into powder using a hammer
mill with 1 mm pore size sieve. Quantities of 100 g of the respective plant materials were mixed with 1000 ml of distilled water and soaked over night. The extracts were filtered using Whatman No.1 filter paper. The filtrate was then lyophilized using a freeze drying system Xerotec (model Cd 052, Kenmore international, Italy) for 72 hrs, yielding 10, 9, 11 and 12g of extracts of *L. camara, T. minuta, A. ferox* and *P. obliquum* respectively. The resulting extracts were stored in capped bottles and kept in the refrigerator at between 4 and 8°C until use. The extracts were reconstituted using distilled water to make different concentrations of 10, 20 and 30% (w/v).

### 4.2.3.2 Aqueous extraction of fresh plant material

Fresh leaves of *L. camara, T. minuta,* and *A. ferox* and the fresh bark of *P. obliquum* were collected and thoroughly washed using distilled water. Plant material of 40, 60 and 80 g were placed in 200 ml of distilled water and macerated for 1 minute using an electric blender. The mixture was stored at room temperature over night and later strained using a muslin cloth. The concentration percentages of extracts were determined using weight per volume (Jayasinghe, 1975) to obtain a 20, 30 and 40% (w/v) extract. The plant extracts were prepared as per information from farmers.

### 4.2.3.3 Extraction of oil

Quantities (200 g) of fresh leaves for *L. camara, A. ferox, T. minuta* and the bark of *P. obliquum* were mixed with 5 litres of distilled water and separately subjected to hydrolisation for 3 hours using a clevenger-type apparatus. With the exception of *T. minuta,* the other leaves yielded negligible quantities of oil. The *Tagetes* oil was diluted to concentrations of 3.125, 6.25, 12.5, 25, 50 and 100% using olive oil.
4.2.3.4 Extraction of Aloe leaf exudates

The Aloe leaf exudates were obtained by cutting the aloe leaves and the exudates was collected, were air dried in room temperature and stored in bottles. It was reconstituted to the following concentrations: 1.8, 3.5, 7.5 and 15% using distilled water.

4.2.4 Preparation of non-plant materials

Jeyes fluid (Adcock Ingram, Bryanston, South Africa) was diluted using distilled water to make the following concentrations: 0.6, 1.2, 2.4, 4.8, 9.6, 19.2, 38.4, 76.8, and 100%. Used engine oil was used undiluted. A commercial acaricide, Ektoban® (cymiazol 17.5% w/v and cypermethrin 2.5% w/v - Novartis Johannesburg, South Africa) registered for the control of ticks (Swan, 2001) was also used.

4.2.5 Ticks

Adult and nymph stages of *Rhipicephalus sanguineus* were obtained from Clinvet International, Bloemfontein, South Africa. They were of the same age. The ticks were held in small transport vials supported with moist Whatman filter paper and fresh green grass. They were kept at 75% relative humidity and a temperature of 25°C (±1°C), to produce an environment conducive for the survival of ticks (Thorsell *et al.*, 2005).
4.2.6  *In vitro* repellency bioassay

The repellency method described by Thorsell *et al.* (2005) was used in this bioassay. The nymphal stage of *Rhipicephalus sanguineus* tick species was used to test the repellency properties of ethno-veterinary materials (Chungsamarnyart, *et al.*, 2003). Two filter papers (Whatman No. 1) were placed inside a Petri-dish with an inner diameter of 9.5 cm. Tabard (diethyltoluamide 350 mg) an insect repellent was used as positive control while distilled water was used as negative control. Aliquots of 0.5 ml of the test solutions were applied along the periphery of the filter papers. The filter papers were then air dried for 2 minutes. Each test was replicated three times.

Six nymphs were placed at the centre of each of the treated filter papers and their movement with regard to avoiding the treated area was observed. If the nymph continued its motion beyond the periphery of the treated area within 5 minutes, the tick was indicated as non-repelled; conversely, if the nymph reversed its direction before reaching the periphery of the treated area the tick was considered as repelled. The Petri dishes were uncovered and exposed to the air from the start up to the end of the experiment. The test was repeated after 0.33, 0.67, 1, 2, 3, 4, 5, 6, 7, 8 and 9 hours after treatment. At each occasion the number of nymphs avoiding the treated area was recorded. The repellency was expressed as number of nymphs avoiding the treated area to the total number of nymphs at each occasion. Thus 6 nymphs avoiding out of a total of 6 is recorded as 100% repellency. The repellency was calculated according to Thorsell *et al.* (2005) as follows:

\[ R = \frac{a}{n} \times 100 \]
Where $R$ is the repellency;

- $a =$ the number of nymphs avoiding the treated area; and
- $n =$ the total number of nymphs put in the centre of filter paper at each occasion.

### 4.2.7 Contact bioassay on ticks

The dipping method was used for the *in vitro* bioassay (Pirali-Kheirabadi *et al.*, 2007). Adult *R. sanguineus* ticks were divided into groups of five and each group was immersed in a specific concentration of test samples ranging from 10, 15, 20, 30 or 40% for one minute. Distilled water and acaricide (Ektoban®) were used as negative and positive control, respectively. After dipping in the respective materials, each group was placed into separate Petri dishes containing moist Whatman No. 1 filter papers measuring $62.63 cm^2$, with pieces of green grass to provide an environment conducive for tick survival (Thorsell *et al.*, 2005). The tick samples were incubated for 7 days at $25^\circ C$ and 75% relative humidity in the dark as described by Pirali-Kheirabadi *et al.* (2007) with slight modifications. Each treatment was replicated three times. The Petri dishes were examined on an hourly basis for the first 6 hours after treatment, and thereafter every 24 hours in the morning; to count and remove the dead ticks (Pamo *et al.*, 2005). The tick mortality rate was calculated as according to Abott, (1925); Chungsamarnyart *et al.* (2003) as follows:

\[
\text{Corrected mortality} \,(\%) = \left(1 - \frac{T}{C}\right) \times 100
\]

Where:

- $T$ is the number of ticks remaining alive after treatment;
- $C$ is the number of ticks remaining alive in the control group.
Ticks were considered alive if they exhibited normal behavior when breathed upon or physically stimulated with a wooden stick. For each time point, if ticks were incapable of moving, maintaining a normal posture, leg coordination, ability to right themselves, or any signs of life they were considered moribund or dead (Penella et al., 2005).

4.2.8 Statistical analyses

4.2.8.1 In vitro repellency bioassay
The percentage tick repellency was calculated according to Thorsell et al. (2005). Mean repellency for all materials used was calculated.

4.2.8.2 Contact bio-assay
The following model was used to analyse tick mortality caused by treatment materials:

\[ Y_{ij} = \mu + T_i + \epsilon_{ij} \]

Where \( Y_{ij} \) = response effect (mortality) due to treatment

- \( \mu \) = overall mean (constant)
- \( T_i \) = effect due to treatment \((i=1, 2, 3\ldots \text{ and } 32)\)
- \( \epsilon_{ij} \) = residual error

The collected data were then analyzed using PROC GLM for repeated measures (SAS, 2003). P-values < 0.05 were regarded as significant. Duncan test was used to compare differences between treatment means.
4.3 Results

4.3.1 *In vitro* Repellency bioassay

With the exception of *P. obliquum*, the other plant extracts did not show any tick repellency effect. Only *P. obliquum* (40%) and Jeyes fluid (9.6 to 100% concentration) showed repellency as shown in Table 1. The repellency duration was shorter for *P. obliquum* (40 minutes) than Jeyes fluid >9.6% (1-8 hours). The Jeyes fluid at 76.8 and 100% concentration was effective for 7 and 8 hours while the positive control. Tabard was effective for 4 hours after application. *Lantana camara* extract (20 and 40%), *A. ferox* (20 and 40 %), *T. minuta* (20 and 40%), used engine oil, olive oil and *A. ferox* leaf exudates (1.8, 3.5, 7.5 and 15%) showed no repellency. The repellency of Jeyes fluid was effective from a concentration of 2.4 to 100%.

4.3.2 Contact bio-assay

The plant extracts did not yield any acaricidal properties. Used engine oil, Ektoban®, *T. minuta* oil (25 and 50%) and Jeyes fluid (19.2, 38.4, 76.8, and 100%) showed variable acaricidal efficacy with the following mortalities 93, 87, 13, 100, 26.7, 66.7, 86.6 and 100% respectively within the first 24 hours after application as shown in Table 2. *Aloe ferox* leaf exudates immobilized the ticks for the first 12 hours and later they became active.
Table 4.1. Tick repelling activity of *P. obliquum* and Jeyes fluid at different concentrations

<table>
<thead>
<tr>
<th>Material</th>
<th>Tick Repellency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20min</td>
</tr>
<tr>
<td><em>P. obliquum</em> (40%)</td>
<td>100</td>
</tr>
<tr>
<td>Jeyes fluid (9.6%)</td>
<td>100</td>
</tr>
<tr>
<td>Jeyes fluid (19.2%)</td>
<td>100</td>
</tr>
<tr>
<td>Jeyes fluid (38.4%)</td>
<td>100</td>
</tr>
<tr>
<td>Jeyes fluid (76.8%)</td>
<td>100</td>
</tr>
<tr>
<td>Jeyes fluid (100%)</td>
<td>100</td>
</tr>
<tr>
<td>Tabard (35%)</td>
<td>100</td>
</tr>
</tbody>
</table>
### Table 4.2. Least square means for acaricidal effect of some ethno-veterinary remedies

<table>
<thead>
<tr>
<th>Material</th>
<th>Tick Mortality (%)</th>
<th>Total Tick Mortality (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1h 2h 3h 4h 5h 6h 1d 2d 3d 4d 5d 6d 7d</td>
<td></td>
</tr>
<tr>
<td>Used engine oil</td>
<td>73 0 0 13 7 0 93 0 0 0 0 0 7 100&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>T. minuta oil</td>
<td>60 40 - - - - 100 - - - - - - 100&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>T. minuta oil</td>
<td>100 - - - - 100 - - - - - - 100&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Jeyes fluid (38.4%)</td>
<td>6.7 60 0 0 0 0 66.7 0 0 0 0 0 0 66.7&lt;sup&gt;c&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Jeyes fluid (76.8%)</td>
<td>73.7 13.3 0 0 0 0 86.6 0 0 0 0 0 0 86.6&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Jeyes fluid (100%)</td>
<td>100 - - - - 100 - - - - - - 100&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Ektoban</td>
<td>87 0 0 0 0 0 87 13 - - - - - - 100&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a,b,c</sup> Means in the column with different superscript letters differ significantly, p<0.05

#### 4.4 Discussion

Use of repellent acaricides for animal protection against ticks, constitute an important prophylactic component of tick-borne disease (TBD) management strategy (Dautel, 2004). Same applies to the contact acaricides which are chemical agents meant to kill ticks and are largely toxic through contact action (Boden and West, 1998). Some of the acaricides have long residual effect while others degrade rapidly after application (Brimecombe, 2006). In all the experiments, it was clear that the nymphs displayed their natural host-seeking behavior during the tests. They
moved around the filter paper and even crossed the treated areas for the extracts that did not show repellency.

The extracts of *P. obliquum* at 40% concentration had a short-lasting protection that provided more than 94% repellency at 40 minutes post-application against the nymph. This short repellency period may not be adequate to protect livestock against ticks. Tabard stick, our positive control, contains 350 mg diethyltoluamide per gram and it provided greater than 94% repellency for 4 hours. The repellency period of *P. obliquum* was quite short compared to that of the reference Tabard stick. The bark of *P. obliquum* has been reported to contain; saptaeroxylon (an acid saponin), pyrogall, resins and an alkaloid (Archer and Reynolds, 2001).

In a study by Pontes *et al.* (2007) resins were reported to possess repellency activities. The aged resin oil induced more tick repellency compared to the fresh one (Pontes *et al.*, 2007). We speculate that the resin oil in the *P. obliquum* was in small quantities that made the repellency to last a short period of time. There is also a possibility that the resin oil was volatile in nature making it to lose its repellency. Therefore further research is necessary to find ways of improving the duration period of repellency. The results of the contact bioassay are in contrast with those of Archer and Reynolds, (2001), who indicated that the powder of the bark added to water kills cattle ticks. The variation could be attributed to the tick species and the age of the tree from where the bark was collected and growth environment.

Jeyes fluid a commercial disinfectant and cleanser is registered for use on non-living materials. It contains tar acids-13% m/m (carbolic acid), sodium hydroxide (1%) and more than 60 % water (Chem. Alert Report, 2005). Carbolic acid is obtained by distillation of coal tar or produced synthetically (Boden and West, 1998). It showed some acaricidal efficacy both through contact and repellency in the study. The active ingredient of Jeyes fluid (carbolic acid) was used
as carbolic dip to control ticks more than 50 years ago (Malesela, 2004). The carbolic acid is poisonous to tissues especially when applied directly to muscle and nerves, causing paralysis to the nerves. After being absorbed in the animal’s body, it acts by affecting the medulla, especially the respiratory and vaso-motor nerves. It briefly stimulates and then completely paralyses the nerves.

Carbolic acid stimulates the cardiac inhibition, first slowing the heart, then depressing and finally paralyzing it. Death from medium dose occurs by paralysis of respiration nerves, and large doses causes paralysis of the heart (Henritte, 2008), hence death of the organisms. Carbolic acid is known to be very destructive to low forms of life when used in sufficient strength (Henritte, 2008), hence causing the mortality of ticks. However the veterinarians do not recommend its use because carbolic dip has very narrow safety margins (Aitken and Barrett, 2007). Carbolic dip caused some poisoning to animals dipped through ingestion and it was characterized by acute pneumonia with severe dyspnoea and marked grunting respirations (Aitken and Barrett, 2007). According to Manhattan, (1907) carbolic dip caused the greatest irritation to the first cattle to be dipped and after one to two hours of dipping the irritation on cattle decreases.

Carbolic acid affects both the targeted pests (ticks) and the host animal (cattle) as its safety margin is very narrow. It has side effects to the host animal. Chem Alert Report (2005) states that Jeyes fluid is a corrosive product that has the potential to cause adverse effects on skin and eyes. With prolonged and repeated skin contact it may result in irritation, skin dermatitis, blisters and burns. Exposure can further cause pathology to various body organs and systems (Chem Alert Report., 2005). Sheep that were dipped using carbolic dip were found to be poisoned by
this carbolic acid through ingestion and skin absorption (Linklater et al., 1982). The above reason could have contributed to its withdrawal from the list of registered acaricides.

Jeyes fluid is locally available in shops and farmers maintain that it was cheaper compared to the conventional acaricides and also kills ticks as reported by Malesela, (2004). Its efficacy compares well with the positive control, Ektoban® acaricide. The safety of Jeyes fluid to animals and the environment, together with its residual effect to consumers are not known; therefore caution needs to be taken when using it and more research need to be done on its toxicity.

The efficacy of used engine oil through contact bioassay compared well to the positive control conventional registered, Ektoban® acaricide. This was in contrast with the field efficacy findings by Dreyer et al. (1998) where it had an average efficacy of 38.1%. The variation could be due to tick species or the field condition. The high mortality caused by used engine oil is ascribed to its action as a physical acaricide clogging the spiracles and causing the tick to suffocate (Dreyer et al., 1998). Therefore direct contact between the oil and the tick is necessary for effective result (mortality). Mbati et al. (2002) and Masika et al. (1997) have documented the wide use of used engine oil however no validation was done. Also, used engine oil is a highly complex mixture, containing compounds distilled from petroleum, for example aliphatic hydrocarbons, aromatic hydrocarbons, polycyclic aromatic hydrocarbons (PAHs), as well as metals such as aluminium, chromium, lead, manganese and others which are toxic (Delistraty and Stone, 2007) and their toxicity increase after use (COEJL, 2004). The toxic components contained, could be the ones that caused the death of the ticks.

The disadvantages using used engine oil have been discussed in Chapter 3, however farmers continue to use it. This necessitates investigation since little/no work has been done in this
regard. However, many farmers in the Eastern Cape Province depend on government pensions (Dreyer, 1997), they cannot afford to buy conventional acaricides as such, they resort to using used engine oil to control ticks on their cattle.

The main components of *T. minuta* oil are α-terpineol, (Z)-β-ocimene, dihydrotagetone, (E)-ocimenone, (Z)-tagetone, and (Z)-ocimenone (Moghaddam *et al.*, 2007). The efficacy of *T. minuta* oil was comparable to that of the reference conventional acaricide, Ektoban®, which is very effective against hard ticks and registered as an acaricide. This makes *T. minuta* oil an alternative acaricide that can be used by farmers; however the cost of the oil may be prohibitive too. Terpenes in the *T. minuta* oil are responsible for the toxic effects reported in mosquitoes (Perich *et al.*, 1995, Macedo *et al.*, 1997, Seyoun *et al.*, 2002). Also, insecticidal activity of *T. minuta* oil has been reported against stored product pests (Keita *et al.*, 2000, Sarin, 2004). The *T. minuta* oil has been reported to have aphicidal properties (Tomova *et al.*, 2005) as aphids were killed by the application of *T. minuta* oil. The effect of this oil on ticks, in this study concurs with its efficacy on other insects. The recommended concentration of *T.minuta* oil to be used as an acaricide could be 50% level. This is more economic than the 100% concentration which uses more essential oil.

Njoroge and Bussmann (2006) have documented that the leaves of *T. minuta* when boiled, they kill the ticks in Kenya. Farmers in the study area could benefit from boiling the leaves which is cheaper than distilling oil from the plants. It was previously reported that topical application of *T. minuta* extracts and oils on rats demonstrated that it possesses some phototoxic potential (SCCP, 2005). The other plant extracts exhibited variable results ranging from no effect to lower mortality, therefore they cannot be used as alternative acaricides in tick control.
The extracts of *L. camara* at 40% concentration had a tick mortality of 27%, which was inadequate for reducing tick burdens in livestock. Our findings however are in contrast with Okello-Onen *et al.* (2004) where its efficacy was 96.6% for all the tick species. The difference in the observations could be due to difference in the environment where the plant was collected from. This affects the chemical composition of the plant. Also this variation could be ascribed to the fact that acaricidal efficacy depends on the tick species.

### 4.5 Conclusion

The results from this study have revealed that the materials rural farmers use as acaricides vary in their efficacy to control ticks. Some are as effective as the conventional acaricides whereas others are not effective at all. Jeyes fluid (38.4, 76.8 and 100%), *T. minuta* oil (50%) and used engine oil had the most acaricidal properties. However we also need to validate them in *in vivo* experiment which is discussed in chapter 5. Despite being effective some of the materials have potential toxic effects in animals and are also environmental contaminants.
CHAPTER 5

5 In vivo validation of the ethno-veterinary remedies used to control cattle ticks by rural farmers of Eastern Cape Province of South Africa

5.1 Introduction

Ticks are important parasites of both domestic and wild animals. Their deleterious effects include transmission of tick-borne diseases, tick worry, tick toxicosis and secondary infections such as abscess and screwworm infection (Hart, 1990). These effects reduce livestock’s productivity.

Ticks are generally controlled by use of conventional acaricides (Zeleke and Bekele, 2004). However, there are problems associated with the wide-use of acaricide to control ticks. These are discussed in chapter 2 and 3. The intensive application of acaricides on animals to control the vector ticks through dipping, spraying and pour-on contribute to the pollution of the environment with toxic residues which endanger the human health (Undeger and Basaran, 2005). Some recent studies have shown that acaricides have a considerable genotoxic and cytotoxic effect on human target cells (Georghiou and Lagunes-Tejada, 1991; Undeger and Basaran, 2005). Therefore, it is necessary to search for alternative tick control methods which are adaptable, safer and cheaper than conventional acaricides.

Interest in alternative methods for the control of ticks has been dramatically increased in recent years, in accordance with increasing demands for safer animal products and environmental protection (Georghiou and Lagunes-Tejada, 1991). Most of the studies have been validated through in vitro bioassays without doing the in vivo bioassays. In in vitro assays the
animals are however not necessarily the preferred hosts of the ticks under study. Therefore, extrapolation of the results might result in inaccurate estimation of natural efficacy as they used the non preferred hosts. It is therefore advisable to use the target tick species and animal to be protected whenever possible for such assays (Schreck, 1977). Therefore, the aim of the study was to validate in vivo acaricidal properties of selected ethno-veterinary remedies from the in vitro study.

5.2 Materials and Methods

5.2.1 Site description
The study was conducted at Mdeni dip tank, in Amatola Basin (32° 40′ 38″S, 26° 59′ 79″E) in the Amathole District Municipality, Eastern Cape Province, South Africa. It has mean annual temperature of 21.7°C. It is situated in the False Thornveld of Eastern Cape, with an annual average rainfall of 580-800mm (ISCW, 2008). The vegetation is composed of several trees, shrubs and grass species. Acacia karoo, Ptaeroxylon obliquum, Themeda triandra, Digitaria erientha, Eragrostis spp., Cynodon dactylon, Pennisetum clandestinum and Sporobolus species are the dominant species (Muchenje, et al., 2008).

5.2.2 Plant materials
The material was collected in the month of March 2008 within Amathole District Municipality (30°15′ S and 30°15′E), South Africa. It comprised of Aloe ferox Mill leaves, Lantana camara L leaves, Tagetes minuta L leaves and P. obliquum (Thunb) Radlk bark as describe in Chapter 4.
5.2.3 Preparation of Materials

Fresh leaves of *L. camara*, *T. minuta*, *A. ferox* and the fresh bark of *P. obliquum* were collected and used. The details of how the materials were prepared are described in chapter 4 under preparation of materials. For plant materials only concentrations of 20 and 40 % (w/v) extract were used. The two highest concentrations from the earlier study for plants that showed non acaricidal and non repellency properties (*A. ferox*, *T. minuta* and *L. camara*) were used. The aim was to find out if they might have effect on other tick species that were not used in the *in vitro* study. Also the idea was to prove their effectiveness in different environment as farmers claim they are effective in reducing tick loads in cattle.

For non plant materials, Jeyes fluid (Adcock Ingram, Brynston, South Africa) at concentrations of 38.4 and 76.8 % and used engine oil were used. A conventional commercial acaricide dip, Ektoban® (Cymiazol 17.5% w/v and cypermethrin 2.5% w/v – Norvartis, Johannesburg, South Africa), was used as a positive control.

5.2.4 Animals

5.2.4.1 Rats

A total of 39 adult Wistar rats of either sex, aged between 6-8 weeks with weights ranging between 250-300 g were used in the study for the dermal irritation tests. They were reared at the animal house of the Agricultural and Rural Development Research Institute (ARDRI), University of Fort Hare. The rats were individually kept in rat cages and fed on commercial rat pellets (EPOL Feeds Ltd, South Africa) and allowed free access to fresh drinking water *ad libitum*. The average temperature of the experimental animal room was 25°C.
5.2.4.2 Cattle

Fifty-two cattle of non-descript beef breed of either sex, aged between 2 and 7 years were used in this study, with full consent by the farmers at Mdeni to avail their cattle for the experiment. In this regard, each farmer had to sign a consent form. The animals were randomly selected for the experiments. Each animal was identified by a number that was painted on the scapular region of the forelimb. Participating cattle were grazed together with the rest of the herd, for the duration of the experiment.

5.2.5 Dermal irritation test

The dermal irritation test was performed according to the procedure of South African Medical Council (SAMRC) test Guidelines (Young et al., 1988; SAMRC, 1993; Liberacki et al., 1996). The pH of ethno-veterinary remedies were tested using the Crison micro pH 2000 meter (Crison Instrument- South Africa) before they were used on the rats. Thirty-nine adult Wistar rats with healthy, intact skin were used. Approximately 24 hours before the test, their fur was shaved off the dorsal area of their trunk. Two parallel patches of 2x3cm area each were shaved off. Care was taken to avoid bruising the skin. The test material of different concentrations was applied using a brush to a small area (2x3cm) of the test site, which was then covered with a gauze patch, which was ultimately covered with non-irritating tape. The parallel patch served as a negative control to which sterile distilled water was applied while conventional acaricide (Ektoban ®) was used as a positive control. These rats were randomly assigned to each test material and were kept separately in individual cages.
The exposure duration was 4 hours, at the end of which, the residual test substance was swabbed off the area using cotton wool soaked in distilled water. Care was taken not to alter the existing response or the integrity of the epidermis. Each test was replicated thrice. The animals were examined for signs of erythema, edema and any abnormal signs developing on the skin. The signs were observed, graded and recorded at 30-60 minutes, and then 24, 48 and 72 hours after patch removal. Initial and terminal weights were recorded, to see if the experiment had effects on the weight of the rats (Kanjanapothi et al., 2004).

5.2.6 **In vivo validations of ethno-veterinary remedies**

Fifty-two cattle were naturally infested with different tick species prior to the commencement of the experiment. On day one ticks were numerated at their predilection sites; ear, anal and scrotal/udder regions on individual cattle before the application of test materials (Tenekeu, 2002). Cattle were randomly divided into thirteen (13) experimental groups, of four cattle. Each test material used had two different concentrations; being 20 and 40% for non plant material and 38.4 and 76.8% for Jeyes fluid that showed most efficacy in the *in vitro* experiments. The treatments were randomly allocated to 13 experimental groups. In the positive control group, cattle were treated with a conventional dip wash (Ektoban ®) while the negative control group was sprayed with distilled water.

All test materials were topically applied using a knapsack sprayer with the exception of used engine oil which was applied using a paint brush. The test materials were applied once at the beginning of the experiment. The counted ticks on the predilection sites were painted with food colourant paint to easily monitor the changes in tick numbers on the animal. Fully engorged female ticks were not counted on the first day of the experiment as they could drop any time.
Cattle were kept with the rest of the herd in the grazing areas. Examination and enumeration of live/dead ticks was done per tick species on the predilection sites (ear; anal and scrotal /udder regions) on the left side of cattle and recorded on day 0, 1, 2, 3, 4 and 7, by the same person (Pereira and Famadas, 2006).

The experimental protocols were in compliance with the University of Fort Hare Ethics Committee on Research in animals, and internationally accepted principles for animal use and care.

### 5.2.7 Statistical analyses

The following model was used to analyse the effect of treatments (ethno-veterinary remedies) on tick load reduction:

$$Y_{ij} = \mu + T_i + \epsilon_{ij}$$

Where $Y_{ij}$ = response effect (tick load reduction) due to treatment

$\mu$ = overall mean (constant)

$T_i$ = effect due to treatment ($i=1, 2, 3\ldots$ and 13)

$\epsilon_{ij}$ = residual error

The counted data was converted to percentages and the data was tested for normality with the aid of the General Linear Model Procedures of SAS (2000). The data was not normally distributed and arcsine transformations were performed. The GLM repeated measures was used to analyze the data (SAS, 2000).
5.3 Results

5.3.1 Screening of test materials for dermal irritation

The materials that were used had a pH range between 3.9 and 9.15 as shown in Table 5.1.

Dermal application of ethno-veterinary remedies at different concentrations did not cause irritation.

Table 5.1. The pH of test materials

<table>
<thead>
<tr>
<th>Material</th>
<th>pH meter reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ektoban</td>
<td>7.24</td>
</tr>
<tr>
<td><em>P. obliquum</em> 20 – 40%</td>
<td>4.95 – 4.96</td>
</tr>
<tr>
<td><em>A. ferox</em> 20 – 40%</td>
<td>4.40 – 4.50</td>
</tr>
<tr>
<td><em>T. minuta</em> 20 – 40%</td>
<td>6.48 – 6.28</td>
</tr>
<tr>
<td>Used engine oil</td>
<td>5.24</td>
</tr>
<tr>
<td>Water</td>
<td>6.90</td>
</tr>
<tr>
<td>Jeyes fluid 38.4 – 76.8%</td>
<td>9.10 – 9.15</td>
</tr>
<tr>
<td><em>L. camara</em> 20 – 40%</td>
<td>3.90 – 4.00</td>
</tr>
</tbody>
</table>
5.3.2  *In vivo* validations of ethno-veterinary remedies

Cattle used in the study were heavily infested with a variety of ticks namely: *Rhipicephalus (Boophilus) microplus*, *Amblyomma hebraeum* and *Rhipicephalus appendiculatus* and with lower numbers of *Rhipicephalus evertsi evertsi*. The tick load reduction of the test materials differed with tick species as shown in Table 5.2. Jeyes fluid at a concentration of 76.8% produced a significant (P <0.05) mean tick load reduction of 71% unlike when it was used at a lower concentration. It had a high efficacy against *R. evertsi evertsi* and *R. appendiculatus* with tick load reduction of 87.8% and 74.5, respectively. Used engine oil had a significant mean tick load reduction of 76.4% compared to the positive control Ektoban® with 97.4% mean tick load reduction. Used engine oil had an overall tick load reduction of 95.5% and 84.5% on *A. hebraeum* and *R. evertsi evertsi*, respectively. The other materials, *T. minuta* and *A. ferox* caused insignificant mean tick load reduction (Table 5.2).
### Table 5.2 Mean tick reduction on different tick species caused by test materials

<table>
<thead>
<tr>
<th>Materials</th>
<th>Mean tick load reduction %</th>
<th>Mean tick load reduction across species %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>R. evertsi evertsi R. appendiculatus A. hebraeum R. (B). microplus</td>
<td></td>
</tr>
<tr>
<td>Ektoban®</td>
<td>100</td>
<td>97.2 98.2 95.8</td>
</tr>
<tr>
<td>Used engine oil</td>
<td>84.5</td>
<td>58.1 95.5 67.5</td>
</tr>
<tr>
<td>Jeyes fluid (76.8 %)</td>
<td>87.8</td>
<td>74.5 65.8 55.0</td>
</tr>
<tr>
<td>Lantana camara (40%)</td>
<td>51.5</td>
<td>62.3 56.5 61.7</td>
</tr>
<tr>
<td>Ptaeroxylon obliquum (40%)</td>
<td>0</td>
<td>26.8 0 11</td>
</tr>
<tr>
<td>Tagetes minuta (40%)</td>
<td>1.9</td>
<td>0 9 8.5</td>
</tr>
<tr>
<td>Jeyes fluid (38.4%)</td>
<td>0</td>
<td>18 0 0</td>
</tr>
<tr>
<td>Lantana camara (20%)</td>
<td>0</td>
<td>0 0 0</td>
</tr>
<tr>
<td>Aloe ferox (40%)</td>
<td>0</td>
<td>0 0 0</td>
</tr>
<tr>
<td>Tagetes minuta (20%)</td>
<td>0</td>
<td>0 0 0</td>
</tr>
<tr>
<td>Ptaeroxylon obliquum (20%)</td>
<td>0</td>
<td>0 0 0</td>
</tr>
<tr>
<td>Aloe ferox (20%)</td>
<td>0</td>
<td>0 0 0</td>
</tr>
<tr>
<td>Water</td>
<td>0</td>
<td>0 0 0</td>
</tr>
</tbody>
</table>

*a, b, c, d, e, f* Means in the same column with different superscripts are different (p<0.05).
Figure 5.1: Mean percentage daily tick load reduction

5.4 Discussion

Farmers have been using ethno-veterinary remedies for time immemorial, and according to their perceptions ethno-veterinary remedies do not cause injury to their livestock (Mathias, 2004). In the Eastern Cape Province, 55% of the human population is economically active, from which 24.4% are unemployed people (Statistics South Africa-census, 2001). They cannot afford to buy conventional acaricides to supplement government dipping services as such, they resort to using ethno-veterinary remedies to control ticks on cattle (Dreyer et al., 1998; Mbati et al., 2002; Moyo and Masika, 2008).

The findings from the study showed that all ethno-veterinary remedies used were non-irritant at the levels tested. Thus there seems to be no immediate visible risk to cattle that were dressed with the ethno-veterinary remedies. However the exposure time was short and repeated application may have different effect on the skin. The various ethno-veterinary remedies used for the control of ticks exhibited significant mean tick load reduction on cattle. Used engine oil was effective for first 5 days while *L. camara* 40% and Jeyes fluid 76.8% were effective for 3 days post application and therefore
in high tick infestations they can be applied in 3 to 5 day intervals, however further trials need to be conducted to determine the effective period before they are recommended for use by farmers.

Several workers have documented the wide use of used engine oil by farmers (Masika et al., 1997; Dreyer et al., 1998; Mbati et al., 2002; Moyo and Masika, 2008). It most probably acts by clogging the spiracles and causing the ticks to suffocate (Dreyer et al., 1998). Direct contact between the oil and the tick is therefore important for effective results. Its efficacy differed with tick species, with A. hebraeum (95.5%) being highly sensitive followed by R. evertsi evertsi (84.5%). Our findings however slightly differ from Dreyer et al. (1998) who found that the average efficacy of used engine oil was 38.1%. This may be ascribed to the extent how the used engine oil covered the tick and the duration the oil was in use in the engine as the toxicity of oil increases with its use (COEJL, 2004). The efficacy of used engine oil is reduced due to difficulties in applying it on ticks in the ears. The ears have long hairs that cover the ticks and prevent tick and oil contact. In addition, cattle do not permit the handling of their ears, making it difficult to effectively cover the ticks with oil as used engine oil is thought to control by suffocating the tick.

In our previous study (Moyo and Masika, 2008), it was reported that used engine oil is a complex mixture, containing toxic compounds that increase after use (COEJL, 2004). Some compounds like manganese and polycyclic aromatic hydrocarbons are used in the formulations of pesticides such as maneb, manganese tricarboryl. (AMHPS, 2006), which could explain its efficacy recorded in this study. The compounds affect the motor nerves, causing respiratory problems in pests (ATSDR, 2004; AMHPS, 2006). Some of the toxic compounds contained in used engine oil can be absorbed through the skin and contaminate the environment as we reported in our earlier study (Moyo and Masika, 2008). Used engine oil is easy to acquire, and farmers obtain it for free from the garages where vehicles are serviced. Another advantage of using used engine oil is that it is easy to apply and no special equipment is required (Dreyer et al., 1998) and no technical knowledge is required for its use.
Jeyes fluid contains tar acids-13% m/m (carbolic acid), sodium hydroxide (1%) and more than 60% water. In the earlier study (Moyo and Masika, 2008), we reported that carbolic dip was once used more than 50 years ago and was de-registered as acaricide. In this study its efficacy differed with tick species being low on *R. (B) microplus* (55.1%) and highly effective on *R. evertsi evertsi* (78.8%), which could be attributed to difference in tick sensitivity to the Jeyes fluid (White *et al.*, 2004). Although Jeyes fluid showed good results in this study, its use as an acaricide has been discouraged because it has been reported to having caused poisoning in sheep (Linklater *et al.*, 1982; Angus and Smith, 1983). Also fatal cattle poisoning has also occurred through the application to their backs of a carbolic-acid preparation against flies (Boden and West, 1998).

Prolonged and repeated application of Jeyes fluid at 1.2% is recorded to cause irritation on the skin, skin dermatitis, blisters and burns to animals, together with pathological damage to various body organs and systems (Chem. Alert Report, 2005). According to the manufacturer’s instructions it should never be used near or directly on animals because of its side effect. The negative potential effects of Jeyes fluid to animals and the environment, together with its residual effect to consumers still require further investigations, for now caution needs to be taken when using it. Despite these potential dangers, farmers still widely use used engine oil and Jeyes fluid, which could be a sign of desperation.

The extracts of *L. camara* at 40% concentration had a mean tick load reduction of 58% which was adequate for reducing tick burdens in livestock. The mean tick load reduction ranged between 51.5 to 62.3% being high on *R. (B) microplus* and low on *R. evertsi evertsi*. Our findings however are in disagreement with those of Okello-Onen *et al.* (2004), who observed a 96.6% control efficacy for all the tick species. The variation could be attributed to the age of plant growth, the season and environment where the plant was collected as this might affect the acaricidal activity of the plant (Taylor and van Staden, 2001). In the earlier study *in vitro* (Moyo and Masika, 2008), we found it had no repellence and acaricidal properties were observed, may it could be attributed to tick species that
were used. This lead us to try it other tick species in the *in vivo* study. The essential oil of *L. camara* consists of caryophyllene, cineol and pinene. Cineol is reported to have insecticidal properties on insects (Abdel-Hady *et al.*, 2005).

Our findings on *A. ferox* agree with Fourie *et al.* (2005) neither of the *A. ferox* concentrations had effect on the magnitude of the tick burdens of the treated animals compared with those of the untreated controls. This is despite the difference in the modes of application; Fourie *et al.* (2005) drenched the animals while in this study the plant extracts were applied topically. Farmers in South Africa widely perceive *A. ferox* to have broad antiparasitic activity against internal and external parasites in and on livestock. As a result some farmers include it in livestock feeds (Fourie *et al.*, 2005) with the aim of controlling internal and external parasites. Farmers perceive the bitterness of the *A. ferox* to cause acaricidal and antihelmintic effects (Fourie *et al.*, 2005; Venu, 2007). Despite its wide use, there is no scientific evidence to corroborate its efficacy.

None of the *T. minuta* concentrations had effect on the magnitude of the tick burden of the treated animals compared with the negative control. Our findings are in contrast with those of Ayacko, (2008), who observed that 250g of *T. minuta* leaves pounded and boiled in 500 mls of water for 30 minutes had 55% mean tick load reduction, and with those of Njoroge and Bussmann (2006), who documented that the leaves of *T. minuta* boiled in water kill the ticks in Kenya.

The mean tick load reduction caused by *P. obliquum* was low (9.5%) which could be attributed to its shorter repellency period. In the *in vitro* work done in 2008 by Moyo and Masika, (unpublished data), the *P. obliquum* was found to have a shorter repellency period. This plant has been reported to contain, saptaroxylen, pyrogall, resins and alkaloid (Archer and Reynolds, 2001). The resins were reported to possess tick repellent activity (Pontes *et al.*, 2007). Other tick species like *R. evertsi evertsi* were not sensitive to the *P. obliquum* while *R (B) microplus* had some slight sensitivity with a mean load reduction of 21.7%.
5.5 Conclusion

The various materials used by rural farmers and tested in this study revealed variable mean tick load reduction, but varied with tick species, which could be ascribed to the variation in sensitivity of ticks against the test materials. Used engine oil and Jeyes fluid had significant acaricidal activities against ticks. In addition, there were no side effects (non irritant) on rats and cattle dressed with ethno-veterinary remedies during the course of the study. This illustrates that through trial and error, the farmers have established the correct formulations that are not harmful to their animals. Their ability to reduce tick load on cattle appears to be promising, as their use could probably reduce tick burdens while maintaining endemic stability to tick–borne diseases. The surviving ticks will promote the cattle to develop immunity to ticks and tick borne diseases (Blood et al., 1983). However, further work has to be done to verify their mechanism of action, residual effect in meat and their implications on the environment before recommending their use as acaricides in cattle.
CHAPTER 6

6 General Discussion, Conclusion and Recommendations

6.1 General Discussion

The Eastern Cape Province had 3.1 million of cattle, which represented 22% of the country’s total cattle population of 14.1 million and the majority (67%) of which are from the communal farming system (National livestock statistics, 2006). Cattle are a resource that contributes, in different ways, to the livelihoods of the rural people. Cattle provide draught power, manure, cash, meat, milk and other socio-economic functions (Dovie et al., 2006). However, the province is endowed with various parasites especially ticks, which is attributable to the favourable climatic conditions in the area (Nyangiwe and Horak, 2007). These ticks lead to various impacts to the productivity of cattle; as vectors of tick-borne diseases and also by causing tick-worry which is a great loss to farmers (Norval et al., 1998). In addition, the fact that Eastern Cape is one of the poorest provinces in South Africa while conventional tick control remedies are expensive, this should be the basis why people widely use alternative methods and remedies to control ticks and other livestock parasites.

Conventional acaricides have been commonly used in the control of ticks for a long time; however, apart from expense, they have detrimental effects of creating residues in animal products and its destructive effects to the environment (Laffont et al., 2001; Undeger and Basaran, 2005). Also, ticks tend to develop resistance against them (Latif and Jongejan, 2002). In addition, the indiscriminate use of conventional acaricides in cattle tick control has caused the loss of enzootic stability to tick-borne diseases. In view of these aforementioned factors, cattle farmers resorted to using ethno-veterinary remedies which are locally available and affordable to the farming communities (Njoroge and Bussmann, 2006). Most of the
ethno-veterinary remedies tend to reduce the density of tick population to an equilibrium level below that which results in appreciable economic or clinical effects (Johnson, 2001). They promote enzootic stability to ticks and tick-borne diseases; however some of the ethno-veterinary remedies are toxic to animals and contaminate the environment (Irwin et al., 1997; Regassa, 2000; Laffont et al., 2001).

Used engine oil alters soil nutrients availability and also destroys the soil and water microbes when it is spilled out on soil and water bodies (Atunya, 1987). Also Jeyes fluid is very toxic to aquatic organisms, it alters the water pH. This may cause long term effects in the aquatic environment if water bodies are contaminated (Irwin, et al., 1997). Its use should be avoided or used with caution to avoid contamination of water bodies (Chapter 2).

In the Eastern Cape Province of South Africa, the use of ethno-veterinary remedies in the control of ticks is poorly documented and little validation has been done, while farmers using them are of the opinion that these remedies are as effective as the conventional acaricides in controlling ticks. It was, therefore, imperative to conduct a questionnaire survey to determine and document the ethno-veterinary remedies the farmers use to control cattle ticks in Centane district of Umnquma local municipality, in the Amathole District Municipality (Chapter 3) The results of the survey showed that the farmers perceived ticks to: transmit tick-borne diseases, cause tick worry and wounds thereby predisposing the animals to screwworm infection. Also farmers perceived the government sponsored acaricide (Triatix 500 TR®) not to be effective in killing ticks. As a result farmers resorted to using other alternatives of controlling ticks like spraying with conventional acaricides, household disinfectants (Jeyes fluid), used engine oil, chickens, manual removal, pouricides and plants (Aloe ferox and Ptaeroxylon obliquum). Jeyes fluid was the most used followed by the used engine oil (Chapter 3)
In vitro validation experiments were carried out to validate the acaricidal properties of ethno-veterinary remedies (Jeyes fluid, used engine oil, *Tagetes minuta* oil, *P. obliquum*, *Lantana camara* and *A. ferox*) and it revealed that Jeyes fluid and *P. obliquum* had some repellency properties against ticks while used engine oil, *T. minuta* oil (50%) and Jeyes fluid (76.8%) had acaricidal properties which significantly caused tick mortality (Chapter 4). The repellency of Jeyes fluid was better than that of the positive control, Tabard (35% diethyltoluamide). In the *in vivo* validation experiments Jeyes fluid, used engine oil and *L. camara* reduced the tick load in cattle, however they varied in their efficacy (Chapter 5). Jeyes fluid and used engine oil were as effective as the positive control, the conventional acaricides Ektoban®, in reducing the tick load of cattle in this study. The plant *L. camara* reduced tick population to almost equilibrium level (58% mean tick load reduction) which promotes enzootic stability. Most farmers perceive *A. ferox* having acaricidal properties; however it has shown that this is not so (Chapter 4 and 5). In addition all the materials were non irritant to the skin of rats and cattle (Chapter 5).

Use of alternative tick control methods is gaining importance in the management of ticks and has generated a lot of research interest (Njoroge and Bussmann, 2006). Also the interest in the consumption of organic products has also promoted the use of alternatives to conventional acaricides and environmental scientists are also interested in methods that are environmentally friendly. The alternatives to conventional acaricides include the use of ethno-veterinary remedies. The study has shown that there are many ways of controlling tick populations without conventional acaricides.
6.2 Conclusions

- Resource-limited cattle farmers in the Eastern Cape Province use a wide range of ethno-veterinary practices and remedies which include non-plant materials (Jeyes fluid, used engine oil), predation by chickens and plant materials (L. camara, P. obliquum and A. ferox) to control cattle ticks.

- In the *in vitro* models, Jeyes fluid and the extracts of *P. obliquum* had repellency activities while in the contact bio-assay *T. minuta* oil, used engine oil and Jeyes fluid had some acaricidal properties.

- All materials that were used were non-irritant to the skin of rats and cattle.

- The *in vivo* studies showed that used engine oil, Jeyes fluid and extracts of *L. camara* had variable acaricidal properties while others did not show any.

- The efficacy of the remedies used in the control of ticks, although variable, validates the choice of interventions used by resource-limited farmers in their effort to maintain the health of their livestock.

6.3 Recommendations

Although findings from the study have shown that Jeyes fluid and used engine oil have acaricidal properties, it is imperative to use them with caution considering that they have been reported to have potential side effects on both livestock and the environment. *Lantana camara* should also be used with caution, as it causes liver toxicity if it is ingested in large quantities by the animal. Also farmers should comply with the government law on such plants.
It can be recommended that further studies need to be done in the following areas:

1. Determine the potential of ethno-veterinary remedies to cause toxicity, when used for prolonged periods on cattle.

2. A study to document and validate the ethno-veterinary remedies used by farmers in the management of livestock diseases and parasites in all the provinces of South Africa.
7 References


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APPENDICES
Appendix 1: Questionnaire

Assessing the Ethno-veterinary Remedies Used in Control of Ticks in Cattle in the Eastern Cape Province

Date…………………………Questionaire Number…………………………

District…………………………

Enumerator’s name………………. Ward…………………………

Respondent’s name……………………………………………………

Village…………………………Sex of the respondent…………………

GPS: co-ordinates:…………………………

SECTION A: Household demography

1. Who is the head of the family? (1) Father □ (2) mother □ (3) children □ (4) other (specify)………………………………………………………………………………

2. Information on the head of the household

<table>
<thead>
<tr>
<th>House hold,s name</th>
<th>AGE</th>
<th>Gender</th>
<th>occupation</th>
<th>Main income source</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. Is there any agriculture training in livestock management done for household members directly involved in cattle management? 1. YES □ 2. NO □
4. What levels of training are farmers exposed to? (1) Master farmer □ (2) advanced master farmer □ (3) certificate □ (4) other (specify)

SECTION B Livestock Information and Health Management

5. Do you own any livestock?


The number of livestock the respondent used for ceremonies in the last 3 years.

<table>
<thead>
<tr>
<th>Date/year</th>
<th>Function</th>
<th>Type of animal</th>
<th>Number of animals</th>
<th>Price</th>
<th>Bought/own</th>
</tr>
</thead>
<tbody>
<tr>
<td>E.g2004</td>
<td>Funeral</td>
<td>Ox</td>
<td>1</td>
<td>R 3000</td>
<td>Own</td>
</tr>
</tbody>
</table>

6. Who manages the animals on a daily basis? 1. Males □ 2. Females □

7. Provide details of management activities

........................................................................................................................................

........................................................................................................................................

........................................................................................................................................

........................................................................................................................................
8. What are the general livestock health problems that you encounter in your herd/ village?

...........................................................................................................................................
...........................................................................................................................................
...........................................................................................................................................

9. How do you overcome such problems in your herd/ area?

...........................................................................................................................................
...........................................................................................................................................

10. Are there any mortalities in your herd that are related to ticks in the past 3 years and state their numbers?...........................................................................................................................................

...........................................................................................................................................

11 Are there any alternative strategies/ methods you use to solve encountered cattle health problems?

...........................................................................................................................................
...........................................................................................................................................

12. In your area what are the problematic external parasites of livestock?

...........................................................................................................................................
...........................................................................................................................................
...........................................................................................................................................
13. What challenges do the external parasites present to the farmers? ..........................

<table>
<thead>
<tr>
<th>Method</th>
<th>Animal species</th>
<th>Frequency of use</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Weekly</td>
</tr>
<tr>
<td>Apply used motor oil</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use paraffin/ diesel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bought chemical</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Name?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sponsored chemical by whom??</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traditional method/plants</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others (specify)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
14. How do you control these external parasites and how often?

15. What effect do ticks have on cattle?

1. Transmits diseases  
2. Cause tick worry  
3. Damages the teats and udder  
4. Cause screwworm sites  
5. Wounds  
6. Other (specify)………………

16. Which diseases are caused by ticks?

17. How many calves have died because of its dam failing to produce milk?

18. What is the main tick control methods used in your village? 1) Synthetic acaricides  
2) use of plant materials  
3) use of old engine oil

19. What are the main tick control methods used by you? 1) Synthetic acaricides  
2) use of plant materials  
3) use of old engine oil

20. What are the different types of ticks you find on your cattle and goats? 1) bont tick  
2) blue tick  
3) bont legged  
4) red legged  
5) brown ear

21. How far is the cattle dip from your village (how long does it take to walk to the dip?)

1 km  
2-3 km  
5 km  
+5km
22. How often do you dip your cattle? Weekly ☐ Fortnight ☐ Monthly ☐ Bi-monthly ☐ Erratic

23. How often do you dip your goats? (if applicable) weekly ☐ fortnight ☐ monthly ☐ bi-monthly ☐ Erratic ☐

24. Is the frequency of dipping adequate? (Provide details for your answer)

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25. State any alternative tick control measures that are being practiced in your area, if there are any

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26. Do you use plants to manage livestock health?  1. Yes ☐  2. No ☐

If yes, fill in the table below

<table>
<thead>
<tr>
<th>Names of plants used</th>
<th>Type of parasites controlled</th>
<th>Part of the plant used</th>
<th>Methods of preparation</th>
<th>Methods of application</th>
<th>Dosage/Quantity applied</th>
<th>Comment on its use/effectiveness</th>
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</tbody>
</table>
27. How long does it take the parasites to fall off from the animal or dies?

<table>
<thead>
<tr>
<th>Type of plant</th>
<th>Recovery period/ time taken</th>
<th>Factor affecting efficiency</th>
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</table>

28. Are there any precautions required in the use of the plant?

<table>
<thead>
<tr>
<th>Type of plant</th>
<th>Precaution</th>
<th>Side effects</th>
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</table>
29. Fill in the table below for the availability of the plant

<table>
<thead>
<tr>
<th>Plant</th>
<th>Area found/ locality</th>
<th>Season</th>
<th>Is it common</th>
<th>Accessibility / easily found</th>
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</table>

30. Fill in the table below. Can the plant be used as fresh and/or dried?

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<tr>
<th>Plant</th>
<th>Fresh</th>
<th>Dried</th>
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31. Are the plants scarce? Yes ☐ No ☐
32. If yes, why are these plants getting scarce?

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33. Does the use of these plants have any impact on the plants/tree population? 1. Yes 2. No

34. If yes, Comment

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35. Do you see yourself, using the plant(s) in future? 1. Yes 2. No

36. Give reasons for your answer above

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37. What are the limitations you have/ know about using plants to treat your livestock?

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38. How effective are the plants in controlling the ticks?
### Plant name
<table>
<thead>
<tr>
<th>Very effective</th>
<th>Moderate</th>
<th>Not effective</th>
<th>Comment</th>
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</thead>
<tbody>
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### 39. With your current situation, which tick control methods, do you prefer? And why?

<table>
<thead>
<tr>
<th>Tick control method</th>
<th>Affordability</th>
<th>Accessibility</th>
<th>Effectiveness</th>
<th>Method final favoured</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modern acaricides</td>
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<tr>
<td>Ethno veterinary/plants</td>
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</tbody>
</table>
40. Which groups in your community uses traditional treatments (ethno-veterinary) and why?

<table>
<thead>
<tr>
<th>Group of farmers</th>
<th>Reasons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td></td>
</tr>
<tr>
<td>Women</td>
<td></td>
</tr>
<tr>
<td>Wealthy</td>
<td></td>
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<tr>
<td>Poor</td>
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<tr>
<td>Young</td>
<td></td>
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<tr>
<td>Educated</td>
<td></td>
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<tr>
<td>Uneducated</td>
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<tr>
<td>Other group</td>
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</tbody>
</table>

41. Who among the above group has more knowledge of using plants to control ticks? Diseases? Why?

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42. How is knowledge on ethno-veterinary uses of plants transferred among the people?

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100
43. Do you feel that people should use traditional treatments more than they are presently doing?

1. Yes ☐  2. No ☐

Give reasons for your answer.

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Siyabulela- Enkosi
Appendix 2: Published Paper