CHAPTER 1

INTRODUCTION

1.1 Background

" The tragedy is that multitudes of the livestock of the world which could supply the animal protein so urgently needed by mankind are themselves suffering from malnutrition and diseases" (Cuthbertson, 1970: 91, cited by Schwabe, 1974)

It is estimated that in 1986 there were approximately 177 million cattle in Africa (Scholtz *et al.*, 1991). However, one of the most important constraints over livestock production is disease. It is estimated that a 6 percent reduction in disease loss would provide food for an additional 250 million people (Schwabe, 1974: 90).

Food shortages are most serious in the developing countries where 75 percent of the world's population lives. Again, it is estimated that 65 to 70 percent of the world's livestock resources exist in these regions, yet they account for only 30 percent of the world's meat output (Murray and Gray, 1984: 24). Moreover, animal protein production is lower in Africa than in any other country.

The causes of this serious situation are complex but one significant factor is the prevalence of diseases that afflict the livestock industry resulting in serious socio-economic consequences. According to Scholtz *et al.* (1991) a large number of these animals are frequently treated with acaricides in an attempt to contain ticks and tick-borne diseases on the general assumption that the numerous tick species causes losses in productivity. The diseases treated include African trypanosomiasis, East Coast fever, heartwater, redwater, anaplasmosis, *etc.* It can therefore be argued that the control of these diseases is an essential component of an economically rational approach to sustainable livestock production.

In the Socialist Republic of Romania, for example, animal health protection is a national concern, representing a permanent obligation for all state bodies and other organisations, and a duty for inhabitants throughout the country (Dida, 1983). However, in most developing countries where livestock industry is managed in the traditional way, animal disease control is still considered as part of routine government services rather than as a specific capital investment. Moreover, livestock owners under-invest in control of animal diseases either because they are inadequately informed of what represent the economically optimal level of control for a particular disease or because such information does not exist. Hence, they adopt a cautious approach and spend only small sums on disease control since the improved financial return is not direct and obvious.

Disease control programmes nevertheless are a form of investment that needs to be seriously promoted and legally enforced as a means of up-lifting the socio-economic status particularly of the rural poor, since livestock will continue to provide a vital and irreplaceable source of human food.

1.2 Problem Statement

In predominantly rural societies in underdeveloped countries, 98 percent of the large animals, such as cattle in certain African nations are raised on small-scale family farms. Livestock has a social, cultural and financial role. Despite all these roles, developing countries, including South Africa's developing areas, have a series of livestock production problems with ticks and tick-borne diseases being a significant problem. Ticks are important ectoparasites of livestock and tick-borne diseases are the most vector-borne afflictions of ruminants. Various tick control programmes have been put in place in South African developing areas to alleviate the problem. Nevertheless, cattle losses due to ticks and tick-borne diseases are still experienced. The existence of a dual economy within the agricultural sector exacerbates the problem. The small-scale, particularly black farmers who aim to increase livestock production face many problems not experienced by the white farmers. For example, in the control of livestock ectoparasites, research and extension services largely addressed problems experienced by the commercial farmers that can afford the effective and expensive acaricides, as well as the facilities needed to use them. As a result agricultural development lagged behind the progress made in the so-called high potential areas (Botha, 1994).

African agriculture according to Macgrecor (1990) does not receive the government support it deserves. For instance, in most developing countries the health budget showed a rising trend in the past years, the veterinary budget did not follow the same trend, although the veterinary services are strongly linked with human health in the broadest World Health Organisation (WHO) meaning (Bellani and Mantovani, 1983). Therefore, considering the substantial cuts in financial support that have affected veterinary services in the past and the probable resultant of under-investment in disease control in most of the Third World countries, it is rather cynical to dismiss the subject with the following questions. Is there going to be a future? Can rates of growth in animal production be successful in meeting the needs of a fast growing human population thereby improving the conditions of life of poor people throughout the world?

Currently the Directorate of Animal Health seems to be reluctant to fund animal health services. This is probably due to the government failure to realise the value to the country of the veterinary service or failure to foresee the consequences to society if such a service is not provided. In South Africa's developing areas, dipping forms an integral part of a properly orchestrated disease control programme through disease diagnostics and surveillance. A fundamental requirement for the national and international control of animal diseases is the provision of a comprehensive system of disease surveillance and disease reporting. Information from the disease diagnostic and surveillance programme benefits the whole economy and cannot be appropriated. Therefore, government intervention is necessary to ensure early warning and control of disease outbreaks.

On the other hand one of the major preoccupations of the government is to ensure sufficient supplies of food products of animal origin to meet the requirements of a balanced diet, which are ever increasing as a result of improvement in the living standards of the population. The continual threat posed by animal diseases can render the aforementioned objective null and void.

1.3 Objectives of the Study

The specific objectives of this study are to:

- Describe the current ticks and tick-borne diseases management practices of small-scale farmers in less developed areas.
- Assess the socio-economic impact of ticks and tick-borne diseases control programmes at farm level.
- Examine the links between ticks and tick-borne diseases control programmes and farmer development.
- Identify policy issues for reducing tick-borne diseases occurrence in resource limited communities.

1.4 Justification of the Study

"*In most of the developing countries the death or illness of even a single work animal may be a tragedy for a family ... an epidemic among such animals may be a national catastrophe" (Macpherson, 1995: 37).*

The livestock sector plays a crucial role in the economies of many developing countries by producing protein rich food supplies, generating vital income and employment, and earning much-valued foreign exchange. Cattle are the most important livestock species in Africa and account for approximately 70 percent of its domestic stock (Scholtz *et al.*, 1991). For many farmers in the developing world, their animals are also a form of stored wealth, a cushion against starvation when food is scarce, a source of fertiliser, a means of transportation and a source of traction in crop production (Umali *et al.*, 1994). However, the availability and quality of animal health service heavily influence the attainment of the full productive potential of livestock.

In the past most studies have focused attention on those producers who experience losses due to animal diseases (Kryder, 1983). Little attention has been given to those producers who are spared the effects of the disease. Also ignored has been the impact on consumers of the product that are affected by the disease. Recent studies have taken a broader approach and have estimated the impact of diseases on the total economy. For instance, in Sub-Saharan Africa, losses from all disease induced deaths and lower meat and milk production in livestock amount to an estimated $2 billion dollars a year (FAO 1985, cited in Umali *et al.*, 1994). Changes taking place in many countries demand a revised approach to meet broad national development requirements in terms of socio-economics.

Apart from having effects on public health and animal welfare, animal diseases also have economic implications, this is true for livestock which is kept for economic purposes. According to Renkema (1983: 47) a quantitative insight into the economic impact of diseases and disease control in livestock can be used for, *inter alia*:

- Assistance in indicating the lines on which veterinary research should develop by providing economic criteria.
- Supporting livestock owners' policy with respect to animal production and animal health.
- Broadening the basis for decisions where a choice must be made from alternative preventative and control procedures.
- Economic considerations are important in so far as they contribute towards policies with regard to animal diseases.
- To assess the long-term consequences of removing or reducing the constraints of ticks and tick-borne diseases from the farming system.

All the action undertaken in the field of animal health has been principally designed to obtain the highest possible level of profitability of animal husbandry resources while at the same time reducing costs, through the eradication or control of infectious or parasitic diseases which have a negative impact on such costs, as a result of either mortality, decreased production, or shortening of the average life span of the animals. Studies conducted in Australia and elsewhere on animal health programmes indicated that the return on invested funds was commonly as large as 500 to 1500 percent (Morris, 1983: 60). Morris (1983) further argues that these returns are so much higher than those from most other investments in livestock that the matter deserves investigation.

A potential benefit on disease control programmes usually results in a reduction of physical losses, increased supply and a decrease in prices to consumers in general. The overall effects according to Kryder (1983) is to reduce the benefits of producers and shift them to consumers. The opposite effect occurs when a devastating animal disease strikes the livestock population and results in reduced supply. In this case consumers are forced to pay more for the products and the net benefits accrue to the producers having little or no disease amongst their stock. These benefits would, however, depend on the relative elasticities of demand and supply.

Moreover, the national economy suffers a loss through animal diseases because resources are being used less efficiently. Additional resources at costs are required (e.g. labour, vaccine, *etc*) that could have been employed alternatively. If these costs could be reduced there will be two effects possible; either the same output can be produced more cheaply or the savings can be converted into increases in output.

It is evident that animal health and economics cannot be studied in isolation. Economic studies and the information derived from them become a basic element for a rational deployment of the technical, economic and financial resources at a national level. A key question that should be at the forefront in the thinking of any research institution should be economic. What research is worth doing?

1.5 METHODOLOGY

1.5.1 Socio-Economic Impact Assessment Technique

The study will be conducted within a Cost-Benefit Analysis approach because it provides a strong theoretical framework for analysing the economic and social impacts of research and development activities. Cost-Benefit Analysis has come to be used as a general technique for the assessment of the benefits and costs of large-scale projects (Roe, 1980). An *ex-post* view will be taken into account with the aim of establishing whether or not various ticks and tick borne diseases control interventions are producing their intended effects. Data on costs that cannot be derived from the farm level will be complemented by data derived from the veterinary service dip records. However, it is acknowledged that certain factors cannot be easily assessed quantitatively. For instance, the role of cattle in marriage contracts, prestige and ceremonial activities cannot be assessed in terms of a quantitative comparison, but should not be ignored. The "with" and "without" programme scenario will be modelled into the analysis to provide a basis for Cost-Benefit Analysis.

1.5.2 Questionnaires

Due to time limitations and financial constraints, this study makes use of the questionnaire as a tool through which information can be elicited from the farmers. The questionnaire can be used in three different ways, *viz.* for personal interviews, telephonic and mail interviews. In this study it was decided to conduct personal interviews because of the following advantages:

- The interviewer has control over question order and can ensure that the respondent does not answer the questions out of order.
- The interviewer can ensure that all of the questions are answered.
- The respondent is unable to cheat by receiving answers from others, or by having others complete the entire questionnaire for them.
- The interviewer can observe behaviour that the questionnaire is not designed to detect.

After completing the construction of the questionnaire a pilot survey was done to pre-test the questionnaire. Only a few changes were done especially with the phrasing of questions that appeared to be sensitive. The required ranking of answers in order of importance was also abandoned. Personal interviews supplemented with informal conversational interviews were conducted with the assistance of an animal health extension officer in charge of a selected diptank and a graduate diploma student in animal production. Their proven competence and enthusiasm minimised the need for training. Most of the interviews were carried out at the diptank to avoid lengthy and time-consuming journeys on foot to find homesteads. In addition, direct observation allowed the collection of data that could not have been revealed by the questionnaire, such as name of acaricides used and the type of the cattle breed kept.

1.5.3 Secondary Data Review

Data that has been acquired by other people before, published or unpublished is also considered useful in this study especially to avoid time wasted in repeating studies. However, it will be used with care to avoid using information that was done to suit a particular place and achieving some personal objectives. These will include books, journals, magazines, *etc.*

1.6 The Study Area

The differences in areas pose a problem to researchers of how to choose an appropriate study area. Moreover, there is always a problem when the researcher has to make a decision as to whether a single site or several sites will be sufficient to give a better picture of the study. For both economic reasons (resources) and the prevailing status of ticks and tick-borne diseases the former Venda homeland was chosen as a study area.

With the new political dispensation Venda now forms part of a larger regional government, in this case the Northern Province. The former Venda homeland lies between 20°45 and 24°45s and 29°50 and 3130E, and is bordered by former Gazankulu in the south-east, and the Kruger National Park in the west. A narrow strip of South Africa separates its northern border from Zimbabwe.

Agriculture is regarded as a cornerstone of the region's economic development strategy. Of the total land area of 649 240 ha in Venda, only 9% of the total area have been identified as dryland while 0.4% have been identified as under irrigation. About 86% of the total area in Venda is identified as potential grazing land. The total number of cattle as estimated by Booysen (undated) was 85 480 followed by goats (74 021) and lastly by sheep (1 516).

Venda is divided into three veterinary zones, namely the Red Line, Yellow Line and Open area (see Figure 1.1). After the presentation of a brief research proposal, on the advice of the former Venda Department of Agriculture (Veterinary Services Division) it was decided that the survey be conducted in all the veterinary zones. However, because of socio-political reasons, surveys could not be conducted in the Red Line area. The two areas surveyed (Yellow Line and the Open area) are generally known as non Foot-and-mouth disease areas. In comparison, however, the Open area is known as a low tick prevalent area and the Yellow Line as a high tick prevalent area.

Because of time constraint and a limited number of enumerators available, as well as very large numbers of cattle owners in Venda and spatial dispersion into widely scattered and sometimes small geographic areas three diptanks from each area were chosen for surveys. Within the Yellow Line area the following diptanks were chosen, namely Tshifudi, Malongana and Matshena. And within the Open area Vyeboom, Guyuni and Dzanani (see Figure 1.1). Factors such as cattle owners and the extension officer's co-operation, dipping attendance and ease of access to transport played a major role in the selection of diptanks.

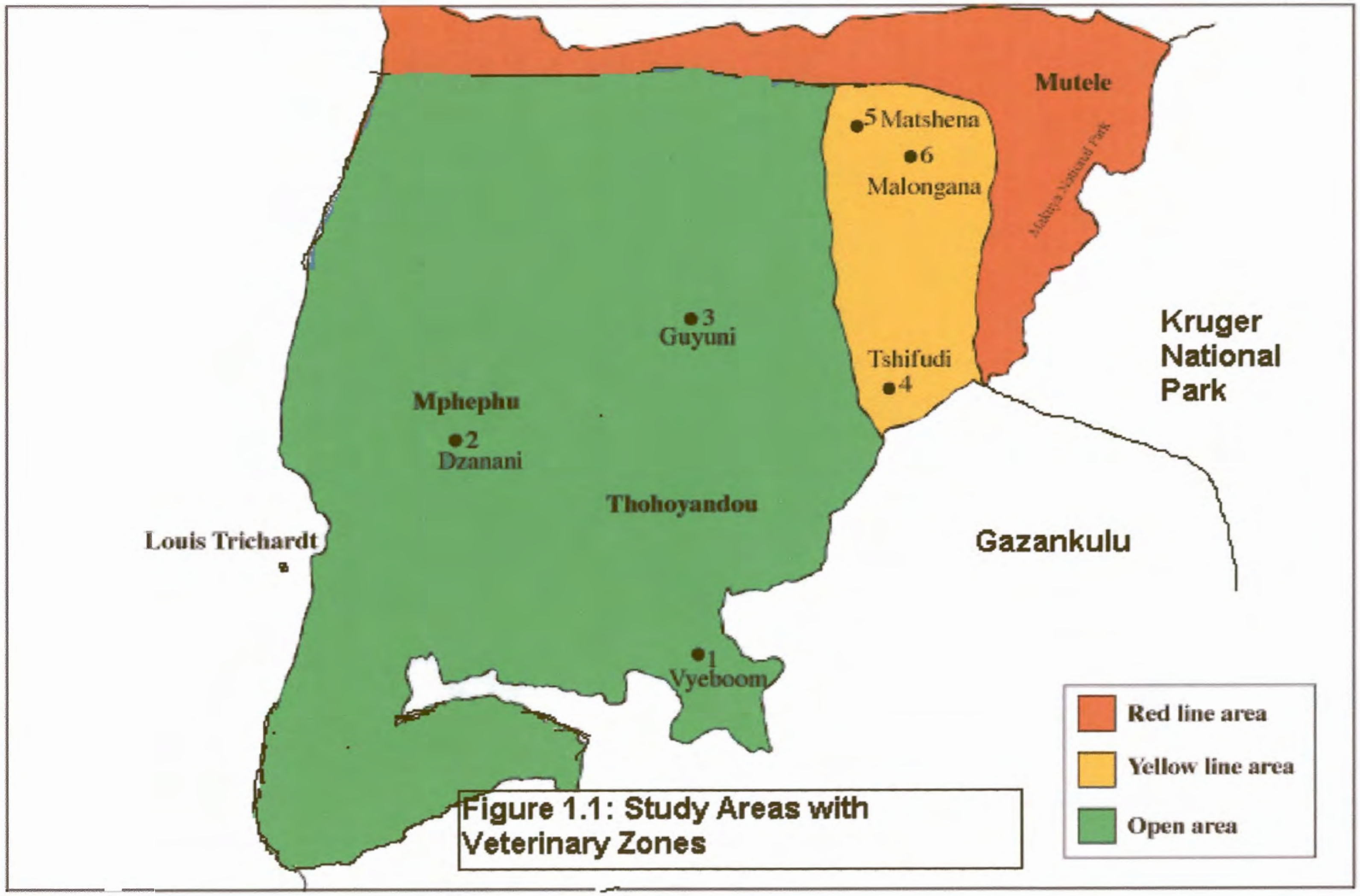

Figure 1.1: Study Areas with Veterinary Zones

1.7 Sampling Procedure and the Sample Size

It is difficult to give precise rules on what sample size is suitable. The suitable sample does not depend on the size of the population nor does it have to include a minimum percentage of that population. However, Bless and Achola (1995) argue that one of the major issues in sampling is to determine samples that best represent a population so as to allow for an accurate generalisation of results.

A very important issue in sampling is to determine the most adequate size of the sample. The major criterion to use when deciding on the sample size is the extent to which the sample's size is representative of the population. Two-stage sampling was performed in this study. Firstly, three diptanks were chosen within each area. Secondly, cattle within each diptank were stratified by number of cattle, namely 1-10 heads of cattle, 11-20; 21-30 and more than 30 heads of cattle representing the categories of stratification. Prior to sampling a list of cattle numbers for all cattle owners was made available by the extension officers in charge of the respective diptanks. Then, within each stratum, a simple random sampling was performed using random number tables. From each diptank, it was targeted that 25 respondents should be obtained using the following formula:

$$(n/N) * 25$$

n= number of cattle owners within each stratum

N= total number of cattle owners in a diptank

1.8 Research Design and Implementation.

The Group for Development Impact Assessment of the Agricultural Research Council (ARC-DIA) requested the Directorate of Veterinary Services of the Department of Agriculture for the participation and collaboration with regard to the project surveys. This was followed by a visit to Tshifudi diptank on a dipping day. After explaining the purpose of the project to cattle owners a group interview was conducted after dipping of the cattle using a structured questionnaire. Cattle owners were notified of the researchers return to conduct personal interviews with sampled cattle owners. A meeting was later held at Sibasa state veterinary office with the chief animal health extension officers of the sampled diptanks to explain the focus of the study, particularly its objectives. A draft questionnaire was also discussed and modifications were made.

Table 1.1: The Size and Distribution of the Cattle Farmer Surveys

Area	Number of farmers actually interviewed	Minimum number of cattle/surveyed area	Maximum number of cattle/surveyed area	Average number of cattle/surveyed area
Vyeboom	17	3	52	23
Malongana	23	2	55	19
Guyuni	23	3	42	15
Matshena	23	2	98	16
Dzanani	22	2	35	13
Tshifudi	17	3	39	13
Total	125	2	98	17

Prior to the conduction of personal interview, it was learnt that children or herdboys bring some of the cattle herds to the diptank. Sampled farmers were then notified about the planned interviews a week in advance of the dipping day. The actual number of farmers who participated in the surveys is, however, less than the targeted number of 150 as indicated in Table 1.1. This can be ascribed to poor dipping attendance (caused by rain and other urgent commitments) and uncooperative behaviour by some cattle owners. This reduced the number of actual respondents to 125. This sample is about 80 percent of the targeted sample, and is considered large enough to be representative. The surveys were conducted from September to mid-December 1997.

1.9 Definition of Terms

In order to examine the socio-economic impact of disease control programmes it is necessary to briefly examine the definitions and context of this area of investigation. The prefix "socio" refers to the whole society or individuals. Sociology includes the study of customs, traditions, pattern of historical development and institution that have evolved within societies. Moreover, it examines the diverse groups within a society, such as women, ethnic groups, poverty, *etc.* Socio-economics refers to both social status and economic position.

Impact assessment according to Anandajayasekeram, Martella and Rukuni (1996: 39) is a special form of evaluation that deals with the effects of the project output on the target beneficiaries. It normally focuses on how well a programme meets its stated objectives and therefore, often deals with the direct output of the activity.
Finally, the other term that will be used throughout the study is disease - which is defined as an unhealthy condition caused by infection.

1.10 Outline of the Study

To achieve the study's objectives, the study begins in Chapter 2 with an economic assessment of the value of livestock to rural community. This chapter provides both qualitative and quantitative information on the value of livestock. Chapter 3 focuses on the emergence, spread and the control of ticks and tick-borne diseases in South Africa. To some extent this provides the basis for future planning with regard to ticks and tick-borne diseases control. Chapter 4 focuses on the control strategies for ticks and tick-borne diseases. More emphasis will be given to the classical ticks and tick-borne diseases control based on acaricides application.

Given the importance of livestock to the rural communities and the imposing threat of diseases in the climate of declining research budget, the costs and benefits of tick control strategies will be highlighted in Chapter 5. Attention will be given to the two scenarios, namely the "with" and "without" dipping scenarios. A comparison will then be made between the two scenarios so as to provide any economic justification for the implementation of the dipping programme. Chapter 6 provides an analysis of the demand for livestock tick control service. It puts more emphasis on those factors influencing farmers' willingness-to-pay and the revealed demand for dipping. Given factors influencing farmers' decisions to adopt tick control strategies, Chapter 7 deals with some future strategies for ticks and tick-borne diseases control based on an integrated system of tick management and pays attention to policy proposals emanating from the study. Finally, Chapter 8 conclude by providing the summary of the results together with future challenges that need further investigation.

CHAPTER 2

AN ECONOMIC ASSESSMENT OF THE VALUE OF LIVESTOCK TO THE RURAL COMMUNITY

2.1 Introduction

An economic assessment of the value of livestock must take into account the range of factors that determine value to local farmers (Scoones, 1992). This chapter attempts to determine the value of cattle to the rural community both quantitatively and qualitatively. In doing so an effort is made to capture all the benefits of cattle within the economy of the rural community. A quantitative valuation of livestock in particular is important in indicating the degree of impact of cattle mortalities to the livelihood of the rural households. It again offers important guidelines for farmers' compensation by the government should a disaster occur.

Unless otherwise specified, the analysis is based on the survey of a sample of 125 households. A common approach used to determine the economic value of cattle production is the sales criteria or production trait approach (Scoones, 1992: 340; Upton, 1993: 463). This approach is based on the assumption that the prices received from cattle sales reflect its value. It does, however, undervalue the other productive roles of livestock.

2.2 Measuring the Economic Value

In estimating the economic value of cattle the several uses of cattle must be considered, as listed below:

- Biological productivity
- Off-take/sales
- Value of milk production
- Value of cattle draught power, this solely include ploughing.
- Value of manure use

The first two criteria are known as the natural rate of increase and the latter three as yield as advocated by Upton (1993). These criteria are evidently representative of the input and output function performed by livestock. These methods are not optimising models but do provide a useful method for estimating the value of livestock for small household herds. A further value of cattle is derived from the ceremonial activities (funerals, wedding) as well as wealth, which could not be easily quantified.

2.3 Reasons for Keeping Livestock: Theoretical Underpinnings

The sampled farmers were questioned on their reasons for keeping livestock. The intention was, *inter alia*, to identify those household that farm for subsistence reasons from those that farm for commercial purposes. To achieve this the sampled farmers were requested to rank in order of importance their reasons for keeping livestock. In general, economists identify commercial livestock production with high rates of animal sales (or rental values) and subsistence production with low rates of sales. This approach is misleading because rates of sale provide no indication of the reasons for sale. In Venda one producer might sell under duress; the other producer may raise cattle in order to profit from their sales. Despite their different levels of commitment to commercial involvement, the live animals' sales rate of the two producers may be remarkably similar under certain circumstances. In this survey attempts to clearly identify the orientation of farmers were disappointing. Failure to determine the respondents' orientation made it difficult to classify with any certainty whether surveyed farmers were subsistence or commercially oriented. However, although the results were inconclusive, it still offered enough information for one to broadly infer the motive.

Survey results shows that the livestock sector plays an important social, economic and cultural role in the economies of the surveyed areas. These roles have been documented over many years (for example in Doran *et al.*, 1979; Feuerstein *et al.*, 1987; Aaker, 1994). The social and cultural role of cattle in less developed countries led to the generally accepted cattle complex myth (Van Rooyen *et al.*, 1981). This myth is based on the assumption that black small-scale farmers were incapable of responding rationally to the market signals. According to this myth, peasant farmers would not sell cattle because their economic concern is overlaid by mystical and ritual devotion to their stock, and by the desire to accumulate cattle merely for prestige and wealth. Doran *et al.* (1979: 42) in this regard defines wealth as the accumulation of assets which confer among other things security, prestige and status, while income provides the means of attaining wealth and supporting current consumption. The essence of this view is that producers may occasionally sell a few animals, but they also strive to maintain surplus animals as an end in itself in order to fulfil traditional social needs. If one subscribes to this view, at least 15% of the sampled farmers keep cattle for the aforementioned purpose.

The view of Doran *et al.* (1979) suggest that one should expect to find an inordinate number of animals which are suitable for sale, but unsold, a sort of 'on the hoof bank account' (as Behnke, 1987 puts it) directly convertible to social status or emotional satisfaction on the part of the owner. This implies that traditional farmers might have their own minimum reference number of animals that they would like to posses. Bembridge (1987: 75) estimated that in subsistence oriented agriculture at least eight animals are needed to meet the many primary and social needs before any secondary or developmental needs could be met. Moreover, some researchers maintain that as many as eighteen head are necessary for primary needs (Tapson and Rose, 1984). Behnke (1987) argues that herds which declines beneath a certain number of animals can inherently be unstable and prone to losses and eventual extinction because of the high demand placed on them for milk, traction and animal sales. The smallholder is therefore not trying to avoid market involvement; he is simply building to a point where such involvement will serve as an asset rather than a drain on his resources.

The survey results (see Table 2.1) reveals that Venda cattle herds produce a wide array of useful goods and services including meat, milk, traction power and donations to the community. These goods and services have a use value in the domestic setting, but have a low or unrealisable cash value. All sampled farmers do sell cattle to meet their cash needs. In addition, the majority of the sampled farmers (97%) simultaneously keep cattle for both subsistence and commercial purposes. These farmers represent the household of

Table 2.1: Respondents' Reasons for Keeping Livestock

Area	Sell	Milk	Lobola	Wealth	Meat	Prestige	Plough	Donation
	% of respondents							
Vyeboom	100	59	-	100	94	-	6	-
Malongana	100	87	-	65	78	-	-	4
Guyuni	100	13	4	57	57	-	17	-
Matshena	100	78	-	78	78	-	-	-
Dzanani	100	18	-	91	41	-	-	-
Tshifudi	100	29	-	100	76	12	35	-
Total number of respondents	125	60	1	100	87	2	11	1

classic micro economic analysis in which rural farm households are dual-purpose institutions.

Of the 125, at least 4 households (3%) in Malongana, Guyuni and Matshena keep cattle solely for commercial purposes with an average herd size of 35 cattle. One can infer that cattle owners with a relatively large herd size approach cattle raising with a different goal in mind – the profitable production of animals for sale.

The survey results show cattle keeping as an alternative system of capital investment with dividends in milk, manure, traction power, *etc.* Thus, farmers have a preference for banking in livestock as it is a self-generating investment. This is evident when taking into consideration one of the respondents answer in vernacular on the reasons for cattle keeping; *kholomo ndi yone bannga yanga* (meaning cattle is my bank). This was also confirmed by 88% of the sampled farmers when asked about any best investment option available besides cattle farming. Investment in cattle is regarded as the best long-term economic option open to many rural households.

It is evident from Table 2.1 that the financial role outweighs both the social and cultural role performed by the cattle. The most important reason for keeping cattle is selling as expressed by all respondents, followed by wealth (100 respondents), meat (87) and milk (60). Reasons for keeping livestock varies within a region. For instance, within Vyeboom, all respondents (17) keep cattle for wealth, followed by meat (16), milk (10) and lastly ploughing as indicated by only one of the respondents. In addition, reasons for keeping livestock also vary amongst regions. For instance, the reason for keeping livestock as a source of milk vary widely from 87% in Malongana to 13% of the respondents in Guyuni as shown in Table 2.1.

The role of the cattle is also determined partly by their importance in religious observances, most of which involve supplication to the spirit of ancestors. This indicate that cattle serve as sacrificial goods and the best means by which the goodwill of ones' ancestors may be won and ones prosperity ensured. The survey results support a study by Düvel and Affull (1996) in which it was indicated that amongst Vendas, the patrilineal male ancestors are usually embodied in a black bull as confirmed by at least 2 % of the respondents. However, the religious and ritual importance of cattle that dominated an old pattern of consumption is changing in the face of the increasing monetary value of cattle, making it difficult for an ordinary man to buy and then dispose the cattle in offerings to the spirit. Moreover, exposure to western culture especially amongst young people, is changing their attitudes and are therefore critical in changing the use of cattle.

It is evident from these results that the objectives and reasons for keeping livestock varies amongst herd owners to the extent that the control of ticks and tick-borne diseases may or may not be a high priority for them.

2.4 A Quantitative Assessment of the Value of Livestock to the Rural Community: A Micro Perspective

This section provides an analysis of data derived from the questionnaire to give an indication of the importance of cattle in milk production, cattle sales, manure and the work of cattle. An animal's value and usefulness influences the owners' attitude towards and time spent on the animal's welfare which in turn affects its health care. In addition, costs of control are limited by the economic value of the animals. In the following section, an analysis of data derived from the questionnaire gives an indication of the importance of cattle in terms of milk production, cattle sales, manure and work of cattle.

2.4.1 Milk Production

Data were collected from farmers on milk production, own consumption and sales of milk, including the average price per litre of milk sold. The results are shown in Table 2.2 in terms of the averages for the different areas under consideration. Average daily consumption per farming family ranged from 2 litres to about 4 litres, while average daily production for all milked cows in the survey area ranged from 1.5 litres to 5 litres. The average daily consumption per family is influenced by the size of the household, number of children, *etc*, while average daily production of milk is dependent upon breed type, number of lactating cows, season and the farmer's objectives. Similarly, milk is only produced by breeding females with calves, so output depends upon the average calving interval, as well as the milk off-take per lactation. It should be noted that the Nguni breed which is most prevalent in these areas, do not produce as much milk as exotic dairy breeds.

Table 2.2: The Value of Milk Production

Area	Average consumption (l/day/ farmer)	Average production (l/day/ farmer)	Average number of cows milked/day	Percentage of farmers who sold milk (%)	Average price (R/ L)	Value of milk production/ cow/year (R)
Vyeboom	3.0	4.0	5	14	7.00	1022
Malongana	4.0	5.0	5	50	4.35	793
Guyuni	2.0	2.0	3	-	3.00	365
Matshena	4.0	5.0	6	21	3.50	532
Dzanani	3.0	1.5	4	20	3.50	240
Tshifudi	2.0	1.5	4	-	3.00	205
Average	3.1	3.2	4.5	18	4.00	526

Note:The value of milk per cow per year was calculated as follows. (Production / no. of cows) * duration of milking (days) * average price. Using the first row as an example: (4/5)*(365*6/12)*7 = 1022

The number of cows milked per farming household was obtained from the number of calves that were available in the herd, *ceteris paribus*. Furthermore, the average milking period of each cow was assumed to be 6 months. This is compatible with the average milking duration obtained through informal interviews after the field survey. At least 40% of the surveyed farmers milk their cows. The majority (60%) of the farmers did not milk largely due to the breed type kept and insufficient grazing (33%). At least 30% of those who milk do sell with the largest percentage in Malongana (50%), Matshena (21%) and

Dzanani (20%). This indicates a fairly active market for milk. The selling market price for milk was used for the farmers who did not sell milk. The average selling price of milk by farmers ranged from R3.00 per litre in Tshifudi and Guyuni to R7.00 per litre in Vyeboom. The former two areas with the highest selling percentage are located in remote areas. A general observation is that as one moves from the Yellow Line to the Open area the percentage of surveyed farmers who milk tend to decline. For some unknown reasons Guyuni appears to be the exception to this rule.

The last column of Table 2.2 gives the average value of milk production per cow per year. This value ranges from R205.00 in Tshifudi to R1022.00 in Vyeboom. These values also represent the value of home consumption since the selling price for milk is also the buying price in the surveyed areas. In addition, the trading of milk takes place amongst community members. The value of milk production is influenced by the selling price, number of farmers selling milk and the average number of lactating cows.

2.4.2 The Value of Cattle Sales

Table 2.3 shows cattle sales and slaughter from which the value per cow can be derived. At least 64% of the surveyed cattle owners sold their cattle with about 58% and 28% of the animals sold being oxen and cows respectively. A relatively insignificant number of bulls (10%) and heifers (5%) are also marketed. Breeding animals decline in value or depreciate as they age and eventually must be disposed. In the same way cows are usually sold when they are no longer productive in the surveyed areas of Venda. Heifers are rarely sold because they form the cornerstone of the future benefit stream. Sampled farmers' responses as to why they sold their animals were household related reasons, such as to buy food, pay school fees and taxes or to meet miscellaneous domestic expenses. Sales percentages (calculated as the number of farmers who sold cattle/total number of farmers in a particular area * 100) ranges from 52% in Tshifudi to 71% in Vyeboom. A possible explanation for such a high sales percentage in Vyeboom is social risk e.g. theft is said to be rife in that area. It is alleged that butchery owners steal cattle, predominantly bulls and oxen.

Table 2.3: The Value of Cattle Sales

Area	Respondents selling cattle (%)	Average number of cattle sold/year	Farmers selling oxen	Farmers selling bulls	Farmers selling heifers	Farmers selling cows	Farmers who slaughtered	Off-take	Price per animal (R)		Average value of sales per cow (A)	Meat value for home consumption per cow (B)	Total value Per cow (A + B)
			%						Auction	Other	R		
Vyeboom	71	2	53	6	6	29	18	13	-	1640	207	128	335
Malongana	59	3	61	13	4	17	4	15	1900	2105	318	128	446
Guyuni	61	2	17	22	9	41	26	15	-	1650	248	128	376
Matshena	61	3	52	9	-	22	4	14	1900	1785	246	128	374
Dzanani	59	2	41	9	5	27	14	11	-	1710	188	128	316
Tshifudi	52	1	24	12	2	29	12	8	-	1811	145	128	273
Average	60	2	42	12	4	27	13	3	950	1784	225	128	353

Note: The average value of sales per animal (R) was calculated as follows: Average price * off-take. Using the second row as an example. ((1900*29) (see Table 2.4) + (2105*71))/100* 0.15=318. Livestock markets were grouped into two categories (auction and others) in such a way that percentages of other markets were added together.

The value of beef for home consumption was calculated based on the 1997 national per capita beef consumption figure due to a lack of data in rural areas. Such a value amounts to 12.82 kg (Abstract of Agricultural Statistics, 1999) and it was multiplied by the beef price of R10/kg.

From Table 2.3 it is interesting to observe that animal off-take is often concentrated on a particular sex and age group. The off-take percentage ranges from 8% in Tshifudi to 15% in Malongana and Guyuni as shown in Table 2.3. There is generally a larger off-take of oxen in surveyed areas indicating that oxen are the preferred animals for sale. It is important to note that, *inter alia*, off-take is largely influenced by mortality which again affect herd population structure. If mortality savings (deaths prevented) are high and the herd is expanding, a higher off-take is possible. With this in mind, the possible presence of a relatively large number of matured oxen especially in big herds leads one to infer that their primary purpose is to maintain (by non-commercial means) the security, prestige or status of their owners (Upton, 1993). However, this statement does not usually hold when one takes into consideration certain market imperfections within the system. For instance, disease quarantine practices applied to cattle within the Yellow Line area makes it difficult for cattle owners to sell their animals at precisely the optimal moment. The marketing problems especially in Malongana and Matshena are expected to worsen due to an indefinite closure of auction venues observed during the survey period.

As shown in Table 2.4, 15% and 29% of the sales made in Matshena and Malongana respectively were done through the use of auction venues as part of the marketing channels respectively. This is because the two areas surveyed are quite remote and situated closer to the Red Line area (Foot-and-mouth disease area). Cattle within the Yellow Line and the Red Line area have to undergo the quarantine process for 21 days before being moved to other places. Therefore auction venues form part of that process as a disease control measure. Moreover, survey results indicate sales to butcheries as the most active market with respondents' percentage range of 29% in Dzanani and 67% in Vyeboom as indicated by Table 2.4. A possible explanation for such a high sales rate is because these markets are easily accessible. The butcheries referred to here are registered meat businesses that perform the retail function. Unfortunately, the survey did not collect data that actually show the different prices received from these markets. For the calculation of the value of cattle sales (see Table 2.3) the different livestock markets were classified into two categories - auction and others. The auction price was collected through discussions with auction participants and this price was representative of both Malongana and Matshena since they both use the same auction venues. Prices received from other livestock markets were a function of the sampled farmers' willingness to sell, *ceteris paribus*.

The percentage of the sampled farmers that slaughter is far lower than the percentage of farmers that actually sell. The slaughtering percentage ranges from 4% in both Malongana and Matshena to 26% in Guyuni. Cattle slaughtering are rare today and restricted to occasions, such as weddings, religious ceremonies or to instances where the animal is about to die. The decision to slaughter seems likely to be influenced or regulated by the need to satisfy a ceremonial demand. From Table 2.3 one would notice that the Open area is leading with regard to the percentage of farmers who slaughtered. This could possibly be explained by, *inter alia,* a lack of reliable formal marketing channels in the area. Thus, some farmers would prefer to slaughter and sell on their own at an average price of five rand per kilogram.

Table 2.4: Various Marketing Channels Used by the Respondents.

Area	Auction	Butchery	Friends	Butchery and Auctions	Auction and friends	Butchery and friends	Informal traders
				%			
Vyeboom	-	67	33	-	-	-	-
Malongana	29	41	6	24	-	-	-
Guyuni	-	57	36	-	-	-	7
Matshena	15	39	15	15	8	8	-
Dzanani	-	29	50	-	-	7	14
Tshifudi	-	50	20	-	-	30	-
Average	22	47	27	20	8	15	11

In comparison, a study by Nkosi (1994) on marketing of livestock in Lebowa revealed a higher respondents percentage of 44% selling to the private buyers. Nkosi (1994) defined private buyers as any household acquiring animals for different social activities. Private sales are important to farmers as they are in a position to determine the prices for their animals. Private sales were followed by auctions (15%) in spite of the low prices received as expressed by 42% of the respondents. It is therefore imperative that the aforementioned market outlets available in developing areas need to be developed and precede production.

2.4.3 The Value of Manure

Manure has other uses besides being an input to agriculture. Manure is used both for decoration and as crop fertilizer as shown in Table 2.5. There is a relatively insignificant use of manure as a crop fertilizer indicating that respondents rate the manure value for decoration higher than its fertiliser value. All sampled farmers use livestock droppings (traditional polish as farmers put it) for decoration purposes. The use of kraal manure as a crop fertilizer ranges from 4% in Malongana to 83% in Guyuni. This percentage difference may be a result of differences in the prevalence of crop farming amongst the regions. With the exception of Matshena, sampled farmers household in other surveyed areas neither sold the traditional polish nor manure for land fertilisation.

Attaching an exact economic value of manure to these communities was a complex problem since kraal manure is freely available. At least 17% of the sampled farmers in Matshena sell the traditional polish at R1.00 a tin (about 20 litres), and only 9% sell manure for crop fertilization at an average price of R265/bakkie (about a ton). To calculate the value of manure for both the aforementioned purposes one would have to make estimates of the portion of manure collected. Moreover, the economic value of kraal manure to a farming household is obtained by multiplying the selling price by the quantity used usually on a yearly basis. An estimation of the quantities of the traditional polish used in particular was a very difficult measurement to make. It should be acknowledged that the use of the traditional polish is the task solely done by women. Therefore, estimation of the quantity of the traditional polish was done by some women and they estimated that about 250 kg (about 10 bucket on average) are used per year. However, the use of the traditional polish is influenced by two factors namely:

- Season of the year. The use of the traditional polish is lower during the rainy season .
- Effects of special days e.g. Prior to Christmas and Good Friday demand for the traditional polish increases.

Table 2.5: The Use of Manure

Area	Respondents using manure for decoration (e.g. floor preparation)	Manure for land fertilisation	Farmers selling for decoration	Selling price for decorat-ion manure	Farmers selling manure for crop fertilisat-ion.	Selling price for soil fertilisation	Average quantity used		Value		Aggregate value of manure (R/animal)
							Decoration	Fertilis-ation	Decora-tion	land fertilisa-tion	
	%	%	%	R/tin	%	R/ton	Kg/animal		R/animal		R
Vyeboom	100	65	-	-	-	-	11	44	1	9	10
Malongana	100	4	-	-	-	-	13	53	1	11	12
Guyuni	100	83	-	-	-	-	18	67	1	13	15
Matshena	100	39	17	1.00	9	265	16	63	1	13	14
Dzanani	100	77	-	-	-	-	19	77	2	15	17
Tshifudi	100	82	-	-	-	-	19	77	2	15	17
Average	100	58	17	1	9	265	16	63	1	13	14

Note: Using Vyeboom as an example, the value of manure for decoration was calculated as follows, (R20/250kg*11kg/animal) = 1

And the value of manure for land fertilisation was calculated as follows (R200/1000kg*44kg/animal) = 9

The survey has shown that the observed selling price for the traditional polish in Matshena, is below the average price of R2.00/tin prevailing in non-sampled areas. This price was adopted as a standard for all the surveyed areas instead. The economic value of the traditional polish used per cow was thus estimated at R20.00 per year. The average quantity of the traditional polish used per cow reported in Table 2.5 was calculated as the total amount used (250kg) divided by the average number of cattle per farmer. The average value per animal was derived by multiplying the price per kg (R20/250 kg) by the average quantity used per cow.

Some farmers, with the assistance of agricultural officials indicated that about 1000kg of manure per household are used at an estimated cost of R200/ton. Again, R200/ton was used as a standard price for all the surveyed areas. The calculation of the average value for manure (land fertilisation) per animal was done similar to the average value for the traditional polish. The aggregate value for manure shown in Table 2.5 ranges between R9.60/kg in Vyeboom and R16.80/kg in Dzanani.

2.4.4 Work (Labour Value) of Cattle

In developing countries animal draught power represents a major output from the livestock sector. In Africa, animals provide 9% of the use of power for agricultural production. Moreover, ploughing accounts for 90% of animal power usage in primary cultivation (Feuerstein *et al.*, 1987: 178). A survey done by Simalenga and Joubert (1997) in 1994 established that in the rural areas of South Africa 40 to 80 percent of the sampled smallholder farmers were using animal power for transport and cultivation. Oxen represent the most powerful draught animals currently used in South Africa.

Data on the use of cattle for ploughing and transport were collected. As expected the use of cattle as a mode of transport no longer applies in the survey areas and consequently was not included in the valuation. Of the sampled households at least 13% of the respondents in Guyuni and 24% in Tshifudi reported the use of cattle for cultivation purposes. The use of cattle for ploughing is limited, largely due to the availability of tractors (71%) and damage that ploughing causes to the animals (9%).

The survey results on the availability of draught power confirm the observation that there is still a countrywide shortage of draught animals. Only a limited market exists for hired spans and the price charged by those who hired span is estimated to be R110/hectare for a span of 4 oxen. This translate to a cost of at least R28/ hectare/ox. This was considered to be a standard price for all the surveyed areas in this study.

Secondary sources indicate that a span of 4 cattle takes 6 hours to cultivate half a hectare (Simalenga and Joubert, 1997: 17). It was assumed that this translates to 12 hours for the same span to cultivate a hectare, *ceteris paribus*. A study by Rocha *et al.*, (1991) in Mozambique showed that oxen worked an average of 62 days in a year and this figure was found to be comparable with figures reported from other countries in Sub-Saharan Africa. In Venda, however, a span of 4 oxen takes 10 hours to cultivate a hectare working for an average of 50 days in a year (Lubbe, 1998). The number of animals' working days is largely influenced by rainfall availability and soil depth. For example, more land will be cultivated during good rainfall years leading to an increase in the number of animal working days.

Table 2.6: The Value of the Work of Cattle

Area	Use of cattle (days/year) plough	Cost (R/ animal/day)	Probability of using draught power	Value of ploughing activity (R / animal)
Guyuni	50	28	0.13	182
Tshifudi	50	28	0.24	336
Average	50	28	0.32	259

Note: The value of the work of an animal was calculated as follows, using the second row as an example: (50*28)*0.13 = 182.00. Probabilities were derived from the survey data.

The average value of ploughing activity per cow per year is estimated to be R259.00 as indicated in Table 2.6. This value can be increased only if animal traction can be seen to have clear social and economic benefits. There is, however, a need for greater government support in terms of a definite animal traction policy as well as training, research, development and extension.

An initiative by the new South African government which introduced a policy that focuses on the needs of the community, as emphasised in the Reconstruction and Development Programme, could perhaps stimulate the use of traction animals to collect water, food, fuel and for transportation, agriculture, as well as the lot of women in rural areas, thereby helping to address gender issues.

2.4.5 Biological Productivity

Table 2.7 shows the average number of cattle and calving rates per farmer by area. Upton (1993: 464) defined calving rate as…"the number of calves born per year as a percentage of the number of cows". Due to paucity of data, calving rate calculations in this study was based on the number of cows and calves available at the end of the year (1996). This was considered as an appropriate period because it largely forms part of the calving season. This period coincide with heavy rains resulting in sufficient feed availability. A calf is defined as animals of both genders less than six month of age and cows as any female with at least one parturition. The minimum herd size was 2 in Malongana, Matshena and Dzanani and the maximum number held by a household was as high as 98 in Matshena. With the exception of Matshena, herd size in other surveyed areas is almost similarly spread. For instance, Vyeboom had a minimum and maximum level of 3 and 52 respectively, while in Malongana these statistics are 2 and 55 respectively. Slightly different to this are Dzanani and Tshifudi with a minimum of 2 and 3 and a maximum of 35 and 39 respectively.

The average cattle ownership by a farmer ranges from 13 in Dzanani and Tshifudi to 23 in Vyeboom. Average values, however, are influenced by extreme values, hence the additional use of the other measures of central tendency (median and mode). The median is the middle value of the observed measurements when arranged from the smallest herd to the largest while the mode indicates the observation (Cattle herd) with the largest relative frequency. From Table 2.7 it appears that both the median and mode values on herd size is smaller than the average, with Guyuni being the only exception. In general, farmers in the surveyed areas mostly have a herd of 10 cattle, although this vary from a minimum of 2 or 3 to as high as 98 in limited cases.

Table 2.7. Cattle Number Per Farmer and Calving Percentage

Area	Cattle per farmer					Calving rate (%)			
	Min	Max	Average	Median	Mode	≤50	51-70	71-90	100
Vyeboom	3	52	23	15	12	64	12	6	18
Malongana	2	55	19	14	-	60	-	10	30
Guyuni	3	42	15	15.5	16	63	14	9	14
Matshena	2	98	16	11.5	13	50	-	5	45
Dzanani	2	35	13	11	6	35	15	10	40
Tshifudi	3	39	13	10	12	76	6	-	18
Total	2	98	17	13	10	58	8	7	28

Table 2.7 shows that at least 28% of the sampled farmers maintain a calving percentage of 100%, whereas the majority (58%) have a calving percentage that is below 50%. Although causality between the low calving percentage and the factors leading to it have not been tested in this survey, it is known that it is caused by factors such as mating rates, poor nutritional status and/or poor health (Herman *et al.*, 1989). More specifically, the incidence of diseases can in many cases quite substantially reduce the general productivity of animals at a loss to the society. Some of the factors can be directly influenced or controlled by farmers in order to avoid high calf and adult cattle mortality and, hence, increase the biological productivity of the herd.

However, factors such as drought are beyond the control of the farmer and one can at best try to limit the effects if the means to implement alternatives are available and affordable. Since biological productivity is usually linked to the number of mature females in the herd, an improvement in the calving rate could be tantamount to an improvement in the return on the investment in cattle. Tick-borne diseases result in death of breeding stock, infertility or abortion, thus effectively destroying the capital stock of the production base.

Against this background and given the large proportion of farmers in Venda who experience a low calving percentage it should be clear that a need exists to improve the biological productivity of the regions' herds. Naturally this would call for sustainable production practices in the broader economic and environmental context of the region.

2.5 Integrated Crop-Livestock System

Crop production and cattle rearing are the dominant economic activities of the area surveyed. The majority of the sampled farmers (86%) practice crop farming largely under dryland conditions. Maize is the main crop, being intercropped with groundnuts, millet, watermelons, *etc*. Ploughing is by far the most common operation for which draught animals are employed in integrated farming. This survey did not collect data that would allow a quantitative relationship to be established between animal traction, area cultivated and total production. Research done in countries like Togo, Sierra Leone, Burkina Faso, Ghana, Zambia and Mali, however, revealed a positive relationship between area cultivated and the utilisation of animal power and overall quantities of crops being produced (Rocha *et al.*, 1991).

The integration of crop and livestock farming promotes the division of labour within a household by age and gender in the interest of optimal resource utilisation. For example, clearing the land for crop production, and then ploughing it with cattle, is work mainly done by men. Women have the responsibility for planting and weeding. Grazing cattle are often supervised by children, although this activity may conflict with school attendance.

During work peaks (such as harvesting time) however, all the available family members work in the fields. The areas of interaction in the livestock-crop system are both complementary and competitive. The following sub-section deals with the areas of interaction.

2.5.1 A Competitive Relationship in Livestock-Crop Integrated Farming

Fertile grazing land competes with the cropping land especially during summer. Farmers devote their land to production in accordance to food needs and economic benefits. Labour requirements for both enterprises differ with respect to different seasons of the year to the extent that, depending on the season, the relationship might be complementary or competitive. As the level of farm activities increase during summer time, the demand for labour also increases. The two enterprises compete for the labour input and for funds available for the purchase of inputs. Labour for herding is employed by 11% of the sampled farmers, but these labourers also work in the crop enterprise. The integration of livestock with crop farming require practices that optimise on human resource utilisation. The nature of livestock production further intensifies competition since it is a long-term investment in contrast to annual/seasonal crops. This competition is very evident during summer time when the increase in tick availability coincides with the cropping season and this exacerbates competition for the purchase of both enterprises inputs.

Competitive relationships between the two enterprises also manifest itself with regard to government policies. Historically government policies have been biased towards crop production to solve food shortages. For example, although the qualification of animal health and crop extension officers are identical; more extension work has been devoted towards crop production. This became evident when respondents were asked whether they normally have animal health based outreach programmes such as farmers days? The response of some of the sampled farmers was yes, referring to crop based outreach programmes. Moreover, some of the respondents expressed that such ventures are rarely done for the livestock sector.

2.5.2 Complementary Contributions of Crops and Livestock to the Welfare of Farmers

In the past when a food shortage problem was addressed it used to automatically refer to food crops. However, crops and livestock complement each other in providing a balanced diet. The other area of complementarity is with regard to employment. Both crops and livestock provide employment at the household level and at times hired labour is used. The use of hired labour is justified in viable enterprises only (Mgheni *et al.*, 1992). Generally income from crops is seasonal while those from livestock are more evenly distributed throughout the year. Crop seasonality creates the existence of a lag between the decision to produce and the decision to sell the surplus produced. Farmers usually prefer a regular source of income that will support them when the need arises. More importantly the existence of the lag, however, depends on the stages of farming development. For instance, its only when one has a well established herd that one can even out the income stream. The most important advantage of introducing livestock into crop farming enterprises and *vice versa* is the reduction of risk through diversification.

Certain outputs from both livestock and crop enterprises serve as inputs for each other. Some of the respondents (58%) use kraal manure to enrich and improve soil productivity on the general assumption that this lead to increased production. Crop residues are fed to the cattle of 73% of the sampled farmers. These residues otherwise have had to be removed by using human labour. It can equally be argued that crop residues provide feed for livestock especially in dry season. Either livestock or crop products can be sold to raise income for the purchase of inputs e.g. acaricides and fertilisers.

The determination of the economic value a rational farmer would place on the home produced inputs under a crop-livestock integrated system is not different from determining the cash value of subsistence consumables. In all cases the appropriate value of subsistence input is the cash cost of purchasing its replacement i.e. the cash cost of purchasing fertiliser to replace manure.

2.6 The Value of Livestock to the Sampled Household Farmers in Venda: A Comparison.

Table 2.8 shows a summary of the results of the value of cattle to the sampled cattle farmers in Venda. These results are compared with similar results of the studies done by Townsend and Sigwele (1997) in the Ngamiland region of Botswana and Scoones (1992) in southern region of Zimbabwe. The results of these studies are presented in Table 2.9 and 2.10. The comparison is done to establish or identify the most important value of cattle, as well as determining the differences that exist amongst the regions thereof. Comparison is done in percentages terms and not in monetary values. This is because of differences in currencies (Rand, Pula and Zimbabwean Dollars) amongst the countries.

There are variations in cattle values amongst Venda regions. For instance, in Vyeboom milk contributes at least 32% of the total value (R3157.00). The percentage contribution of milk value to the total milk value of the survey areas ranges from 32% in Vyeboom to 6% in Tshifudi. In addition, there is no any single cattle value that dominates all the cattle values across all the regions. For instance, in Vyeboom milk contribute the highest percentage (75%) of the total average cattle value (R1367.00) in that region. Whereas in Dzanani sales contribute the highest percentage (55%) of the total average cattle value (R573).

Table 2.8: The Value of Cattle to a Rural Household in the Sampled Areas of Venda (R/animal)

Area	Milk	Sales	Manure	Work of cattle	Total value per animal
Vyeboom	1022	335	10	-	1367
Malongana	793	446	12	-	1251
Guyuni	365	376	15	182	938
Matshena	532	374	14	-	920
Dzanani	240	316	17	-	573
Tshifudi	205	273	17	336	831
Total	3157	2120	85	518	5880
Average	526	353	14	259	1152
	Comparison within and amongst regions (%)				
Vyeboom	32 (75)	16 (25)	13 (1)	-	23 (100)
Malongana	25 (63)	21 (36)	15 (1)	-	21 (100)
Guyuni	12 (39)	18 (40)	19 (2)	35 (19)	16 (100)
Matshena	17 (58)	18 (41)	18 (2)	-	16 (100)
Dzanani	8 (42)	15 (55)	21 (3)	-	10 (100)
Tshifudi	6 (25)	13 (33)	18 (2)	65 (41)	14 (100)
Total	100(54)	100(36)	100(1)	100 (9)	100 (100)
% contribution	46	31	1	23	100

Note: Figures in parenthesis deal with a comparison within a region and those outside deal with comparison amongst regions. All figures are in percentages.

Table 2.9: The Value of Cattle to a Rural Household in Ngamiland, Botswana (P/animal)

	Milk	Sales	Manure	Work of Cattle	Total Value per Animal
Total	2922	513	5	10 430	13 869
Average	244	43	-	869	1156
% contribution	21	4	-	75	100

Source: Townsend and Sigwele (1998)

Table 2.10: The Value of Cattle to a Rural Household in Zimbabwe (Z$) (1987)

	Milk	Sales	Manure	Work of cattle	Total value per animal/year
Average	187	15	26	593	821
% contribution	23	2	3	72	100

Source: Scoones (1992)

Of the total average value of an animal (R1152) in Venda, milk contribute the greatest percentage (46%) followed by sales (31%), work of cattle (23%) and finally manure (1%). However, the results of the study done in Botswana (Ngamiland) and Zimbabwe almost show the same order pattern of cattle values, but there exist a slight difference amongst all the countries. Of the total average value of cattle in Botswana work of cattle contributes the highest percentage (75%) followed by milk (21%), sales (4%) and lastly manure (0%). In Zimbabwe work of cattle also contributes the highest percentage (72%) followed by milk (23%), manure (3%) and lastly sales (2%). This comparative analysis seems to show milk as the most common important cattle value in all the countries under review. Differences that exist in cattle values within various regions in Venda, as well as amongst different countries probably depends upon how respondents value their cattle or cattle product. This valuation is influenced largely by the market forces.

2.7 Conclusion

This chapter attempted to determine the value of cattle in the surveyed areas in Venda using several criteria. The rationale for undertaking this analysis was to show the importance of cattle and the impact which mortalities could have to the surveyed rural household. A quantitative valuation of cattle is done because it forms the basis for cost-benefit analysis. In addition, it assists both farmers and the government in assessing the extent of the impact that cattle mortalities have to the rural household. The criteria used for valuation are the sales value, milk, manure and ploughing which were quantified using the replacement value method. Table 2.8 shows a summary of the results by area. More importantly, the values expressed should be viewed as an opportunity cost of the cattle.

Benefits derived from integrated crop-livestock farming are not quantified due to paucity of data and as a result are not included in the summary Table 2.8. In the past many policy proclamations have decreed the low productivity of the livestock system in small-scale farming areas. This was because the productivity of the system was being measured according to a single criterion – the sales value. The average total value is R1 152 per animal and this value represents the value of an adult cow. Depending on the age, sex and the condition of an animal, *etc.*, this value can be low or high.

CHAPTER 3

THE EMERGENCE AND SPREAD OF TICK-BORNE DISEASES AND THEIR CONTROL IN SOUTH AFRICA

3.1 Introduction

Ticks and tick-borne diseases constitute one of the principal threats to the livestock industry in Africa. The most serious tick-borne disease problems of the 19th century were the spread of heartwater disease through the coastal areas of the Eastern Cape Province due to the spread of the tick vector, *Amblyomma Hebraeum* (Norval, 1994). The literature suggests that tick-borne diseases were not a major problem in the indigenous cattle breeds prior to the introduction of the exotic breeds. Due to heavy stock losses in the face of the rinderpest disease, exotic breeds were introduced in an attempt to re-establish the herd.

This chapter examines the occurrence and spread of tick-borne diseases in South Africa from a historical perspective. It then focuses on the epidemiology of tick-borne diseases. This is followed by a review of past options for tick control, which then form the basis for future tick control strategies.

3.2 Historical Occurrence and Spread of Tick-borne Diseases in South Africa

3.2.1 Heartwater

Addressing parasitologists in a meeting held at Onderstepoort on the 15th January 1975, Theiler (1975: 303) indicated that ticks have been with us since the beginning of time. Tick-borne diseases of major economic importance that affect cattle are heartwater, redwater and gallsickness. Heartwater is generally the most prevalent and the first to be established tick-borne disease of cattle in Africa (Lawrence *et al.*, 1994). According to Neitz (1968, cited in Provost and Bezuidenhout, 1987:165), the first record of what probably could have been heartwater was made in South Africa by the Voortrekker pioneer, Louis Trichardt in 1838. He mentioned a fatal disease "nintas" following on a massive tick infestation amongst his sheep.

In 1888, a disease that was apparently known as heartwater was reported to the Cattle and Sheep Disease Commission in Grahamstown by a farmer, John Webb. He was of the opinion that the disease was introduced into the Eastern Cape from a cow that was imported from Zululand in approximately 1837. Subsequently, the disease was reported from various parts of South Africa. This confusion makes the information regarding the incidence of heartwater unreliable.

Gray and Robertson first described heartwater in 1902 following its introduction into Zimbabwe and it was named Rhodesian redwater. It was introduced into Zimbabwe by cattle that were imported from Kenya and Tanzania during 1901 to 1903 for the purpose of restocking the region after the ravages of the rinderpest epidemic of 1896. Except in Zimbabwe, the disease was later called African Coast fever. The causal organism was named *Theileria parva parva* to distinguish it from other members of the *parva* complex that causes diseases.

The disease spread southward along the East Coast of southern Africa through Mozambique, Swaziland, Natal, Transkei and the Cape Province. Between the period 1901-1914, the disease was estimated to have killed one and a quarter million of the four million cattle that were present in the affected territories. In South Africa, losses attributable to ticks and tick-borne diseases have been estimated to be between 70 and 200 million rand annually. On a worldwide basis, losses estimated to amount to hundred of millions dollars (Bigalke, 1980 cited in Soll, 1989).

However, there seem to be no definite answer as to whether heartwater is an indigenous disease of Africa. In their overview of the history of tick-borne diseases, Lawrence *et al.* (1994) seem to suggest that heartwater is a disease indigenous to Africa. No conclusive evidence is, however, put forward in their study to support this suggested conclusion.

The southward advance was halted in the East London region, and the disease was subsequently eradicated by a prolonged campaign consisting of movement control, tick control, quarantine procedures, destocking of infected pastures, slaughter and dipping in arsenic solutions. The disease was eradicated in South Africa by 1954. Such a breakthrough with regard to the control can be attributed to a blood vaccine that was developed at Onderstepoort Veterinary Institute in 1945 after several unsuccessful attempts of proper vaccine development by an eminent microbiologist Robert Koch and Sir Arnold Theiler.

3.2.2 Redwater

Henning (1949) argues that redwater has been known to exist in some parts of the southern states of North America for a very long time. The first record of the disease dates back to 1796 when an outbreak of Texas fever occurred amongst the local cattle breeds in the state of Pennsylvania soon after the introduction of a herd of cattle from South Carolina. The disease was first noticed in South Africa in 1870 along the Natal Coast. In South Africa redwater is transmitted by *Boophilus decoloratus* (the blue tick). The manner in which the infection was introduced into South Africa has not yet been definitely cleared up (Henning, 1949: 372). Three probable sources of infection have been suggested:

- Since the first outbreak of redwater occurred shortly after the importation of a number of cattle from Madagascar, the introduction of the infection into Natal has been ascribed to these cattle.
- While investigating Texas fever (redwater) in east Africa in 1897, Koch obtained information indicating that the disease had been existing enzootically for a long time on the island of Mafia and along the East Coast of Africa. The possibility that the infection extended southwards from east Africa until it finally reaches Natal cannot be excluded.
- The possibility exists that cattle that were imported introduced the infection from Australia or America.

Soon after the disease was first identified it became established along the coastal regions of Natal from where it was carried inland by means of transport oxen returning from the coast.

From Natal, redwater spread both into Transvaal and the Cape Colony reaching both provinces at about the same time: 1873 is the date given by Henning (1949). Due to the non-existence of any restrictions imposed on the movements of cattle in the Transvaal, the greater part of South Africa became infected within a short time and the locally bred cattle acquired immunity against the infection. By 1883 the disease had established itself in almost all the provinces.

3.2.3 Gallsickness (Anaplasmosis)

Finally, the other tick-borne disease of great importance is gallsickness (anaplasmosis). It is believed that gallsickness may have existed in South Africa possibly before the appearance of redwater, but it was commonly confused with redwater (Henning, 1949). What is probably the first description of gallsickness in South Africa was given by Hutcheon as "Jaundice or Biliary fever" in his annual report for 1897[1]. According to the report the disease was first observed by Spreull in the Barkly East district, where it appeared amongst several cattle inoculated with defibrinated blood obtained from bovines immune of rinderpest. An outbreak of a similar disease was also reported in Robben Island, which again occurred amongst cattle inoculated against rinderpest. In 1898 a similar disease was reported amongst cattle inoculated against rinderpest in Kimberly. Gallsickness is caused by an endoglobular parasite, *Anaplasma marginale* belonging to the protozoa.

3.3 Epidemiology of Tick-borne Diseases of Cattle

The epidemiology of tick-borne diseases of cattle has been studied intensively and is well documented in the literature (see for example Coetzer *et al.* (1994) and Lawrence, 1996). Although each disease has its own special characteristics, they share many features, which makes it possible to discuss their epidemiology in general terms.

The presence of tick-borne diseases exists in one of two epidemiological states, endemic or epidemic (Bezuidenhout *et al.*, 1994; Lawrence, 1996). An endemic state is one in which the disease is constantly present at a predictable level that causes only a minimal effect to cattle production. Where hosts, haemoparasite and vector coexist in a stable environment with a virtual absence of clinical disease, the state is regarded as one of endemic stability.

[1] Hutcheon was one of the veterinarians in South Africa located in the Cape Province. He was also one of the veterinarians in South Africa who were successful in eradicating the tick that caused East Coast fever through regular dipping.

Where clinical disease occurs in an endemic situation, the epidemiological state is regarded as endemically unstable. In contrast, an epidemic state is one in which the disease occurs at a rate above the expected level, particularly where the disease has not been present previously. It occurs where infection is introduced into a previously disease-free area with a fully susceptible cattle population (Lawrence *et al.*, 1994).

The epidemiological status of disease depends mainly on the status of the ticks and of the cattle that they feed on. Both factors are dynamic. Changes in climate, vegetation, as influenced by changes in land use and climate, and in methods of tick control have major effects on the abundance of the tick population in an area (Lawrence, 1996: 179). In addition, Bezuidenhout *et al.* (1994) argue that the transmission of tick-borne diseases does not solely depend on tick vector competence, but also on their distribution and the adaptations of domestic stock, their activity and abundance being influenced by temperature and humidity. On the other hand changes in cattle production systems resulting mainly from movements of human population, economic factors and diseases have major effects on the abundance and breeds of cattle in an area. For these reasons, the epidemiological status of an area may change rapidly, from disease free to epidemics or from endemic stability to instability, and vice versa (Lawrence, 1996).

It is believed that Africa was generally endemically stable for tick-borne diseases among cattle until European colonists began to introduce European breeds to the local cattle herds in 1901/02. The resistance of local breeds e.g. Nguni was probably due to an inherited resistance acquired through years of natural selection. This resistance does not prevent the establishment of infection, but reduces the severity of clinical diseases (Vos and Potgieter, 1994). Lawrence (1994) attributes the indigenous breeds' resistance to ticks and a tolerance for tick-borne diseases to genetic factors that they evolved.
European colonists introduced their own breed of cattle that were perceived to be much more productive than the indigenous breeds of Africa. With no resistance to ticks or a tolerance for tick-borne diseases and no previous exposure to develop immunity, these cattle were highly susceptible to tick-borne diseases and their introduction led to epidemics of all the tick-borne diseases. The colonists introduced the use of acaricides in an attempt to control the tick vectors. The use of acaricides has become increasingly

less efficient for a variety of reasons (Lawrence, 1996). As a result tick-borne diseases has assumed a more important role as a limiting factor in the improvement of animal production in Africa.

3.4 Previous Control Strategies for Ticks and Tick-borne Diseases.

Various governments and individuals widely adopted a practical and economical approach of controlling tick-borne diseases through tick control. Although vaccination or immunization forms part of the control strategies, the two are beyond the scope of this discussion since they appear to be too specific for a particular tick-borne disease, hence, making it impossible to discuss them in general terms. Some of the strategies discussed here are no longer practiced today particularly in the communal farming areas where communal grazing is the custom.

The emergence of East Coast fever left South Africa with only two control options, namely: to control or not to control. However, perhaps for economic reasons South Africa opted for the former that largely depended upon dipping. As a result in 1901 the first diptank was constructed in South Africa. The first acaricides of importance in Africa was arsenious oxide that was in wide use from the early part of the century until the 1960s and 1970s. Since then a succession of acaricides (e.g. organophosphates, carbamates, amidines and synthetic pyrethroids) has been marketed (Norval *et al.*, 1992). Animals were dipped at three, five or seven day intervals in the first half of the century to control East Coast fever (de Vos and Potgieter, 1994). However, short interval dipping failed to eradicate the infection. In affected areas all cattle which died had a spleen smear prepared and the smears were sent to an examination centre.

In addition, cattle on the infected farms and also on the first and second contact farms were kept in quarantine for at least 18 month and acaricides application carried out on a 5-5-4 day basis in an effort to destroy infected ticks. The essence of this strategy was to control all stages of tick development throughout the year, a strategy known as intensive tick control. This practice spread rapidly throughout Africa following the introduction of exotic breeds (Pegram *et al.*, 1993).

According to Young *et al.* (1988) such a policy succeeded in reducing the number of outbreaks, but failed to eradicate East Coast fever. From 1948 onwards all cattle on infected farms were slaughtered and the farms were kept clear of cattle for 15 to 18 months, a practice known as destocking. Stocks, such as sheep and goats not susceptible to East Coast fever were introduced to clean the *T. Parva* infection from ticks. All fences on the infected farms were officially inspected and maintained. This method was used effectively in southern Africa (Lawrence *et al.*, 1994). However, this technique fell into disuse as the cattle population grew and vacant clean pastures became more difficult to locate. Closely related to destocking is isolation. Susceptible cattle are maintained as a closed herd on properly fenced pastures. In situations where fencing is not practicable, zero grazing can be practised. Isolation as a technique is too prone to breakdown to be relied upon as a sole method of tick control. Therefore, it is closely applied in conjunction with acaricides.

In many areas of Africa the co-existence of wildlife with cattle compounds the problems of control and it maintains tick-borne diseases and their tick vector. No control measure other than slaughter can be implemented for these populations (Young *et al.*, 1988). The slaughter policy is impracticable and probably undesirable, therefore many areas of Africa will have to continue living with ticks and tick-borne diseases. Without any doubt complete ticks and tick-borne diseases eradication is prohibitively expensive and probably impossible. Current thought dictates that an integrated control strategy has to be found which will allow cattle to live in reasonable harmony with tick-borne diseases. This implies the control of ticks in such a way that natural infection of livestock at an early age is possible, while there is also subsequent regular exposure to ticks so that high levels of immunity is maintained.

3.5 Conclusion

This chapter attempted to examine the occurrence and spread of tick-borne diseases and their control in South Africa. The first tick-borne disease of economic importance to be established in southern Africa is heartwater. It invaded South Africa from Zimbabwe moving along the coastal regions. Various ticks and tick-borne diseases control measures have been applied. Short interval cattle dipping in acaricides proved to be the most successful tick control measure. The efficacy of such acaricides manifested themselves by eradicating East Coast fever in 1954 in South Africa. Despite this success, cattle dipping continued to be applied to reduce the outbreak of other major tick-borne diseases such as gallsickness and redwater.

However, it is believed that short interval dipping cannot be economically justified, particularly in the case of the indigenous African breeds. In endemic areas cattle lose their immunity to all tick-borne diseases because of the lack of natural challenge. It is on this account that experts are in favour of a strategic tick control strategy. It should be acknowledged that control strategies and the intensity of application vary greatly among different countries and geographic regions due to variations in ecological conditions. Therefore, it is not possible to advocate a single control strategy.

CHAPTER 4

TICKS AND TICK-BORNE DISEASES CONTROL STRATEGIES.

4.1 Introduction

Ticks are among the most important parasitic vectors of cattle diseases in South Africa and through their blood sucking activity, they also have a devastating effect on their hosts, unless measures are applied to reduce their numbers (Howell *et al.*, 1981). Veterinarians and farmers believe that the control of ticks is of importance in maintaining the health and productivity of cattle. Hence a variety of control measures, conventional and traditional are currently employed to control tick numbers. Chemicals form an important part of most of the currently used tick control measures, of which the classical plunge dip system is the most widely used.

The use of this system is not a function of personal choice, but it is compulsory by law. The plunge dip system also forms part of a comprehensive strategy of disease surveillance. In the Venda region, disease surveillance is a public good primarily monitored by the animal health extension officer and the state veterinarian. The duties of the animal health extension officer are to inspect, count, dip, educate and immunize cattle against notifiable diseases like brucellosis and anthrax. The state veterinarian performs disease diagnosis and control, and provide clinical services and do the regulatory work.

The objective of this chapter is to describe various ticks and tick-borne diseases control measures employed by small-scale farmers surveyed under the communal grazing system. By necessity cattle dipping in acaricides remains the prime method for controlling ticks in South Africa. Other tick control measures have largely been left to the skills of the stock farmers who mostly apply them in the traditional manner. Lacking the basic scientific knowledge of either the parasites or the remedies involved, and since the degree of tick control obtained was generally satisfactory the tradition is still in operation.

4.2 The Classical Ticks and Tick-borne Diseases Control Strategy in Venda

Control measures against ticks and tick-borne diseases were applied on a large scale in Southern Africa following the spread of East Coast fever from East Africa (Norval, 1994). Prior to that, tick-borne diseases had not been reported as problematic in indigenous African breeds. *As a result of a 95 percent mortality rate caused by East Coast fever during the period 1901-02 in southern Africa, a considerable effort was therefore devoted to the development of control measures.*

Early attempts at vaccination by Robert Koch and later by sir Arnold Theiler were largely unsuccessful. However, the knowledge about the tick responsible for the disease transmission (brown ear tick) led to more successful control measures which were based on tick control, quarantine procedures, pasture spelling, slaughter and dipping in arsenic solutions. Dipping proved to be the most practical and effective measure, which then became a compulsory mainstay of tick control. This occurred after East Coast fever was brought under control and its complete eradication in 1960.

After the eradication of East Coast fever two options were essentially open to southern African countries; they could either control the remaining major tick-borne diseases (babesiosis, anaplasmosis and heartwater) by vaccination and move towards reduced tick control and endemic stability, or they could continue to control the diseases by intensive dipping. It was established that the most efficient and economical manner for tick control was to target treatment at the parasitic stage, and short interval dipping of livestock became the standard method of tick control. This method promotes endemic stability so that infection is universal but there are no losses.

In South Africa compulsory dipping was abolished and the choice was left to individual farmers (Norval, 1994). However, in some of the autonomous South African homelands compulsory dipping carried out by government on communal grazing continued to be enforced through legislation. Although indirectly stated this was also the case in Venda as was stipulated in the Venda government gazette which state that, "By law a stockowner is now compelled to produce his cattle for inspection and tally recording by a stock inspector at the stock inspection point (diptanks) at least every 14 days" (Republic of

Venda, 1984: 2), and this practice is still in operation today. Cattle are brought to the diptank for the aforementioned two purposes to be immersed at the expense of acaricides. According to Lawrence (1996), there is no justification in insisting that every animal be produced every week and immersed at considerable expense in a tank for other disease control purposes. Compulsory dipping may at one time have been thought to be leading towards eventual tick eradication, which would have provided a possible case for public funding, but today the perception is gaining that eradication is an unlikely prospect.

Presently there are 127 diptanks in Venda of which some were initially erected in the mid 1920s (Neluvhalani, 1997). Cattle are either dipped on a weekly or fortnightly cycle depending on the tick challenge of a particular area, although Bachmann (1992) argues that less than 10% of the cattle in Africa are dipped with any regularity. There is a large variety of acaricides to choose from, each having its own application and management system (Dipping Policy Survey, 1997). The commonly used acaricides are Grenade, Triatix and Clout (pour-on). Pour-on is used in cases where there is a shortage of dipping water with a heavy tick infestation and when cattle are not in a good enough condition capable of swimming. Unlike Grenade and Triatix provided by the government, Hoechst as part of the Reconstruction and Development Programme package donated Clout. It is a worrying fact that cases of resistance by ticks to the available acaricides is on the increase. The increase of tick resistance to acaricides and the rapidly rising costs of running dipping services lead to doubts as to whether the Northern Province will be able to sustain effective tick control.

4.3 Purpose of the Dipping Venues (diptanks)

The assessment of any programme is done against its intended objectives or purpose. Unless the programme has achieved its primary objectives, it is hard to defend its continuation.

The main reason for the construction of diptanks was because of the outbreak of East Coast fever whose control was dependent on the control of the tick vector, as previously discussed. Once East Coast fever was brought under control, it was apparent that dipping was beneficial to the farmer, as well as to the veterinary services. The gathering of animals at dipping venues offers opportunities to veterinary services to perform the following important functions:

- Diseases surveillance
  - The physical concentration of cattle at diptanks is used by the state to perform compulsory cattle inspection. This inspection is in respect of controlled diseases such as Foot-and-mouth disease. Surveillance of Foot-and-mouth disease is a function of international, national, provincial and local importance based on compulsory inspection at various intervals and movement control (through quarantines) of various intensities in the whole of the Foot-and-mouth disease controlled area. However, the danger associated with communal diptanks is that they can act as centres for disease transmission.
  - The surveillance of the status of animals with respect to condition, general health, production and reproduction, as well as monitoring of mortalities is also made possible by the communal cattle dipping system. Finally, it is hardly possible to perform diagnostic testing in respect of controlled diseases such as brucellosis in the absence of the communal cattle dipping set up.

- Extension
  - Dipping at communal diptanks is also seen as an opportunity for effective extension, education, training, practical demonstration and the collection of census data. Similarly, dipping attendance, *inter alia*, is an important forum for interface between cattle owners and government veterinary officials where cattle statistics are collected and movements permits authorised, *etc*. Under this system the farmer is obliged to explain the whereabouts of absent cattle. The costs of performing extension as effectively without this opportunity would be enormous, rendering extension unaffordable and unachievable.

Finally, dipping venues also offer some unintended services. It was observed that nowadays it also serves as a slaughterhouse for private buyers. Private buyers e.g. butchers use diptanks as a place where they can get animals for slaughtering, negotiate terms of trade and conclude the transaction only if the buyer and the seller satisfactorily agree on the price. However, the cattle owner priorities and the objectives of keeping the cattle, play a significant role on the decision to sell. It can be argued that dipping venues provide place utility to buyers and sellers. Thus, the advantage of reducing the transaction costs to both buyers and sellers (farmers). Fortunately, because of lack of formal reliable market both farmers and private buyers sometimes find themselves in a coincidence of needs situation.

4.4 Limitations of the Existing Ticks and Tick-Borne Diseases Control Measures

Tick-borne diseases can be effectively controlled by the control of the vector ticks with acaricides. The widespread application of acaricides does, however, have certain limitations. The classical method of controlling ticks on cattle is by dipping in acaricides. Cattle are passed through the plunge dip where complete immersion of cattle is attained to kill the attached ticks. This method has certain flaws and limitations[2]. Eleven percent (14) of the 125 sampled farmers expressed some dissatisfaction with the classical control method and with the majority of these (8%) being Dzanani cattle owners. The development of tick resistance to successive acaricides compounds is a major problem stated by 79% of the dissatisfied cattle owners. This problem ranges from 9% of the dissatisfied respondent in Vyeboom to 91% in Dzanani as shown in Table 4.1. The problem of tick resistance can be attributed to incorrect use of acaricides (Dipping Policy Survey, 1997). However, the exact extent of acaricides resistance is not yet known (Oberem and Schroder, 1994).

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[2] The problem of the classical tick control method forms part of a complex problem limiting cattle production in Venda. See figure 1 (Appendix 1) for a diagrammatical outlay of the problems confronting respondents.

Table 4.1: **Limitations Associated with the Classical Tick Control Measure as identified by the Sampled Farmers**

	Tick resistance	Lack of dipping water supply	Incorrect use of acaricides	Total number of respondents
		%		
Vyeboom	9	-	-	1
Malongana	-	-	-	-
Guyuni	-	-	-	-
Matshena	-	-	100	1
Dzanani	91	-	-	10
Tshifudi	-	100	-	2
Total number of respondents	11	2	1	14
Percentages	79	14	7	100

Note: Values are calculated as a percentage of the total number of dissatisfied farmers and not the total number of the respondents (125)

As resistance to one compound builds up new acaricides are developed, but its effectiveness does not last and it must eventually be replaced by newer and different compounds. Thus, the use of acaricides demands continuous checks on the development of acaricides. The resistance problem has been exacerbated by the increasing costs of acaricides and poor management by the farmers. The increasing costs of acaricides coincide with year-on-year cuts in the veterinary budget.

Other considerations which have rendered acaricides application a less reliable method include shortages of water for public dips and incorrect use of acaricides. Respectively, an insignificant number of the dissatisfied cattle owners 14% and 7% expressed lack of dipping water supply and wrong use of acaricides as some of the major problems experienced. Lack of water renders diptanks non-operational especially during drought years. For instance, the devastating drought of 1983 made all the diptanks in Venda non-operational. Furthermore, this method is not applicable during drought times because of the weak condition of cattle. Another complication associated with the use of acaricides is that they are environmental pollutants and contaminate meat and milk and may endanger human health. This arises from direct contact, spilled or misused acaricides and from the consumption of products derived from treated animals.

Finally the use of communal diptanks put a large demand on human labour for trekking animals to and from diptanks. Losses are also incurred whilst driving animals through diptanks as it creates stress induced abortions, drowning and physical injury (Mukhebi and Perry, 1992). In addition, the constant trekking of animals to and from diptanks often creates gullies and the frequent concentration around the tanks lead to overgrazing both of which cause erosion and environmental degradation. The limitations associated with the current methods of ticks and tick-borne diseases control are prompting a search for new, safer, cheaper, more effective, environmentally friendly and sustainable control.

4.5 Alternative Tick Control Measures Used by the Sampled Farmers

It has been acknowledged that of all the ectoparasites, ticks cause the greatest economical losses in livestock production (Okello-Onen *et al.*, 1992). And as a result tick control is perceived by cattle owners as an important aspect of animal husbandry. In the past tick control largely carried out by the plunge dip used to be viewed as part of the government routine services. However, this view no longer hold to all cattle owners surveyed.

Some of the sampled farmers (61%) supplement dipping with other individual organised tick control methods to control high tick burdens on their cattle as shown by Table 4.2. The term dipping in the sense of tick control applies to all forms of chemical usage on cattle i.e. plunge dipping, handdressing, mechanical spraying and the use of pour-on. For the purpose of this section dipping refers to the use of plunge dip only. Table 4.2 reveals that 49 (39%) of the respondents solely use the plunge dip as a tick control measure. The plunge dip is good and is the cheapest method as far as communal dips are concerned (Wamukoya, 1992). The majority of sole plunge dip users (78%) are situated within the Yellow Line area. Table 4.2 also shows that as one moves from the Yellow Line to the Open area the number of sole plunge dip users decreases. Three possible explanations can be advanced for this. Firstly, Malongana and Matshena diptanks in particular are remotely located leaving cattle owners with slim opportunities for other income sources to be able to apply other control measures. Secondly, there might be a lower tick challenge within the area. Thirdly, past application of home-made plant preparations had a negative impact on the health of livestock (plant poisoning effects) to the extent that cattle losses were even experienced.

Dipping is supplemented with one or more combinations of other tick control strategies. Such strategies involve the use of engine-oil, handpicking, handdressing, *etc.* The frequency of the type of treatment highly preferred is handdressing followed by engine-oil both with a frequency of thirty seven and twenty two respectively as shown in Table 4.2. Because of the respondents low socio-economic status one could infer that the frequency of the type of treatment most preferred is a function of its cheapness i.e. the higher the frequency of the type of treatment the lower the cost of treatment of that particular tick control method. The frequency of the type of treatment, handdressing, is almost similar amongst regions compared to engine-oil. In addition, there are also variations within a region with regard to the frequency of the type of treatment. In Vyeboom, for example, engine-oil is preferred to other tick control strategies.

Table 4.2: Number of Respondents and the Frequency of the Type of Treatment

		Number of respondents applying dip with:			Type of treatment					
Areas	Sole dip users	One combination	Two combination	Three or more combination	Engine -oil	Handpicking	Biological control	Handspraying	Pour-on	Handdressing
Vyeboom	1	3	13	-	9	-	-	4	1	7
Malongana	14	4	5	-	1	-	-	-	4	4
Guyuni	9	7	7	-	-	-	-	1	8	7
Matshena	14	-	9	-	2	-	-	1	-	7
Dzanani	1	6	11	4	9	7	2	7	6	8
Tshifudi	10	2	5	-	1	-	-	1	1	4
Total	49	22	50	4	22	7	2	14	20	37

Table 4.3: Various Ticks and Tick-Borne Diseases Strategies Used by the Sampled Farmers

	Engine-oil and handdressing	Pour -on	Hand-spraying	Pour-on and Handdressing	Engine-oil, handpicking and Pour-on	Hand-picking	Hand-picking and pour-on	Hand-spraying and pour-on	Engine-oil, hand-picking and handdressing	Engine-oil and handspraying	Handspraying and handdressing
Vyeboom	11	1	2	-	-	-	-	-	-	2	-
Malongana	5	4	-	-	-	-	-	-	-	-	-
Guyuni	2	7	-	4	-	-	-	-	-	-	1
Matshena	8	-	-	-	-	-	-	-	-	-	1
Dzanani	6	-	5	1	2	1	2	1	2	1	-
Tshifudi	5	1	1	-	-	-	-	-	-	-	-
Total	37	13	8	5	2	1	2	1	2	3	2
Percentage	30	10	6	4	2	1	2	1	2	2	2

The majority of respondents (30%) uses engine-oil and handdressing (sometimes with household insecticides e.g. Doom, paraffin, *etc*) to supplement dipping as shown in Table 4.3. This combination is most preferred in Vyeboom, with eleven respondents, followed by Matshena with eight respondents. With the exception of Guyuni, this combination is the most preferred choice of all other control strategies or combination of strategies as indicated in Table 4.3. Handdressing although laborious, is highly recommended and particularly valuable in the control of various ticks species in those body areas vulnerable to tick infestation such as the udder, ear, scrotum and the tail.

Both Table 4.2 and 4.3 show that handpicking is only done in Dzanani. Handpicking saves time and can be carried out at anytime and in conjunction with other husbandry practices such as milking. It is flawed because it is directed at engorging female ticks thereby leaving off the larvae and nymphs which are usually minute in size, but capable of transmitting a good number of tick-borne diseases (Fasanmi and Onyima, 1992). However, its success depends upon light tick infestation. This practice has limited impact on ticks but it still forms part of animal husbandry practices for resource poor farmers.

Other widely used methods of acaricides application involve pour-on and handspraying using various types of small pumps. Handspraying seldom achieve complete wetting and so usually results in poor tick control. It also tends to be very uneconomical since the excess acaricides solution, which drips off animals, is not recovered. Nevertheless, if used sensibly, it offers the small farmer with the means to control excessive tick numbers on the udder and scrotum (Norval *et al.*, 1992). On the other hand, pour-on seem to hold better prospects for tick control since one application along the dorsal line of the animal effectively eliminates ticks (Fasanmi and Onyima, 1992). Pour-on are proving to be popular as shown by a treatment frequency of 20 respondents (see Table 4.2) coupled with at least 10% of the respondents utilising it to supplement dipping (see Table 4.3).

Table 4.4 shows the various reasons advanced by the respondents for the use of several tick control methods, as well as, the number of respondents selecting a certain reason. Most respondents (39%) use various alternative combinations of tick control strategies because of the low cost involved and ease of use. The second most important reason advanced is because of limited knowledge about husbandry practices and options available as indicated by 36 respondents. This problem is most prevalent in the Malongana, Matshena and Guyuni areas with thirteen, ten and eight respondents per region, respectively. This shows some variation in the effectiveness of the extension services between the regions. To some extent, these reasons gives an indication on the type of the livestock technology transfer strategy to be used for increased livestock production. Thus, before any livestock programme is introduced, it is important for any institution to be sure of the farmers' resources since they have an effect on farmers' behaviour.

Table 4.4: Various Reasons for the Utilisation of Various Tick Control Measures

Areas	Cheap and easy to use	Reliable	Communal	Effective in control	Western contacts	Control ticks when I feel like	Limited knowledge and options	Tradition
Vyeboom	13	5	3	7	-	-	1	-
Malongana	7	1	3	2	1	2	13	-
Guyuni	2	-	2	9	1	-	8	-
Matshena	10	6	2	1	-	-	10	-
Dzanani	12	6	2	10	-	1	3	-
Tshifudi	5	2	7	4	-	-	1	5
Total	49	20	19	33	2	3	36	5

Note: Numbers do not add-up because some respondents have more than one reason for the use of a particular tick control strategy.

Farmers claim that traditional methods do effectively kill the ticks on their livestock. A study by Dreyer (1997: 155) on the efficacy of engine oil in some parts of Free State Province revealed a 38% engine oil efficacy that does not compare very well to the efficacy of commercial acaricides of at least 95%. The efficacy of any tick control method depends entirely on its ability to prevent female ticks from feeding and reaching the egg laying stage (Owen, 1985). Norval *et al.* (1992) argues that tick control using acaricides has proved to be a simple and effective veterinary tick control procedure. He further argued that acaricides may cause epidemiological problems and are becoming increasingly costly. The development of alternative approaches, such as the use of tick resistant cattle and the possibility of effective immunisation against tick-borne diseases, has thus given rise to a mounting debate about the future role of acaricides in ticks and tick-borne diseases control in southern Africa.

Judging from the results in Table 4.3 the available options for tick control in Venda indicates that reliance on one method of control would not be particularly effective in alleviating the various tick problems to be discussed below.

4.6 Tick Problems and Reasons for Tick Control

Ticks and the diseases they transmit are present throughout the world, but they are most prevalent and numerous and exert their greatest impact in the tropical and sub-tropical regions (Mukhebi, 1992). They are the major health impediment to the development and improvement of the livestock industry. Tick control according to Norval *et al.* (1992) provide a means of preventing direct tick damage and associated production losses, as well as secondary infestation with screw worm fly larvae, hide damage and tick associated paralysis.

The effects of tick infestation on animals may be direct or indirect (Soll, 1989: 1 and Oberem and Schroder, 1993: 334). The direct effects include:

- Anaemia from blood sucking
- Damage to skins and hides with subsequent quality losses to the leather industry
- Irritation leading to biting, licking and scratching

- Toxins produced in the saliva of ticks, which causes paralysis, bacterial, fungal and other parasitic infections of bite wounds with resultant abscessation, mastitis or loss of teats and udder quarters
- Restlessness which hampers productive grazing due to discomfort

A total of 94% of the sampled farmers viewed ticks and tick-borne diseases as a serious problem in the surveyed areas. Damages afflicted on cattle are serious enough to justify appropriate tick control. To the animal producer, ticks are destructive blood sucking parasites that are capable of causing spectacular physical damage to the animals on which they live and feed. The majority of the respondents (70%) indicated tick wounds and tick damage (teat loss) as the most common tick problem amongst their livestock. This problem ranges from 53 % in Tshifudi to 83% of the respondents in Malongana and Guyuni as shown in Table 4.5. Young *et al.* (1988) argue that ticks with large mouth parts, such as *Amblyomma* species, are capable of damaging udders and teats of cows to such an extent that they become non-functional. At least 13% of the respondents viewed tick worry, tick wounds and tick damage as the second biggest problem caused by ticks.

Table 4.5: Common Tick Problems Experienced by the Sampled Farmers (n=118)

Tick Problems	Vyeboom	Malongana	Guyuni	Matshena	Dzanani	Tshifudi	Respondents (total)
	(%)						
Tick worry	-	6	-	-	-	6	2
Tick wounds	6	6	-	5	-	18	6
Tick damage	-	6	17	5	-	6	7
Tick wounds and tick damage	82	83	83	76	64	53	87
Tick worry, tick wounds and damage	12	-	-	14	36	18	16
Respondents (total)	17	18	23	21	22	17	118

The occurrence of ticks and their control is a cause for concern (tick worry) to 2% of the sampled farmers. These farmers incidentally represent those farmers with a relatively large herd size of 45 on average. Tick worry refers to a situation where the incidence or number of ticks in the herd is above a certain subjective minimum beyond which they are capable of causing physical damage. As a result the farmer becomes concerned, even though this level is highly subjective. Typically these farmers tend to apply more acaricidal treatment which leads to higher control costs. As indicated in Table 4.6, farmers' positive attitude towards tick control is done predominantly to avoid wounds, diseases and stock losses. This problem ranges from 18% in Tshifudi to 77% in Dzanani.

Table 4.6: Sampled Farmers' Reasons for Tick Control

Reasons	Vyeboom	Malongana	Guyuni	Matshena	Dzanani	Tshifudi	Total
	(%)						
Avoid teat loss and skin damage	-	4	13	4	-	6	6
Avoid diseases and death	35	17	22	44	-	18	28
Avoid wounds and teat losses	-	17	30	4	23	18	20
Avoid wounds, diseases and death	47	56	35	30	77	18	56
Avoid teat losses and diseases	18	4	-	17	-	41	15
Respondents (Total)	17	23	23	23	22	17	125

Disease transmission is the single most important indirect effect of tick infestation, which if untreated can cause heavy mortalities especially among susceptible breeds of cattle. Should the animal survive the effects of the disease, there is still a loss of productivity of milk or meat, *etc.* during the recovery period.

4.7 Cattle Dipping Frequency

The practice of intensive dipping of cattle is still widely practiced throughout the East Coast fever endemic areas. With certain reservations the same can be said for the surveyed areas putting indigenous breed at risk. Due to a high tick challenge, cattle in Vyeboom and Tshifudi are dipped once per week in summer, whereas in the other surveyed areas they are dipped once every two weeks. However, weekly dipping can be extended to once every two weeks in winter. Because of natural immunity, regular dipping of particularly the indigenous breed cattle at even once every two weeks is too costly, inefficient in controlling diseases and ecologically undesirable (Fasanmi and Onyima, 1991).

The frequency of acaricides application depends on the area, the tick challenge, breed of cattle and the level of control required (Norval *et al.*, 1992). Due to communal farming complexities, dipping frequency in the surveyed areas seem to be influenced solely by the level of tick challenge because in the dry season when the tick challenge is low, fortnightly dipping can be adopted in those areas that normally uses weekly dipping. However, it remains essential to monitor cattle carefully during the dry season, since the immature ticks are most active during this period (Oberem and Schroder, 1994). Therefore, under certain circumstances weekly dipping in the dry season can be used subject to a joint agreement between cattle owners and the general assistant animal health officers. Again, acaricides in the surveyed areas have been applied indiscriminately in all breeds of cattle.

Strict acaricides application results in a highly susceptible cattle population, because cattle are not exposed to the parasites; when tick control breaks down due to, for example civil unrest, enormous losses can occur (Latif, 1992). An extreme example was the break down of dipping infrastructure during the pre-independence war (1972-1980) in Zimbabwe where compulsory-dipping policy had been in force since 1914. This resulted in approximately one million cattle deaths from tick-borne diseases (Norval *et al.*, 1984). Literature indicates that Venda has been following a pattern of chronological usage of acaricides similar to that of Zimbabwe and other southern African countries. Thus, creating the same vulnerability to a breakdown in tick control programmes.

Production losses due to tick infestation *per se*, are too small to justify intensive tick acaricides application on economic grounds. This is especially so in the case of indigenous breeds (Mukhebi and Perry, 1992). The dipping frequency can be linked primarily to the farmer's reasons for his/her involvement with farming. Under certain circumstances intensive tick control is not cost effective and is often required only for valuable exotic breeds. Apparently, it is assumed that indigenous livestock requires the same degree of control as exotic stock. The consequence of this is that indigenous resistant cattle have been dipped regularly for the sake of a small proportion of susceptible exotic breeds, leading to the loss of both resistance to ticks and enzootic stability to tick-borne diseases amongst indigenous breeds (Pegram *et al.*, 1993). Thus, in evaluating the need for intensive tick control, the primary issue is not whether tick infestation leads to any losses in productivity, but whether such losses are sufficient to justify the expenditure on tick control.

4.8 Conclusion

This chapter described various ticks and tick-borne diseases control strategies. It seems that successful tick control is possible if the various tick control strategies complement each other. For various reasons, farmers complement cattle dipping in acaricides with other traditional and modern tick control methods such as pour-on. The socio-economic status seems to be an important determinant of the adoption of other optional alternative ticks and tick-borne diseases control measures. The traditional acaricides seem to have a low efficacy rate. In addition, being compulsory by law, dipping in acaricides have been intensively applied, either on weekly or fortnightly basis.

Production losses caused by ticks and tick-borne diseases are probably less important than previously believed and may perhaps not justify intensive tick control programmes. There is also no an economic justification for continuing with short interval dipping among the indigenous African breeds. Therefore, there may be a need to revise ticks and tick-borne diseases control policies if profitable animal production is to keep up with the increasing demand for animal products by a growing population.

The limitation associated with the current control methods of ticks and tick-borne diseases and the opportunities for reliance on intensive acaricides use in the area surveyed calls for a search for a new, safer, cheaper and more sustainable control strategies depending on thorough knowledge of the cattle type, tick ecology and epidemiology.