Smallholder livestock farmers' Knowledge, Attitudes, Practices and Perceptions towards vaccinations: The case of five provinces in South Africa

Submitted to the

International Development Research Centre

by

Human and Social Development Programme

Human Sciences Research Council (HSRC)

&
Economic Analysis unit

Agricultural Research Council (ARC)

2017

This study was commissioned by the ARC's Onderstepoort Veterinary Institute (OVI) under the Project Novel livestock vaccines for viral diseases in Africa towards improved food security (CIFSRF 107848). The project is funded by Canada's International Development Research Centre (IDRC), www.idrc.ca, and the Government of Canada, provided through Global Affairs Canada (GAC), www.international.gc.ca. It was prepared by the Human and Social Development unit at the HSRC, *Pretoria, South Africa, in collaboration with the Economic Analysis Unit of the ARC, Pretoria, South Africa.*

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ACKNOWLEDGEMENTS

We gratefully acknowledge assistance received from the project implementation partners at the Agricultural Research Council and their support in this study. Special thanks also go to the smallholder livestock farmers of KwaZulu-Natal, Eastern Cape, Mpumalanga, North-West and Free State provinces for providing us with valuable information, without whom the completion of this study would not have been possible.

Executive summary

Animal husbandry is one of the most important farming activities in South Africa as it constitutes the primary source of livelihood for a sizeable number of rural farmers across the country. This livelihood source is intermittently threatened by disease outbreaks, which put an enormous challenge on smallholder livestock farmers. Preventative measures, such as animal vaccinations could play a significant role in the curbing of disease outbreaks. To address these challenges, farmers need to develop sufficient knowledge of the disease, adopt appropriate attitudes for preventing the diseases, and direct their perceptions towards practices that optimize livestock production while minimizing the risk of disease outbreaks and other causes of livestock loss. The Agricultural Research Council-Onderstepoort Veterinary Institute (OVI) is developing a 2-in-1 vaccine for the prevention of lumpy skin disease and Rift Valley fever. Both Rift Valley fever and lumpy skin disease are classified as notifiable diseases, which means that every suspected case of either disease must be reported to the nearest state veterinarian. This notification procedure is in place because both diseases can result in dire economic consequences if an outbreak is not prevented. The main aim of this study was to investigate smallholder farmers' knowledge, attitudes, practices and perceptions (KAPP) towards primary animal healthcare, especially the use of animal vaccine for disease prevention. The specific objectives of this study were:

- To identify and analyse farmers knowledge and attitudes towards animal vaccines;
- To determine farmers' knowledge of lumpy skin disease and Rift Valley fever;
- To identify knowledge of other diseases of significance across the covered geographical area;
- To determine farmers needs and preferences with regards to animal vaccines and medicines;
- To analyse how farmers' knowledge, attitudes and practices differ across socio-economic characteristics as well as spatially.

The study was conducted across five provinces in South Africa: Eastern Cape, the Free State, KwaZulu-Natal, Mpumalanga and North-West. This study used a combination of multi-stage sampling and stratified sampling techniques. A structured questionnaire was administered to 593

livestock farmers who were selected across the five provinces. Descriptive statistics were used to present the research findings.

The results of the descriptive statistics show that livestock farming in the study areas was still predominantly in the hands of male farmers. Livestock among rural farmers serves primarily as financial security in times of need. When it comes to knowledge about livestock diseases, farmers have limited knowledge of Rift Valley fever (RVF), irrespective of individual farmers' educational level. In contrast, most farmers know about Lumpy skin disease (LSD) and this disease was cited as the most problematic among those affecting farmers, followed by Black quarter and Heart water. According to our findings, farmers generally spend a sizable amount (R2272.44 on average) of money on animal healthcare and prevention products (i.e. medicines, vaccines and food supplements). Factors such as education level, total household income and number of cattle owned significantly influenced farmers' spending on animal healthcare. Despite the spending on animal healthcare, farmers view vaccines as too expensive. However, an overwhelming majority of farmers are willing to purchase a 2-in-1 vaccine for prevention of Rift Valley fever and lumpy skin disease. In addition, most rural livestock farmers prefer a vaccine which can be used in cattle, sheep and goats and a vaccine which can be used to prevent multiple diseases. Although farmers were able to differentiate between vaccines and medicines, it emerged that they did not know much about vaccines and this is attributed to the lack of training on primary animal healthcare.

In light of these findings, the study identified some weaknesses in the provision of veterinary services in rural areas. Although Animal Health Technicians (AHT) are always visible, very few farmers have received training related to primary animal healthcare. Capacitating rural livestock farmers may help them use and store vaccines effectively and this can improve production which may in turn raise household income. Based on the study, the following recommendations are made, for consideration by various role players in the animal health sector;

- Animal Health Technicians should focus on lumpy skin disease, Black quarter and Heart water over and above focusing on Rift Valley fever as these diseases are perceived to constitute the most severe threat to livestock production in the 5 studied provinces.

- Continuous farmer training on primary animal health care and handling of livestock vaccines and medicines is important. The training approach should be participatory.
- Multiple methods of awareness creation and information dissemination, that include farmer field days, study groups, and social media should be utilised. There could also be local level central points of information established, so that farmers can easily access the information
- Innovative ways to deliver affordable vaccines should be explored. The ARC's 2-in-1 vaccine presents a step in the right direction. There should be closer collaboration between livestock vaccine developers, producers and farmers so that real, not perceived needs of farmers are addressed through innovative products. For example, vaccine information leaflets should be provided in the different vernacular languages.
- There is need for better understanding of the gender specific issues pertinent to livestock production and primary animal health care practices in smallholder agriculture. This will unravel the bottlenecks for smallholder livestock to contribute towards poverty alleviation and food security.
- Local level interventions to improve primary animal health care should be gender sensitive and inclusive. Deliberate efforts to level the playing field and facilitate better inclusion of women farmers in livestock development programmes are necessary.
- Because farmers are not a homogenous group, even in SA there are some differences in KAPP across provinces, there is need for targeted interventions that are driven through bottom up approaches.

LIST OF ABBREVIATIONS AND ACRYNOMS

DAFF: Department of Agriculture, Forestry and Fisheries

ARC: Agricultural Research Council

HSRC: Human Sciences Research Council

LSD: Lumpy Skin Disease

RVF: Rift Valley fever

KAPP: Knowledge, Attitudes, Practices and Perceptions

WTP: Willingness to Pay

OVI: Onderstepoort Veterinary Institute

GDP: Gross Domestic Product

AHT: Animal Health Technician

1. Introduction

1.1 Economic and social role of livestock keeping

Agriculture is the single largest source of income and livelihoods for rural households in the developing world, normally providing more than 50% of household income (Jayne et al., 2003; Otte and Chilonda, 2002). Nearly three quarters of the extremely poor, about 1 billion people worldwide, live in rural areas (World Bank, 2008) and 90% of them are small-scale farmers depending directly on farming as the main part of their livelihoods (Lipton, 2005). Many poor households, especially those in rural areas, are continuously faced with the difficult struggle to make ends meet. Coping with food insecurity and meeting basic household expenses are some of their major daily challenges.

In South Africa, livestock rearing is one of the most important farming activities. It has great significance in the livelihoods of most rural households, and has played a historical role as a major source of agricultural income for generations. The multiple roles of livestock production include food provision, as a store of wealth, use of animal products and through the commercial sale of animals. It is estimated that approximately 240 000 emerging farmers are currently rearing livestock in South Africa. It is therefore not a coincidence that the Integrated Sustainable Rural Development Strategy of 2004 identified livestock farming as one of the strategies to alleviate poverty and improve food security in rural South Africa (Musemwa et al., 2007). Cattle farming in South Africa is estimated to contribute between 25 and 30 % each year to the agricultural gross domestic product (GDP) (Musemwa et al., 2007). According to 2015 data from the South African Department of Agriculture, Forestry and Fisheries (DAFF), the country counts have about 13.84 million herds of cattle, composed of international beef and dairy breeds as well as indigenous breeds. Approximately 40% of the total herd is owned by emerging and rural farmers (DAFF, 2015). Earlier data indicate that the highest concentration of cattle farming is to be found in the Eastern Cape, KwaZulu-Natal, Free State and North-West Provinces (DAFF, 2011).

However, in spite of the benefits that can accrue from engaging in livestock farming, rural livestock farmers face a myriad of challenges that limit their capacity to generate adequate income from their livestock (Sikhweni and Hassan, 2013). The thorniest amongst these challenges is the livestock vulnerability to disease outbreaks. Disease outbreaks cause reduction in the productive capacity of animals and the subsequent reduction in the supply of meat and other animal products (Prichett et al., 2005). The African continent is home to 12 of the 16 most devastating diseases globally and eight of these inflict their ravages predominantly in sub-Saharan Africa (Wallace et al., 2014). One of the most important mechanisms put in place by DAFF to combat these devastating and infectious diseases is through vaccinations, as disease prevention constitutes a vital part of Primary Animal Healthcare (PAHC). Thorough prevention through vaccination is however made difficult by the many challenges livestock farmers face in the sourcing, storage and correct use of animal vaccines. These challenges often result from the low awareness levels of correct vaccine use and the importance of keeping the vaccines refrigerated throughout the vaccine value chain until they are administered. The role of educating smallholders with regards to vaccine use falls within the responsibility and policy domain of the Department of Agriculture, Forestry and Fisheries (DAFF). In South Africa, the state, through DAFF, is also responsible for the provision of veterinary services to livestock farmers. Veterinary services play a key role in ensuring that sanitary requirements for livestock production, health and trade are adequate and that the meat value chain and other animal products are safe for use.

1.2 The scientific innovation of the project

Researchers at the Agricultural Research Council-Onderstepoort Veterinary Institute (OVI) are in the process of developing a 2-in-1 vaccine for the prevention of Rift Valley fever (RVF) and lumpy skin disease (LSD). Both RVF and LSD are classified as notifiable diseases, which means that every suspected case of either disease must be reported to the nearest state veterinarian. This notification procedure has been put in place because both diseases can result in dire economic consequences if an outbreak is not prevented.

Rift Valley fever is a viral zoonotic disease endemic in Africa and it affects domestic ruminants causing high mortality rates in young animals and abortions (Archer et al., 2011) and this results

in substantial economic losses due to restrictions on animal trade (El Many et al., 2011). RVF is transmitted by infected mosquitos. Humans can also contract the disease if they are in direct contact with infected animal tissues, blood and other body fluids. Sporadic outbreaks of RVF have been recorded in South Africa over the past five decades, the last major outbreak having been between 1974 and 1976 and the latest outbreak having been reported between 2008 and 2010 in five South African provinces (Eastern Cape, Mpumalanga, Gauteng, Limpopo, Mpumalanga and North-West). On the other hand, LSD is a pox viral disease of cattle with major socio economic impact. The disease is spread by biting flies and it is more prevalent during wet summer and autumn months when there are more flies. The disease is characterized by fever, multiple firm, circumscribed skin nodules, mastitis, orchitis and swelling of the peripheral lymph nodes. If untreated, LSD may cause major losses, such as abortion among pregnant cows, significant reduction in milk production, pneumonia, infertility, permanent damage to hides (skin), and emaciation (loss of body condition). In addition, LSD can disrupt trade in cattle and their products from LSD endemic countries (Babiuk et al., 2008) and this can lead to significant economic losses due to cross-border trade bans.

1.3 Study Objectives

This technical report presents the survey results of a study addressing a human and social development component of the Agricultural Research Council-Onderstepoort Veterinary Institute New generation Vaccine Study: Livestock Vaccines against Viral Diseases for Developing Farmers in sub-Saharan Africa. The main aim of this study was to investigate smallholder farmers' knowledge, attitudes, practices and perceptions (KAPP) towards primary animal healthcare especially the use of animal vaccines for disease prevention.

The study's specific objectives were:

i. To identify and analyse farmers knowledge and attitudes towards animal vaccines;
ii. To determine farmers' knowledge of LSD and RVF;
iii. To identify other diseases of significance across the five provinces;
iv. To determine farmers needs and preferences with regards to animal vaccines and medicines;

v. To analyse how farmers' knowledge, attitudes and practices differ across socio-economic characteristics as well as spatially.

The KAPP study is part of a series of socioeconomic studies aimed at collecting data and information outlining the environments into which the 2-in-1 vaccine will enter (Table 1). These studies include the policy and regulatory framework, impact studies (cost-benefit analysis), and stakeholder engagement platforms.

Table 1: Components of the socioeconomic studies

Socioeconomic component	Description
Policy and regulatory framework (vaccine value chain analysis)	This desktop study will assist in identifying the enablers and disablers of the 2-in-1vaccine to be developed, manufactured, tested, registered, delivered, scaled up and scaled out. This study will also give an indication of the different role players in the 2-in-1vaccine along the value chain.
Impact Assessment studies: Cost-benefit analysis	Data will assist state decision-makers in realizing the cost-savings of the LSD RVF vaccine to local and national economies through LSD RVF disease prevention; incomes and food security generated through widespread adoption; understanding the national and provincial contexts in terms of cattle and smallholder farmer numbers
KAPP study Willingness To Pay (WTP) study	WTP and KAPP – understanding of the end-users for the vaccine and the possibilities for uptake given prevailing attitudes, practices, perceptions, and knowledge and willingness to pay for and affordability of vaccines
Stakeholder engagements	Focus Group Discussions (FGD's) with groups of stakeholders (both groups of farmers as well as groups of different stakeholders) will assist researchers in assessing the plausibility of the 2-in-1vaccine roll-out, its practical implications and its desirability

1.4 Limitations of the study

The KAPP study was predominantly quantitative in nature. Unlike studies that have to do with laboratory experiments, surveys rely on respondents subjective reports. While this in itself is not a problem as it allows respondents to report on their experiences, such data is sometimes limited on people's ability to recall their experiences.

1.5 Ethical considerations

The study adhered to the ethical standards set out by the Research Ethics Committee of the HSRC, including informed consent and confidentiality, which comprised part of the formal procedure in the form of a verbal briefing, information, and consent forms. To this end, fieldworkers were trained to explain the purpose of the study to potential respondents, obtain informed consent, and inform respondents about their rights and benefits in a factual and neutral way without coercing people to participate. Those who participated did so freely, were fully informed of potential risks and rewards of participation, any limits to confidentiality, and how the information they provided would be used. No minors were allowed to participate in the study.

2 Methodology

2.1 Sampling design

The study focused on smallholder[1] farmers who kept cattle, or any combination of cattle with small stock (sheep and goats). These types of farmers are spread throughout the nine provinces of the country. One of the objectives of the study was to determine the farmer's knowledge of both RVF and LSD; hence, the plan was to select areas with a significant number of smallholder farmers and a reported combination of the two diseases. Based on the 2011census, the Eastern Cape, KwaZulu-Natal, North-West, Mpumalanga and Free State provinces have the largest numbers of farmers owning less than 10 cattle (Stats SA, 2013).

Table 2: Statistics of smallholder livestock farmers in nine provinces of South Africa

Provinces	**Household involved in livestock production**	**Agricultural households owning 1-10 cattle**	**Agricultural households owning 11-100 cattle**
Limpopo	215 333	69 089	21 714

[1] Households owning 100 or less cattle

Mpumalanga	119 150	33 088	10 566
Gauteng	46 235	4 519	2 923
North-West	134 092	35 546	13 756
Free State	53 249	21 952	6 354
KwaZulu-Natal	300 564	136 728	31 014
Northern Cape	34 827	6 355	3 513
Eastern Cape	294 385	172 507	25 909
Western Cape	21 997	2 487	2 187

Source: Stats SA (2013)

In addition, the selected provinces also had the highest number of livestock (cattle, goats and sheep) as indicated in Table 3.

Table 3: Number of cattle, goats and sheep per province

Province	**Cattle**	**Sheep**	**Goats**
Western cape	692 495	2 282 396	182 669
Eastern Cape	2 819 086	7 605 248	3 221 829
Northern cape	591 607	4 279 133	554 254
Free State	1 869 583	2 509 463	131 532
KwaZulu-Natal	2 498 209	549 943	1 930 175
North West	2 207 342	840 180	538 991
Gauteng	509 804	217 406	202 091
Mpumalanga	1 508 508	945 118	337 217
Limpopo	1 237 493	250 279	731 888

Source: Stats SA (2017)

This study used a combination of multi-stage and stratified sampling techniques. The first stage involved the purposive selection of the five provinces: the Eastern Cape, Free State, North-West, KwaZulu-Natal and Mpumalanga. This was informed by the numbers of smallholder livestock farmers, as well as historical outbreaks and incidence of the two diseases. Based on the availability of resources (time and personnel) as well as the geographical spread of the diseases

and the size of the municipality, one or two local municipalities in each district were selected. Expert opinion was solicited from the respective local veterinarians to confirm the selection of the districts as well as the villages/townships/farming communities affected by the diseases in each province. The plan was to select two villages per municipality. However, some of the villages that had reported the diseases had very few cattle-farming households. Hence, in some study sites more than two villages were selected to make up for the correspondingly low number of cattle farmers per village. The selection of villages was based on disease report information received from the local animal health technician. Preference was given to those villages that reported highest incidence of the disease. The process of selecting study areas is mapped out in Figure 1.

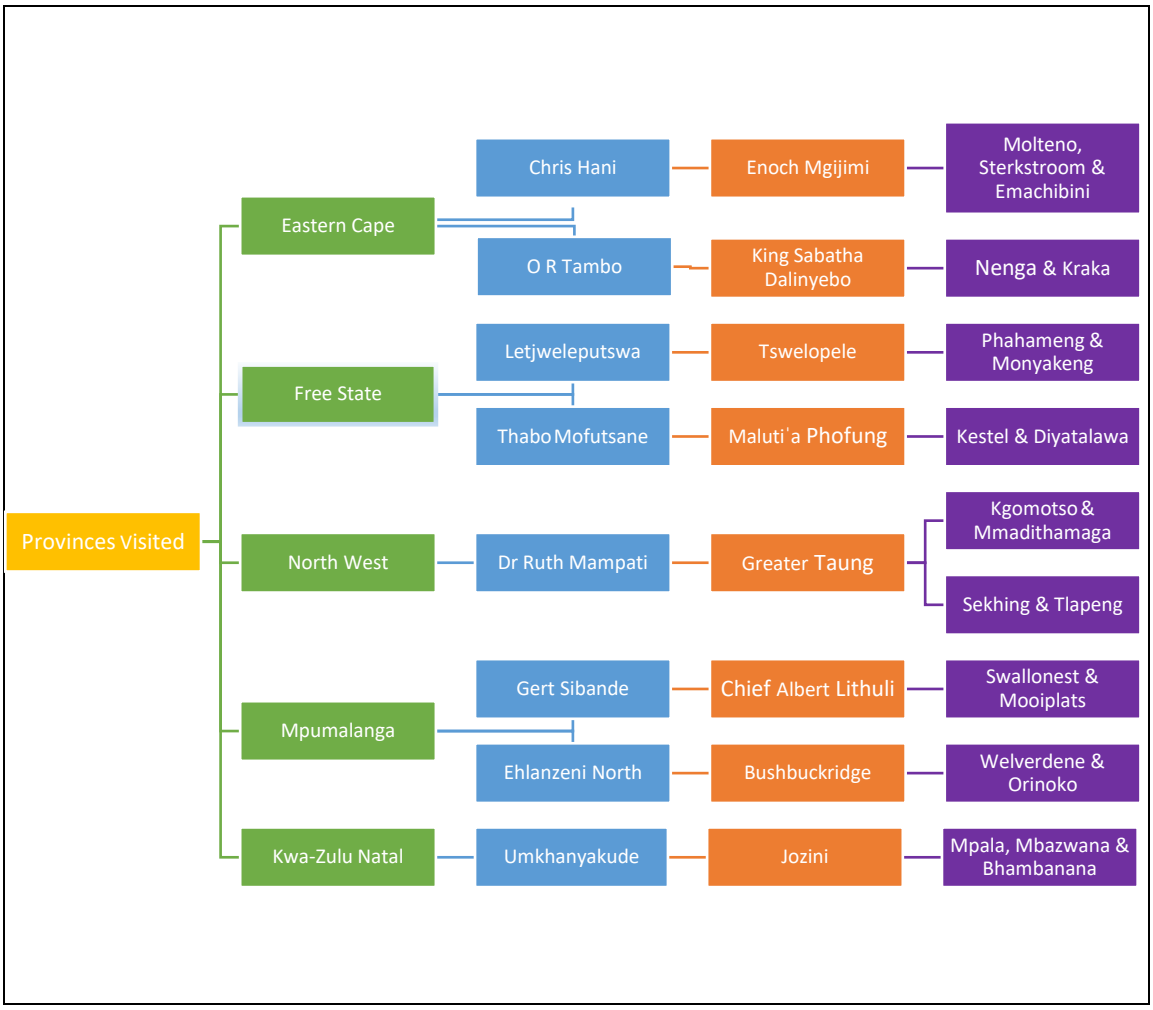

Figure 1: Study areas[2]

[2] Green = Provinces
Blue = District municipalities

2.2 Site description

Five provinces were chosen for this study: the Eastern Cape, Free State, KwaZulu-Natal, Mpumalanga and North-West. A map received from the Department of Agriculture, Forestry and Fisheries (DAFF) depicting reported outbreaks of RVF and LSD between 2010 to 2015 shows that livestock farmers in these five provinces have been affected by the two diseases during those outbreaks (Figure 2). Observing the map, RVF is most prevalent in Eastern Cape, Northern Cape and Free State provinces with few outbreaks in North-West province. Pienaar and Thompson (2013) also reported that livestock farmers in these three provinces were most severely affected by the 2010 outbreaks. LSD is most prevalent in Gauteng, Limpopo, North-West, Northern Cape, Western Cape and Eastern Cape, with few outbreaks in Mpumalanga and KwaZulu-Natal provinces.

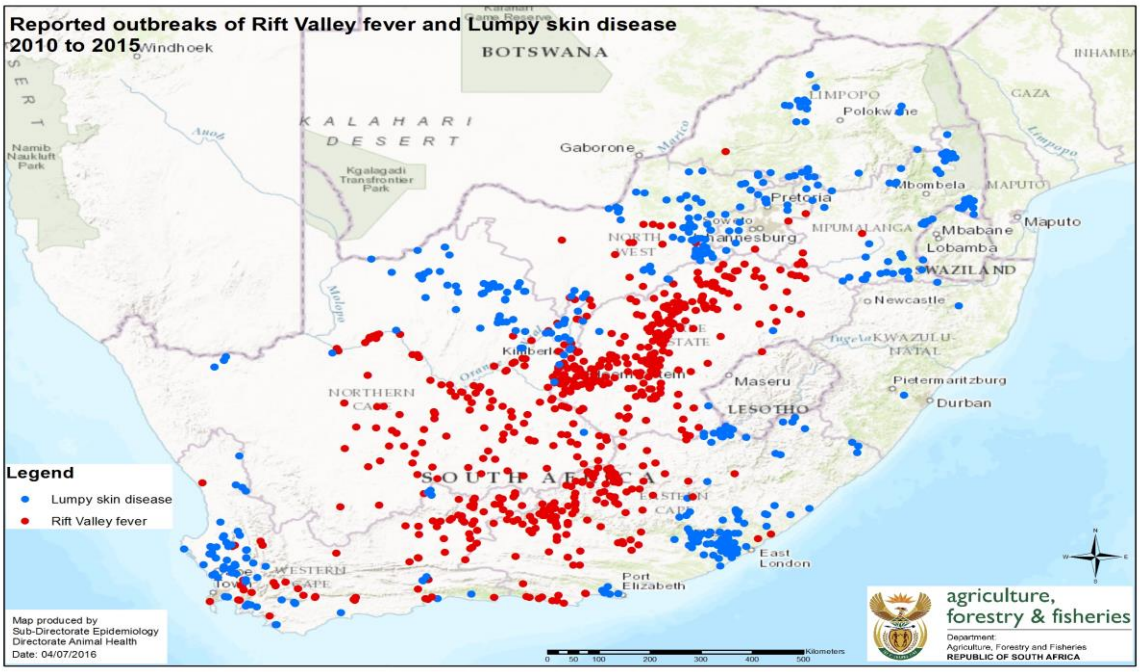

Figure 2: RVF and LSD outbreaks

Source: DAFF (2016)

Orange = Local municipalities
Purple = Farming communities

2.2.1 Chris Hani District Municipality

The Chris Hani municipal district is situated in the center of the Eastern Cape Province. It is the second largest district in the Eastern Cape, covering an area of about 3 7111 square kilometres (Figure 3). The greater part of the district is arid to semi-arid and receives less than 400 mm of rainfall per annum. The survey was conducted in the farming communities of Molteno, Sterkstroom and Emachibini in Enoch Mgijima local municipality. This municipality has recently been formed in August 2016 by amalgamation of Tsolwana, Inkwanca and Lukhanji local municipalities. Based on Census 2011 there were about 10 115 households involved in livestock activities in Enoch Mgijima (EM) local municipality.

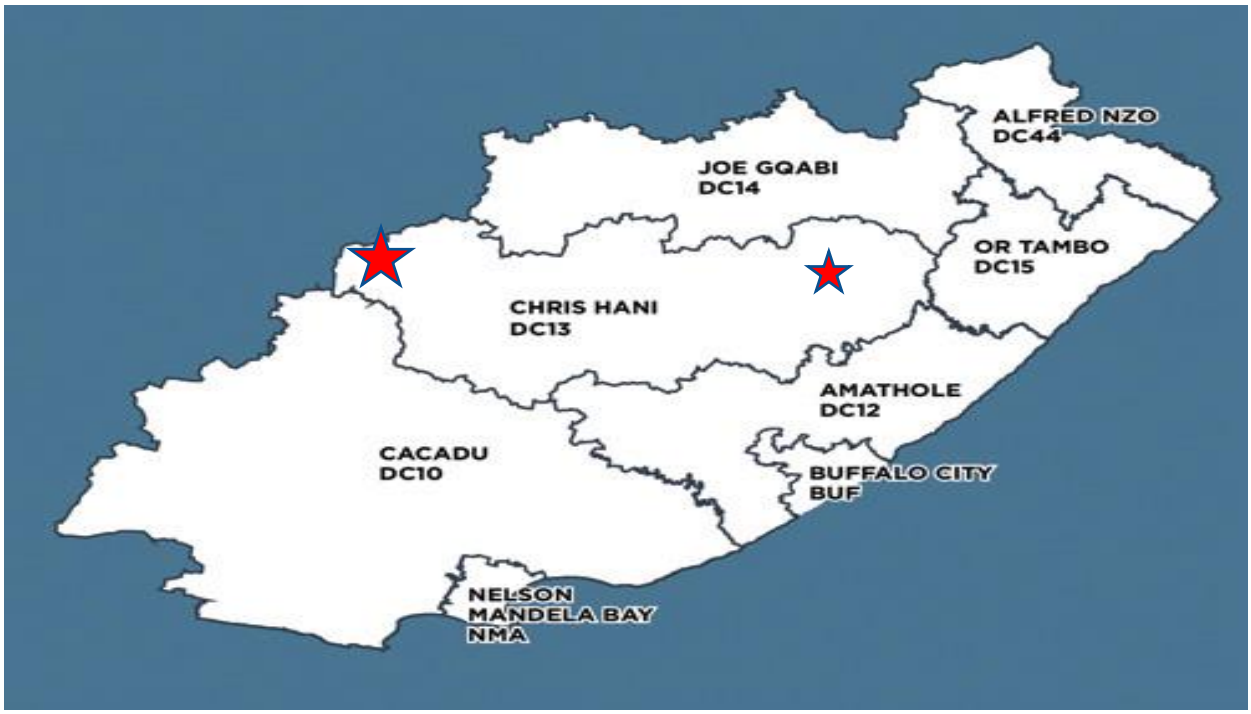

Figure 3: District municipalities of Eastern Cape Province

Source: Local Government Handbook (2016)

2.2.2 OR Tambo District Municipality

The municipality is located to the east of the Eastern Cape Province, on the coastline (Figure 3). The main economic sectors include community services (55%), trade (18.5%), finance (16.9%), agriculture (3.5%), transport (3.1%), manufacturing (2.8%), and construction

(2.7%). Based on the data from the Local Government Handbook (LGHB), the average household size in 2016 was reported at 4.6 with about 57.1% of households headed by women. The survey was conducted in Nenga and Krakra villages in King Sabatha Dalidyebo (KSD) local municipality. About 27 613 of households in KSD are involved in livestock production (StatsSA, 2013).

2.2.3 Lejweleputswa District Municipality

This district is situated in the northwestern part of the Free State (Figure 4). It shares borders with the Northern Cape, North-West and Gauteng provinces. The main agricultural product in this district is maize. It has the second-largest area in the province (24.3%). The survey was conducted on Phahameng and Monyakeng farming communities in Tswelopele and Nala local municipalities, respectively. There is about 892 and 1 422 households involved in livestock production in Tswelopele and Nala local municipalities, respectively (Stats SA, 2013).

Figure 4: District municipalities of Free State Province

Source: Local Government Handbook (2016)

2.2.4 Thabo Mofutsanyane District Municipality

Located in the eastern part of the Free State Province (Figure 4), the municipality borders on Lesotho and the provinces of KwaZulu-Natal and Mpumalanga. The district makes up almost a

third of the geographical area of the province and is comprised of six local municipalities. Agriculture and tourism are the main economic sectors in the district. The average household size in 2016 was reported at 3.2 with about 46.31% of households headed by women (LGHB, 2016). The survey was conducted on farming communities of Kestel and Diyatalawa in Maluti-A-Phofung (MA) local municipality. Based on census, 2011 there is about 6161 households involved in livestock production (Stats SA, 2013).

2.2.5 Ehlanzeni District Municipality

The municipality is situated in the northeast of the Mpumalanga Province (Figure 5). It makes up just over a third of the province's geographical area (27 896km²). The district is comprised of four local municipalities and it features three border gates to both Swaziland and Mozambique. The survey was conducted on Welverdene and Orinoko farming communities in Bushbuckridge Local municipality (BLM). Based on census conducted in 2011, about 13 103 households in BLM are involved in livestock production (StatsSA, 2013).

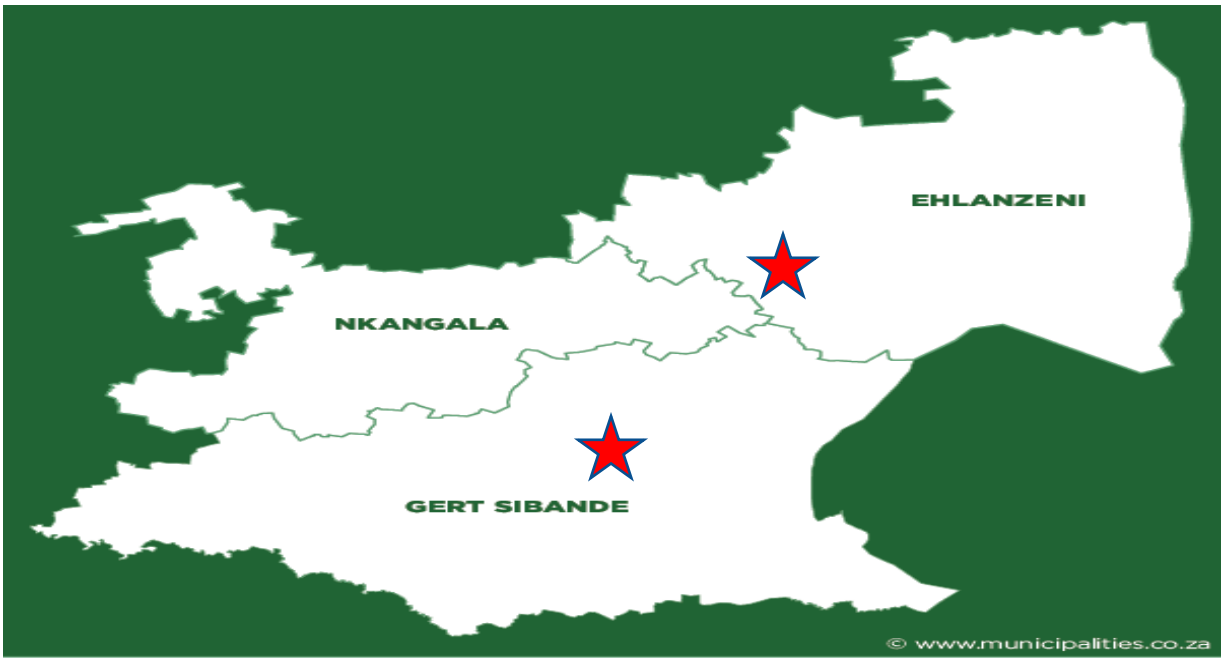

Figure 5: District municipalities of Mpumalanga Province

Source: Local Government Handbook (2016)

2.2.6 Gert Sibande District Municipality

As depicted in figure 5, the municipality is the largest of the three districts in the province, making up almost half of its geographical area. It occupies about 31 841km² of the province (LGHB, 2016). It is bordered by KwaZulu-Natal and the Free State to the south, Swaziland to the east and Gauteng to the west. It is comprised of seven local municipalities. Agriculture claims 4.7% of the main economic sectors (LGHB, 2016). The survey was conducted in the farming communities of Swallownest and Mooiplats in Chief Albert Luthuli (CAL) local municipality. There is about 6 041 households involved in livestock production in CAL (StatsSA, 2013).

2.2.7 UMkhanyakude District Municipality

Sharing boarders with Swaziland and Mozambique, the municipality is located along the coast in the far north of the KwaZulu-Natal Province. It is the second-largest district in the province, covering an area of about 13855km² (Figure 6). It is divided into four local municipalities: Main Economic Sectors include agriculture, trade, and tourism. The survey was conducted on Mpala, Mbazwana and Bhambanana farming communities in Jozini local municipality. Based on census 2011, there is about 21 273 households in livestock production (StatsSA, 2013).

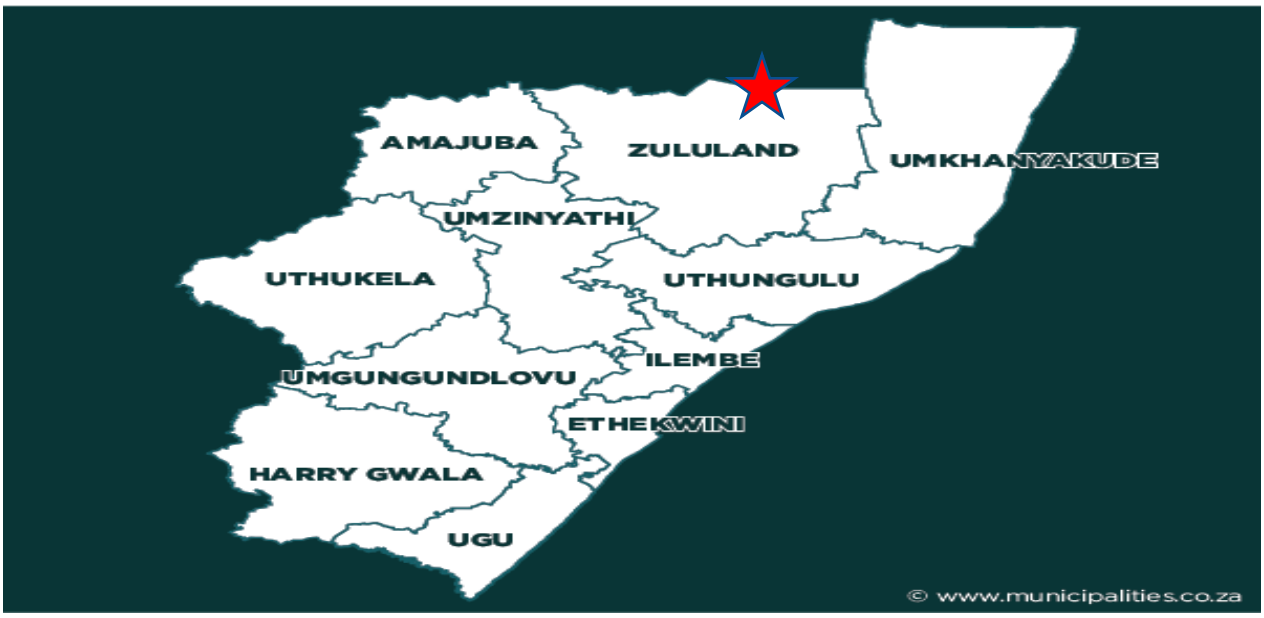

Figure 6: District municipalities of KwaZulu- Natal Province

Source: Local Government Handbook (2016)

2.2.8 Dr Ruth Mompati District

Spread over about 43700km², the Umkhanyakude district is the largest in the province making up almost half of its geographical area (Figure 7). It is one of four districts in the province, with poor rural areas, formerly situated in the former Bophuthatswana homeland. The district municipality comprises five local municipalities. The Main Economic Sectors include community services (33.1%), agriculture (17.1%), finance (16.2%), trade (12.7%), transport (9%), manufacturing (4%), mining (3.2%), and construction (3.2%). The survey was conducted on four farming communities (Kgomotso, Mmadithamaga, Sekhing and Tlapeng) of Greater Taung Local municipality. According to the data from the 2011census, the local municipality had about 10 441 households involved in livestock production (Stats SA, 2013).

Figure 7: District municipalities of North-West Province

Source: Local Government Handbook (2016)

2.3 Sample size

Based on census, 2011 there is about 50563 smallholder farmers in the selected local municipalities (Table 4). To determine a sample size, the study adopted a simplified formula for proportions suggested by Yamane (1967).

$$n = \frac{N}{1 + N(e)2}$$

Where,

$n = sample\ size$

$N = population\ size$

$e = level\ of\ precision$

At 5%, precision level where confidence level is 95% and degree of variability is 50%, an appropriate sample size is 397. To allow for unavailability of respondents and non-response, a sample of 600 households involved in smallholder livestock farming from five provinces was targeted. A stratified proportional sampling was used to determine the sample size per local municipality in each province where more than one district was selected. This was achieved by using a method proposed by Barreiro & Albandoz (2001) which is based on the following formula:

$$n_i = n.\frac{N_i}{N}$$

Where,

$ni = required\ sample\ size$

$n = sample\ size\ in\ stratum$

$Ni = size\ of\ the\ stratum$

$N = size\ of\ the\ population$

The process ended up with nine stratums as indicated in Table 3.

Table 4: Population and sample statistics

Province	District	Local Municipality	Size of stratus[3]	Required sample size	Actual sample size
Eastern Cape	Chris Hani	Enoch Mgijima	7 157	49	98
	OR Tambo	King Sabatha Dalindyebo	14 887	101	104
		Total	**22 043**	**150**	**202**
Free State	Lejweleputswa	Tswelopele & Nala	1 133	35	68
	Thabo Mofutsanyane	Maloti -A-Phofung	3 738	115	51
		Total	**4 871**	**150**	**119**
Mpumalanga	Ehlanzeni	Bushbuckridge	7 411	90	97
	Gert Sibande	CAL	4 811	60	50
		Total	**12 222**	**150**	**147**
KwaZulu-Natal	Umkhanyakude	Jozini	6 043	75	51
North-West	Dr Ruth Mompati	Greater Taung	5 384	75	74
		Total	**50 564**	**600**	**593**

2.4 Procedure for selecting households at community level

To ensure a representative and random selection of households at local level, the following procedure was followed by the leaders of the research teams;

[3] Obtained from Stats SA, Census 2011: Agricultural households

i. Lists of livestock farmers from the selected study sites (villages) of the five provinces were obtained from the respective animal health practitioners. The lists included the name of the farmers, type and number of livestock kept and some with contact details.
ii. Households to be interviewed were selected using systematic interval random sampling methods.
iii. In the absence of the selected households, the closest household not previously selected was used to replace the unavailable household.

3 Survey instruments and data collection

3.1 Questionnaire

A questionnaire consisting of open-ended and closed questions was used to collect household data (Annex 1). The purpose of this study was to determine the knowledge, attitudes, perceptions and practices of smallholder farmers on animal health and vaccine use. Data gathered in the household survey included the following; demographic details, household characteristics, household source of income, livestock activities and access to facilities, prevailing animal diseases and livestock vaccination. Questions pertaining to the location (province, district, local municipality and village) of the household were included in the questionnaire to enable the analysis of impact on a provincial basis.

One of the specific objectives of this study was to establish whether there is any relationship between household characteristics and primary animal healthcare as well as animal vaccination. Hence, sections two, three and four of the questionnaire dealt with investigating household characteristics. Questions on number, age and gender of people who reside in the household for at least four nights a week were asked. Respondents were asked about their position within the household relationship (household head, spouse, etc.) as well as questions including the level of education, employment status, farming experience and household sources of income with percentage contribution to the total household income.

Sections five, six and seven dealt with aspects related to farming types, livestock keeping activities and facilities. To understand animal production systems and animal healthcare-

practices, farmers were asked to provide data on production systems, type of livestock kept, land tenure system as well as the outlets they use for marketing of their livestock. To investigate accessibility to enablers for better livestock production, respondents were asked if the household had access to refrigeration appliances for storage of vaccines, access to phone, TV and radio for sourcing information from broadcasted agricultural programmes, notices and awareness raising on disease outbreaks. Questions relating to choice of marketing outlets, access to market information, animal handling facilities, training on primary animal healthcare were also asked. Additional questions were asked on livestock ownership, management of day-to-day livestock activities, reasons for keeping livestock and decision-making on livestock production and marketing matters.

In order to understand farmers' practices on disease management, respondents were equally asked to identify the disease control measures they apply as well as the five most prevalent animal diseases or symptoms usually experienced. To determine farmer's knowledge about RVF and LSD, respondents were asked if they knew the diseases, what they know about them as well as symptoms of cattle when affected by each of these diseases. They were also asked if they had recently lost their cattle to any of the two diseases, and if so, the number of animals lost. Respondents were also asked about their first point of call if they have a sick animal, including the frequency of contact with animal health practitioner.

Section eight deals with questions relating to vaccines. Respondents were asked if they usually vaccinate their livestock and against which diseases. They were also asked where they sourced, and kept vaccines. Section nine deals with questions that investigate attitudes and perceptions of farmers with regard to animal vaccines and their use. Questions using the Likert scale ranged from availability, accessibility, affordability knowledge and effectiveness of vaccines as well as estimated annual expenditure and expenditure items for livestock production. Farmers were also asked about the desirability of vaccines that needed refrigeration as well as those that protect more than one type of disease. Farmers were also given an opportunity to raise any matters related to animal healthcare and prevention of diseases.

3.2 Questionnaire pre-testing and enumerator training

The questionnaire was pre-tested on a group of farmers in the Free State province, in a community in which the survey was not going to be administered. Following pre-testing of the questionnaire, some questions that were not clear were rephrased. Once the questionnaire was finalised, ten enumerators were trained to translate the questionnaire in the vernacular languages of the different provinces. The enumerators were trained in how to conduct a survey and how they should conduct themselves when conducting the survey. The enumerators interviewed and filled the questionnaires on behalf of the farmers. Interviews with farmers, in this case, ensured direct communication and this was necessary to ensure that there was clarity with the questions in the questionnaire.

3.3 Data collection, data capturing and analysis

The questionnaire was administered with the use of Mobenzi technology that allowed the field workers to capture data with cell phones. Upon completing the questionnaire, the fieldworkers uploaded the data, which got stored on Mobenzi server. On completion of the field survey, data was retrieved form the server. The data was then transferred and stored on a designed excel spreadsheet. Validation and exploration of data was performed to check for the inconsistencies in captured data. The coding system was developed and subsequently implemented for questions that needed post coding. The data was also stored in formatted text (space delimited – prn) format to be analysed in statistical packages (SAS, SPSS and STATA). The chi-square test (χ^2) for equal proportion technique was used to analyse the data. To analyse the closed-ended questions (quantitative data), we used frequencies (the actual number of respondents who chose each response) and percentages (the proportion of people who chose each response out of the total number of respondents). In addition, the chi-square test (χ^2) was used to test for independence in a two-way contingency table as well as to compare the achieved sample proportions for the categories of variables of the qualitative data such as demographics data (Holt, Scott and Ewings, 1980). Cramer's V tests were performed as post-test to determine strengths of association after chi-square has determined significance.

4 Results

4.1 Demographic characteristics of the farmers

In this section, household head's demographical characteristics such as gender, age and highest educational levels are discussed. Table 5 presents the survey results in relation to the gender of the de-facto household head across five provinces in South Africa. All sampled livestock farmers are of African origin. The results show that male headed households constitute 65.3% of those involved in cattle rearing, almost double of the female headed households (34.7%). The Free State and North-West provinces, at (80%) and (74%) respectively, had the highest proportion of male respondents. The results also indicate that the majority of the respondents came from the Eastern Cape and Mpumalanga due to the relative size of livestock owners across the five provinces

Table 5: Distribution of households by gender across the five surveyed provinces

Province	**Gender**			
	Male		**Female**	
	N	**%**	**N**	**%**
Free State	95	79.8	24	20.1
Eastern Cape	104	51.5	98	48.5
KwaZulu-Natal	37	72.5	14	27.5
Mpumalanga	96	63.3	51	34.7
North-West	55	74.3	19	25.7
Total	**387**	**65.3**	**206**	**34.7**

Age of the farmers

In terms of age, the respondents have an average age of 58. As shown in Table 6, the majority (71.3%) of livestock farmers are above 50 years. Female household heads among smallholder farmers are on average a few years older than their male counterparts in the North-West Province (64.5 years versus 56 years for males), Mpumalanga (61 years versus 58 for males) and only one year older in KwaZulu-Natal (50 years versus 49 years for males). They are on average younger than their male counterparts in Eastern Cape (56.7 years versus 59 years for males) and in the Free State (57 years versus 60.6 years for males).

Table 6: Average age of household heads per province

Province	Average age of household heads per province (number of respondents)		
	Male	Female	Average
Free State	60.6 (95)	57.2 (24)	59.9 (119)
Eastern Cape	58.9 (104)	56.7 (98)	57.8 (202)
KwaZulu-Natal	49.0 (37)	50.3 (14)	49.3 (51)
Mpumalanga	58.0 (96)	61.1 (51)	59.1 (147)
North West	56.0 (55)	64.5 (19)	58.2 (74)
Total	**57.7 (387)**	**58.1 (206)**	**57.9 (593)**

Education level of the farmers

More than half (66.3%) of the respondents attained at least some level of formal education, while 33.7% have no formal education. Only 30% of respondents had attained secondary education, while an even smaller portion (3.7%) reported to have attained tertiary education. The responses display virtually the same distribution of educational attainment between male and female-headed farming households (see Figure 8).

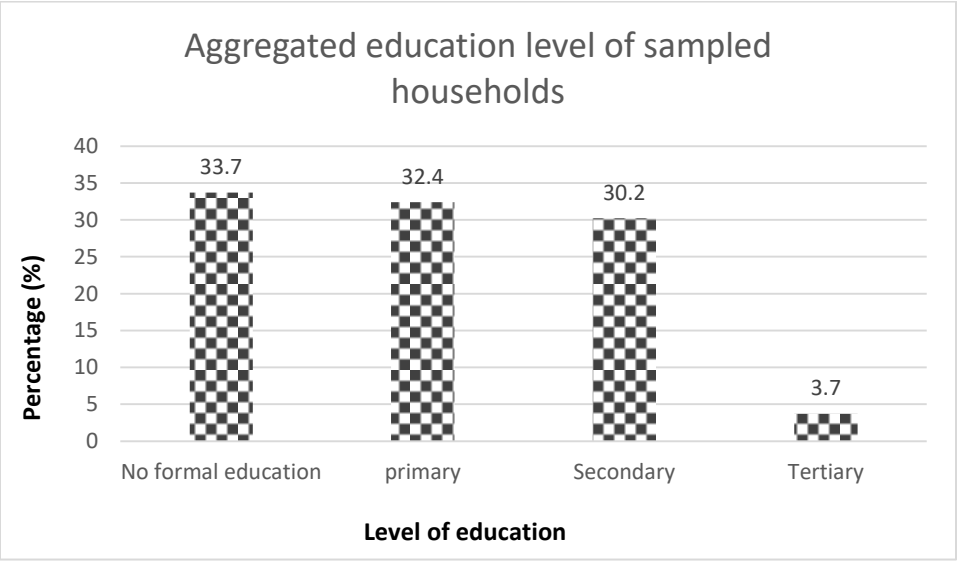

Figure 8: Relative distribution of educational levels of surveyed livestock owners

4.2 Socio-economic characteristics

Occupational status

As for the occupational aspects of the surveyed farmers, the survey results reported in Table 7 indicate that less than half of them (43%) devote their full time to rearing livestock. About 35% of surveyed male farmers and only 8% of female livestock holders are engaged in livestock

farming on a full-time basis. The fact that more men than women are involved in full-time livestock keeping may be a sequel of gendered nature of livestock keeping and the patriarchal role distribution among African families in rural areas, where the males as heads of households have the responsibility for looking and caring for their livestock, while the women may be more engaged in activities in and around the household. The survey results also indicate that fewer young or middle-aged people own cattle or are involved in full time livestock farming.

Table 7: Employment status of the farmers

Employment status	Male (%)	Female (%)	Total (%)
Work full time with livestock	35	8	43
Work part time with livestock	3	2	5
Employed	5	1	6
Employed part time	3	3	6
Unemployed	30	27	57
Student	0.7	0.2	0.9
Other	0	0	0

Income and income sources

In terms of main sources of household income, for a large majority of respondents, social grants are by far the largest contributor to household income, followed by pension. Livestock sales constitute only a marginal income source, less important than income from remunerated work or own business.

Average household income is 2974 rand, but there are sizable variations across the surveyed households (see Figure 9). Median household income is only R 2000 and 75% of respondents still have an average income of less than R3000. The highest reported household income in the entire sample is R 74,774. Highest average incomes by province are registered in the Free State (R 3755), while farmers from Mpumalanga report the lowest incomes with an average household income of only R 2189.

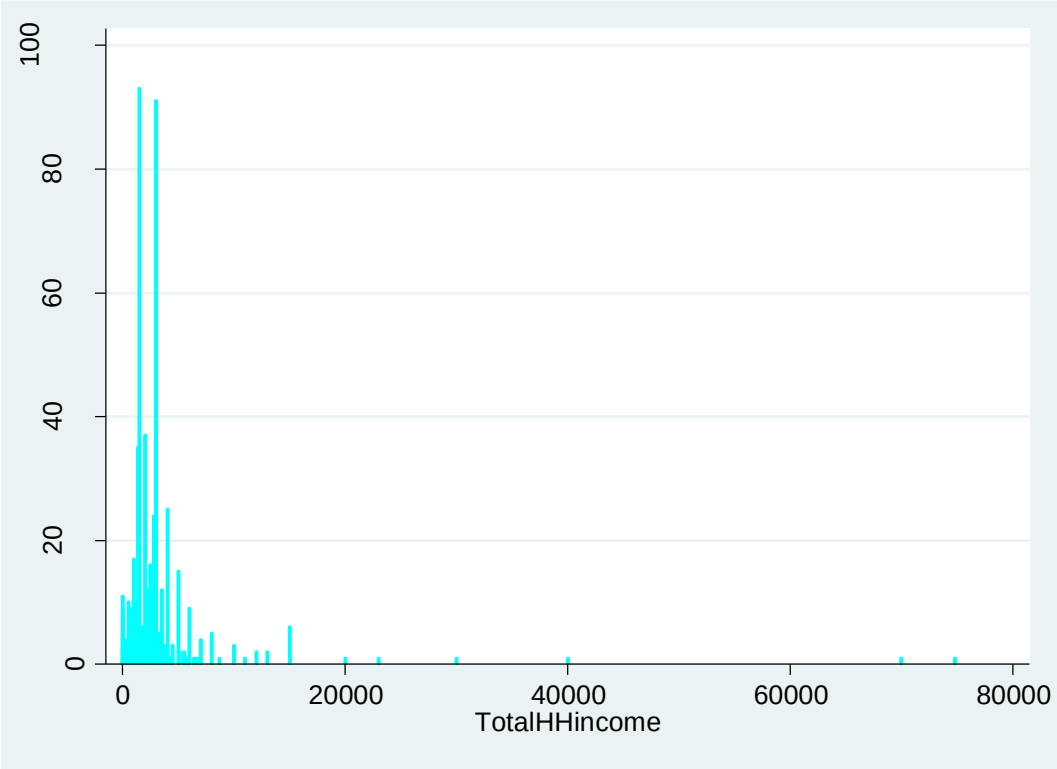

Figure 9: Total household income distribution of the sampled livestock farmers

4.3 Type of farming and livestock ownership structure

Farming land ownership structure

The distribution of land ownership among surveyed households is as follows: slightly less than 18% of respondents own the land on which they practice the farming, while almost 82% of them practice it on communal, municipal or other owner's land. Farmers who own their farming land and practice mainly livestock farming on it have on average almost two times as many heads of cattle as their counterparts who rear their cattle on land they don't own (19 versus 10). For those who practice mixed farming (livestock + crops), cattle holding for households owning their farming land is still higher on average with respect to their counterparts farming on non-owned land, but the proportion is somewhat lower (14 versus10).

Close to 59% of the surveyed households, almost half of which are engaged in mixed farming, practice farming activities on communal land. As for municipal land, 23% of the surveyed farmers reported to use it for their farming activities, and those of them who use it only for

livestock holding (i.e. 85.5% of them) have on average 4 times less heads of cattle than those who practice their farming on other forms of land tenure (7 versus 28).

Livestock management

The results indicate that in most instances, household heads are responsible for running the day-to-day activities related to livestock rearing (see Figure 10). The results also show that a considerable number of cattle owners hire workers to look after their livestock. It is however not clear if the workers are hired when the household head is around or not around to look after the livestock. A very small proportion (4.6%) of the farmers cited spouses as the responsible persons for management of livestock.

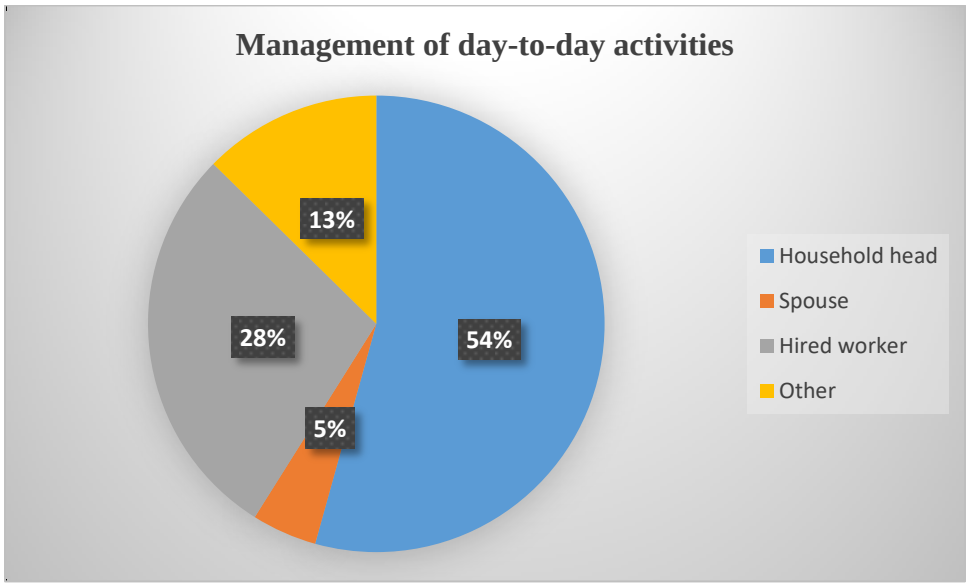

Figure 10: Management of day-to-day activities

Livestock ownership and gender

When it comes to gender and cattle ownership, the study results show that female-headed households tend to own fewer cattle heads than their male counterparts with similar educational attainment for all levels of education as illustrated in Table 8. This difference is even more noticeable for farming households with tertiary levels of education, where average cattle ownership is more than 2.5 times more for males than for females.

Table 8: Average cattle ownership by gender and education level

Gender		No formal education	Primary	Secondary	Tertiary	Total
Male	Number of cattle	12.2	9.0	12.4	42.5	12.6
	N	138	120	111	17	386
Female	Number of cattle	9.5	7.2	7.9	16.6	8.3
	N	61	70	67	5	203
Total	Number of cattle	11.4	8.3	10.7	36.6	11.2
	N	199	190	178	22	589

When cattle ownership by educational attainment is viewed from the perspective of provincial distribution, the survey results indicate more or less important geographical differences. Whereas average cattle ownership increases with education level in the Eastern Cape and Free state, with tertiary educated farmers owning respectively 12 times and more than fivefold the number owned by those with primary education, this pattern is reverses in KwaZulu-Natal and in Mpumalanga, where farmers without formal education tend to have more cattle than those with increasing levels of formal education (Table 9).

Table 9: Distribution of cattle ownership per education level, by province

Educ. level Province		No formal	Primary	Secondary	Tertiary	Total
	Av. nr of cattle					
Free State		6.6	6.9	6.9	36.6	8.1
	N	32	45	37	5	119
Eastern Cape	Av. nr of cattle	7.0	6.2	8.7	86	9.1
	N	72	72	51	5	200
KZN	Av. nr of cattle	13.4	10.5	11.1	.	11.9
	N	20	18	12	0	50
Mpumalanga	Av. nr of cattle	17.2	13	14.3	9.7	14.9
	N	60	31	47	8	146
North-West	Av. nr of cattle	16.5	9.8	13.0	28.5	13.5
	N	15	24	31	4	74
Total	Av. nr of cattle	11.4	8.3	10.7	36.9	11.2
	N	199	190	178	22	589

In total, 25% of the surveyed cattle farmers reported also owning sheep, with two third of them also owning goats in addition. The average sheep holding among livestock farmers is approximately 22 heads, with a maximum holding of 140 and a minimum of one sheep.

Likewise, goat ownership is reported by 48% of sampled households, 35% of which also own sheep and only one does not have any other form of livestock holding. This means that 31% of the surveyed households keep goats and cattle. The minimum holding is one goat, while the maximum is 135 goats. Among women, the average income for those who own goats is higher compared to those who do not own goats whereas it is the opposite among man.

Table 10: Household income and goat ownership

Do you own any goats?				
Gender		**Yes**	**No**	**Total**
Male	Average income	2993	3470	3235
	N	191	196	387
Female	Average income	2955	2103	2484
	N	92	114	206
Total	Average income	2980	2968	2974
	N	283	310	593

4.4 Livestock management on a daily basis

Reason for holding livestock

The top reason for holding livestock, as reported by respondents, is the sale of livestock. Livestock keeping serves as a financial security and a source of income and investment. A limited number of respondents reported to consider household consumption as their second most reason to hold livestock. Approximately 42% of the respondents keep livestock as a continuation of their ancestral main occupation as they grew up in farming families and received cattle as inheritance.

Table 11: Reasons for keeping livestock

Reason for keeping livestock	Percentage (%)
Sale of animals	41
Household consumption and use	34
Continuation of occupation	42

Reasons for selling cattle

Only slightly more than half of the surveyed households (53.6%) reported to sell their cattle for any of the various possible reasons. Decision to sell cattle is taken by the head of household in about 52% of the cases for male-headed households, while 45% of the households make that decision jointly with their spouse, or leave it to the spouse altogether. For the female-headed households, the corresponding ratios are about 57% and 37 % respectively.

Top reasons to sell the cattle are: household needs (58.7% of sales), emergency (31.5%) and profit making (22.7%). The outcome of the reasons for selling the cattle mirrors the reason given for holding the cattle in the first place. Household needs mainly include meeting household budget constraints and use of cattle for rituals and traditional ceremonies. Most emergency cases concern funeral in the family or paying for medical expenses for a family member who suddenly fell sick.

Seven respondents (all of them male) out of the total number of those who reported to have sold their cattle indicated to have transferred their animals to the abattoir. About 35% of those who sold their animals brought them to the auction, while 60% sell their animals through informal transactions. Only a relatively low proportion (14%) of respondents reported to have sold their animals to family members or relatives.

Determination of cattle selling price

In order to determine the selling price, 37% of respondents use market information, while 34% of them consult other farmers or their friends and relatives before making the decision. These

percentages become divergent and inverted when we disaggregate data by gender. Female-headed household tend to rely less on market information (22% of them) than on information obtained from other farmers and relatives (43%). In contrast, 43% of male-headed farming households tend to rely more on market information for their decision-making, whereas only 30% of them rely on other farmers.

Access to animal handling facilities

The smallholder livestock farmers were asked if they have access to animal handling facilities. These animal handling facilities include dipping tanks, neck clamp, loading ramp and crush pans. Animal handling facilities are particularly important because livestock farmers can utilize them when treating and vaccinating their livestock. The North-West (92%) and KwaZulu-Natal (96%) provinces, respectively, have the largest proportion of farmers with access to animal handling facilities. The Eastern Cape (21%) and Free State (41%) have the lowest proportion of farmers who reported to have access to animal handling facilities (Table 12). These findings in the Eastern Cape and Free State display an alarming picture with regards to the South African Government's responsibility to provide primary animal healthcare services. It was observed that in the Free State, land reform beneficiaries had access to animal handling facilities while these services were non-existent among farmers in communal areas.

Table 12: Access to animal handling facilities

Province	Yes (%)	No (%)
Free State	41	59
Eastern Cape	21	79
KZN	96	4
Mpumalanga	70	30
North-West	92	8

Use of farm products

Among respondents, about 71% use or sell cattle products for their household consumption, while 29% do not. Of those who use animal products, 69% use or sell milk products from their farm animals, while 31% of them report that they don't use any milk products from their cattle.

There are some provincial variations though: in the Free State, for example, 97% of respondents who derive farming products produce and use milk, whereas in the North-West, this ratio is only 49%. As for manure, another cattle farming product, it is collected and used by only 12% of respondents.

Record keeping

In general, the keeping of written records of farming activities and events is low amongst the surveyed farmers. About 92.5% do not keep records of cattle sales. Only 8% of respondents reported to keep such records and this difference was not found to be attributable to differences in education level. In contrast, within each province, those who keep records of their cattle sales own on average a relatively higher number of cattle heads than those who do not.

Similarly, only 17.5% of the surveyed farmers keep records of livestock inventory and those who keep records tend to have more cattle on average than their counterparts who do not keep such records. Records of cattle deaths are kept by 21.5% of surveyed farmers, who also appear to own on average two times more cattle than their counterparts who do not record animal deaths. Even more striking, only 4% of all surveyed farmers keep records on expenditure made for cattle holding. The percentage of farmers who keep records of vaccinations is somewhat higher than for other records (40.7% of cattle owners) and the difference in cattle ownership between vaccine records keepers and non-keepers is much less important than for other records (see Figure 11).

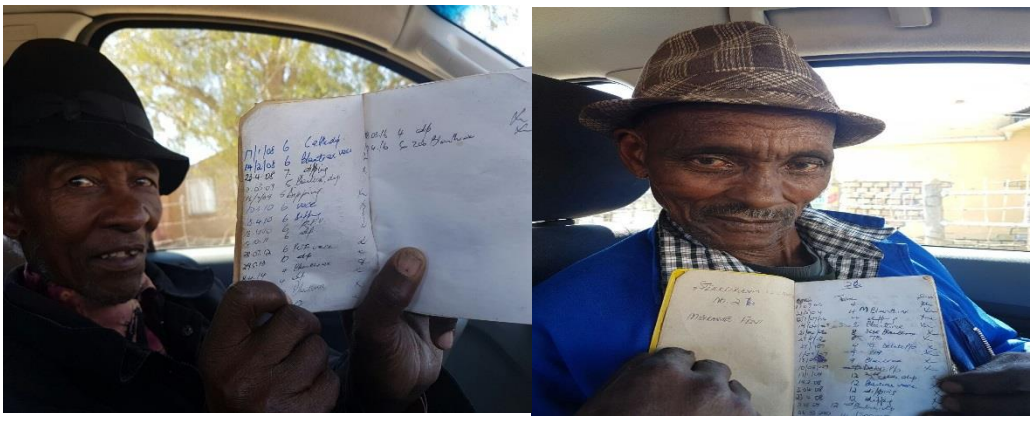

Figure 11: Farmers showing their cattle records in the Eastern Cape

For the record keeping of sick animals, only 8% of the surveyed farmers keep registers, whereas 92% do not. Record keepers own on average more cattle than those who do not keep records, which may indicate that a large number of cattle is an indicator of whether the farmers deem records necessary.

Similarly, only 25% of the farmers keep records of animal births, again with record keepers owning on average more cattle heads per household than those who do not keep records. Education level does not appear to influence the keeping of records. As for milk production records, they are also kept only by a very small percentage of the surveyed farmers (2% out of a total sample of 591 cattle owners), who tend to own more cattle on average and have a slightly higher average level of education than their counterparts who do not keep such records.

As for the type of farming, 38.4% of surveyed farmers reported to be engaged in mixed farming (livestock and crop farming), while 61.6% reported to be engaged in livestock farming only. This proportion does not vary much across education level categories.

4.5 Disease knowledge and disease control practices

Knowledge of disease: Rift Valley fever (RVF) and lumpy skin disease (LSD)

When it comes to knowledge about diseases affecting cattle, there is limited knowledge of the RVF disease in general, irrespective of the level of education. Many of the farmers did not answer RVF related questions, while most of those who did could only mention the calf abortion symptom of the disease. Among respondents, a majority (59.2%) reported that they do not know anything about the Rift Valley fever (RVF). Only 40% of respondents reported to know of RVF, but even among those claiming to know about this disease, their knowledge remains relatively limited to a few symptoms. In general, there was no difference in education level of those who had knowledge of RVF and those who did not.

In contrast, a larger majority of the surveyed farmers (73.4%) reported to have knowledge of LSD. Most respondents who knew about LSD were also able to point out the main symptoms of the disease. Respondents from all levels of educations were equally likely to identify these

symptoms; there were, therefore, no observable differences in educational level to which differences in knowledge of the disease could be attributed.

Most prevalent diseases as perceived by farmers

The surveyed farmers were asked to list top five diseases affecting them in terms of their severity. The top three most severe diseases as indicated by the farmers were lumpy skin disease, black quarter and heart water. These three diseases featured the most amongst farmers across the five provinces covered by our study.

Lumpy skin disease

Lumpy skin disease was the foremost prevalent disease across the five surveyed provinces. About 32% of respondents throughout the covered localities cited LSD as the most severe disease in their respective provinces. KwaZulu-Natal had the highest (37%) proportion of farmers who reported the disease as problematic. There was no much variation in reported cases in the other four provinces (Table 13). It is thus not surprising that LSD is widely known by farmers, because it is by far the most prevalent disease across the five provinces.

Table 13: Proportion of farmers who reported lumpy skin disease as the most prevalent

Province	Frequency	Percentage (%)
Free State	38	32
Eastern Cape	67	33
KwaZulu-Natal	19	37
Mpumalanga	43	29
North-West	24	32
TOTAL	**191**	**32**

Black quarter

Black quarter was the second most prevalent disease across the five provinces (see Table 14). About 10% of the farmers cited black quarter as another disease of significance in their provinces. Approximately 25% of the farmers in KwaZulu-Natal view black quarter as the second most severe disease. The North-West province had the lowest proportion (1.4%) of farmers who cited the disease as problematic. Most farmers who complained about the disease were able to articulate the major symptoms of black quarter, which include limping. It also emerged from the interviews that government has rolled out vaccination programmes for the

disease in almost all provinces. However, it was remarkable that farmers could not recall the name of the vaccine used by the AHT to vaccinate their cattle against black quarter.

Table 14: Proportion of farmers who reported Black quarter

Province	Frequency	Percentage (%)
Free State	9	7.6
Eastern Cape	15	7.4
KwaZulu-Natal	13	25
Mpumalanga	19	13
North-West	1	1.4
TOTAL	**57**	**10**

Heart water

Heart water was the third most prevalent disease with 6.6% of the farmers reporting the disease across the five provinces. The disease was most prevalent in the Eastern Cape Province as 13% of the sampled farmers reported it. Mpumalanga had the lowest proportion (0.6%) of farmers who reported the disease as prevalent in the province (see Table 15).

Table 15: Proportion of farmers who reported Heart water

Province	Frequency	Percentage (%)
Free State	9	8
Eastern Cape	26	13
KwaZulu-Natal	1	2
Mpumalanga	1	0.6
North-West	2	2.7
TOTAL	**39**	**6.6**

Loss of animals due to diseases

Almost a third of respondents reported to have lost cattle in the past twelve months as a result of disease. This is a sizable portion of smallholder farmers and deserves further attention. This proportion is close to 48% in the Free State but only 20% in North-West, with the other 3 provinces ranging in between. Such a rate of animal death occurrence due to diseases means that there is scope for improvement in animal healthcare and disease prevention. With almost half of

respondents losing their livestock to diseases, smallholder farmers in the Free State need specific attention and support in combatting the causes and consequences of disease outbreaks, although the rates in other provinces are almost equally disquieting.

Adopted disease control measures

To control disease in their animals, 69 % of farmers (71% of male farmers) purchase antibiotics. The corresponding percentages for the use of dewormers are 40% for total average and 61% for male farmers among them. As for spending on tick dipping, only 51% of surveyed farmers reported to use this as a disease control measure. The proportion is the same for male and female farmers. More than 91% of farmers in the North-West province used tick dipping to keep the disease in check while only 30 % of farmers in Mpumalanga use this measure.

Use of animal health services when animal is sick

When their animals are affected by a disease, most farmers turn to other farmers (20%) or to co-ops (20%) for help, while only 18% and 11% go to state veterinary and community animal health service respectively (Table 16). Among those who have lost some of their animals to diseases, there is a somewhat higher tendency to turn to state veterinaries (24%), but only less than 8% of them turn to community animal healthcare centres.

When this propensity to select which service to turn to in case of disease is broken down by level of educational attainment of respondents, the only noticeable difference is that farmers with tertiary education are more likely to turn to state veterinary than to coops and to other farmers in case of disease, in contrast to farmers with the other education levels.

Table 16: First person contacted when animals are sick

Name of stakeholder	Frequency	Percentage (%)
State Veterinarian	107	18.1
Community Animal Healthcare Worker	69	11.7
AHT	88	14.9
Co-operative	120	20.3
Other farmers	117	19.8
Other	90	15.2
TOTAL	**591**	**100**

Disease prevention: animal health practitioners

For disease prevention, most farmers report that animal health practitioners visit their animals regularly for vaccination, especially against anthrax and black quarter, but a non-negligible number of farmers report that they do not get enough information about the diseases their health practitioners are vaccinating against.

As for training in disease prevention, only less than 15% of responding farmers indicated to have been trained. The corresponding percentage is 16.6% for male farmers and only 10% for female farmers. Most of the training was organized by government services, accounting for 48 people trained (37 males and 11 females) out of the total 87 farmers who received training. In contrast, private sector provided disease prevention training to only 16 farmers whereas universities trained 6 and NGO's only one.

Table 17 : Distribution of farmers who received training on PAHC

Did you receive training on PAHC				
Gender		**Yes**	**No**	**Total**
Male	Frequency	66	320	386
	%	17	83	100
Female	Frequency	21	184	205
	%	10	90	100
Total	Frequency	87	504	591
	%	14.7	85.3	100

4.6 Knowledge about vaccines

Farmers' perceptions of the effects of vaccine on their livestock

It was observed that farmers seem to have general knowledge on the importance of vaccines. Overall, 64% of farmers indicated that they usually vaccinate their cattle while 36% did not

vaccinate. The majority (86%) of farmers disagreed with the statement that vaccines are not necessary while only 10% agreed and 4% was not sure (Table 18). This did not come as a surprise, since 70% of farmers already disagreed with the statement suggesting that vaccines cause harm to animals. The majority (90%) of farmers indicated that they see positive results from using vaccines, hence most (39%) of the farmers disagreed that other remedies and medicines work effectively when compared with vaccines. Both male and female farmers shared the positive sentiments on the vaccines. However, a contrasting sentiment was observed on the statement suggesting that other remedies and medicines work more effectively in comparison to vaccines. Here, a large group representing 39% of male farmers agreed with the statement while inversely 42% of female farmers disagreed.

Table 18: Overall perception of farmers about vaccines effects

	Strongly Agree (%)	**Agree (%)**	**Not sure (%)**	**Disagree (%)**	**Strongly disagree (%)**
Vaccines cause harm*	2	14	14	44	26
Vaccines are not necessary$	6	4	4	57	29
I see no positive results#	1	4	5	58	32
Other remedies work effectively@	3	31	27	24	15

*ChiSq = 299.8 , DF = 4 , Pr > ChiSq <.0001
$ChiSq = 633.1, DF = 4 , Pr > ChiSq <.0001
#ChiSq = 710.1 , DF = 4 , Pr > ChiSq <.0001
@ChiSq = 144.9 , DF = 4 , Pr > ChiSq <.0001

It was presumed that education, age and household income would have an influence on farmer's perceptions about vaccines. However, the study revealed that there was a significant relationship only between education and the response to vaccines are not necessary while age group and household income was only significant when crossed with the response to other remedies work effectively.

With the exception of farmers from the Free State and Mpumalanga provinces, it was acknowledged that vaccines were indispensable in disease prevention since only few farmers agreed that other remedies were as effective (Table 19). On further exploration, when this response was cross-tabulated with household income for the entire sample, a non-significant

relationship was observed. Interestingly, the Free State and Mpumalanga provinces yielded responses conveying a significantly positive relationship between the degree of agreement with this statement and income levels. In the Free State, farmers who agreed with the statement were those within the high-income groups while in Mpumalanga, it was those within the lowest income group.

Remarkably, quite a sizable proportion of respondents perceived the vaccines as being potentially harmful to their animals. Among farmers with only primary level or no formal education around 30 percent either thought vaccines were harmful for their animals or were unsure whether they were not harmful. This proportion is around 25% among respondents with secondary or tertiary education (Figure 12).

Table 19: Perception of farmers about vaccines per province

	EC (%)	**FS (%)**	**KZN (%)**	**MP (%)**	**NW (%)**
Vaccines are not necessary					
Strongly Agree	1	18	2	5	7
Agree	1	5	6	8	4
Not sure	4	2	8	5	0
Disagree	59	38	58	66	65
Strongly Disagree	35	37	26	16	24
Vaccines cause harm					
Strongly Agree	2	1	4	1	1
Agree	25	6	10	9	10
Not sure	9	24	8	9	27
Disagree	29	37	42	62	59
Strongly Disagree	35	32	36	19	3
No positive results from vaccines					
Strongly Agree	0	3	2	2	0
Agree	1	3	10	10	0
Not sure	4	6	4	6	4
Disagree	56	52	52	61	69
Strongly Disagree	39	36	32	21	27
Other remedies are effective					
Strongly Agree	2	8	8	1	0
Agree	9	54	20	45	35
Not sure	21	20	28	38	33
Disagree	39	14	30	7	27
Strongly Disagree	29	4	14	9	5

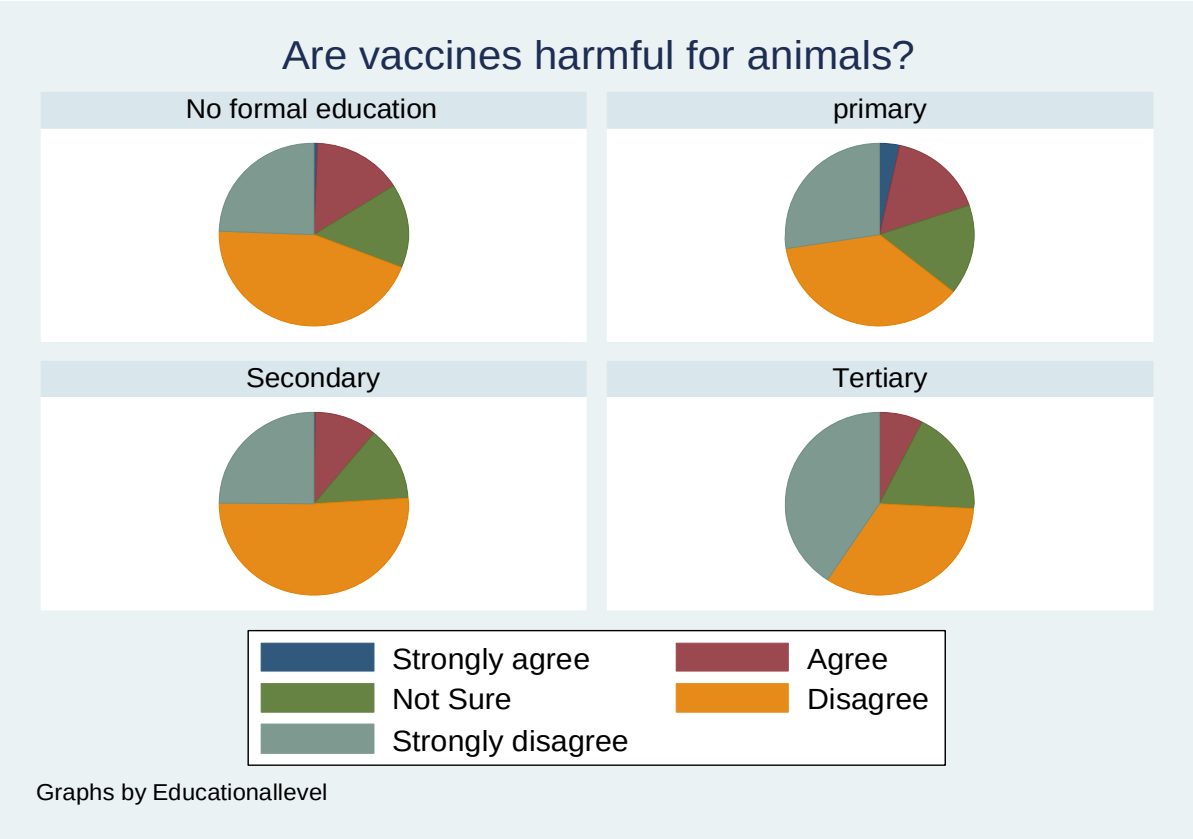

Figure 12: Perception of possible harmful effects of vaccine, by educational attainment

Perceived role of vaccine

Farmers understood the roles of vaccines and medicines where 95% and 96% of them agreed that vaccines are for prevention of diseases and medicines are for treatment of an already sick animal, respectively (Table 20). It was also interesting to notice that farmers could clearly articulate the complementarity role they play where most of them stated that both vaccines and medicines are important. Farmers stated that if you miss vaccination you could always treat animals if sick to avoid losses. Farmers indicated that although there were no disease outbreaks in their areas, vaccines were important to prevent such outbreaks because when such diseases come they do not give notice. Farmers also indicated that since all animals graze together in the fields one can never be sure that when a rare disease strike their animals will not be affected.

Table 20: Farmers Knowledge about vaccines

	Strongly agree (%)	Agree (%)	Not sure (%)	Disagree (%)	Strongly disagree (%)
Vaccines are for prevention of disease*	50	45	4	1	0
Medicines are for treatment of diseases$	48	48	3	1	0
Vaccines not necessary as there are no disease outbreaks in this area#	0	2	4	60	34
Vaccines are for disease that are rare and do not affect my animals@	1	3	5	60	31
Do not know enough about vaccines**	18	50	9	17	6
No one to administer vaccines$$	1	5	8	63	23

*ChiSq = 481.4, DF =3 Pr > ChiSq < .0001
$ChiSq = 499.4, DF = 3, Pr > ChiSq < .0001
#ChiSq = 795.5, DF = 4, Pr > ChiSq < .0001
@ChiSq = 765.3,DF = 4, Pr > ChiSq < .0001
**ChiSq = 269.6, DF = 4, Pr > ChiSq < .0001
$$ChiSq = 765.5,DF = 4, Pr > ChiSq < .0001

While farmers understood the importance and role of both vaccines and medicines, 68% of them indicated that they do not know enough about vaccines and their effective use. This was not surprising considering that only 15% of the farmers acknowledged that they had received training on animal health and disease prevention. Nevertheless, it was interesting to notice that although the majority of farmers had not received any training, 86% of them indicated that they did not have problems to get someone to administer vaccines on their animals. Other farmers, family members and animal health practitioners assisted both male and female farmers who could not administer vaccines. Farmers from all provinces displayed similar knowledge about livestock vaccines and their importance (Table 21).

Table 21: Knowledge about vaccines per province

	EC (%)	FS (%)	KZN (%)	MP (%)	NW (%)
Vaccines are for prevention of disease					
Strongly Agree	41	84	44	38	47
Agree	56	8	54	58	41
Not sure	1	8	2	3	11
Disagree	2	0	0	1	1
Strongly Disagree	0	0	0	0	0
Medicines are for treatment of diseases					
Strongly Agree	39	87	46	32	45
Agree	57	9	52	65	47
Not sure	1	4	2	2	8
Disagree	3	0	0	1	0
Strongly Disagree	0	0	0	0	0
Vaccines not necessary as there are no disease outbreaks in this area					
Strongly Agree	0	1	0	1	0
Agree	1	3	4	3	1
Not sure	3	7	4	5	1
Disagree	59	44	56	67	76
Strongly Disagree	37	45	36	24	22
Vaccines are for disease that are rare and do not affect my animals					
Strongly Agree	0	2	2	3	0
Agree	1	8	4	3	3
Not sure	3	4	6	7	3
Disagree	62	47	54	64	71
Strongly Disagree	34	39	34	23	23
Do not know enough about vaccines	14	30	8	17	19
Strongly Agree	66	22	46	41	73
Agree	7	17	2	12	1
Not sure	9	26	20	24	6
Disagree	4	5	24	6	1
Strongly Disagree					
No one to administers Vaccines					
Strongly Agree	0	4	4	0	0
Agree	5	8	4	6	1
Not sure	2	8	64	21	0
Disagree	63	66	28	58	66
Strongly Disagree	30	14	0	15	33

When aggregated by gender, more than half of males and females either agreed or strongly agreed that they do not know enough about vaccines.

Table 22: I do not know enough about vaccines

Gender	Strongly agree (%)	Agree (%)	Not sure (%)	Disagree (%)	Strongly disagree (%)
Female	22	56	11	7	4
Male	16	48	8	22	6

Information on new vaccines

When farmers were asked about whether they usually get information about new vaccines, it was established that the majority (65%) did not have access to this information while the rest did. This was surprising as most farmers indicated that they had contact with the animal healthcare practitioner in the last twelve months, one would have expected that this information be provided during such visitations. For those farmers who had access to information, veterinary services and animal health technicians were their main sources (Table 23). Both gender groups received information from same sources except that more female farmers reported that they received information from other farmers compared to their male counterparts.

Table 23: The relationship between gender and access to information

	Gender	
Source	**Male**	**Female**
Vet & AHT	59	56
Extension Officers	20	18
Media	2	3
ARC	5	2
Private Sources	6	8
Other Farmers	8	13
Total	100	100

4.7 Attitudes and perception towards vaccine accessibility

Farmers were asked whether vaccines were easily accessible if one had money. The majority (66%) agreed that if they have money to buy vaccines it is easy to access them while 23% disagreed and 11% was not sure. Most farmers indicated that they buy vaccines at their own cost. However, they also indicated that the prices were too high; hence, the majority (83%) of farmers believed that government should always pay for vaccine (Table 24). However, 11% disagreed and 6% was not sure, as they believed that government could assist where necessary, as they themselves are responsible for their animals.

Table 24: Attitudes towards vaccine accessibility

	Strongly Agree (%)	**Agree (%)**	**Not sure (%)**	**Disagree (%)**	**Strongly disagree (%)**
Vaccine are readily available*	22	44	11	19	4
Vaccines are too expensive$	50	35	8	6	1
Government should always pay for vaccines#	43	40	6	10	1

*ChiSq = 278.8 , DF = 4 , Pr > ChiSq <.0001
$ChiSq = 555.6.1, DF = 4, Pr > ChiSq <.0001
#ChiSq = 459.5, DF = 4 , Pr > ChiSq <.0001

On further analysis, as expected it was found that both household income and money spent on animals have a positive influence on the perception on who should pay for animal vaccines. A statistically significant relationship (p= 0.035) was found between the amount of money farmers spent on animals and the perception on who should pay for animal vaccines (Table 25).

Table 25: Relationship between money spent on animals and responses to government should always pay for vaccines

	Money spent on animals (R)				
Response	**<50**	**50-1000**	**1001-2000**	**2001-4000**	**>4000**
Strongly Agree	42	40	52	42	40
Agree	43	45	31	38	30
Not Sure	9	5	5	6	11
Disagree	6	10	8	13	16
Strongly Disagree	0	0	4	1	3
Total	**100**	**100**	**100**	**100**	**100**
Chi-Square (p)	0.035				
Degrees of Freedom	16				
Cramer's V	0,108				

Within the provinces, it was acknowledged that vaccines are readily available to farmers; however, affordability was a challenge (Table 26). The majority of both male and female farmers shared this sentiment. KwaZulu-Natal and Free State farmers seem to agree or strongly agree that vaccines are readily available in larger proportion compared to other provinces. Across all surveyed provinces, there was a strong sentiment that vaccines are too expensive (more on this in the next subsection). Similarly, the majority of farmers in all the provinces agreed or strongly agreed with the statement that government should always pay for livestock vaccines.

Table 26: Farmers' attitudes on vaccines per province

	EC (%)	**FS (%)**	**KZN (%)**	**MP (%)**	**NW (%)**
Vaccines are readily available					
Strongly Agree	20	38	14	19	15
Agree	50	24	40	47	57
Not sure	3	17	20	11	19
Disagree	21	18	26	20	9
Strongly Disagree	6	3	0	3	0
Vaccines are too expensive					
Strongly Agree	54	60	44	37	57
Agree	33	24	40	46	32
Not sure	5	8	6	12	7
Disagree	7	5	8	5	4
Strongly Disagree	1	3	2	0	0
Government should always pay for vaccines					
Strongly Agree	29	71	60	36	38
Agree	55	13	30	48	30
Not sure	6	7	4	8	5
Disagree	8	8	6	8	24
Strongly Disagree	2	1	0	0	3

Farmers' perception of vaccine affordability

This study sought to analyse the perception of vaccine affordability in more detail by grouping respondents according to their provinces, income and level of educational attainment. We sought to understand how income and educational level affect the perception of vaccine affordability.

Farmers were asked whether they perceive cattle vaccines as too expensive and were directed to scale their responses in the following categories: strongly agree, agree, not sure, disagree and strongly disagree. In the Free State province, 84 % of respondents agree, with (60%) of them strongly agreeing with the statement that cattle vaccines are too expensive. Only 8% of respondents disagree, among which 3 % who strongly disagree with the statement. Those respondents who strongly disagree with the statement are those with the highest income levels of their group in the province.

Those who report to be unsure of the affordability have the lowest income, while the rest of the respondents' perception of affordability is ranked according to their average income. In the Eastern Cape Province, the distribution of perception with respect to total household income levels is slightly different but conveys the same picture: 87 % of respondents agree with the statement (with 54% of the total strongly in agreement) and only 7% disagree, while another 7 % is unsure (see Figure 13). Respondents with the highest income average in that province are surprisingly those who perceive the vaccine as being too expensive.

In the same vein, 84% of respondents in KwaZulu-Natal find vaccines too expensive, with more than half of them strongly agreeing with that perception. Only 10 % of surveyed farmers, curiously those with the lowest average income levels, find the vaccines not too expensive. The remaining 6% are unsure about the affordability. In Mpumalanga, 83 % of respondents find vaccines too expensive, with 37% of the total strongly in agreement with this statement. A mere 5% disagree with the statement, although their average income appears to be lower than that of their counterparts.

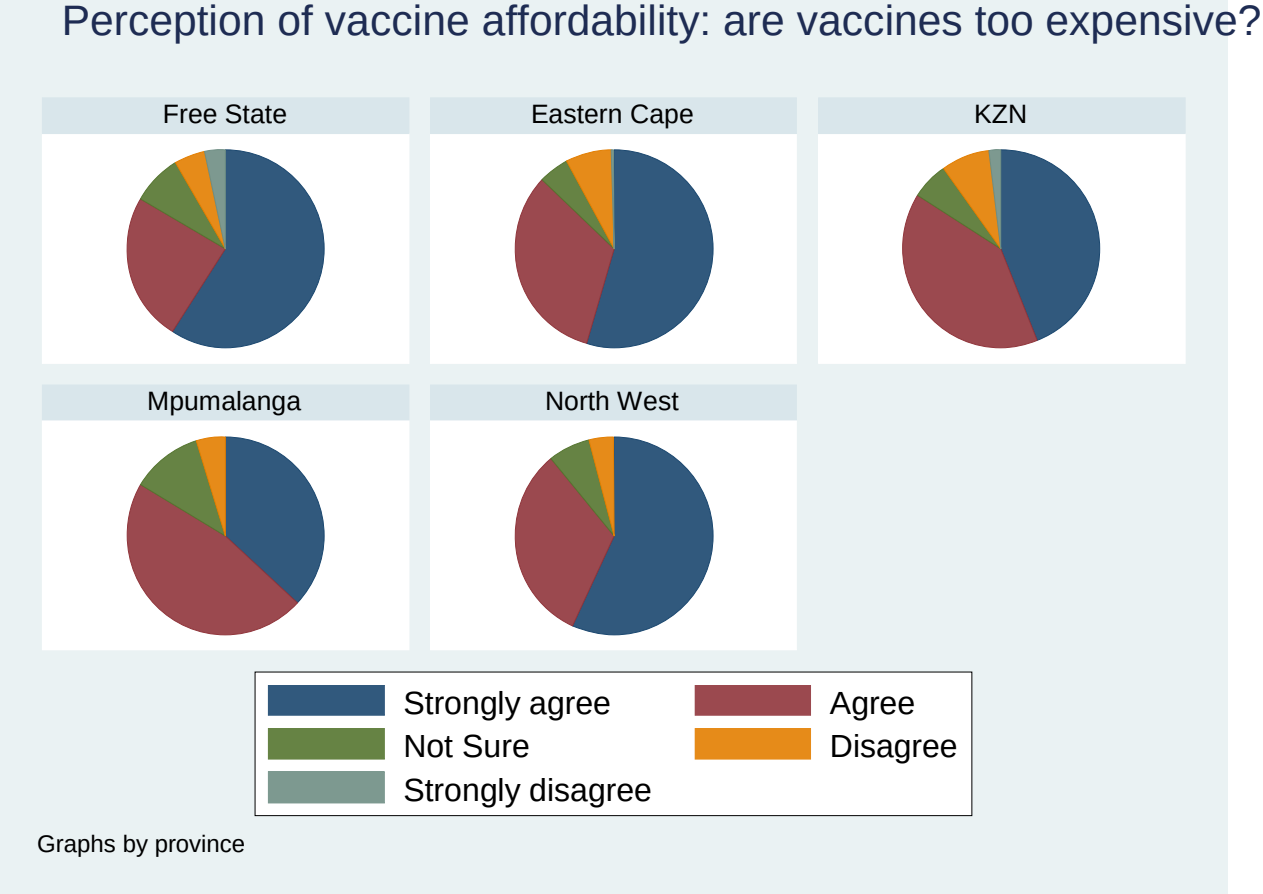

Figure 13: Perceptions of vaccine affordability by province

When aggregated by gender, an overwhelmingly proportion of both male and female farmers agreed that vaccines were too expensive (Table 27). A very small proportion of both males and females either disagreed or strongly disagreed with the statement.

Table 27: Vaccines are too expensive

Gender	Strongly agree (%)	Agree (%)	Not sure (%)	Disagree (%)	Strongly disagree (%)
Female	42	38	12	7	1
Male	55	34	5	5	1

Spending on vaccines

More than half of the farmers in each of the five provinces purchases animal vaccines. The purchase and use of vaccines by farmers is crucial as these vaccines are used to prevent animal diseases. The Free State (94%) and the North-West (92%) had the highest proportion of farmers who purchase animal vaccines. Mpumalanga province has the lowest (53%) proportion of farmers who purchases vaccines. The results also show that almost 73% of farmers across the five provinces purchase animal vaccines. The surveyed farmers were asked to indicate where they buy animal vaccines. Most farmers (71%) buy animal vaccines in cooperative shops like TWK. OBP was the least cited place where farmers buy their vaccines.

Table 28: Distribution of farmers who purchase vaccines

Province	Frequency	Percentage (%)
Free State	112	94
Eastern Cape	139	69
KwaZulu-Natal	35	70
Mpumalanga	77	53
North-West	68	92
TOTAL	**432**	**73**

As for the desirability of vaccines preventing more than one disease an overwhelmingly large majority of 97% of surveyed farmers find it desirable of which 85% find such a vaccine highly desirable. In the whole sample, only two respondents found such a vaccine not necessary, while 16 were unsure. These results are distributed evenly across provinces, gender and education level.

For the desirability of the specific case of a two-in-one vaccine against LSD and RVF, the opinions also remain convincingly convergent, with 95% of all surveyed farmers finding it desirable. This high convergence of views about the combined LSD RVF vaccine is the same for both genders, and remain stable across education levels and provinces, with farmers in the Free State unanimously behind such a vaccine, whereas the support for it lapses at 90% in the Mpumalanga province.

Farmers' perceptions about vaccine attributes

The majority of farmers indicated that they own and have access to refrigerators; however, only 50% of them that had preference for vaccines that needs refrigeration (Table 29). Those that preferred such vaccines indicated that refrigeration maintains efficacy and extends the shelf life of a vaccine. Due to safety concerns, such as possibilities of food contamination and high risk of children consuming vaccines, 31% of them did not show the preference while 19% was not sure about a vaccine that needs refrigeration, also stating safety issues.

Table 29: Farmer's perceptions on attributes of vaccines

	Highly desirable (%)	**Quite desirable (%)**	**Not sure (%)**	**Not desirable (%)**	**Highly undesirable (%)**
Vaccine that protects against more than one disease*	86	11	3	0	0
Vaccine that needs refrigeration $	21	29	19	17	14

*ChiSq = 1198 DF =3 Pr > ChiSq < .0001

$ChiSq = 40.1, DF = 4, Pr > ChiSq < .0001

While farmers showed preference of refrigerated vaccines, they also stated that due to unstable supply of electricity, one is never sure of the efficacy of the vaccine; hence, the majority 94% of farmers highly preferred a vaccine that can be used on cattle, sheep and goats (Figure 14). It was observed that farmers were storing vaccines in the same refrigeration used for storage household items.

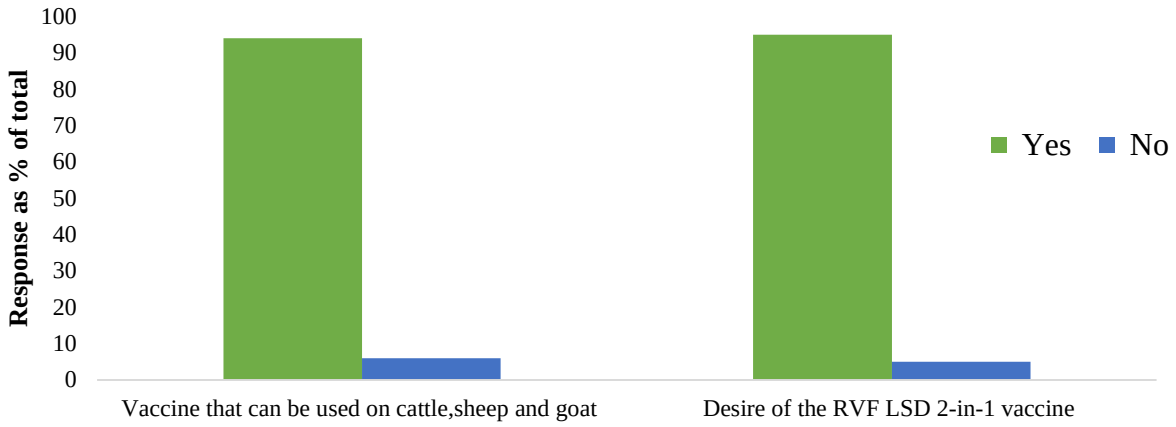

Figure 14: Farmers' preference for a vaccine that works on cattle, sheep and goats

Most farmers (97%) from all provinces preferred a vaccine that protects more than one disease. It was no surprise then that 95% of farmers indicated an interest in buying the 2-in-1 RVF LSD vaccine when available in the market (Figure 14). Although few (33%) farmers indicated to have lost animals to any disease outbreak, and few (41%) of them knew about RVF compared to LSD (70%), they still indicated the interest in the vaccine. The majority of farmers who knew about RVF were from Free State province. Based on literature, the farmers in the province had always been affected every time there is an outbreak. The majority of farmers in Free State indicated that they had in the past lost cattle to disease outbreaks, it was then no surprise that all farmers from the Free State province indicated that they would buy the vaccine if available in the market (Table 30). On further analysis, a significant relationship was established between previous loss of animals to disease outbreaks and the interest to buy the 2-in 1 LSD RVF vaccine.

Table 30: Farmers' attitude towards an LSD RVF 2-in-1 vaccine per province

	Province				
Response	**EC (%)**	**FS (%)**	**KZN (%)**	**MP (%)**	**NW (%)**
Yes	97	100	96	90	92
No	3	0	4	10	8
Total	**100**	**100**	**100**	**100**	**100**

4.8 Household spending on animal healthcare and preventive measures

Almost 89% of farmers in our study spend a more or less sizable amount of money on animal healthcare. Only about 11% of the surveyed household reported that they do not spend money on animal healthcare. Those are mostly located in Mpumalanga (40% of them), in Eastern Cape

(30% of them) and in KwaZulu-Natal (20%). Average annual household spending on animal healthcare is R 2272, but is unevenly distributed over the five provinces of our study. The highest provincial average spending was recorded in the Free State with R3327, while the lowest was found in KwaZulu-Natal, with only an annual expenditure of R1347. Variations within each province are very large as well.

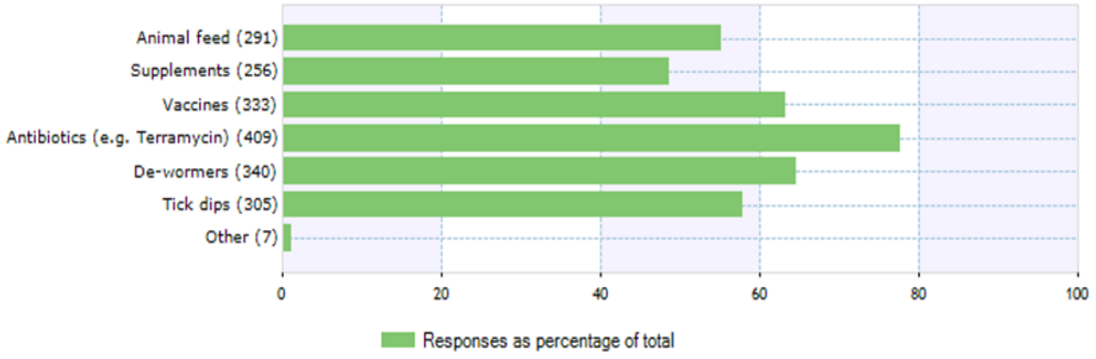

Figure 15: Household spending on animal welfare

When animal related expenditures are analysed considering perceptions about the potential harmful effect of vaccines, we note a clear trend among respondents with no formal education. Farmers who fear vaccines are harmful to health are also those who spend the least on healthcare for their livestock, while those who strongly disagree with this misconception also spend significantly more on animal healthcare. Here, lack of proper knowledge of vaccine effects corresponds to lower spending on animal healthcare and prevention products.

Among respondents with completed primary education, the pattern changes, with the highest spending on livestock healthcare coming strangely enough from a small group of respondents who think that vaccines are harmful to animal health. For the group with completed secondary education, those who are unsure about the vaccine effects have the highest spending level on animal healthcare, followed by the group of those who think that vaccine are harmful to animal health. A plausible explanation for these patterns is that the absence of proper knowledge about disease prevention by vaccination drives uncertainty about the damages that could be caused by diseases and prompts farmers to spend more on products for treating sick animals.

Figure 16: Items used for animal healthcare as shown by three farmers

As for farmers with tertiary education, in addition to having the highest animal healthcare spending budget of all educational level groups, those of them who strongly disagree with the perception of harmful effects of vaccine on animal health spend considerably more than those who think vaccine can harm animal health. For respondents with tertiary education, better knowledge of the benefits of vaccines and other prevention measures seems to be associated with spending aimed at preventing and controlling animal diseases.

In general, spending on animal healthcare is, influenced not only by the number of cattle held, but also by education level and total household income. All those variables have impact on spending for animal healthcare at the 1 % significance level.

Table 31: Estimated yearly spending on animal healthcare as explained by level of education, hh income and number of cattle owned

Estimated yearly amount	Coeff	Std dev	P>|t|
Educ. level	412.25**	170.65	0.016
Total hh income	0.20 ***	0,04	0.000
Number of cattle	53.77***	8.01	0.000
Constant	223.27	374.11	0.552
Number of obs	523		
R-sq	0.226		
F	50.60		

Spending on animal feed

Nearly half (49%) of surveyed farmers spend money on animal feed, but only 38.5% % of female farmers buy animal feed versus 55% for male farmers. Similarly, almost 43% of surveyed farmers responded to spend significant amounts of money on feeding supplements, although this percentage also differ between male and female farmers, where 50% of males buy food supplement versus only 31% of female farmers.

5 Discussion

This study analysed the knowledge, attitudes, perceptions and practices of smallholder livestock farmers in five provinces of South Africa. The analysed data was collected through a household survey and focus group discussions. The majority (65.3%) of smallholder farmers who depend on rearing livestock were males and the remaining 34.7% were females. This means that for each female livestock farmer, there are almost two male farmers. This is a clear indication that livestock farming in rural South Africa remains a male dominated activity. This finding tallies with findings of Oladele et al (2013), who also reported that cattle farming in South Africa and Namibia remains mainly a male-dominated business. About 71% of the sampled farmers were above 50 years and 26% of the respondents fall within the age bracket of 61-70 years old. This agricultural household's average age is slightly higher than the national average age of agricultural households of between 45 to 54 years (Stats SA, 2011).

This age distribution clearly shows that old people are involved in cattle farming across the five provinces. This skewed age distribution of livestock farmers might be because of the lack of interest in livestock farming by the youth, who may have taken other, better paying jobs as means of livelihoods. Another contributory factor could be that older and retired people are more likely to have resources to purchase livestock to start up farming, unlike the younger ones. About 33.7% of the respondents had not attained any formal education and the remainder had attained either secondary or tertiary education. This is an indication that the majority of the farmers are literate. High literacy among farmers can be a precursor for innovation and technology adoption (Oladele et al., 2013) and this can potentially translate into higher productivity resulting from the harnessing of new technologies (i.e. improved vaccines and medicines). Household heads who had attained higher education levels were found to be likely to spend more money on animal healthcare. It is interesting to note that of all the vaccines that the farmers showed the research team that they used, none of them had information inserts written in the vernacular language. They were all written in English or Afrikaans, suggesting that they were targeted at large scale commercial farmers. This could potentially be a problem for those farmers who are not comfortable with the use of either language.

Approximately 53.6% of the surveyed households had sold their cattle for various reasons. There were fewer (22.7%) households who reported to have sold their cattle for profit maximization purposes. This might be an indication that the majority of rural livestock farmers prefer to attach more value to non-cash benefits rather than the commercialization of their livestock production. This result conforms with the narrative by Lubungu et al (2012), who point out that apart from cash benefits, livestock in an African setting are closely linked to the social and cultural lives of smallholder farmers for whom livestock ownership ensures varying degrees of household economic stability. Generally, the decision whether to sell or not is made by the household head. In the sample of this study, the majority of household heads were males and they are thus more likely to be the ones who make the decision to sell their cattle. Approximately 60% of farmers sell their cattle through informal marketing channels which is a clear indication of the non-existence of formal marketing channels. Makhura et al (2001) identified high transaction costs as one of the key reasons that restrict smallholder participation in formal marketing channels.

Moreover, livestock was not the largest contributor to household income, their biggest income contributor to household total income being social grants. This might have a negative effect on livestock farmers' propensity to spend on animal welfare. It is thus not surprising that 82.6% of livestock farmers were of the view that government should always pay for animal vaccines and 85% of farmers felt that vaccines were expensive. In contrast, 89% of farmers spend money on animal healthcare and this might mean that farmers use money from their social/pension grants or money from off-farm activities to spend on animal healthcare. This study has also found that farmers with high education level, high income levels and those who own more cattle are more likely to spend on animal healthcare. This is so because all these factors improve farmers' buying power.

The majority of smallholder farmers vaccinate their cattle and perceived vaccines to be necessary for disease prevention. This result conforms to the findings by Hesterberg et al (2007) who reported that 84.8% of smallholder livestock farmers vaccinated their cattle in KZN. The overall uptake of this practice may be due to a somewhat to a well-functioning veterinary services in rural areas as most farmers reported that their animal health practitioners visit them regularly for vaccinations. However, despite the presence of animal health practitioners, the majority of farmers (85.3%) indicated that they have never received any form of training relating to primary animal healthcare. This is an indication of bottlenecks in the delivery of animal healthcare services in rural areas.

Overall, livestock farmers were able to distinguish the difference between vaccines and medicines. This is crucial as the two are designed for different purposes; vaccines for prevention of diseases while medicines are for the treatment of diseases. In contrast, a majority of farmers do not know enough about vaccines and their effectiveness. This may be because most of the farmers did not receive any form of training on animal healthcare. It was also observed that there is limited use of traditional remedies by surveyed livestock farmers. However, this result contrasts with the findings by Hesterberg et al (2007) who reported that 59% of farmers in KZN used traditional medicines for their stock.

The majority of farmers across the five provinces had limited knowledge of RVF and they could hardly articulate the symptoms of the disease. This is despite the fact that most of the areas visited were areas where RVF outbreaks were reported by the DAFF. Animal health technicians, especially in the Eastern Cape, indicated that most RVF outbreaks had occurred in commercial farms and they had taken a proactive approach to quarantine affected commercial farms and vaccinate cattle in the surrounding rural villages. Hence, this proactive approach by government could explain the limited knowledge of RVF among smallholder livestock farmers. In contrast, the majority of farmers across the five provinces knew about LSD and were able to clearly articulate the symptoms associated with the disease and as to when they expect outbreaks. The extensive knowledge demonstrated by farmers on LSD may be attributed that it occurs more frequently than RVF and farmers have to find remedies to deal with LSD themselves unlike RVF, which involves state assistance. Given the extensive knowledge of LSD among livestock farmers, it is therefore not surprising that most farmers across the five provinces felt that LSD was the most severe disease, followed by black quarter and heart water.

About 85% of the farmers prefer a vaccine that can be used to treat multiple diseases. Farmers further indicated that they assume that this would be cheaper than buying two different vaccines and that it would save time in terms of collecting livestock and administering the vaccine. It is therefore not surprising that the majority (more 90% in each province) of farmers indicated that they are willing to buy a 2-in-1vaccine that protects against RVF and LSD. To maintain some vaccine's cold chain and efficacy it is crucial that some vaccines are refrigerated. It was observed that smallholder livestock farmers store their vaccines in the same fridge where they store household food items. This poses some danger, especially in households where there are children. Most of the farmers also indicated that they prefer a vaccine that can be used on cattle, goats and sheep. They argued that since they have low numbers of cattle it is high likely that if they also administer the vaccine on small stock it will get finished and this would reduce the need for refrigeration and will be less costly.

Access to animal handling facilities such as dipping tanks and neck clamps are crucial in ensuring primary animal healthcare in rural communities. Farmers in Mpumalanga, KwaZulu-Natal and North-West provinces all have access to animal handling facilities. However, the

majority farmers in Eastern Cape and Free State do not have access to these services. This may have serious repercussion in the control of animal diseases.

6 Conclusions and recommendations

Livestock production in rural areas is still a male dominated activity and on average, male farmers own about twice as many cattle heads as their female counterparts. This is evidence of the gendered nature of livestock farming in rural areas. However, this study did not explore whether there were gender disparities in the ownership of other forms of livestock (i.e chicken, goats and sheep). Although the main reason given for owning livestock was continuation of ancestral main occupation, livestock production serves as financial security for households in times of need, as evidenced by the fact that more than 50% of the households had sold cattle in the previous year, and the most common reason given for selling was to meet household needs.

While the majority of the farmers knew about LSD, knowledge about RVF was lacking. LSD is perceived as the most severe disease hence it is of paramount importance that veterinary services pay particular attention to this disease as it has significant economic implications. It also emerged in this study that most farmers, irrespective of their education level, have not received any training relating to primary animal healthcare. Thus there is a need to support farmers in terms of training. Capacitating smallholder livestock farmers may go a long way in ensuring that animal vaccines and medicines are stored and used in a correct and secure manner. This can in turn improve animal health and their productivity, and consequently raise household income. Given the gendered nature of livestock farming in rural areas, it will be necessary to design training programmes that are gender sensitive and gender inclusive.

In all the five provinces animal vaccines are readily available but the major problem is affordability. Consequently, farmers prefer a vaccine that can be used to prevent multiple diseases and which can be used on a broader spectrum of livestock i.e cattle, goats and sheep. This is worth noting considering that most farmers are either pensioners or grant beneficiaries. Generally, farmers are able to differentiate between vaccines and medicines and they perceive vaccines as important for disease prevention. Although RVF was not widespread, most farmers

were interested in buying a 2-in-1vaccine for RVF and LSD. It also emerged that most farmers do not know enough about vaccines. If vaccinations are to be considered as an effective disease preventative measure among livestock farmers, it is thus crucial that the issue of proper storage of vaccines be adequately addressed. The effectiveness of existing vaccines solely depends on the preservation of the vaccine's cold chain. This study revealed that vaccines were stored in the same refrigerators where households keep their food items. A proper training and warning mechanism for those farmers is thus essential to avoid potential dangers from such practices. However, the study did not establish if farmers were indeed storing these vaccines at the right temperature. Information inserts inside vaccine packages should also be provided in vernacular languages for those farmers who are not comfortable with the use of English or Afrikaans.

From all study sites, farmers shared similar knowledge, attitude, perception and practices of animal vaccines and their use for disease prevention. The study revealed that there is no significant relationship between gender and farmers' knowledge, attitude, perception and practices of vaccines. When this matter was unpacked further in focus group discussions, a number of gender specific issues were unravelled. These included differences in access to information and knowledge, security for women farmers, cultural norms that prohibit women from getting involved in certain livestock husbandry activities and ability to negotiate livestock prices. These issues are unpacked further in a separate report that focusses on the narratives of smallholder farmers on gender dynamics of livestock farming. Survey results suggest that both male and female farmers have similar understanding about livestock vaccines and their importance in animal healthcare. This, however, does not negate the need for gender integrated planning of interventions in the smallholder livestock sector. It was also observed that education played a minimal role towards farmers KAPP on animal vaccines. This might be due to the value and role that livestock plays to the livelihoods of smallholder farmers, and the social networks that enable those without sufficient literacy levels to be assisted. Farmers acknowledged that technology is always evolving; hence, most of them, regardless of educational level had limited knowledge on vaccines and requested regular training on primary animal healthcare, vaccine use and animal disease prevention and management.

There is need to improve access to information for farmers in terms of disease identification, primary animal health care practices, technical information on livestock production, and product information on the range of animal vaccines and medicines that are available in the market. Different agencies such as ARC, Provincial Departments of Agriculture, National Department of Agriculture and farmer organisations should coordinate their efforts to assist smallholder livestock farmers. Multiple methods of information dissemination, that include farmer field days, study groups, and social media should be utilised. There could also be local level central points of information established, so that farmers can easily access the information. To deliver livestock vaccines and other animal health care products that are responsive to real, not perceived needs of farmers, there is need for collaboration and consistent interaction of various players along the vaccine value chain, which centres on farmers. Bottom up approaches to develop and implement interventions should be promoted to ensure successful delivery of innovative solutions to increase livestock productivity, for poverty alleviation and food and nutrition security among smallholder rural communities.

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