BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF AGRICULTURE AND ENVIRONMENTAL SCIENCE

FACTORS AFFECTING THE ADOPTION AND UTILIZATION OF AN ELECTRONIC LIVESTOCK IDENTIFICATION AND TRACEABILITY SYSTEM IN GOROMONZI: A CASE STUDY OF WARD 12.

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A dissertation submitted in partial fulfillment of the requirements of the Bachelor of Agricultural Science Honours Degree in Animal Health and Production Extension.

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Approval Form

The undersigned certified that they have supervised and recommended to Bindura University of Science Education for acceptance of dissertation entitled "**Factors affecting the adoption and utilization of an electronic livestock identification and traceability system in Goromonzi: A case study of ward 12".** Submitted in partial fulfillment of the Bachelor of Agricultural Science Honours Degree in Animal Health and Production Extension.

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Declaration

I hereby declare that the research project entitled "**Factors affecting the adoption and utilization of an electronic livestock identification and traceability system in Goromonzi: A case study of ward 12"** submitted to Bindura University of Science Education, Department of Animal Science is a record of an original work done by me under the guidance of my project supervisor. This work is submitted in partial fulfillment of the requirements for the award of the Bachelor of Agricultural Science Honours Degree in Animal Health and Production Extension. The results embodied in this dissertation have not been submitted to any University or Institute for the award of any degree of diploma.

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Abstract

The main objective of the study was to determine factors affecting the adoption and utilization of an electronic livestock identification and traceability system in Goromonzi District ward 12. The researcher identified three (3) factors which influenced the adoption and utilisation of an electronic livestock identification and traceability system namely: i) the unsanctioned movement of diseased animals within the district, ii) the need for communal farmers in Goromonzi ward 12 to have access to international markets and lastly iii) the ever increasing cases of ownership wrangles as well as stock theft within the district. The study's primary population were livestock owners in Goromonzi Rural District Ward 12, which serves as the district's livestock hub. Three hundred and Three (303) cattle owners are recorded at Nyachivi dip tank. The researcher used stratified random sampling method which is also referred to as proportional or quota sampling method. The population was divided into five (5) strata: farmers, abattoirs, partners (NGOs) veterinary officers and Zimbabwe Republic Police. The study recorded a response rate of 97% and the majority of the respondents were males who accounted for approximately 65.5% of the respondents and females were 34.5%.The results illustrated that the majority of the respondents agreed (43.1%) that the adoption and utilization of electronic identification and traceability system in Goromonzi district reduces the spread or movement of diseased animals to abattoirs. Furthermore, the results indicated that the majority of the respondents were neutral (31.0%) about the influence the electronic identification and traceability of cattle on having access to European markets.

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I'd want to convey my heartfelt appreciation to my research advisor, Mr. K. Kunaka, who paid the ultimate price and committed so much valuable time to provide assistance and useful criticism on this research project. All various departments' members of staff and the University at large deserve special recognition for their skills and experience in advancing my educational career. Moreover, I am grateful to Animal health Services, Mashonaland East colleagues, and friends who made available unwavering support throughout my research.

Dedication

This Research Study is dedicated to my late father Mr. Murewa Stephen

Table of Contents

List of Tables

List of Figures

List of acronyms

AIRT	Animal Identification Recording and Traceability
ILRI	International Livestock Research Institute
FAO	Food and Agriculture Organization of the United Nations
LITS	Livestock Identification and Traceability System
GPS	Global Positioning System
ICAR	International Committee for Animal Recording
MDAs	Ministries, departments, and agencies
NAITS	National Animal Identification and Traceability System
RMPA	Red Meat Producers Association
RFID	Radio Frequency Identification
ODK	Open Data Kit

CHAPTER ONE

1.0 Introduction

The concept of livestock identification has been motivated by different factors around the world (Kim, et al.,2017). Several studies have attempted to address why farmer need to implement various livestock identification systems and conclusions varied from study to study and from region to region. Studies have also indicated that the traceability of livestock was specifically targeting the movement of livestock from their date of birth up until the animal has been slaughtered as well as the processing location (Congressional Research Services , 2010). Various organisations including those responsible for safety of food, international animal health as well as world associations have concurred that these animal identification and traceability systems are valuable to all the global players in the beef industry (Schroeder & Tonsor, 2011). The increase in both local and international demand in livestock products as well as emerging opportunities in the exportation of livestock products has contributed towards the massive investment in infrastructure as well as processes. Studies have also indicated that animal traceability is part of the sanitary control systems within the processing of food of livestock origin. In addition, animal traceability provides the connection amongst animal health, public health as well as food safety and quality (Department of Agriculture, forestry and fisheries, 2018).

In this study, the primary focus was to establish the factors which influence the adoption and utilisation of an electronic identification and traceability system in Goromonzi district, ward 12.

1.1 Background of the Study

Animal Identification (ID) is an ancient tradition (Sehularo, 2021). Researchers observed that animal identification has traditionally been motivated by ownership rather than health concerns (Malusi & Falowo, 2021). However, contemporarily animal ID and traceability are primarily motivated by concerns about animal health and food safety. In many countries especially those trading in animals and animal products traceability of animals and products of animal origin is a legal requirement. The concept of traceability system was founded on the ability to identify individual animals or homogenous groups of animals, the ability to track their movements, proper identification of premises, and recording information in appropriate registers (Gwala-, et al., 2016) It has also been observed that effective Animal ID and traceability system is dependent on participation of all stakeholders (Hangara-, et al., 2011). In addition, animal ID and traceability system should aim to achieve traceability throughout the animal production and food

chain in line with international standards set by the World Organization for Animal Health (OIE) and the Codex Alimentarius Commission (CAC) production continuum. Bailey & Slade, (2004) observed that the US government considered adopting an identification system as a result of the outbreak of the Bovine Spongiform Encephalopathy (BSE or Mad-Cow Disease) in 2003. The study further observed that the National Identification Work Plan (NIWP) was the first formal public initiative in the United States to investigate the feasibility of implementing a U.S. animal ill system.

In addition, European countries have also attempted to adopt the electronic animal identification and traceability system. In the United Kingdom, the outbreak of the foot-and-mouth disease (FMD) in early 2000s expedited the adoption of the electronic system. Studies indicated that during the initial stages of the FMD disease more than 57 premises were affected (Scudamore, 2002). As at September 2001, at least 6 million animals were infected and as such the disease spread to other countries such as Netherlands, France and Ireland.

Furthermore, the adoption of the electronic animal identification and traceability system was also motivated by the outbreak of deadly diseases such as FMD in Asia. FMD outbreaks were reported in Korea between 2000 and 2010 which prompted their central government to adopt the electronic system (Korea Rural Economic Institute (KREI), 2011). It was observed that the FMD outbreak was more severe during the period 2010-2011 as close to 3.5 million head of animals were culled. Severe losses were recorded in the direct supply in the dairy and beef sectors (Korea Rural Economic Institute (KREI), 2011). Studies estimated that the total economic impact of the FMD outbreak in South Korea was within the region of US$3.2 billion which prompted the fast transition to the electronic identification system (Moon , Park, & Soh, 2013). Given that FMD epidemics can cause such enormous and unanticipated economic losses in a region or country, there are significant economic incentives to develop public policies that can aid in minimising or limiting the effects of FMD outbreaks. Such public polices advocates for the adoption of an electronic identification system which helps governments across the globe to identify and trace the infected animals and administer the necessary measures which minimise the economic effects of such outbreaks.

Mutua, et al., (2018) attempted to develop and test a livestock identification and traceability system (LITS) along the Northern Tanzania-Narok-Kenya beef value chain. The electronic

identification system was designed so that it's reliability could be tested. Meat and blood samples were gathered from slain animals and used to assess the reliability of the project's online trace-back system. The system was adopted such that diseased animals moving between Kenya and Tanzania could be traced and identified. Their study identified that animal identification can only contribute to disease surveillance and food safety if identification programmes are linked to traceability. Furthermore, theory also claimed that traceability systems allow animals or their products to be tracked back to farms of origin via market channels.

Studies in Southern Africa specifically in Eswatini and Namibia already have operational identification and traceability systems. Swaziland's traceability system, known as the Swaziland Livestock Information and Traceability System (SLITS), was launched in 2012. A similar programme was launched in Namibia, where the Namibian Livestock Identification and Traceability System (NamLITS) was expanded to cover previously excluded Northern Communal Areas (NCAs) beginning in 2010, where more than half of Namibia's cattle are located. The systems developed in Eswatini and Namibia targeted communal farmers who were previously not able to export their meat products to Europe where there is a deficit of meat products.

Cases of stock theft and illegal movement of diseased livestock to farms are on the rise in Goromonzi district despite having electronically tagged 1600 cattle for identification and traceability (Ministry of Agriculture, 2020). The report specifically mentioned that stock theft at Nyachivi Dip tank remains high, and animal straying from one farm to another has remained uncontrolled (Ministry of lands,agriculture and fisheries , 2020). Permits for manual movement are still in use but compliance by farmers has been very low. There is no cooperation on the use of Radio Frequency Identification (RFID) electronic ear tags among farmers, abattoirs, and the veterinary department. The freedom of movement of animals from one site to another raises the possibility of disease transmission and, as a result, the contamination of meat products (Brester, et al., 2011). Furthermore, Zhao, et al.,(2017) suggested that establishing the health of living cattle and identifying diseases early is critical for greater consumer awareness and food safety in the supply chain. Cattle identification is an important ethical issue since it affects human health, cattle production, preservation, and management (Malusi & Falowo, 2021). This has however

not been the case in the district of Goromonzi as more cases of the movement of diseased animals has the potential of threatening human health.

It is also observed that in some parts of the district cattle can be raised in several regions and then traded before slaughter without proper documentation (Ministry of lands,agriculture and fisheries , 2020). Even the slaughtering process might take place far from the original location of the animal, and it may lack recognised information regarding the genuine source of cattle.

Another study conducted in Zimbabwe attributed the adoption of an electronic system in Zimbabwe to veterinary concerns which include diseases such as mad-cow as well as the fact that it's now part of the best animal practises (Zawe, 2021). The report suggested that such an electronic system would allow farmers and other stakeholders in the livestock industry to track the animals back to the origin of the problem. In addition, the study also identified that the adoption of the electronic identification and traceability system in Zimbabwe was motivated by the need to export livestock products to the European Union (EU). The EU regulations made it mandatory that the system be in place such that Zimbabwe could be able to export its livestock products to the EU markets. The electronic identification system has a unique property ID which identifies where the livestock are kept as well as a unique animal ID which identifies the animal in question.

The Animal Identification Trust (LIT) was founded in 1999 with the express purpose of implementing the Zimbabwe Cattle Traceability Scheme (ZCTS) in order to ensure that the Zimbabwean beef industry meets the international requirements for continued trade in beef and beef products, primarily to the European Union. Despite having been established way back and with its benefits the absorption of animal ID and traceability has slowly been absorbed within the Zimbabwean context. On the other hand, factors such as EU Regulation 820/97 which demands traceability to farm of origin of beef commerce in the EU prompted the Zimbabwean Ministry of Agriculture, in collaboration with stakeholders, to install Radio Frequency Identification ear tags at Nyachivi Dip tank in Goromonzi District (Ministry of lands,agriculture and fisheries , 2020). The South African LITS observed that livestock identification and traceability also aids in the fight against animal theft and illegal livestock importation.

Studies have also indicated that the concept of cattle traceability does not only aids in disease prevention, but it also enhances the possibility of beef exports especially for those countries

whose economies are based on agricultural activities (Gwala, at al., 2016). Given, the above background several countries have adopted several animal identification systems based on different factors (Brester, at al 2011). However, in Goromonzi District the majority of smallholder farmers sell their cattle in informal markets, where adequate animal records are not required which threatens the health of humans. Studies have also observed that one of the reasons why smallholder farmers are unable to access official markets is a lack of achieving international standards set by international bodies.

1.2 Statement of the problem

As has been observed by the Department of Veterinary Services, (2021) rampant cases of illegal movement of cattle which resulted in the movement of diseased cattle to safe regions are on the rise in Goromonzi District. The Veterinary Services department in Goromonzi district office reported that cases of animal diseases rose from 204 cases in 2019 to 775 cases in 2022. This was a 280% increases in diseases such as Theileriosis, Gall sickness, lumpy skin diseases, dematophilosis as well as Foot and Mouth Diseases (FMD). Efforts were made to tag 1600 cattle for identification and traceability using electronic methods (Ministry of lands,agriculture and fisheries , 2020) however the problem persisted. Goromonzi was declared a FMD free zone, however with the electronic system in place cases of FMD in Goromonzi district are rising. This contradiction prompted the researcher to find factors affecting the adoption and utilization of an electronic Livestock Identification and Traceability system in Goromonzi District Ward 12.

1.3 Main objective of the study

To determine factors affecting the adoption and utilization of an electronic livestock identification and traceability system in Goromonzi.

1.3.1 Specific Objectives

1. To determine whether the movement of diseased cattle to abattoirs influences the adoption of an electronic identification and traceability system of livestock in Goromonzi district, ward 12.

2. To determine if the need to have access to European markets influences the adoption of the electronic identification and traceability of livestock in Goromonzi district, ward 12.

3. To determine if ownership of livestock contributes to the adoption of electronic identification and traceability of livestock in Goromonzi**,** ward 12.

1.4.1 Main Research Question

What are the factors that influence the adoption and utilization of electronic animal identification and traceability system in ward 12 of Goromonzi district?

1.4.2 Minor Research Questions

1) In what ways does the movement of diseased cattle to abattoirs influences the adoption of an electronic identification and traceability system of livestock in ward 12 of Goromonzi district?
2) Does the need to have access to European markets influences the adoption and utilization of the electronic identification and traceability of livestock in ward 12 of Goromonzi district?
3) Does the need to identify ownership of livestock contributes to the adoption and utilization of an electronic identification and traceability of livestock in ward 12 Goromonzi district?

1.5 Justification of the study

The study is of great significance to various stakeholders in the agricultural industry and some of the identified stakeholders are explained below.

1.5.1 The Government

The study is significant to the government in the field of livestock as measures to improve cattle identity and traceability at the national level, allowing it to enter the lucrative beef market on a global scale. Furthermore, the study will assist the government in making policy decisions regarding livestock management for the benefit of farmers and the nation. The Zimbabwean government has a National Livestock Development Policy that intends to help small-scale producers' incorporation into the official market chain. This will also result in the acknowledgement of the value addition of animal products that are suitable for the international market and are disease free.

1.5.2 Department of veterinary services

The findings of the study project will be used by veterinary services to develop farmer training on the necessity of animal identification and traceability. The Veterinary department would employ this electronic system to reduce cases of cattle theft with other government departments like the Zimbabwe Republic Police.

1.5.3 Communal farmers of Goromonzi ward 12

The communal farmers of ward 12 would be more aware of the significance of real-time livestock identification and traceability as they will be able to obtain bank loans with RFID ear tags as collateral. The tracking system with RFID ear tags protects farmers' cattle from stock theft and will also be able to have access to lucrative international markets.

1.6 Limitation of the study

The study was conducted within a limited time frame and hence could not cover the whole district. However, the researcher selected a sample for the study which was well representative and unbiased to capture the diversity within the district of Goromonzi. In addition, ward 12 Nyachivi dip-tank selected has the highest population of livestock within the district hence the population and the sample from the population were well represented.

1.7 Delimitation of the study

This study was limited to the Goromonzi District and only one dip tank out of the district's 32 dip tanks. As a result, while the results cannot be generalised nationally, they can be used to develop intervention strategies to improve the existence and operation of livestock identification and traceability on a national and international scale. It was attended by veterinary extension supervisors, veterinary extension workers, livestock development committees, non-governmental officers, and abattoir personnel. The purpose of this study was to identify the factors that influence livestock identification and traceability at the Goromonzi District communal dip tank.

1.8 Assumption of the study

The study was based on the following assumptions:

The adoption and utilization of an electronic identification and traceability system would ensure that:

i) Communal farmers in Goromonzi district ward 12 would be able to have access to international lucrative markets
ii) Livestock would be easily traced in the event of being stolen or getting lost.
iii) Livestock is easily identified and lastly
iv) The movement of diseased livestock to abattoirs is minimized

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

In this chapter, the researcher focused on the studies previously conducted to determine the factors that influenced the adoption and utilization of an electronic livestock identification and traceability system. The chapter also focused on identifying the research gap left by previous studies such that this research will be well-positioned within the literature of studies focusing on factors influencing the adoption of an electronic livestock identification and traceability system.

2.2 Definition of Key terms

Radio Frequency Identification (RFID) is an electronic system which is capable of conveying the identity (which is captured using an inimitable serial number) for either an object, animal or person using wireless radio waves (Bailey & Slade , 2004). Kim, et al., (2017) observed that the system is based on two recyclable as well as programmable RFID tags which are known separately as transponders and readers which are also known as interrogators. Brester , et al., (2011) observed that the advantage of using such tags is on their ability to be attached or built – in on any item and it possesses adequate storage capacity.

The Congressional Research Services , (2010) defined Animal identification (ID) as the practise of keeping records on individual farm animals or groups of farm animals in order to easily track them from birth through the marketing chain. Animal identification was originally used to identify owners and prevent theft, but the reasons for identification as well as animal tracking have been changing such that quick response to animal health as well as concerns on food safety are also key reasons for animal identification (Korea Rural Economic Institute (KREI), 2011).

The Canadian Food Inspection Agency, (2022) defined Livestock traceability as the use of modern technology to follow or track down a single animal or a group of animals from one particular point in the supply chain to another. The livestock traceability system is generally built around three key components namely:

i) Identification of animal
ii) Premise identification as well as
iii) The movement of animals

Studies have observed that the concept of traceability is a crucial and effective tool which plays a pivotal role in many areas including food safety as well as animal and public health (Hangara , Teweldemedhin , & Groenewald, 2011).

2.3 Legal framework regarding animal traceability

There are several legal frameworks which has been laid down to control the movement of animal from the point of birth throughout the value chain of the livestock. It has also been observed that these laws have been instituted by different organisations but with a common goal of protecting consumers from diseased animals. The main organisations which instituted these laws include the Food and Agriculture Organisation (FAO) of the United Nations and the European Parliament.

2.3.1 The Food and Agriculture Organisation (FAO) of the United Nations

"Law No. 287-Z "On identification, registration, traceability of agricultural animals (herds), and identification and traceability of foodstuffs of animal origin".

In order to obtain reliable data, the above quoted law established legal and organisational grounds for the identification, registration, and traceability of agricultural animals (herds), as well as the identification and traceability of foodstuffs of animal origin. It applies to the breeding, keeping, transferring, slaughtering, trading, and other issues concerning the management of agricultural animals (herds) on national territory, as well as the processing, trade, and recycling of animal-derived foodstuffs.

The provisions of this Law, in particular, applied to meat, milk, and dairy products. The aforementioned issues are regulated by the state through public authorities. The state information system must include information about the owners of agricultural animals (herds), the registration of animals (herds), and the registration of means of identification. The issuance of agricultural animal certificates shall be the responsibility of an authorised state institution. Tags, markings, and microchips are used to identify agricultural animals. Animal identification numbers must be unique and cannot be reissued after death, loss, or slaughter of the animals.

2.3.2 Regulation (EU) 2016/429 on transmissible animal diseases

Its goal was to prevent and control animal diseases that can be transmitted to humans or other animals. The animal health law was part of a package of measures proposed in May 2013 by the

European Commission to strengthen the enforcement of health and safety standards throughout the Agri-food chain.

In terms of sustainability, competitiveness, growth, and job creation, this comprehensive regulation benefits the European Union (EU) livestock and food production sectors, as well as the related EU market. It replaced and expanded the existing EU animal health rules, combining the majority of them into a single, simpler law that focuses on the key priorities in disease control. Among these priorities are:

- Clearly defined duties and responsibilities for the farmers (livestock, fish, and shellfish farms) as well as other stakeholders in the industry including veterinary doctors in terms of early detection in order to prevent major disease outbreaks or prevent diseases from spreading to limit their damage;
- The administration of international trade in specified live animals to be made simple as well as animal products such as semen, ova and embryos;
- a clearer legal foundation and better tools for veterinary authorities to combat potentially lethal transmissible diseases, particularly for surveillance, diagnosis,
- greater adaptability to local circumstances and emerging issues such as climate and social change;
- reduction of negative effects on animal and human health and the environment

2.4 Factors influencing the adoption and utilisation of electronic livestock identification system

The review of empirical literature suggested that there are several factors that influence the adoption and utilisation of an electronic livestock identification system. In this section of the study, the researcher provided several factors why different countries in different regions of the world adopted different livestock identification systems.

2.4.1 Ownership, Stock theft and the role of Radio Frequency Identification ear tags in livestock production.

Stock theft is defined as the acquisition of stolen stock or produce, entering enclosed land with the intent to steal stock or produce, and the theft of any produce from a person other than the owner or person having lawful custody of the stock from which such produce is derived or obtained. The Zimbabwe Republic Police (ZRP) has reported that nearly 3800 cattle have been stolen across the country and nearly 336 suspects were arrested (Herald, 2022). This indicates

that the use of Radio Frequency Identification ear tags need to be employed to reduce the cases of stock theft across the country. Maluleka et al, (2016) noted that the cases of stock theft has resulted in farmers incurring costs to improve livestock security which roughly preceded the financial planning intended for production. However, research on the extent on economic impact, dark figures, and problem areas of rural stock theft remains limited. The study by Maluleka et al, (2016) revealed that the responses of selected farmers noted that there is no single solution tailored to combat this phenomenon. Because authorities are not fully combating this scourge, it manifests itself in rural areas. Their paper was based on detailed stock theft statistics reports.

RFID tags enable farmers to do more than just identify specific animals. The tags and software that goes with them can store an animal's entire history, including weight, age, sex, parturition time, offspring, and medical records. This enables veterinarians, for example, to obtain detailed information about an animal's health by simply scanning the animal's tag. Veterinary officers can quickly isolate animals for treatment, update health records at the point of care, track weight gain in specific animals, correlate feeding programmes with yield, select specific bulls for breeding, and track animal family trees. Livestock are not only valuable assets; they are also the beginning of a food supply chain with serious health and financial consequences if risks are not properly managed (Burger 2004).

Mutasa, et al (2021) attempted to critically analyse and evaluate the extent of stock theft in a rural community in Nyanga, in Manicaland province, of Zimbabwe, taking into account all contributing factors. Their study employed a sample of 64 people in order to investigate and identify the actual perceptions and experiences of Nyanga ZRP Service Stock Theft Unit and local officers, livestock owners, community members, and other relevant stakeholders involved in understanding contributory factors to stock theft crime. However, their study's main findings indicated that the following factors contribute to stock theft in Nyanga District Policing Area: slaughtering of stock to sell to butchery owners; and the alleged involvement of ZRP officers and Department of Justice: Nyanga Magistrates Courts' officials in stock theft. They recommended the use of RFID tags to mitigate the effects of stock theft within the district.

LITS (Livestock Identification and Traceability, RFIDs) assist farmers in managing all aspects of livestock management. By collecting the necessary data, farmers can better manage milking, feeding, breeding, and other activities from birth to slaughter. Farmers who use RFID technology

gain a competitive advantage over those who use traditional tracking methods. RFID offers a number of significant advantages, including time and labour savings, faster identification of diseased animals, more accurate tracking of cattle inventory, and animal authentication.

Dambe and Fombad, (2019) examined the factors that influenced the stock theft in Botswana and they observed that stock theft was common in Botswana, as it is throughout the Southern African Development Community (SADC). The problem compelled the country's parliament to intervene and pass the Stock Theft Act in 1996. However, after 22 years of operation, there is little evidence that the Act's harsh penalties have resulted in a decrease in cattle theft. A more serious issue with the law is that its penalties are imposed by customary courts with few safeguards to ensure that justice is served. In response to widespread public revulsion toward cattle thieves, justice may be sacrificed on the altar of expediency.

2.4.2 The role of Radio Frequency Identification ear tags in monitoring (traceability system) of movement of diseased livestock

The movement of undocumented animals has always been a problem across many African countries (Gwala , Monde , & Muchenje, 2016). In order to control the problems associated with the movement of undocumented animals, governments were urged to adopt and utilize the electronic monitoring system. The RFID is clearly the dominant technology being used to achieve this goal, as there is a growing global trend for countries to implement whole-of-life traceability systems for livestock. In line with this global trend, and to meet the needs of key trading partners (such as the EU), Australia has implemented the National Livestock Identification System (NLIS) to provide whole-of-life traceability for livestock—a system based on RFID devices. As a result, it is proposed that dairy farmers use RFID not only to comply with NLIS requirements, but also to extend the use of RFID onto their farms in order to provide additional benefits for themselves through subsequent improvements in farm management practices.

It was also observed that food safety is a major concern in India due to the inconsistency and unpredictability of the food safety monitoring system, as evidenced by the presence of antibiotics in honey, the increasing use of milk adulterants, and tainted meat (Korea Rural Economic Institute (KREI), 2011). The export of bovine meat from India to Russia was prohibited in 2010, and restrictions on trading food products from the country were imposed. Thus, in order to ensure the quality of our food products and avoid economic and trade barriers, a proper

traceability system must be implemented. Livestock traceability refers to the ability and mechanism for tracing an animal product back to the holding of origin of the live animal from which the product was derived (FAO 2007). Traceability is a method used in the food industry to ensure the identification of animals or animal products (DALVIT et al 2007). Livestock traceability aims to create a network of meat animal producers, processors, and other stakeholders.

It has also been observed that the supporting infrastructure of wireless communication systems has continued to play an important role in modern life Akinsolu, et al (2021). Due to the unprecedented levels of interconnectivity achieved between wireless devices in recent times, many countries are always interested in new insights and paradigms for the robust deployment and better utilization of wireless communication systems for socioeconomic development. According to many scholarly works and news reports, contemporary Nigeria faces the challenge of insurgencies whose funding is linked to proceeds from livestock theft or rustling.

In order to minimize the movement of undocumented as well as the sale of stolen livestock through identification and traceability from 'herds to markets to homes, Akinsolu et al (2021) proposed the design considerations and data communication architecture for Nigeria's national animal identification and traceability system (NAITS) for safer and improved livestock farming and production. Their paper also highlighted and analyzed technical insights into the co-use of radio frequency identification (RFID) and fifth-generation new radio (5G NR) technologies for the implementation of NAITS for a prospective technological policy plan and development in Nigeria.

2.4.3 The need to have access to European markets influences and the adoption and utilization of the Radio Frequency Identification ear tags.

Traditionally, animal and livestock identification and traceability were used to establish ownership and prevent theft across the world. However, as a result of consumer demand for comprehensive and integrated food safety policies, the reasons for identification have evolved and become a priority. Controlling animal diseases and gaining access to trade in animals and their products are now critical (Malusi & Falowo, 2021). It has been observed that the tracking of livestock has become more difficult as animals are traded multiple times before slaughter in India (Hangara , Teweldemedhin , & Groenewald, 2011). Furthermore, some are slaughtered thousands of kilometers away from their birth farm. Furthermore, the trade of live animals is

common in India, increasing the risk of epidemic disease spread. It can be difficult for some livestock farmers to identify specific animals, such as when breeding strong family lines, because characteristics are passed down through genetics.

Prinsloo, (2017) observed that livestock traceability systems are now mandatory for exporting meat, especially in light of recent food scares and the risk of eating meat from cattle infected with Bovine Spongiform Encephalopathy (BSE), also known as mad cow disease. Furthermore, it has been noted that in Europe there is beef shortage and imports large quotas of meat from developing countries such as Swaziland and Namibia, but the effectiveness of the two countries' traceability systems is non-negotiable due to strict regulations and legislation.

There are several mandatory technical regulations and requirements on the trading of goods and agricultural products that affect trade patterns, and members of the World Trade Organization (WTO) agreed on the TBT and the Application of Sanitary and Phytosanitary Standards (SPS) (Calvin & Krissoff, 1998), paving the way for resolving potential product standard disputes (Maskus & Wilson, 2001). The TBT ensured that there is no unjustified discrimination against specific countries whose products meet all fair trade requirements (Fliess et al., 2018)

Swaziland transitioned from a paper-based system to a modern computerized system known as the Swaziland Livestock Information and Traceability System (SLITS) (Prinsloo, 2017). They began free tagging of communal farmers' cattle in 2010, and fully implemented SLITS in 2014. The system is widely used, and the project's success can be seen throughout Swaziland. On the other hand, Namibia expanded its traceability system, the Namibian Livestock Identification and Traceability System (NamLITS), to track communal farmers' cattle in the Northern Communal Areas (NCAs), which are barred from exporting meat due to the high risk of exposure to foot-and-mouth disease. Their cattle were ear-tagged and captured on NamLITS, ensuring complete traceability (Prinsloo, 2017).

There are several mandatory technical regulations and requirements on the trading of goods and agricultural products that affect trade patterns, and members of the World Trade Organization (WTO) agreed on the TBT and the Application of Sanitary and Phytosanitary Standards (SPS) (Calvin & Krissoff, 1998), paving the way for resolving potential product standard disputes (Maskus & Wilson, 2001). The TBT ensure that there is no unjustified discrimination against specific countries whose products meet all fair trade requirements (Fliess, et al., 2018).

Studies have indicated that Namibia is at high risk of FMD outbreaks due to exposure from Zambia and Botswana, where FMD-carrying buffalo cross borders (Schultz, 2013). According to Schultz (2013), buffalo exposure is difficult to control, with the area above the Namibian Red Line, also known as the Veterinary Cordon Fence (VCF), at high risk of exposure. The Red Line serves as an imaginary line north of which communal farmers could previously not export beef due to the risk of FMD exposure (Kumba, 2003). Studies have also indicated that livestock trading can help to alleviate poverty and promote food security in developing countries. Reliable livestock traceability systems can pave the way for local, national, and international trade; however, it would be ideal if every country could meet its own meat needs. Another millennium goal is to import meat from countries that have a low disease-risk (Rweyemamu et al., 2008). The use of traceability systems significantly reduces the risk of disease outbreaks.

2.5 Radio Frequency Ear-tags

The most well-known method of cattle identification is ear tags (Caja et al., 2014). Ear-tags can be made of metal or plastic, are pre-numbered, come in various sizes, and are inserted with special pliers (Dahlborn et al., 2013). Typically, a small ear-tag with an RFID chip is inserted in one ear, and a larger ear-tag is inserted in the other ear, with the animal number clearly indicated on the larger ear-tag.

2.5.1 Advantages

The ear-tags are simple to use, inexpensive, have no negative effects on animals, and are easily visible (Dahlborn et al., 2013). They are simple to apply, have no problems during or after application, and are easy to read (Kowalski et al., 2014); the plastic ear-tag is long-lasting, and animals of all ages can be tagged.

2.5.2 Disadvantages

Studies have indicated that tags can be lost in the event that they are not accurately inserted (Pinna, Sedda, Moniello, & Ribó, 2006), and in cases of theft, the animal's ears are severed, making identification more difficult, though the animal's branding can be used to identify it.

2.6 Chapter Summary

In this chapter, the literature deliberated provided a detailed description of how and why traceability evolved, briefly touching on agricultural pressures to ensure food security and safety, recent food safety scares, the definition of traceability, and, more specifically, livestock

traceability systems. Legislation and standards are followed by certification, and the chapter concluded with a brief discussion of various countries' implementation of traceability systems.

CHAPTER THREE
RESEARCH DESIGN AND METHODOLOGY

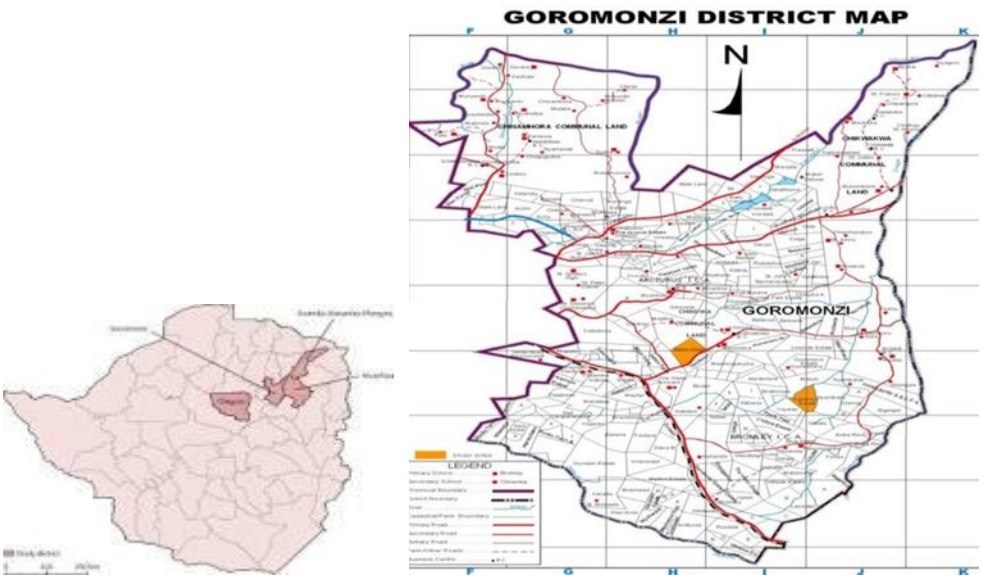
3.1 Introduction

In this chapter, the researcher intends to describe the research design of the study. In addition, the chapter also covered the sample size and sampling techniques employed in this study. The research instruments used in this study are also covered in great detail as well. Furthermore, the validity and reliability of data instruments are explained in great detail, as well as data presentation. A chapter summary is provided to conclude the chapter.

3.2 Project Site

The study was conducted in Goromonzi District of Mashonaland East province in Zimbabwe. The researcher targeted farmers in ward 12 which has the highest concentration of farmers focusing on animal husbandry. The district is located in the eastern part of Zimbabwe and covers an area of approximately 9,100 square kilometres. The district is made up of 25 wards in total. The map showing the location of the study is provided below in Figure 1. The project site is specifically located at Grid referenceUr390400 Latitude -18,0843 and longitude -31,47865

Figure 1: Map of the location of the project site.



Source: Mashonaland East Quantity Surveyor

3.3 Research Population

Several researchers have provided various definitions for a population of the study. Crashaw & Chambers, (2017), defined the population of the study as the pool from which the actual elements for the study, which represent the entire population, would be drawn. Similarly, Dooley (2012) defined a population as the sum of a group or, more precisely, a collection of various elements that are usually similar in nature or have similar characteristics.

Furthermore, Creswell (2013), defined a population as any target group of individuals who share one or more characteristics that the researcher is interested in learning about and drawing conclusions from. The study's primary population was residents of Goromonzi Rural District Ward 12, which serves as the district's livestock hub. Three hundred and Three (303) cattle owners are recorded at Nyachivi dip tank. This was considered too large to work with due to time and financial constraints.

3.4 Sampling Method

The District of Goromonzi is highly diversified, and in order to capture the district's diversity the researcher used stratified random sampling. The method is also referred to as proportional or quota sampling method (Creswell, 2013). The total population was divided into homogeneous

groups by random sampling (strata). The population was divided into five (5) strata: farmers, abattoirs, partners (NGOs) veterinary officers and Zimbabwe Republic Police.

Each group or stratum is formed on the basis of shared or similar characteristics or attributes, such as education level, income, or gender. After that, random samples are drawn from each stratum and compared to one another to arrive at specific conclusions. The method is credited with producing an unbiased sample that accurately represents the entire population. It is also beneficial in terms of enabling efficient and accurate data collection. A smaller, more relevant sample means a more manageable and cost-effective research study.

However, because the sampling method necessitates more administration, researchers must account for this extra time and order. Finally, when strata are defined, researchers may have prior knowledge of the shared characteristics of the population, which increases the risk of selection bias.

3.5 Sample Size

A sample is defined as a subset or a fraction of the entire population from which study participants will be carefully chosen (Hale, 2013). As mentioned earlier, the population was made up of cattle owners in Goromonzi ward 12 who were amounting to 303. These were targeted so that the researcher would gain an understanding of the factors that influence livestock traceability and identification through their direct personal experiences.

Furthermore, Saunders et al., (2003) defined a sample size by using 10-20% of the targeted population. The sample was selected using stratified random sampling and the purposive sampling technique were used. This specific group was chosen because they were the primary source of information and were convenient for the researcher. In order to determine the sample size from the population the researcher employed the modified Cochran Formula for Sample Size calculation in smaller populations which is stated below:

$$n = \left(\frac{z^2 * p(1-p)}{e^2}\right)/\left(1 + \left(\frac{z^2 * p(1-p)}{e^2 N}\right)\right.$$

Where, n is the sample size to be calculated, z is the z-score which is in this case at 95% confidence level (1.96), p is the standard deviation which is generally assumed to be 0.5, e is the

margin of error and lastly N is the size of the population. Given this values the sample size would then be calculated as follows:

$$n = \frac{\frac{(1.96)^2 * 0.5(1-0.5)}{(0.05)^2}}{1 + \left(\frac{(1.96)^2 * 0.5(1-0.5)}{(0.05)^2 * 303}\right)} = 60.2795$$

As indicated in the above illustrations, the researcher employed a sample of 60 individuals who were selected based on their possession of cattle and experience in using electronic systems.

3.6 Data Collection Tool

There is a need for data collection in order to achieve the study's objectives. Researchers use a variety of methods to collect primary data, including questionnaires, interviews, and observation (Kothari, 2004).

Since the primary goal of the study was to assess the factors that influence the adoption and utilisation of electronic livestock identification and traceability system in Goromonzi District ward 12, the primary data collection instrument used was a questionnaire distributed to the respondents who made up the sample. The researcher used 60 respondents from the specified ward in Goromonzi district. As previously stated, the primary data collection instrument used in the study are questionnaires. The advantage of using questionnaires is that they can consider a larger audience than other data collection methods such as interviews. However, unlike other data collection instruments, questionnaires are extremely difficult to tailor to individuals. The questionnaire is included as an appendix to the study. The data collection process entails gathering all relevant data for case study research, such as interviews, observations, official documents, media articles, and websites.

According to the studies reviewed, the questionnaire was the most commonly used data collection tool. Questionnaires were used as the main method to describe people's attitudes and the practical use of electronic traceability and identification systems. In order to encourage a high response rate, the questionnaire was designed with a cover letter which explained the purpose of the study as well as the confidentiality of information.

However, Questionnaires are discredited for ask pre-defined questions in a particular order (Oates, 2015) and do not allow the researcher to go back and ask something else or request additional explanations.

The questionnaire used in this study was previously used in Prinsloo's study on the Livestock Traceability Systems in Eswatini and Namibia (2017). The researcher ensured that the questionnaire included all of the study's research objectives as well as all of the variables that the study intended to use.

3.7 Data Analysis procedures

SPSS statistical software version 20 (2018) was used to analyse the data. Tables and graphs were used in the study to help interpret quantitative and qualitative data. The responses were entered into SPSS for analysis. In terms of the research's validity and reliability, the reliability primarily describes the correctness and appropriateness of the research's conduct. According to Saunders et al. (2009), the authenticity of information, methods of analysis, and the reliability of the source define the reliability. The author attempted to ensure the study's dependability. Almost all of the information used and presented in this study was gathered from reliable sources and analysed in a logical and insightful manner.

3.8 Regression Analysis

In order to determine the factors that influence the adoption and utilization of an electronic livestock identification and traceability system in Goromonzi, the researcher employed a regression model specified below.

$$\gamma = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon_t$$

Where

$\beta_0 = Constant,\ \beta_1 = Coefficient\ of\ movement\ of\ animals\ \ (X_1), \beta_2 = Coefficient\ of\ Access\ to\ European\ Markets\ (X_2),$

$\beta_3 is\ the\ coefficient\ of\ Identification\ of\ cattle\ (X_3), \varepsilon_t\ is\ the\ error\ term$

3.9 Chapter Summary

The chapter provided a thorough overview of the research design and approach. The study also identified a questionnaire as the primary data collection instrument or tool. The factors that influenced the adoption and utilisation of an electronic livestock identification and traceability

system in Goromonzi District ward 12 would be studied using a sample of Sixty (60) respondents. Furthermore, the chapter discussed data analysis techniques, as well as the research study's validity and reliability tests. The researcher would provide data analysis in chapter four (4), and the results of the analysis would also be interpreted in the same chapter which is also the following chapter.

CHAPTER FOUR
RESULTS OF THE STUDY

4.1 Introduction

In this chapter, the researcher analysed the data obtained from the questionnaire in order to achieve the objectives of the study. A detailed description under different sub-questions was provided such that all the objectives are clearly presented and explained which also help bring light the factors that influence the adoption and utilisation of electronic ear tagging of cattle in Goromonzi district ward 12. The study employed the use of a questionnaire as the main research instrument in which a descriptive approach was employed. In addition, the outcome of the study was described through the use of presentations, analysis as well as interpretation of data. The data is presented in tables and figures such as graphs and pie charts.

4.2 Response rate

The study had a targeted sample of 60 individuals drawn from across various stakeholders in the veterinary, police services as well as NGOs. However, only 58 of the targeted individuals managed to participate in the study. The response rate is therefore calculated as follows:

$$\frac{58}{60} * 100 \approx 97\%$$

From the above calculations, the study had a response rate of 97%. Creswell, (2014) revealed that a response rate of 65% and above is considered as appropriate for a study to be valid.

4.3 Distribution of respondents by gender

The majority of the respondents were males who accounted for approximately 65.5% of the respondents and females were 34.5%. The results showing the demographic distribution of the study are illustrated in table 1 below. The table shows that there were 38 males and 20 females with their corresponding percentage indicated in Table 4.1 below.

Table 1: Demographic Distribution of the study

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	38	65.5	65.5	65.5
	Female	20	34.5	34.5	100.0
	Total	58	100.0	100.0	

Source: SPSS computations

Table 4.1 above indicates the demographic distribution of the study and as indicated the study was dominated by males followed by females.

4.4 Highest Academic Qualifications of the respondents

The questionnaire also captured the academic qualifications of the respondents to ascertain the ability of the respondents to respond to the needs of the questionnaires as well comprehending the nature of the study. The frequencies of the respondents with highest academic qualifications of the respondents are indicated in the table 4.2 below.

Table 4.2: The distribution of respondent's academic qualifications

Highest Level of Academic Qualifications

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Diploma	11	19.0	19.0	19.0
	Bachelors	8	13.8	13.8	32.8
	Masters	4	6.9	6.9	39.7
	Others	35	60.3	60.3	100.0
	Total	58	100.0	100.0	

Source: SPSS Computations

The table above indicates that the majority of the respondents had other qualifications which were usually secondary school certificates. These individuals were approximately 60.3%. The majority of the respondents who had secondary school qualifications were farmers and police officers. In addition, the second highest academic qualifications were those with a 19% representation. Furthermore, 13.8% of the respondents had first degrees and lastly 6.9% had Master's degree. The majority of the veterinary services officers and NGO workers had either a bachelor's degree or a master's degree.

4.5 Age groups of the respondents

The questionnaires also captured the age of the respondents and the majority of the respondents were aged between 41-50 years representing 34.5% of the sample. This was followed by those above 50 years representing 32.8% of the sample. The study also had 27.6% of the respondents

aged between 30-40 years. Lastly, those aged below 30 years had a presentation of 5.2%. The age groups of the respondents are depicted in table below.

Table 4.3: Age group of the respondents

Age of the Participants

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Below 30 years	3	5.2	5.2	5.2
	30-40 years	16	27.6	27.6	32.8
	41-50 years	20	34.5	34.5	67.2
	Above 50 years	19	32.8	32.8	100.0
	Total	58	100.0	100.0	

Source: SPSS Computations

4.6 Positions of the Respondents

The questionnaire also captured the position of the respondents to determine if the respondents are relevant to the study. In addition, the position of the respondents also ensures that the respondents are familiar with the questionnaire and could provide responds to the best of their knowledge. The positions of the respondents are illustrated in table 4 and figure 2 below.

The table indicates that the majority of the respondents who participated in the study were farmers represented by approximately 77.6%. Other participants from NGOs also participated in the study representing approximately 12.1% of the respondents. Lastly police officers and veterinary services officers had a 5.2 presentation each. The results for the positions of the respondents are depicted in table 4 and figure 2 below.

Table 4.4: Positions of the respondents

Type of Position

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Farmer	45	77.6	77.6	77.6

	Veterinary Officer	3	5.2	5.2	82.8
	Police Officers	3	5.2	5.2	87.9
	Others	7	12.1	12.1	100.0
	Total	58	100.0	100.0	

Source: SPSS Computations.

4.7 Experience of the respondents

The last question of section A captured the experience measured in years of the respondents. The results for the experience of the respondents in years are depicted in Table 4.4 below

Table 4.5: Number of years of experience for the respondents.

Years of experience in veterinary services

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 5	17	29.3	29.3	29.3
	5-10 years	38	65.5	65.5	94.8
	11-15 years	1	1.7	1.7	96.6
	Above 15	2	3.4	3.4	100.0
	Total	58	100.0	100.0	

Source: SPSS Computations

The study was dominated by respondents with years of experience between 5-10 years representing 65.5%, followed by those with less than 5 years of experience representing 29.3%. Those with experience exceeding 15 years were 3.4% and lastly those between 11-15 years were 1.7%.

4.8 Does the movement of diseased cattle to abattoirs influences the adoption of an electronic identification and traceability system of livestock in Goromonzi district, ward 12.

In section B of the questionnaire, the researcher wanted to establish if the movement of diseased cattle to abattoirs influences the adoption of an electronic identification and traceability system of livestock in Goromonzi district in ward 12. The results for this question are illustrated in figure below:

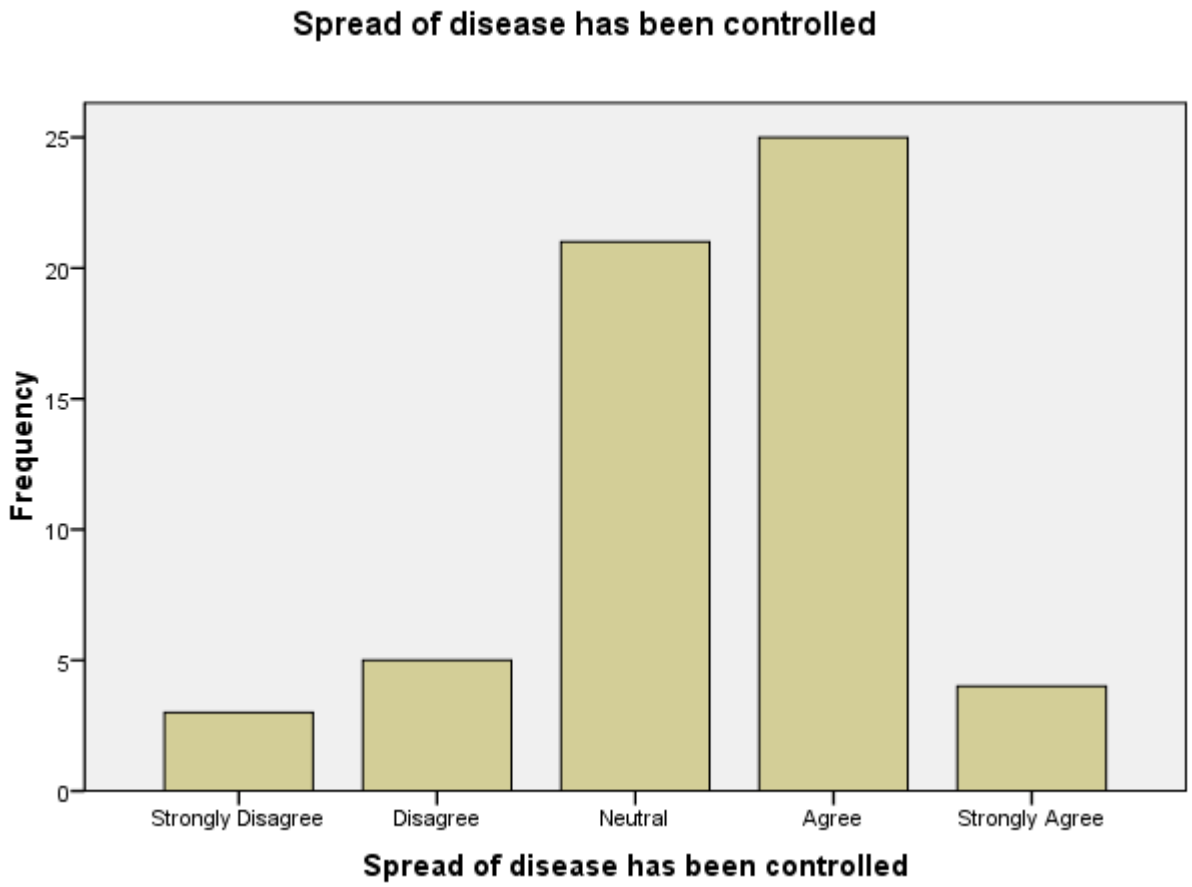


Figure 1.1: The use of electronic identification and traceability system reduces the spreading of diseases

Source: SPSS Computations

The results illustrated above depicts that the majority of the respondents agreed (43.1%) that the adoption and utilization of electronic identification and traceability system in Goromonzi district reduces the spread or movement of diseased animals to abattoirs. In addition, 36.2% of the respondents were neutral about the use of an electronic identification system reducing the movement of diseased animals to abattoirs in Goromonzi district. However, 8.6% of the respondents disagreed whilst 5.2% strongly disagreed. The percentage of respondents who strongly agreed was 6.9%. The total percentage (50%) of respondents who either strongly agreed (6.9%) or agreed (43.1%) was greater than those (13.8%) who disagreed (8.6%) and strongly disagreed (5.2%).

4.9 Does the need to have access to European markets influences the adoption of the electronic identification and traceability of livestock in Goromonzi district?

Another objective of the study was to determine if the adoption and utilization of an electronic system is influenced by the need to have access to lucrative markets in Europe. The results of this objective are depicted in table 5 below:

Table 4.5: The need to have access to lucrative markets influences the adoption and utilisation of an electronic identification system.

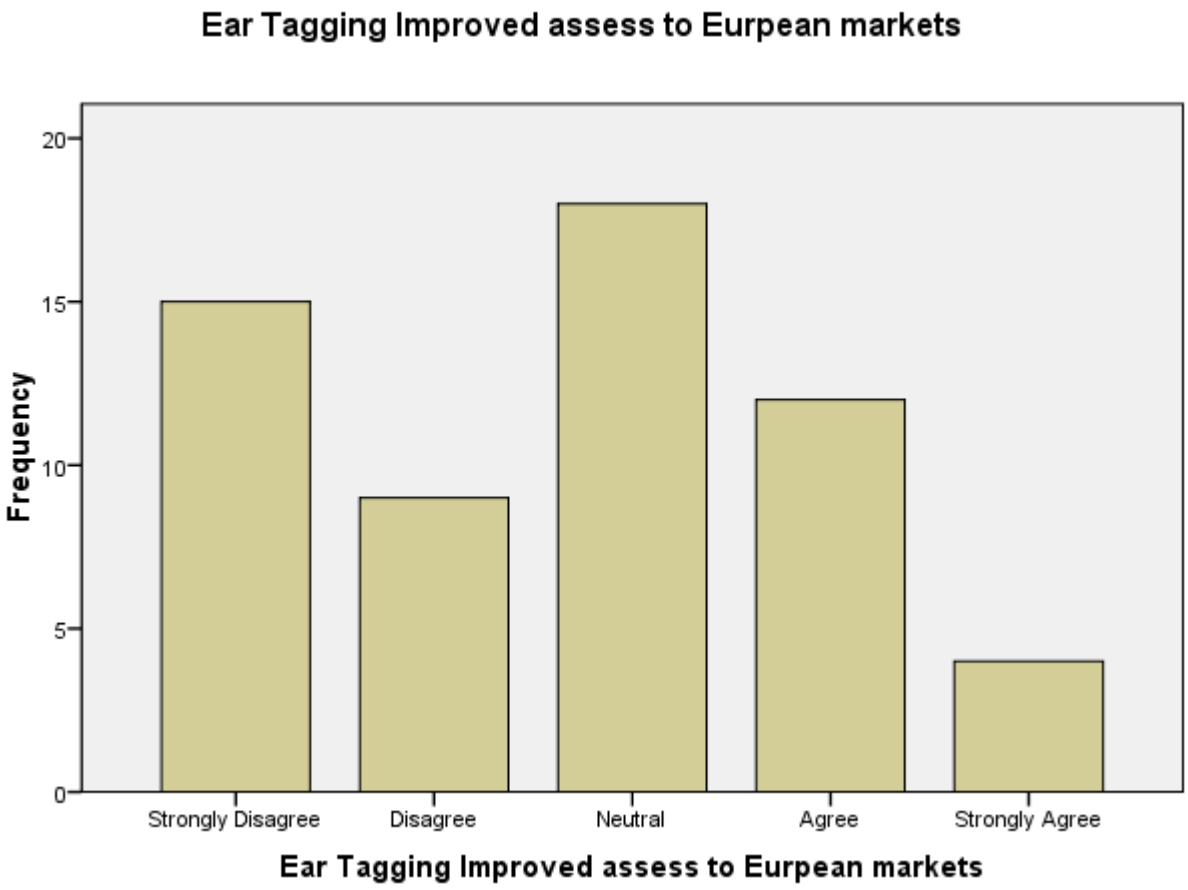
Ear Tagging Improved access to European markets

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	15	25.9	25.9	25.9
	Disagree	9	15.5	15.5	41.4
	Neutral	18	31.0	31.0	72.4
	Agree	12	20.7	20.7	93.1
	Strongly Agree	4	6.9	6.9	100.0
	Total	58	100.0	100.0	

Source: SPSS Computations

Table 5 above indicates that the majority of the respondents were neutral (31.0%) about the influence the electronic identification and traceability of cattle on having access to European markets. Approximately 25.9% of the respondents strongly disagreed whilst 15.5% disagreed that the use of an electronic identification system allows the farmers to have access to European markets. On the other hand, 20.7% of the respondents agreed whilst 6.9% of the respondents strongly agreed that the adoption and utilization of an electronic identification and traceability system does influence the access to European markets. The total percentage (41.4%) of respondents who disagreed (15.5%) and strongly disagreed (25.9%) was greater than those (27.6%) who agreed (20.7%) and strongly agreed (6.9%). The results are also depicted in the pie chat below.

Figure 2: The adoption and utilisation of an electronic identifications and traceability system influences the access to European markets



Source: SPSS Computations

4.10 Ownership resolution and the adoption and utilization of an electronic identification system in Goromonzi District.

The study established the extent to which cattle in Goromonzi district ward 12 are tagged and the results are established in table below:

Table 6: All the cattle in the respondent's pen has been ear tagged electronically

All the cattle has been tagged

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	1.7	1.7	1.7
	Disagree	3	5.2	5.2	6.9
	Neutral	11	19.0	19.0	25.9
	Agree	36	62.1	62.1	87.9
	Strongly Agree	7	12.1	12.1	100.0
	Total	58	100.0	100.0	

Source: SPSS Computations.

The majority of the respondents agreed (62.1%) that all the cattle were electronically ear tagged. On the other hand 12.1% of the respondents strongly agreed that all the cattle in their pen were all electronically ear tagged. 19% of the respondents were neutral about their pen being all electronically tagged. However, 5.2% disagreed and 1.7% strongly disagreed that all the cattle in their pen were electronically tagged. The total percentage (74.2%) of the respondents who agreed (62.1%) and those who strongly agreed (12.1%) was greater than the total percentage (6.9%) those who disagreed (5.2%) and strongly disagreed (1.7%).

As a result of the ear tagging of cattle within Goromonzi district ward 12, the majority of the respondents agreed (44.8%) that the tagging of cattle reduced the ownership wrangles whilst 46.6% of the respondents strongly agreed. In addition, 3.4% of the respondents disagreed whilst 5.2% of the respondents were neutral. None of the respondents strongly disagreed that the ear tagging of cattle within Goromonzi district ward 12 reduced ownership wrangles. The total percentage (91.4%) of the respondents who agreed (44.8%) and strongly agreed (46.6%) is greater than the total percentage (3.4%) those who disagreed (3.4%) and strongly disagreed (0%). The results are depicted in table below.

Table 4.7: Cases of ownership are reduced due to ear tagging.

cases of Ownership wrangles are reduced due to ear tagging

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	2	3.4	3.4	3.4

	Neutral	3	5.2	5.2	8.6
	Agree	26	44.8	44.8	53.4
	Strongly Agree	27	46.6	46.6	100.0
	Total	58	100.0	100.0	

Source: SPSS Computations.

4.11 Regression Results

In order to test the factors that influence the adoption and utilization of an electronic system, the researcher employed simple regression analysis. The results of the regression analysis are illustrated in Table 4.8 below.

The results in Table 4.8 below indicates that the adoption and utilization of an electronic livestock identification and traceability system would reduce the unsanctioned movement of cattle within ward 16 as depicted by a negative coefficient of 0.450. In addition, the need to identify cattle amongst the cattle owners also positively influences the adoption and utilization of an electronic livestock identification and traceability system as indicated by a positive coefficient of 0.228. Lastly, the need to have access to European markets also positively influences the adoption and utilization of an electronic livestock identification and traceability system as depicted by a positive coefficient of 0.180.

Table 4.8: Regression Results of the study

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.955	.475		4.116	.000
	Movement	.419	.114	-.450	3.673	.000
	Identification	.209	.112	.228	1.864	.067
	European Mkts	.160	.114	.180	-1.406	.564

a. Dependent Variable: Use of Electronic System

$$Use\ of\ Electronic\ System_t = 1.955 - 0.450X_1 + 0.228X_2 + 0.180X_3 + error\ term$$

The error term captures other variables that are not mentioned by the study. The negative sign indicates that the unsanctioned movement of cattle within the district is reduced by the adoption and utilization of an electronic system.

4.12 Chapter Summary

In this chapter, the researcher dwelt on the analysis, presentation and interpretation of results using tables, figures and numbers. The data was collected from Veterinary Extension officers, Police officers, NGOs and farmers. The research questions and objectives were employed to scrutinize the problem under scrutiny. A 97% response rate was recorded and the results were presented according to the research objectives of the study to provide easy of analysis and the research uses words to provide explanations and meanings. Analysis as well as discussions of the research outcomes are provided in the following chapter.

CHAPTER FIVE
DISCUSSIONS

5.1 Introduction

This section concentrates on the analysis, interpretation, and discussion of data obtained from Goromonzi Rural District Council ward 12 Veterinary Extension officers, employees of various NGOs, Zimbabwe Republic Police, as well as livestock farmers. The findings have been

examined and summarized, as well as contrasted and compared with published studies, in order supply foundations for attempting to answer the research goals and questions.

5.2 Trends and spatial differences

The results of the study indicated that the adoption and utilisation of an electronic system helps reduce the movement of diseased animals across the district. The veterinary service department in Goromonzi District observed an increasing trend in the movement of diseased animals to various abattoirs coming from various farmers. Most of the farmers were based in ward 12 which has the largest population of livestock across the district. The increase in such a trend would decrease as a result of adopting and utilising the electronic identification and traceability system as depicted by the regression results. Previously, the district recorded alarming levels of diseases outbreak which mainly affected ward 12. In 2019, approximately 204 cases of diseases were reported affecting cattle, whilst in 2022 cases rose to 775. This can be translated to a 280% in various diseases which include Theileriosis, Gall sickness, lumpy skin diseases, dematophilosis as well as Foot and Mouth Disease. The increase in such diseases can be reduced and monitored through the use of an electronic livestock identification and traceability system.

Furthermore, Trevarthen (2016) ascertained that the use of a Radio Frequency Identification (RFID) system which is a form of electronic identification and traceability system minimises increasing trend of diseased livestock in Australia which also validated the outcome of this study. He further observed that in Australia, Canada as well as the United States the electronic livestock management system has emerged as a pre-requirement method of cattle farming.

More so, the study has also established that the adoption and utilisation of an electronic system helps farmers in communal areas enabled access to European markets. Farmers in Goromonzi previously could not have access to external markets but only relied on domestic markets. That had always been the norm and their income from domestic markets was very minimal. As such the study identified that the adoption and utilisation of an electronic system would ensure that the farmers would have access to lucrative markets in Europe. Goromonzi was once a free FMD zone but due to the unmonitored movement of diseased animals cases of FMD, Theilenosis, Gall sickness, lumpy skins and dematophilosis have been increasing within the district.

Lastly, the study observed that ownership wrangles amongst livestock owners have been on the increase within the district. Cases reported to Goromonzi Police Station indicates that in 2019

there were 65 cases of ownership disputes amongst the farmers and in 2022 there were 175 cases reported at the same police station. These statistics indicates that there has been an approximately 170% increase in ownership wrangles. The Congressional Research Service (CRS), (2017) indicated that stray animals which are not monitored are likely to result in ownership wrangles due to striking similarities amongst animals. As part of their solution to the problem the CRS, (2017) suggested that the use of an electronic livestock identification and traceability system would minimise cases of ownership disputes amongst farmers.

5.3 Insightful interpretation of results

Prinsloo, (2018) examined the impact of adopting an electronic identification and monitoring system in Swaziland and Namibia and observed that the system was useful reducing the movement of diseased animals within the countries. The results of their study concurred with the outcome of this study in which the researcher observed that the adoption and utilisation of an electronic system reduces the movement of diseased animals. In addition, Trevarthen (2016) also concurred to the outcome of this study by establishing that the use of a RFID system which is another kind of an electronic livestock identification and traceability system helps to abate the disappointing increasing trend of contaminated cattle in Australia. As observed by Trevarthen (2016) authorities in Zimbabwe should also make it mandatory for livestock farmers to have an electronic identification and traceability system which has been adapted as a norm in countries like Australia, Canada as well as the United States. These countries have made this electronic livestock management system a pre-requirement to all livestock farming regions.

In Namibia and Swaziland, Prinsloo (2018) observed that communal farmers gained access to previously inaccessible markets like in Europe where there is huge demand for beef and beef products. The results of this study further concurred with those obtained by Prinsloo in 2018. According to Prinsloo, (2018) the Swaziland Livestock Identification and Traceability system as well as the Namibian Livestock Identification and Traceability system were made mandatory incompliance to international standards and further continue to gain access to the lucrative markets in Europe.

Lastly, a research study conducted by the Congressional Research Service (CRS), (2017) indicated that stray animals which are not monitored are likely to result in ownership wrangles due to striking similarities amongst animals. As part of their solution to the problem the CRS,

(2017) suggested that the use of an electronic livestock identification and traceability system would minimise cases of ownership disputes amongst farmers.

5.4 Generalizations of the study

Based on the outcome of this study, the research assumes that the movement of diseased animals within ward 12 of Goromonzi Rural District would decline as a result of the adoption and utilisation of an electronic livestock identification and traceability system. Such a system would enable veterinary officers to trace livestock movement within the district and ensure that only health animals are allowed to be slaughtered at any abattoir in Goromonzi. The system would also ensure that abattoirs would keep information for each slaughtered animal kept in the electronic identification and traceability system for the safety of the consumers.

Furthermore, exports of beef and beef products to Europe are also expected to increase as a result of the new electronic identification and traceability system. The system would provide the historical data of each animal before exporting and also satisfying the key requirements of beef exports to Europe. This is also another way of ensuring that the farmer's income increases and are able to meet the financial needs of their livestock such as treatment.

Lastly, the cases of ownership wrangles are also expected to decline as a result of such an electronic system which provides the necessary information of the animal form its date of birth, place of birth, owner of the animal as well as its movements throughout its entire life. In addition, the system would also reduce straying animals which have resulted in many accidents across the district and also cases of stock theft within the district. It is also expected that the authorities in Zimbabwe should adopt the electronic livestock identification and traceability system such that communal farmers gain access to lucrative markets in Europe, reduce cases of ownership wrangles and also reduce the movement of diseased animals across the country.

5.4 Justification of the Results

The use of an electronic livestock identification and traceability system would ensure that there is a limited movement of diseased animals within the district of Goromonzi. The absence of the electronic system necessitated or facilitated the movement of diseased animals across the district. In order to minimise the unsanctioned movement of livestock within the Goromonzi district there is need for the veterinary services department to ensure that farmers adopt the electronic

livestock identification system. The rising trend in unauthorised movement of diseased animals is justified by the absence of any form of tracking system.

Furthermore, the observed increasing trend in limited access to lucrative markets in Europe where there is huge demand for beef and beef related products. The unavailability of such an electronic livestock identification and monitoring system which is a pre-requisite to gain access to European markets has resulted in communal farmers in Goromonzi ward 12 not having access to lucrative markets in Europe. More so, farmers have failed to maximise their revenue due to limited access to markets as domestic markets are usually dominated by low income earners. As observed by the researcher the adoption and utilisation of such an electronic livestock identification and monitoring system would ensure that farmers comply with the requirements of international markets and boost their incomes by expanding their markets to Europe.

Lastly, an increase in livestock ownership wrangles within ward 12 has been on an increasing trend for the past years and that could also be attributed to the absence of any tracking system which provides the history of the animal in question. In addition, stock theft cases which have also been on the rise are attributed to the absence any tracing device which would result in a decreasing trend in stock theft cases as well as unnecessary ownership disputes.

5.6 Contribution of the study.

The study aimed to identify the factors that influence the adoption and utilisation of an electronic livestock identification and traceability system in Goromonzi. Previous studies reviewed by the researcher mainly concentrated on commercial farmers excluding communal farmers. The study therefore aimed at covering the gap within the literature by including communal farmers in Goromonzi ward 12. This would assist the farmers to diversify their market for beef and beef products to global markets where there is huge demand for their products.

Furthermore, the study identified the importance of livestock production within the district of Goromonzi and as such provides suggestions that communal farmers need to adopt the electronic livestock identification and traceability system such that they also participate in international markets and realise more revenue.

5.7 Summary of the chapter

In this section of the study, the researcher describes and discusses the outcome of the study. The analysis concentrated on the analysis of the outcome paying attention to the factors like

movement of diseased animals, access to lucrative markets as well as the ownership wrangles amongst the owners of livestock. Recommendations for potential resolutions to problems encountered by livestock owners, veterinary officers as well as police officers in performing their responsibilities on livestock well-being and production in Goromonzi District were also examined and summarized. The assessment and discussion of results were enriched by specifically referring to published previous studies and utilizing it to raise questions regarding whether the study's outcome were coherent with or distinct from existing studies.

CHAPTER SIX
CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

This last section of the study outlines the research findings of the study and suggestions to the relevant parties involved in the study. Additional recommendations for future research in this area have also been made.

6.2 Conclusions

Given the preceding research outcome in relation to the problem under study which was raised at the initial phase of the study showed that:

a) The movement of diseased animals across ward 16 of Goromonzi Rural District Council is a key determinant of the adoption and utilisation of an electronic livestock identification and traceability system.
b) The need to have access to international markets in Europe by communal farmers in Goromonzi is also a key factor which influences the adoption and utilisation of an electronic livestock identification and traceability system.
c) In addition, the increasing trend in ownership wrangles as well as increasing trends in stock theft also contributes towards the adoption and utilisation of an electronic livestock identification and traceability system in Goromonzi ward 12 which has the largest population of livestock within the district.
d) Lastly, the adoption and utilisation of electronic livestock identification and traceability system is a pre-requisite for communal farmers to have access to international markets.

6.3 Recommendations

The researcher identified the following stakeholders to the study and provided the following recommendations to the different stakeholders:

6.3.1 The Government/Ministry of Agriculture

- The government should make it a priority for all the livestock farmers to have an electronic livestock identification and traceability system such that the country records more exports to European countries and earn more export revenue for the continued growth of the industry.
- In addition, the government should provide the necessary funding for the new technology which is now a requirement for export markets.

6.3.2 NGO's

- The various NGOs operating within the district to promote animal health should continue providing the required funding for the training to equip the farmers with the necessary skills to use the new electronic identification and traceability system.
- Furthermore, the NGOs should complement government efforts through providing funds for the implementation of the new electronic system.

6.3.3 Livestock Farmers

- The farmers should ensure that their animals are electronically tagged to ensure that cases of stock theft are minimized, ownership disputes are also reduced and lastly to ensure that they do have access to international markets.
- In addition, the farmers should immediately report any suspicious cases of diseases within their stocks such that cases for diseases spreading across the district are minimsed as well.

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Appendix
Survey Questionnaire

To all the respondents

The study is conducted as part of the requirements for the successful competition of a Bachelor of Science Degree at BUSE by Murewa Mary Registration Number B1953377. The study is entitled **"FACTORS AFFECTING THE ADOPTION AND UTILIZATION OF AN ELECTRONIC LIVESTOCK IDENTIFICATION AND TRACEABILITY SYSTEM IN GOROMONZI: A CASE STUDY OF WARD 12"**

The aim of the study is to investigate factors affecting the adoption and utilization of an electronic livestock identification and Traceability system in Goromonzi. It is the researcher's intention to inform the respondents that they have the freedom to participate in this research study and their responds will be treated with the confidential it deserves. The respondents are also guaranteed that their responds would only be used for the purposes of the scientific research. If any of the respondents has a question they should contact the researcher on the number on this questionnaire or BUSE. The researcher extents his best regards to all the participants and would like to show is appreciation to every participant in this study.

MUREWA MARY

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SECTION A: Personal Information

Would you please put a tick (√) beside the appropriate answer

1. **Gender** Male Female

2. **Highest level of Academic Qualifications**

Diploma ☐ Bachelors ☐ Masters ☐

3. **Age**

Below 30 years ☐ 30 - 40 yrs. ☐ 41 - 50 yrs. ☐ Above 50 yrs. ☐

4. **Type of position**

FARMER ☐ VETERIARY OFFICER ☐ POLICE OFFICERS ☐

PARTNERS (NGOs) ☐ ABATTAIORS ☐ OTHERS ☐

IF OTHERS TICKED SPECIFY IN THE SPACE PROVIDED BELOW

☐

5. **Number of years using electronic related devices and or in veterinary services**

Less than 5 ☐ 5- 10 yrs. ☐ 11- 15yrs. ☐

Above 15 ☐

Instruction: Please indicate how strongly you agree or disagree with each by using the following scale.

1= strongly disagree 2= Disagree 3= Neutral 4=Agree 5= strongly agree

Part B: The Effect of the factors that influence the adoption and utilisation of electronic livestock traceability and identification system in Goromonzi District ward 12.

	Items					
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
The adoption and utilisation of electronic livestock traceability and identification system in Goromonzi District ward 12.						
1	All the cattle in your area been ear-tagged?					
2	The general health of the communal farmer's herd has improved since electronic ear-tagging was introduced.					
3	The incidence of highly contagious diseases, such as foot-and-mouth disease has declined since the electronic ear-tagging was introduced.					
4	Ear-tagging assists in disease outbreak investigation.					
5	Ear-tagging improves Veterinary Service's ability to contain/manage disease outbreak.					
6	Since the electronic ear-tagging was introduced, the communal farmers receive a more commercial market-related price					

	for cattle sold.					
7	Since the introduction of the electronic system communal farmers in Goromonzi had access to European markets.					
8	Ear-tagging assists in recovering stolen cattle					
9	Ear-tagging assists in identifying stray animals.					
10	Electronic identification of cattle reduced cases of ownership wrangles amongst farmers					