DISEASE SURVEILLANCE INFORMATION SYSTEM FOR LIVESTOCK CASE STUDY MBALE DISTRICT

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A DISSERTATION SUBMITTED TO THE FACULTY OF ENGINEERING, DESIGN AND TECHNOLOGY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE MASTER SCIENCE OF INFORMATION TECHNOLOGY OF UGANDA CHRISTIAN UNIVERSITY

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UGANDA CHRISTIAN UNIVERSITY

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DECLARATION

I, Macho Honest declare that I am the author of this proposal and that any assistance I received in its preparation is fully acknowledged and disclosed in the report. I have also acknowledged any sources from which I used data, ideas or words, either quoted directly or paraphrased. I also certify that this research report was prepared by me specifically for the partial fulfilment for the degree of Masters in Information Technology at Uganda Christian University.

Signature: …… Date: ……/……/……

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APPROVAL

Having gone through the content and structure of this work, I therefore certify that the work; "Disease surveillance information system for livestock" is original and has been done under my close supervision and is now ready for submission for examination, with my approval.

Signature:  .....

Dr. Odongtoo Godfrey (PhD)

Supervisor

Date: 20/01/2023 .....

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LIST OF ABBREVIATIONS

GDP – Gross Domestic Product

LITS - Livestock Identification and Traceability System

MAAIF -Uganda Ministry of Agriculture, Animal Industry and Fisheries

ODK - Open Data Kit

COVAB - Makerere University College of Veterinary Medicine, Animal Resources and Biosecurity

KLWSS - Kenya Livestock and Wildlife Syndromic Surveillance System

KABS - Kenya Animal Bio surveillance System

UCU - Uganda Christian University

SDLC – System Development Life Cycle

SRS - Software Requirements Specifications

ERD - Entity Relationship Diagrams

DFD - Data flow diagrams

ABSTRACT

Livestock diseases pose significant threats to animal health, agricultural economies. Surveillance systems play a crucial role in monitoring, detecting, and controlling the spread of these diseases. The Livestock Disease Surveillance Information System is designed to enhance the efficiency and effectiveness of disease surveillance in large and small scale livestock populations.

The researcher focused on how the Livestock diseases surveillance system can be integrates various data sources, including veterinary clinics, laboratories, and agricultural authorities, to provide a comprehensive view of disease dynamics. Through advanced data analytics and machine learning algorithms, Livestock Disease Surveillance Information System can identify patterns, trends, and potential outbreaks in real-time, allowing for timely interventions and control measures. These platforms facilitate information sharing, harmonize surveillance standards, and coordinate responses to Trans boundary diseases and can also impact the effectiveness of surveillance systems and the ability to respond to outbreaks quickly.

Uganda, like many African countries, faces a significant burden from livestock diseases such as Foot-and-Mouth Disease, Contagious Bovine Pleuropneumonia, and African Swine Fever. These diseases impact livestock productivity and trade, affecting the livelihoods of millions of Ugandans who depend on livestock.

CHAPTER ONE: INTRODUCTION

1.1 Background of the Study

This study aimed at contributing to the improvement of livestock farms and in Mbale district. The study undertook efforts of exploring different avenues to ensure better management of livestock through the development of an integrated disease surveillance information for livestock in Mbale district, which later was to be applied to other areas after the system is up and running, with efficiency and effectiveness.

The world is under substantial pressure to reduce food insecurity, soaring food prices and deepening poverty due to the projected increase in human population of about 8.3 billion by 2030 (UNPP 2008). Increased population will certainly result into increase in demand for food and shelter which otherwise impact on agricultural farming and livestock systems. In Uganda, the majority of smallholder farmers operate mixed crop-livestock systems. The National Livestock Census revealed that 4.5 million households kept at least one type of livestock with the major ones being cattle, sheep, goats, pigs and poultry (UBOS 2012). There will be a need for more intensified systems to reduce on the pressures of producing feeds for livestock, disease control and ensure safety for human consumption (Herrero et al 2009a; McDermott et al 2010; Udo et al 2011). Since much of livestock production is generally more resource demanding, there is a great need to ensure that reliable systems are developed that bridge the information gap among the livestock farmers which will support and promote animal welfare and health.

Livestock systems occupy about 30 per cent of the planet's ice-free terrestrial surface area (Seinfeld *et al*. 2006) and are a significant global asset with a value of at least $1.4 trillion. The livestock sector is increasingly organized in long market chains that employ at least 1.3 billion people globally and directly support the livelihoods of 600 million poor smallholder farmers in the developing world (Thornton *et al*. 2006). Keeping livestock is an important risk reduction strategy for vulnerable communities, and livestock are important providers of nutrients and traction for growing crops in smallholder systems. Livestock products contribute 17 per cent to kilocalorie consumption and 33 per cent to protein consumption globally, but there are large differences between rich and poor countries (Rosegrant *et al*. 2009).

Livestock systems have both positive and negative effects on the natural resource base, public health, social equity and economic growth (World Bank 2009). Currently, livestock is one of the fastest growing agricultural subsectors in developing countries. Its share of agricultural GDP is already 33 per cent and is quickly increasing. This growth is driven by the rapidly increasing demand for livestock products, this demand being driven by population growth, urbanization and increasing incomes in developing countries (Delgado 2005).

The global livestock sector is characterized by a dichotomy between developing and developed countries. Total meat production in the developing world tripled between 1980 and 2002, from 45 to 134 million tons (World Bank 2009). Much of this growth was concentrated in countries that experienced rapid economic growth, particularly in East Asia, and revolved around poultry and pigs. In developed countries, on the other hand, production and consumption of livestock products are now growing only slowly or stagnating, although at high levels. Even so, livestock production and merchandizing in industrialized countries account for 53 per cent of agricultural GDP (World Bank 2009). This combination of growing demand in the developing world and stagnant demand

in industrialized countries represents a major opportunity for livestock keepers in developing countries, where most demand is met by local production, and this is likely to continue well into the foreseeable future. At the same time, the expansion of agricultural production needs to take place in a way that allows the less well-off to benefit from increased demand and that moderates its impact on the environment.

China is one of the leading livestock farming nations in the world Livestock production is a key sector in China's agriculture. The value associated with livestock production relative to total agricultural production has increased from 18% in 1980 to 37% in 2006; and income from livestock production accounts for 40% of total peasant income (Li et al., 2008). Although total livestock weight is smaller than that of cereals, the production and consumption of livestock products are increasing such that China will become the world's leading producer and consumer. There were 106 million cattle; 465 million pigs; 300 million sheep and goats; and 14.2 billion chickens, ducks, and geese in 2003 (number of livestock in China).

Livestock disease surveillance has been identified as playing an essential role in setting a platform for intervention strategies aimed at lowering incidence or completely eradicating infections (FAO 2011). The system involves an organized, systematic means of, reporting, recording, analysing and disseminating data on the occurrence of disease based on evidence from the field (Thacker et al. 1983). An efficiently working livestock disease surveillance system has been described as very important in minimizing rapidly spreading diseases that cause heavy economic losses to farmers and suppress zoonotic diseases that could endanger human lives (Doherr and Audigé 2001; Hoinville et al. 2013).

The cross-sectional study was conducted in Mbale district in Eastern Uganda. The livestock sector is one of Uganda’s important growth sectors contributing about US $ 290 million to total GDP in

2008/09 up from US $ 210 million in 2007/08. It constitutes 17 percent of the agricultural GDP and is a source of livelihood to about 4.5 million people in the country. The sector is categorized into cattle, goats, pigs, sheep and poultry. The growing local and regional demand for meat and milk products has escalated the number of livestock in the country over the years to an estimated 68 million in 2008 compared with about 49 million livestock in 2002. The 2008 national livestock census estimated the number of cattle at 11.4 million whereas the sheep, goats, pigs and poultry were estimated at 3.4 million, 8.5 million, 3.2 million and about 27.5 million respectively (MAAIF, 2009).

Mbale district, the area of sturdy has been a principal area for coffee production in the country (UEPB 2005) however it's coupled with livestock keeping. Mbale district is bordered by districts Manafwa, Tororo, Budaka and Pallisa which mainly depend on agriculture that represents 90% of total employment. Farmers in these two districts rely on livestock production and cultivation. The rainfall pattern is bimodal with the rainy seasons in March to May and October to November.

Conceptual Framework

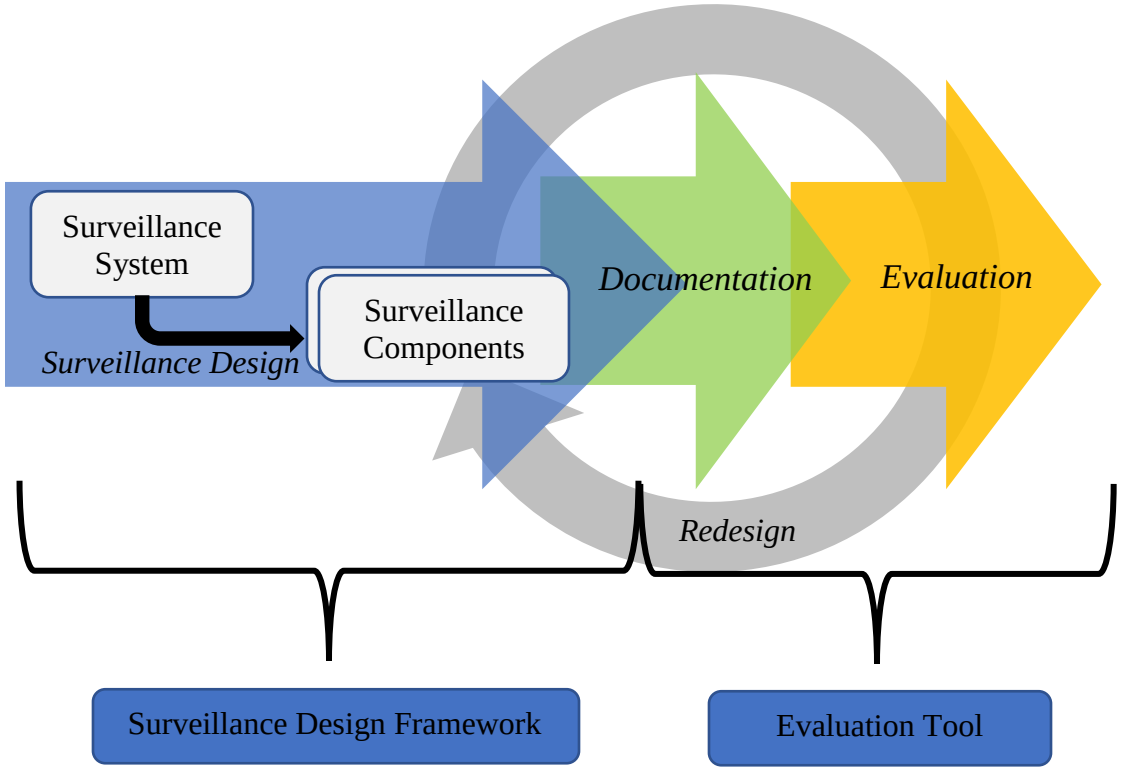


Figure 1: Conceptual Framework

1.2 Problem Statement

Livestock health practices vary among different regions of the world. These practices are influenced by a number of factors, including, but not limited to, the region's livestock demographics, regional animal health status, as well as economic, cultural and social circumstances. Because of these differences, there is not a one-size-fits-all blueprint for livestock health practices. Yet, there are international guidelines and resources for improvement of livestock health across the globe. The risks of insufficient livestock health practices within a region,

particularly are particularly because of inadequate disease surveillance and information systems, inability to rapidly detect disease, implement emergency response measures and prevent the spread of disease. Many diseases can be transmitted from one animal to another during the incubation period, which is the period of time before the infected animal exhibits clinical signs. Other diseases may go unrecognized or mistaken for other less severe health conditions due to common clinical symptoms. Prior to disease detection, the infectious agent can be transmitted, directly or indirectly, within the herd and/or farm-to-farm. Development of disease surveillance information system seems to be the best solution to these challenges.

1.3 General Objective

To enhance livestock disease surveillance through a comprehensive review of current studies, technologies, and best practices, and identification of essential architectural components and features for developing an effective Livestock Disease Surveillance Information System.

1.3.1 Specific Objectives;

i To review current studies, technologies, and best practices in livestock disease surveillance.

ii To identify essential architectural components and features for designing an effective Livestock Disease Surveillance Information System.

iii To evaluate the performance of the developed Livestock Disease Surveillance Information System in terms of accuracy, reliability, usability, and scalability, and to compare its performance to existing systems or methods.

1.4 Research questions

i What are the current studies, technologies, and best practices in livestock disease surveillance?

ii What architectural components and features are essential for designing an effective Livestock Disease Surveillance Information System?

iii How does the developed disease surveillance information system for livestock perform in terms of accuracy, reliability, usability, and scalability, and how does it compare to existing systems or methods?

1.5 Justification of study

Livestock Disease Surveillance System lies in the critical importance of effective disease surveillance for the health, welfare, and productivity of livestock populations such as well as for public health and food safety.

The study aim was to;

i Improve Disease Control: Enhancing surveillance can lead to early detection and more effective control measures, reducing the impact of diseases on livestock populations.

ii Protect Public Health: Surveillance helps to monitor diseases that can be transmitted from animals to humans.

iii Facilitate Trade: Accurate surveillance data is essential for demonstrating disease-free status, which is crucial for international trade in livestock and livestock products.

iv Inform Policy and Decision Making: The study is to provide insights into the best practices, technologies, and methodologies for disease surveillance, informing the development of evidence-based policies and strategies.

v Enhance Capacity Building: By identifying gaps and challenges in existing surveillance systems, the study can inform capacity-building efforts to strengthen surveillance capabilities.

vi Promote Sustainable Livestock Production: Effective disease surveillance contributes to sustainable livestock production by minimizing disease-related losses and supporting the overall health and welfare of livestock.

1.6 Scope of the Study

1.6.1 Geographical scope

The study was carried out in Mbale, Uganda, which is an integral part of the region's agricultural economy and culture. Mbale, located in the Eastern Region of Uganda, has a predominantly rural population engaged in subsistence farming, with livestock playing a crucial role in livelihoods and food security.

Livestock keeping in Mbale faces various challenges, including disease outbreaks such as Foot-and-Mouth Disease and East Coast Fever, limited access to veterinary services and inputs, inadequate market access, and climate change impacts leading to feed and water shortages. Despite the challenges, there are opportunities for improving livestock keeping in Mbale. Common livestock species kept in Mbale include cattle, goats, sheep, pigs, and poultry. Cattle are often kept for milk production and as a source of income through sales, while goats and sheep are valued for meat and as a form of savings.

1.6.2 Time Scope

The study covered a period between October 2022 to January 2023 That duration involved data collection and system development as indicated in Chapter 3,4,5 and 6 respectively. This was to help a project researcher to collect appropriate data, analyze data to get appropriate results and then develop a system to be used. Time frame was also in line with the academic requirements.

1.6.3 Technical Scope

A number of questionnaires was distributed to a sample population, data was collected and analysed using the SPSS and Excel software. Then the system was developed following the

collected data and later was tested by different users. MySQL, PHP, and JavaScript were the softwares and languages used in system development.

1.7 Conclusion (Organization of the Thesis)

This chapter provided the snapshot to the relationship between Disease Surveillance System and Livestock in Mbale District. The background to the study, the statement of the problem, purpose and objectives of the study, significance, the conceptual framework of the study, and definition of key terms was presented. From this study, the researcher developed the data collection tools using the desired population as shown in Chapter 3 and also looked into various literatures written in relation to his work as in Chapter 2. Chapter two looked deep into the literature review and study of the related developed systems, the comparison was done before choice was made to develop a disease surveillance system . Chapter 3 dealt with data collection tools, and in-depth of the requirement to the development of the required system.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter presented the theoretical review of the livestock disease surveillance systems, it also looked into the disease surveillance systems in Uganda and lastly it focused on other related literatures discussed by various researchers and authors. The review focused mainly on the establishment of the existing gaps in relation to the objectives of the study as stated in chapter one of this research project.

2.2 Theoretical Review

According to Angus (2012), surveillance in livestock is a requirement in order to understand the health status of an animal which helps in the identifications of various problems hence quick actions can be taken towards that. He further stated that the disease surveillance majorly looks at four purposes, first is demonstrating freedom from disease. This focuses on the identification of the missing diseases in the country which comes with various benefits such as animal exportation, public heath control measures and many more such as country political pride. Second, early disease detections, this looked at identifying the disease before it widely spreads across. This helps in prevention of the spread. Third, measuring the level of disease, this helps in determining the impact that kind of disease may cause. Lastly, finding various disease cases. In this, it looks at detection of outbreaks of disease.

VSF (2018), defined surveillance as means of tracking, follow ups and monitoring of occurrence of diseases and their change in patterns. Failure in control of livestock diseases leads to constraints to food security, livelihood and proper health of communities.

The spread of animal infectious diseases is high in various countries due to ecosystem, international trade, public health and the economic wellbeing of people depending on the

food from animals. Those challenges bring in the need of Livestock Disease Surveillance System, (George, 2021). The effective system must be able to provide timely data and able to sensitively capture and analyzing any abnormal patterns to fast track any disease and allow appropriate actions towards it. The system should as well be able to detect animal diseases including those transmissible between animals and humans (zoonosis). According to George 2021, the system data can be used in planning and budgeting as well in hypotheses generation towards a recorded disease variance. This data majorly comes from animal production units, veterinary clinical data, laboratory diagnostics, meat inspections reports, livestock farmers' observation and many more others.

In accordance with Aluma etl 2009, a livestock disease surveillance system must include the following element to be complete; passive surveillance: this majorly is concerned with capturing information from data sources as livestock keepers, livestock health workers, veterinarians. Secondly, Active surveillance: deals with searching for a specific disease or infection in a population, the data to prove this is recorded from the sample from laboratories. Lastly, Epidemiological studies: this involves a study of the results to understand the manifestation of a disease in a population.

2.3 Review of Existing Livestock Disease Surveillance Systems

Ochola 2022, stated that the Uganda Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) partnered with Makerere University College of Veterinary Medicine had developed a Livestock Identification and Traceability System (LITS) that will help in the control of animal health, curb cattle rustling and theft. The system is to provide the reliable up-to-date data, track of quality animal products, food safety and enhancing animal disease control. The system is also to trace the origin of animals across the country and chemicals that animal has been subjected to.

As the Ugandan government plans to roll out the LITS system in this era, Ethiopia, Kenya, South Africa, Namibia is some of the neighboring countries that already use the LITS System. Pamela 2022, explained that meat inspectors in Uganda use Open Data Kit (ODK) tool to improve animal disease surveillance and reporting, and sharing their experience and knowledge with peers. The ODK was rolled out in Uganda in October 2021at the Makerere

University College of Veterinary Medicine, Animal Resources and Biosecurity (COVAB). The ODK system is an open-source mobile data collection platform that enables users to fill out forms offline and data is sent to a server once connections are established. The collected data can then be viewed, downloaded and acted upon depending on the needs. The data helps in determining prevalence of diseases, locations and age-group of animals affected and inform response. According to the system users, its user friendly especially is uploading data. Challenges noted with the system were lengthy forms to be filled hence inconvenient data entry.

Jaguza Livestock App (JLA) is an artificial intelligent and computer vision System (IOT), Mobile (android, windows, IOS) as well as SMS and USSD enabled system and WEB

(Both online and Offline) that its main aim is to improve livestock production in Uganda (Katamba, 2016). The system collects animal health information from farmers and health workers and correlates it with external data sources including laboratory data, historical data and early warning signals. This helps in the system predicting diseases before they break into communities. Due to lack of a real-time disease reporting tool in the Kenyan animal surveillance system,

CDC Kenya and Kenya Wildlife service launched the Kenya Livestock and Wildlife Syndromic Surveillance System (KLWSS). The system enables the field surveillance officers submit data via mobile application and data are made available to county and national authorities through a central server. the integrated system called Kenya Animal Biosurveillance System (KABS)

collects data and presents it on a web-based dashboard with an automated data analysis and feedback. KABS application was built on Java platforms and is compatible with mobile phones and its web-based account management, form editing and data monitoring.

2.3.1 Livestock Identification and Traceability System (LITS)

It is a crucial for livestock management, disease control, and food safety. It is purposed to improve livestock management practices, enhance food safety, and contribute to disease control efforts, benefiting both producers and consumers.

Key functionalities of an effective LITS include:

i Assigning a unique identification number or code to each animal, linked to its owner and farm of origin.

ii Use of electronic tags or implants for quick and reliable identification, especially useful in large-scale operations.

iii A centralized database that stores information about each animal, including its identification, movements, health status, and ownership history.

iv Ability to track the movement of animals from farm to farm, auction houses, slaughterhouses, and other locations.

v Capability to record data in real-time, ensuring that information is up-to-date and accurate.

vi Ability to exchange information with other databases and systems, such as veterinary databases or national livestock databases.

vii Monitoring compliance with regulations and standards related to livestock identification and traceability.

viii The system can be Integration with other livestock management systems, such as health monitoring or breeding programs.

ix Ensuring the security and integrity of data, protecting it from unauthorized access or tampering.

x An easy-to-use interfaces for farmers, veterinarians, and other stakeholders to access and update information.

xi Generating reports and analysis based on the data collected, providing insights for decision-making and policy development.

xii Facilitating rapid response to disease outbreaks by enabling the identification and tracking of potentially affected animals.

xiii Meeting requirements for international trade by providing traceability and quality assurance for exported livestock products.

2.3.2 Kenya Livestock and Wildlife Syndromic Surveillance System (KLWSSS)

The platform is designed to monitor and detect health issues in livestock and wildlife populations. The platform is incorporated with features to enhance the surveillance and management of health issues in both livestock and wildlife populations.

Key functionalities of the system include:

i Monitoring of syndromes or groups of symptoms in both livestock and wildlife to detect potential disease outbreaks.

ii Collecting and analyzing data in real-time to provide timely alerts and responses to health issues.

iii Integrating data from various sources such as veterinary clinics, wildlife reserves, and community reports to provide a comprehensive view of health trends.

iv Mapping of health data to identify hotspots and trends, aiding in targeted interventions and resource allocation.

v Providing early warnings for disease outbreaks or other health issues to facilitate rapid response and control measures.

vi Allowing for mobile reporting of health data by field workers, enabling quick and efficient data collection.

vii Facilitating collaboration between different stakeholders, including government agencies, researchers, and communities, and sharing of information for improved decision-making.

viii Using collected data to model disease spread and assesses the effectiveness of control measures.

ix Providing training and support to local communities and stakeholders to improve their capacity for surveillance and response.

x Conducting risk assessments and implementing mitigation measures to reduce the impact of health threats on livestock and wildlife populations.

xi Ensuring the security and privacy of collected data, complying with relevant regulations and standards.

2.3.2 The Kenya Animal Bio surveillance System (KABS)

The system is intended to monitor and detect animal diseases and to management of animal diseases in Kenya, ultimately improving animal health and welfare.

Key functionalities of this system include:

i Integration of data from various sources, including veterinary clinics, laboratories, and animal markets, to provide a comprehensive view of disease trends.

ii The system is capable of providing early warnings for disease outbreaks or unusual health events to facilitate rapid response and control measures.

iii It is used for Collecting and analyzing data in real-time to provide timely alerts and responses to health issues.

iv Mapping of disease data to identify hotspots and trends, aiding in targeted interventions and resource allocation.

v Allowing for mobile reporting of disease data by field workers, enabling quick and efficient data collection.

vi Facilitating collaboration between different stakeholders, including government agencies, researchers, and communities, and sharing of information for improved decision-making.

vii Using collected data to model disease spread and assess the effectiveness of control measures.

viii It Provides training and support to local communities and stakeholders to improve their capacity for surveillance and response.

ix Conducting risk assessments and implementing mitigation measures to reduce the impact of health threats on animal populations.

x Ensuring the security and privacy of collected data, complying with relevant regulations and standards.

xi Providing feedback to the stakeholders about the outcomes of surveillance activities and the effectiveness of interventions.

2.3.3 Uganda Livestock Surveillance System (ULSS)

It a Uganda tool for monitoring and managing livestock health. ULSS aims to enhance the surveillance and management of livestock diseases in Uganda, ultimately improving animal health, productivity, and food security.

Key functionalities of ULSS include:

i ULSS facilitates the reporting of livestock diseases from various sources such as farmers, veterinary officers, and laboratories.

ii It collects and analyzes data on livestock diseases to identify trends, hotspots, and emerging threats.

iii It provides an early warning system for livestock diseases, enabling timely response and control measures.

iv It integrates data from various sources including veterinary clinics, laboratories, and field surveys to provide a comprehensive view of livestock health.

v ULSS enables real-time monitoring of livestock health, allowing for quick detection and response to disease outbreaks.

vi It utilizes geospatial mapping to visualize disease patterns and trends, aiding in targeted interventions and resource allocation.

vii ULSS provides training and support to veterinary officers, farmers, and other stakeholders to improve their capacity for disease surveillance and control.

viii It facilitates collaboration between government agencies, research institutions, and other stakeholders, and promotes the sharing of information for improved decision-making.

2.4 Comparison Analysis Table of the Related Systems Drawn

The table gives a summary of the discussed systems above looking at their general purpose, web based or app and the country of existence.

Table 1: *Comparison of the Related systems*

S	Related System	Purpose	Web/ App	Country	In Use
1	**Livestock Identification & Traceability System (LITS)**	Control of animal health, curb cattle rustling & theft	Web	Uganda	No
2	**Open Data Kit (ODK)**	Collected data helps in determining prevalence of diseases, locations and age-group of animals affected and inform response.	Web & App	Uganda	Yes
3	**Jaguza Livestock App (JLA)**	Improve livestock production in Uganda. system collects animal health information from farmers and health workers and correlates it with external data sources including laboratory data	Web & App	Uganda	Yes
4	**Kenya Livestock and Wildlife Syndromic Surveillance System (KLWSS)**	System enables the field surveillance officers submit data via mobile application and data are made available to county and national authorities through a central server	Web & App	Kenya	Yes
5	**Kenya Animal Biosurveillance System (KABS)**	Collects data and presents it on a web-based dashboard with an automated data analysis and feedback	Web & App	Kenya	Yes

Comparison features of the related existing systems with proposed LDSIS

The table shows the comparison features of the related existing with the Livestock disease surveillance systems used in different countries.

Table 2: *Comparison features of the related existing systems with proposed system*

Key Features	Livestock Disease Surveillance Systems					
	Livestock Identification & Traceability (LITS)	Open Data Kit (ODK)	Jaguza Livestock App (JLA)	Kenya Animal Bio surveillance System (KABS)	Uganda Livestock Surveillance System (ULSS)	Livestock Disease Surveillance Information System
Security	✓	✓	✓	✓	✓	✓
Data Compilation	✓	✓	✗	✓	✓	✓

Customization	✗	✗	✓	✗	✗	✓
Vet Registration	✗	✓	✗	✗	✗	✓
Online Surveillance	✓	✗	✗	✓	✓	✓

2.5 New intended Livestock Disease Surveillance System

Following the literature review on the existing systems, the researcher's main objectives of developing a disease surveillance information system is to ensure that the following key factors are captured in the new system.

i. Monitor number of times a specific disease was reported
ii. The remote access of livestock information and reports by the stakeholders.
iii. Farmers having the required information of livestock health and diseases.
iv. Guide the public on the health actions to be handled
v. Determine risk factors of diseases and population risks
vi. On time data analysis and interpretation about the livestock health.

2.6 Conclusion

This chapter presented the theoretical literature review of disease surveillance system, the review of existing systems, system comparison, and weaknesses in the existing systems and finally it focused on the general reasons of the new system. The chapter gave appropriate direction on the methodology, Chapter 3 of this document and later the system design in Chapter 4.

CHAPTER THREE: METHODOLOGY

3.1 Introduction

This chapter presents the research design, methodology, the population of the study, sample size and sampling methods, data collection methods, study and project procedure, procedure for data analysis, limitations of the study, and ethical considerations and system development process.

3.2 Study design and methodological approach

A research design constitutes the blueprint for the collection, measurement, and analysis of data (Trochim, 2006). Kothari, (2004) defines a research design as arrangement of conditions for collection and analysis of data in a manner that aims to combine relevancy to the research purpose, with economy in procedure. The study intends to establish the relationship between Surveillance Information System and Livestock farming in Mbale District, and then develop a system in which surveillance system has components to: to manage disease mapping, social network analysis and disease bio-portal mechanism. The objective of the study focused on stablishing the relationship between the two variables: Surveillance Information System and Livestock farming. Therefore, a descriptive research design was adopted in this study. A triangulation of methods was used in this study, combining information from different sources of data collection namely, review of secondary literature, and the use of self-administered questionnaires.

3.3 Area of study

The area of study for this research project was Mbale District in the Eastern Region of Uganda. It was recently separated from Mbale city which is the main municipal, administrative, and commercial centre in the East of Uganda. For descriptive purposes, the stakeholders of the livestock surveillance system evaluated were categorized into three, namely bottom-level actors (livestock farmers), mid-level (sub-county and district veterinary staff) and the top level (Assistant Commissioner of the Department of Veterinary Diagnostics and Epidemiology Division and the Commissioner of Animal Health, MAAIF). Mbale District is rounded by districts of Tororo, Manafwa, Butaleja, Pallisa and Kumi. According to the recent mapping in (2019) the records show that the city lies at an average elevation of 1,156 metres (3,793 ft) above sea level and the city also lies on the railway from Tororo to Pakwach. Mount Elgon, one of the highest peaks in East Africa, is approximately 57 kilometres (35 mi) north-east of Mbale, by road (Globefeed, 2019).

Livestock keeping in Mbale, Uganda, is deeply rooted in the region's agricultural history and plays a significant role in the local economy and livelihoods. Mbale, located in the Eastern Region of Uganda, has a favourable climate and fertile soils, making it conducive for livestock rearing.

Traditional agricultural practices in Mbale included the keeping of cattle, goats, sheep, and poultry for subsistence purposes, providing food, clothing, and agricultural traction. These practices have evolved over time, transitioning from subsistence to more commercialized ventures.

The commercialization of livestock keeping in Mbale has been driven by factors such as population pressure, the need for income diversification, and increasing market demand for livestock products. Today, livestock farming in Mbale is a vital component of the local economy, providing income and livelihoods for many households.

Livestock production in Mbale is diverse, including dairy farming, beef production, poultry farming, and small ruminant rearing. Dairy farming, in particular, is a significant subsector, with Mbale being known for its high-quality milk production.

Despite its importance, livestock keeping in Mbale faces several challenges. These include disease outbreaks, limited access to veterinary services, inadequate market infrastructure, and environmental degradation due to overgrazing.

3.4 Information Sources and target population

Research data and information consisted of a population of the district Agricultural officers (management – 07), the district veterinary technical staff (65), and the livestock farms, which consisted of 120 participants. The whole research population of study adds up to 192 potential respondents, who were sampled according to the methods that this study used.

3.5 Sample size

Sample size is the justifiable denotation of variability, numerical structure. The sample size of 148 respondents out of a targeted population of 192, by using Krejcie & Morgan (1970) table, as shown in the List of Appendices, Appendix I.

Table 3: Population of study

Study Area	Category of respondents	Popn.	Sample	Sampling technique
Mbale District	Agricultural Officers (Top management)	07	04	Purposive sampling
	Veterinary Technical Staff	65	34	Purposive sampling
	Livestock Farmers	120	110	Simple random sampling
	Totals	192	148	

3.6 Sampling method

With the fact that the research project dealt with Livestock Diseases, the Livestock Agricultural Officers and the Veterinary technical officers were selected by the researcher using the purposive sampling method. Method was used because the researcher's judgement focused on the livestock and this group had a general understanding of the livestock health.

Livestock farmers with the fact that they keep different types of livestock in their farm, the researcher had to use the simple random sampling method in order to get the desired results from different farmers.

3.7 Data collection methods

The study adopted a questionnaire to collect statistical data, because it is an ideal instrument to gather information from a large sample in a shorter time (Kothari, 2004). The results of the collected data guided the development of the surveillance information system for livestock system for Mbale district and also the government of Uganda.

3.7.1 Questionnaires

A semi-structured questionnaire was designed. This was modified by the researcher into "tick the appropriate opinion." A list of structured questions was drawn capturing the questions on the on the surveillance information system and livestock. The questionnaires were then distributed by the researcher and his assistants. Questionnaires were pretested and standardized to ensure validity and reliability of the instrument. This was applied to a group of veterinary technical team at the district.

3.8 Quality/error control and measurement of variables

Quality/error control is tests of measurement that were used to evaluate the effectiveness of a measurement instrument (Kothari, 2004). The instruments for data collection in this study was validated through application of content validity, determined through expert judgment from both supervisors and other related experts in the field of information management systems and their workability. Both the questionnaire and interview instruments were also evaluated for effectiveness through establishing reliability

3.8.1 Validity

After constructing the questionnaire, the supervisors and other related experts reviewed the items and check for content comprehensiveness. The researcher computed the validity of the instruments by using the expert judgment method (Gay, 1996). Following was a formula that was used to test the content validity index of the questionnaire.

$$\mathbf{CVI} = \frac{VR+R}{N}$$

Where, **VR**: very relevant, **R**: relevant, and **N**: number of items.

Interpretation of the CVI (Content Validity Index) obtained was done using George and Mallery (2003) scale, in which a value above 0.7 was considered acceptable validity.

3.8.2 Reliability

To ensure this, the researcher measured the internal consistency using the Cronbach Alpha (Cronbach, 1951) basing on the five-point Likert scale adopted in this study. SPSS was used to compute reliability after the pilot study, where 10 non-respondents participated. Those respondents were not part of the sample population of the study, but they were chosen from another municipality in Eastern Uganda and preferably, Tororo Municipality. Cronbach Alpha was selected during the analysis process. Further, the interpretation of the coefficient of reliability obtained based on the George and Mallery (2003) scale whereby, a value above 0.7 was considered acceptable reliability.

3.9 Measurement of variables

Measurement of variables is the process of transforming abstractly conceived concepts or variables into numerical quantities (Amin, 2005). This was done basing on the Likert scale used in the study. The typical Likert scale is a 5- or 7-point ordinal scale used by respondents to rate the degree to which they agree or disagree with a statement (Likert, 1932) and it helps the researcher to measure attitudes and opinions of the study participants. Likert scales are common ratings for surveys (Allen & Seaman, 2007).

This study used the Likert scale model for measurement of the respondents' opinions, given as:

Study Likert Scale:

1. *Strongly disagree*	-	0.0-1.0	-	*very low*
2. *Disagree*	-	1.1-2.0	-	*low*
3. *Not sure*	-	2.1-3.0	-	*moderate*
4. *Agree*	-	3.1-4.0	-	*high*
5. *Strongly agree*	-	4.1-5.0	-	*very high*

3.10 Data processing and analysis

Data collected will be both be analysed using descriptive and statistical analysis. Data analysis is a process of bringing order, structure and meaning to mass of information collected through editing, coding, classifying, and tabulating the collected data. The strategy for data analysis for this research project is clearly illustrated in the subsequent subsections following.

3.10.1 Analysing quantitative data

The quantitative data obtained from the questionnaire participants will be analysed using

SPSS and correlation analyses will enable the researcher establish the degree of correlation within the variables. Regression analyses will be used to establish the relationships between the surveillance information and livestock.

Regression is given by the equation:

$$Y = c + b(x)$$

Where; Y = estimated dependent variable score,

c = constant, b = regression

coefficient, and x = score on the

independent variable.

(Statistics Solutions, 2013)

3.11 Ethical considerations

The researcher will ensure to obtain permission form Mbale District Agricultural office and a letter of introduction from the UCU Mbale College administration as identification and endorsement of the research study and the project. Other veterinary officers will sign the

copies of the university letter to show prove their acceptance for the research project. These letters and documents will aid in curbing the study limitations. Further, convenient and mutually acceptable appointments with respondents will be made, before any attempts to conduct any data collection. Interview respondents will be given informed consent forms, to be signed before proceeding to provide information for the study.

3.12 System Development

The Waterfall Model was used in the development of this project. Bassil (2011) defined Waterfall SDLC model as a sequential software development process in which progress is related as flowing increasingly downwards through list of phases that must be executed in order to successfully build a computer software. This model is comprised of five phases: Analysis, design, implementation, testing and maintenance. Each phase can be endlessly repeated until it is perfected.

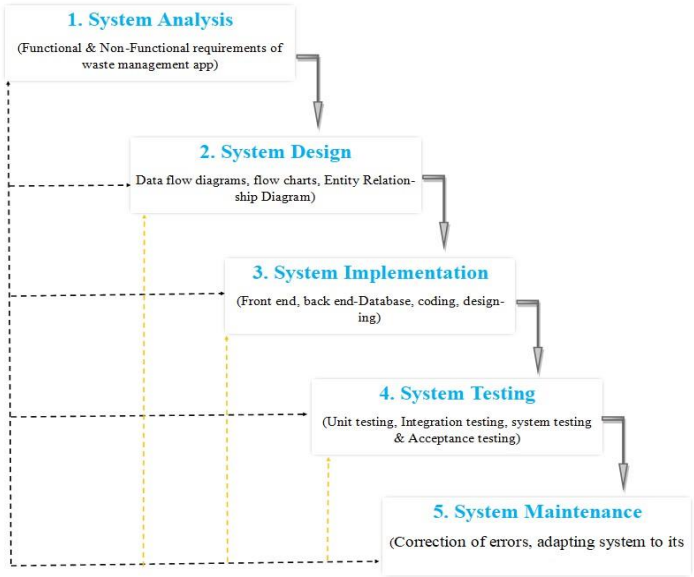


Figure 2: Water fall Model

Spiral Model

The spiral model is a risk-driven software development process model that combines elements of both waterfall and iterative development models. It emphasizes the iterative nature of development and incorporates risk analysis and prototyping in each iteration. On Identification phase included requirements gathering at the initial stage of the system development and review for the system for improvement, Design phase entailed conceptual, Architectural, logical and physical design of the system. Construction phase includes the proof of concept and add functionality for system improvement and evaluation phase to find out whether the system meets its purposed requirements. The researcher employed this model on the system development.

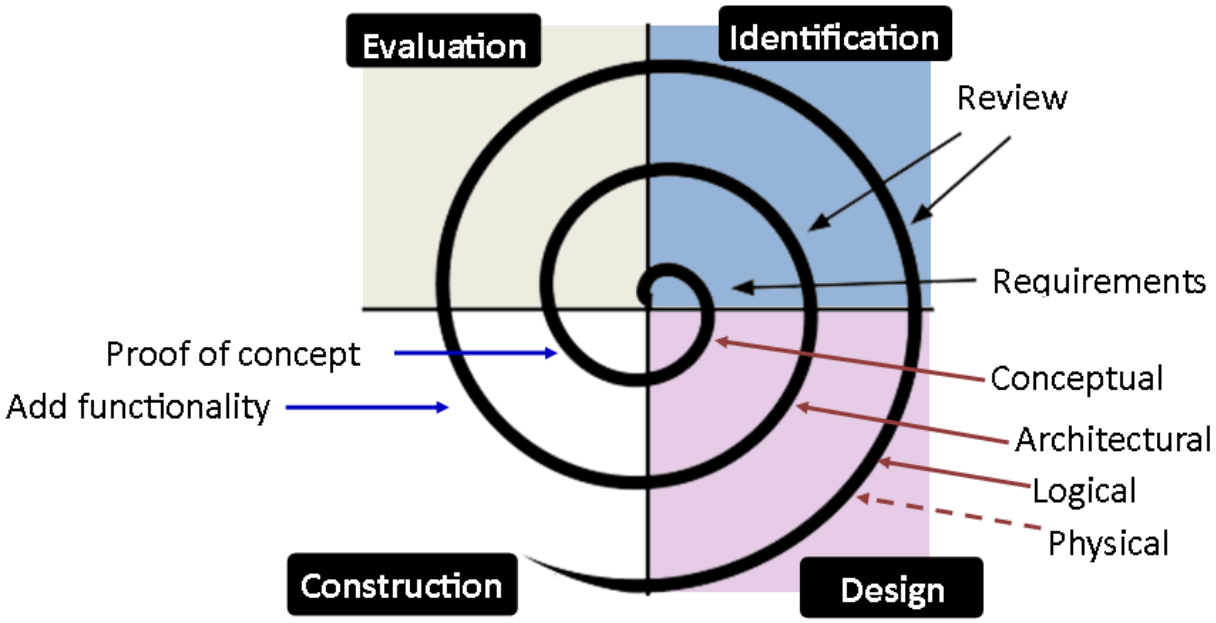


Figure 3: Spiral Model

3.12.1 System Analysis

Bassil (2011) stated that system analysis is mainly known as Software Requirements Specifications (SRS) which is a complete and comprehensive description of the software that is developed. This phase describes mainly the functional and non-functional requirements of the system. A disease Surveillance Information System for Livestock was developed with consideration of physical database design, user interfaces and security.

i) Following the needs of livestock data storage for easy access to the farmers any ware at any time, the system physical database was designed using the SQL. SQL was chosen depending on its integrated security measures that meets the ACID database properties.

ii) Different programming languages were used in order to fit the end user needs in terms of the graphical user interface. HTML, Python, JavaScript and PHP languages were used by the programmer. Adobe Photoshop CS6 was used to design the attractive interface.

3.12.2 System Design

System design is the second phase of waterfall model that has to be achieved first. Bassil (2011) clarified that system design is the process of planning and problem solving for software solution and it includes the software architecture design, algorithm design, database conceptual schema and logical diagram design. Graphical user interface design and data structure definition are also included.

Data Flow Diagrams were used by the developer since they are easy to understand and helped in defining the boundaries of the system and also very helpful during documentation. Flow Charts showing the logical structure of the system were also used by the developer. Entity Relationship Diagrams (ERD) were used as they graphically represent entities and their relationships to each other.

3.12.3 System Implementation

System implementation is the realization of the business requirements and design specifications into concrete executable programs, database and other components and also deployment (Bassil, 2011). The programmer did cod and program execution. Programming languages and Software used to implement the disease surveillance systems were:

(a) SQL database was chosen depending on its integrated security measures that meets the ACID database properties.

(b) JavaScript, PHP, Python and HTML programming languages were used in designed the user-friendly graphical interface as most of the farmers were learning to use the current technology.

(c) Adobe Cs6 was used to design the Application logo and any other images and pictures that was needed by the application.

3.12.4 System Testing and Integration

Process of verification and validation of a developed software or system by checking is it meets the original requirements and specifications with accomplishment to the intended purpose is known as system testing. Debugging process is also achieved by testing Bassil (2011). Testing of the system was carried out to evaluate and check if the system meets its obligations and objectives. Unit testing, Integration testing, System testing and Acceptance testing was done before the system was deployed

3.13 System Functions

i. Monitor number of times a specific disease was reported ii. Enable remote access of livestock information and reports by the stakeholders.

iii. Provide farmers with required information of livestock health and diseases.

iv. Guide the public on the health actions to be handled urgently by stakeholders

3.13.1 Functions provided to System Administrators

System allows the administrator to add, edit and delete users such as field veterinary officers, field research officers. The system also allows monitoring and management of all users' databases. Additionally, the system administrator can update the database.

3.13.2 Functions provided to the Farmers

Farmers can only be able to view the different livestock diseases, their prevation measures and treatment measures. They also have a comment section that they provide their views which can be posted by the system admin.

3.13.3 Functions provided to the Field Research Team

The research team can upload the livestock information to the system. This is the information that helps the end user who is either a farmer or budgeting stakeholders.

3.14 User Requirements

User requirements included the functionalities under the different constraints that the proposed system covered and were provided in accordance to the users' access and usage of the system. The identified functionalities were: System administrators, field officers and farmers.

3.14. 1 Functional Requirements

i. The system allows users and admin to register using their username and passwords.

ii. Only Administrators have the right to view and edit the registered users in the system.

iii. The system should only work if there is internet access to the mobile devices. iv. The System should allow the livestock information to be uploaded to the database

3.14.2 Non-Functional Requirements

i The system should be portable for android phones

ii Users should not be able to add or delete details or data from the database

iii .Privacy of information of the system should be audited

iv System database should be able to handle more than 20 million users

v System database should be updated regularly to identifies the customers on the system

3.15 Conclusion

This chapter examined the research design, which was descriptive; methodology (mixed approach); study area – Mbale district and population, sample size and sampling methods, which included the purposive and simple random sampling due to the nature of selected target groups. Data collection tools of questionnaires and interview guides were also discussed. The chapter focused and depended on the Introduction and Literature review as in Chapter 1 and 2 respectively. This led to Chapter four that discussed on the data collected and analysed using the proposed softwares SPSS and MS Excel. Chapter 4 looked at the data analysis and system design in relation to the provided details in Chapter 3, 2, and 1.

CHAPTER FOUR: ANALYSIS AND DESIGN

4.1 Introduction

This chapter looked at the data analysis, system study and investigation, system analysis, and system design which described broadly the tools, instruments, approaches, processes, techniques and methods that were employed as stated in the methodology.

4.2 Data Analysis

Data collection was done by distribution of one hundred and forty-eight (148) questionnaires to appropriate respondents by the researcher who filled them. Data was then collected and grouped, coded and analysed to relations of the objectives of the study as was outlined earlier in chapter one. The results were then recorded as below.

4.2.1 Response Rate

Response rate is the proportion of the eligible sample that completed a survey (Carlson, 2013). Survey response rates can give an indication of the success of survey operations and performance; be used for non-responsive weighing adjustments, weighted response rates can represent the proportion of the target population represented by the respondents and often can be correlated with the risk of nonresponsive bias.

The response rate for this study was computed as follows:

$$Response\ rate = \frac{number\ of\ completed\ surveys}{number\ of\ people\ contacted}$$

4.2.2 Demographic data of respondents

The demographic features in the study included; sex, marital status, classification of the respondents and duration of stay at the organization. The tables below categorically reflected the results retrieved from the SPSS software

4.2.2.1 Gender (Sex) of the respondents

Table 4: *Gender (Sex) of the Respondents*

Gender	Frequency	Percent
Male	**90**	**64.3**
Female	**50**	**35.7**
Total	**140**	**100**

Source (*Primary Data 2022*)

The results reflected from the above table 3.0 clearly shows that majority of the respondents were male 64.3% ($^{90}/_{140}$) compared to females who were just 35.7% ($^{50}/_{140}$) of the total population. Male respondents took the higher lead because the targeted population had many male staff members compared to females.

4.2.2.2 Marital Status of the respondents

Table 4: Marital Status of the Respondents

Marital Status	**Frequency**	**Percent**
Single	48	34.2
Married	62	44.3
Divorced	0	0
Others	30	21.4

Total	140	100.0

(Source*: Primary Data 2022*)

The results clearly stipulate that married respondents lead by 44.3% ($^{62}/_{140}$), single respondents were 34.2% ($^{48}/_{140}$), and others were 21.4% ($^{30}/_{10}$). There was no divorced respondent that provided data. This explains that most staff members were married.

4.2.2.3 Classification of the Respondent (Position Held)

Table 5: *Classification of the Respondents*

Position held	**Frequency**	**Percent**
Agricultural Officer	03	2.1
Veterinary Staff	32	22.9
Livestock Farmer	105	75
Total	140	100.0

(Source: *Primary Data 2022*)

Respondents were classified for the need to differentiate agricultural officers, veterinary staff and livestock farmers in the district. From the above table 4, it clearly shows 2.1% ($^{3}/_{140}$) of the respondents were agricultural officers, 22.9% ($^{32}/_{140}$) were veterinary staff and 75% ($^{105}/_{140}$), were livestock farmers.

4.2.2.4 Work duration at the organization

Table 6: Work duration at the organization (municipal council)

Duration in Years	**Frequency**	**Percent**
1 Year	85	60.7
2 Years	20	12.3
3 Years	14	10
4 Years	6	4.3
5 Years and More Years	15	10.7

Total	140	100.0

(Source: *Primary Data 2022*)

Depending on how long the respondents worked in livestock industry, the above results clearly shows that most respondents have worked for 1 year 60.7% ($^{85}/_{140}$), followed by 2 years 12.3% ($^{20}/_{140}$), then 5 years and more 10.7% ($^{15}/_{140}$), then 3 years at 10% ($^{6}/_{140}$) and lastly those who worked for 4years at 4.3% ($^{6}/_{140}$). The result is out of honesty as the literature of the study focused on three years ago.

4.3 Findings from Research Objectives

The findings below were based on the research objectives that were to establish the use of a disease surveillance information system on livestock farming. Findings are as below;

4.3.1 Use of disease surveillance information system on animal disease detection

Table 7*: Objective One: (Source: Primary Data 2022)*

Questions	**SD (%)**	**D (%)**	**N (%)**	**A (%)**	**SA (%)**
Animal identification, registration, traceability and movement control helps in diseases detection in an animal.	10.2	23.9	11.4	34.1	20.5
Parasites (both internal and external) causes diseases to animal's 100%	17.0	17.0	8.0	23.9	33.0
Well trained farmers can discover diseases very first in the animals	20.5	15.9	9.1	30.7	22.7
Enough information to a farmer about his animals is very necessary.	4.5	8.0	15.9	34.1	37.5
Animal Samples and specimens' collections help in diseases detections	3.4	12.5	13.6	42.0	28.4
Animal clinical examination is necessary to all animals by the farmer.	6.8	13.6	11.4	30.7	36.4

The first objective was determining the use of a disease surveillance information system on animal disease detection. A questionnaire was distributed to a population of one hundred and forty-eight

(148) although one hundred and forty (140) respondents responded. The below are the results analysed from SPSS software

Legend

SD	*Strongly Disagree*
D	*Disagree*
N	*Neutral*
A	*Agree*
SA	*Strongly Agree*

From table 6 above, 10.2% strongly disagreed with the idea that *Animal identification, registration, traceability and movement control helps in diseases detection in an animal.* 23.9% disagreed, and 11.4% of the respondents were not sure, but majority of the respondents had support with the statement as 34.1% agreed and 20.5% strongly agreed that *Animal identification, registration, traceability and movement control helps in diseases detection in an animal*. The above table 6 also showed that 17.0% of the respondents strongly disagreed that *Parasites (both internal and external) causes diseases to animal's 100%* while 17.0% of the respondents disagreed and 8.0% of the respondents were not sure with the statement but 23.9% of the respondents agreed and 33.0% strongly agreed that *parasites (both internal and external) cause diseases to animal's 100%*. Further, the results shows that 20.5% of the respondents strongly disagreed that *well trained farmers can discover diseases very first in the animals,* 15.9% disagreed, 9.1% were not sure, 30.7% agreed while 22.7% strongly agreed. When the respondents were asked if enough

information to a farmer about his animals is very necessary. The table 7.0 shows that 4.5% strongly disagreed, 8.0% disagreed, 15.9% were not sure, 34.1% agreed and 37.5% strongly agreed that *enough information to a farmer about his animals is very necessary*. 3.4% respondents strongly disagreed that the *animal samples and specimens' collections help in diseases detections,* 12.5 % disagreed, 13.6% were not sure, 42.0% agreed and 28.4% strongly agreed to the statement. When asked if *animal clinical examination is necessary to all animals by the farmer.* 6.8% strongly disagreed, 13.6% disagreed, 11.4% were not sure, 30.7% agreed with the statement and then 36.4% strongly agreed.

4.3.2 Use of disease surveillance information system on animal disease transmission

The second objective was determining the use of disease surveillance information system on animal disease transmission. The below are the results from SPSS software:

Table 8: *Objective Two (Source: Primary Data 2022)*

Questions	SD (%)	D (%)	NS (%)	A (%)	SA (%)
Dumping of xenobiotics into the environment (medicine residue) affects animals	2.3	4.5	12.5	39.8	40.9
Infectious diseases can be transmitted between domestic and wild animals.	19.3	20.5	9.1	18.2	33.0
Resistance to antibiotics and traces of medicines in animal products causes infections to an animal.	12.5	17.0	27.3	30.7	12.5
Animal food scarcity always causes diseases hence transmission	10.2	13.6	25.0	25.0	26.1
Consumption of wild animals lead to spread of novel Coronavirus (COVID-19) outbreak	4.5	13.6	17.2	35.1	29.5
Non-human animals have infected humans by infectious disease (zoonosis)	10.2	6.8	15.9	23.9	43.2

Legend

SD	*Strongly Disagree*
D	*Disagree*

N	*Neutral*
A	*Agree*
SA	*Strongly Agree*

From the above table 7**,** the results shows that 2.3% of the respondents strongly disagreed to the statement that *dumping of xenobiotics into the environment (medicine residue) affects animals*, 4.5% disagreed, 12.5% were not sure, 39.8% agreed to the statement and 40.9% strongly agreed that *dumping of xenobiotics into the environment (medicine residue) affects animals*. 19.3% of the respondents strongly disagreed *that Infectious diseases can be transmitted between domestic and wild animals.* 20.5% disagreed to the statement, 9.1% were not sure, 18.2% agreed and 33.0% strongly agreed that *infectious diseases can be transmitted between domestic and wild animals.* Furthermore, the results shows that 12.5% of the respondents strongly disagreed that *resistance to antibiotics and traces of medicines in animal products causes infections to an animal*, 17.0 % disagreed, 27.3% were neutral, 30.7% agreed and 12.5% strongly agreed to the statement. When respondents were asked if *animal food scarcity always causes diseases hence transmission*, 10.2% strongly disagreed, 13.6% disagreed, 25.0% were not sure of the statement, 25.0% agreed and largest respondent of 26.1% strongly agreed. From the table, it also shows that 4.5% strongly disagreed when asked if *consumption of wild animals lead to spread of novel Coronavirus (COVID-19) outbreak.* 13.6% disagreed, 17.2% were not sure, majority of respondents by 35.1% agreed that it's true and lastly 29.5% strongly agreed to the statement. 10.2% of the respondents strongly disagreed when asked if *non-human animals have infected humans by infectious disease (zoonosis), 6.8*% disagreed, 15.9% were not sure, 23.9% agreed while the majority of 43.2% strongly agreed that *non-human animals have infected humans by infectious disease (zoonosis).*

4.3.3 Use of disease surveillance information system on animal disease prevention

Table 8: *Objective Three (Source: Primary Data 2022)*

Questions	SD (%)	D (%)	NS (%)	A (%)	SA (%)
Animal balanced diet is highly important on daily animal feeds.	9.9	16.5	8.8	33.0	33.3
Vaccination and treatment of animals is the best measures of disease control in animals.	10.1	25.3	12.1	15.4	37.2
Discount on medicines and vaccines for the farmers leads to proper prevention of diseases by majority of farmers.	14.3	22.0	13.2	20.3	30.3
Good selection of animal breeds reduces the effects of sicknesses in animals.	16.4	8.6	15.4	14.3	42.1
Proper and well record management about an animal helps in planning	5.5	17.6	25.3	25.3	26.4
Early disease recognition and control must be practiced by every animal farmer	14.2	11.8	16.3	29.8	27.8

Table 8 above shows the results obtained from the SPSS software about the third research objective of determining the use of disease surveillance information system on animal disease prevention

The results clearly showed that 9.9% strongly disagreed that *animal balanced diet is highly important on daily animal feeds.*, 16.5% of the respondents disagreed, 8.8% were not sure, 33.0% agreed and lastly 33. % strongly agreed with the statement. Table also showed that 10.1% of the respondents strongly disagreed to the statement that *vaccination and treatment of animals is the*

best measures of disease control in animals. 25.3% of respondents disagreed, 12.1% were no sure, 15.4% agreed while 37.2% strongly agreed that *vaccination and treatment of animals is the best measures of disease control in animals.* From the results in the table, 14.3% strongly disagreed *that discount on medicines and vaccines for the farmers leads to proper prevention of diseases by majority of farmers,* 22.0% disagreed with the question and 13.2% were not sure of the statement. 20.3% and 30.3% agreed and strongly agreed respectively with the idea. The analysed results also clearly indicated that 16.4 % of the respondents strongly disagreed with the statement that *good selection of animal breeds reduces the effects of sicknesses in animals,* whereas 8.6% disagreed, 15.4% were not sure, 14.3% agreed and 42.1% strongly agreed. Furthermore, 5.5% strongly disagreed with the statement *that proper and well record management about an animal helps in planning, 17.6% disagreed, 25.3% were not sure, 25.3% agreed with the statement while 26.4% strongly agreed that proper and well record management about an animal helps in planning*. When asked if, *early disease recognition and control must be practiced by every animal farmer,* 14.2% of the respondents strongly disagreed, 11.8% disagreed, 16.3 % not sure, 29.8% agreed and 27.8% strongly agreed with the statement

4.4 System Study and Investigation

In accordance with this project's problem statement in chapter one, the risks of insufficient livestock health practices within a region are particularly because of inadequate disease surveillance and information systems, inability to rapidly detect disease, implement emergency response measures and prevent the spread of disease. Many diseases can be transmitted from one animal to another during the incubation period, which is the period of time before the infected animal exhibits clinical signs. Other diseases may go unrecognized or mistaken for other less severe health conditions due to common clinical symptoms. Prior to disease detection, the

infectious agent can be transmitted, directly or indirectly, within the herd and/or farm-to-farm. Therefore, the development of a disease surveillance information system seems to be the best solution to these challenges.

4.5 System Requirements

System requirements included the tools, platform (software) and languages that was used in developing the proposed system. In order to curb issues such compatibility, efficiency and smooth running of the software the following configurations and requirement will be implemented.

a) Hardware Requirements

Table 9: *Database Host PC Hardware Requirements*

Hardware Components for Database Host PC

Hardware Components (Laptops & Desktop) - Hosting Database	Minimum System Requirements
Disk Space	80 GB free space or higher
Memory (Random Access Memory (RAM))	512 MB but (1GB highly Recommended)
Processor Speed	0.98 GHz or Higher
Screen Resolutions	800X 600 color (1024 x 768 High color-16 bit Recommended)

Table 10*: Android Phone/Tablets Hardware Requirements*

Hardware Components for Android Phone & Tablets

Hardware Components (Laptops & Desktop) - Hosting Database	Minimum System Requirements
Internal Storage	4.00 GB or higher
Memory (Random Access Memory (RAM))	1.00 GB or higher
Screen Resolution	854x480 or higher
CPU Core-Count	2 and above
CPU Frequency	1.3GHz and above
Android Version	7.0 and above

b) Software Requirements

Table 11: *Software Requirements*

Software Requirements	
Operating System	Windows 7 or Higher version
Javascript	
Adobe Collection	CS 6
Web Browser	Google Chrome, Microsoft Edge, Firefox, Opera etc

4.6 Conclusion

Basing on the designed and distributed questionnaires to the selected correspondents in Chapter 3, data was collected and analysed using the softwares in Chapter 1 and 3. This chapter therefore focused in giving the details of the analysed data and it also further looked in the system requirements to be developed. This was used by the researcher to design and develop the system as in the next chapter 5.

CHAPTER FIVE: SYSTEM DESIGN, TESTING AND IMPLEMENTATION

5.1 Introduction

This section described the system design, implementation of the design models of the system and also showed the different results generated by the system. Therefore, various screen shots of the system were displayed to show how the system displays results given a command by the end user**.**

5.2 System Design

According to Bassil (2011), system design is the process of planning and problem solving software solution and it includes the software architecture design, algorithm design, database conceptual schema and logical diagram design. Graphical user interface design and data structure definition are also included. The developed system included a backend Sql Database, with a front end php, html, python and Javascript platform for faster information saving and retrieval. This section describes the system design that includes the architectural system design, and flow charts.

5.2.1 Architectural Design for the System

The designed system had front end that was designed using php, python and html. Javascript was also used to make it a user friendly graphical user interface which has the capability of authentication. The system is also integrated with various processes that includes security integrity, disease surveillance information about livestock. The back end of system was developed using the SL Database. The details are shown the figure below.

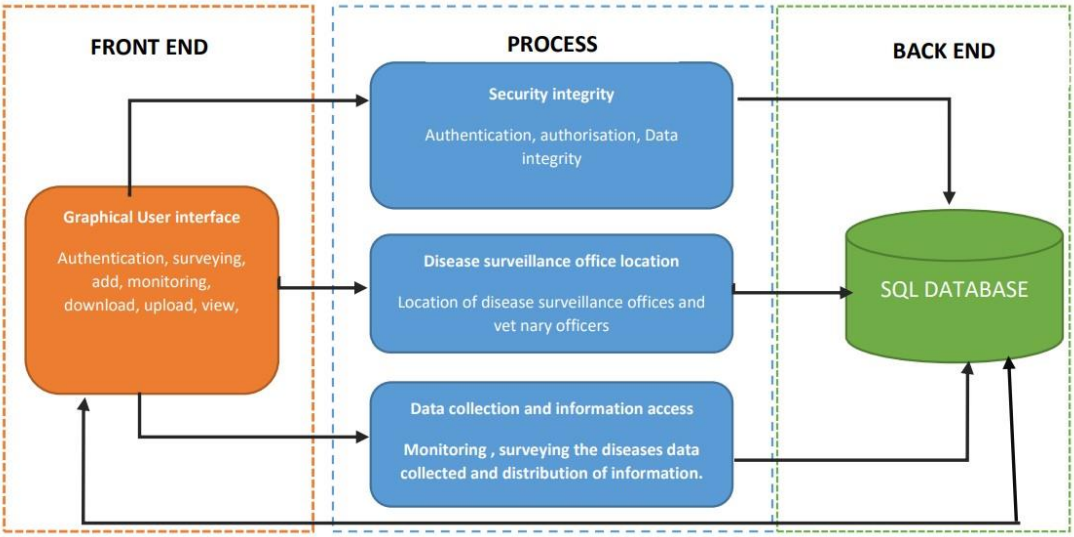


Figure 3: Architectural Design of Disease Surveillance system

5.2.2 Data Flow Diagram (DFD)

Data flow diagrams (DFDs) provides a graphical representation of the flow of information through the system and the activities that process that information. The developer in this project used DFD diagrams.

5.2.2.1 Context Flow Diagram

The Context data flow diagram, **also known as a level 0 DFD,** defines the boundary between the system, or part of a system and its environment, showing all the external entities that interact with it, with no details of its interior structure. The figure 2.0 shown below described clearly the context flow diagram of a diseases surveillance information system.

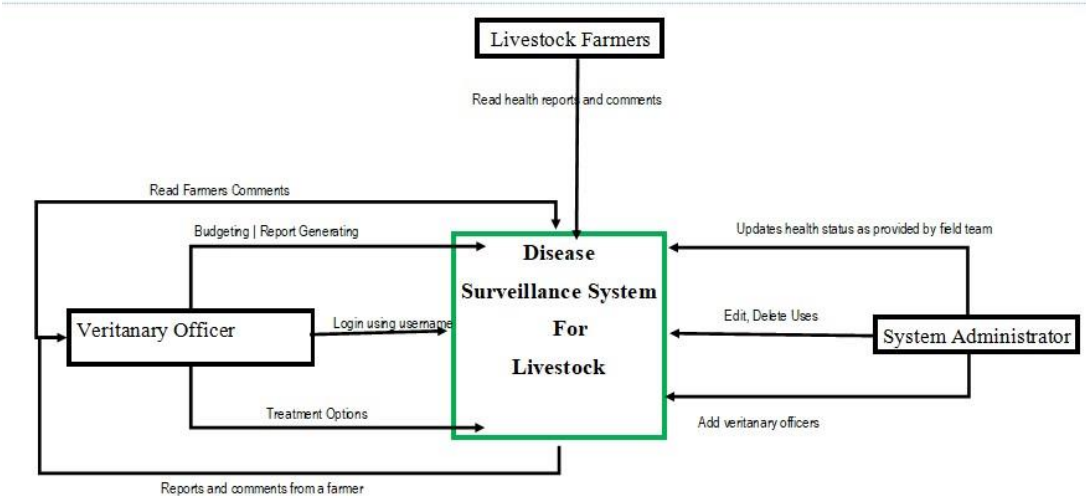


Figure 4: Context Flow Diagram (DFD Level 0) of disease surveillance system

5.2.3 Flowchart Diagrams

The flowchart is a diagram which visually presents the flow of data through processing system (Amir, 2013). The flowcharts were drawn showing the accessibility and system usage.

Flowchart Symbols Used

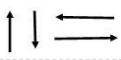
Symbol	Name	Function
	**Process**	Indicates any type of internal operation inside the Processor or Memory
	**Decision**	Used to ask a question that can be answered in a binary format (Yes/ No, True/False)
	**Terminal**	Indicates the starting or ending of the program, process, or interrupt program
	**Flow Lines**	Shows direction of flow.

Table 12: Flowchart Symbols used

5.2.3.1 End User's (Farmers) Flowcharts

The user access the system from the home page and is able to view, monitor the survey section of the system. The user can view as a guest or have login details from the user admin and he can log in. He/ she can down information provided in pdf. Figure 3.0 below illustrates flowchart of an end user.

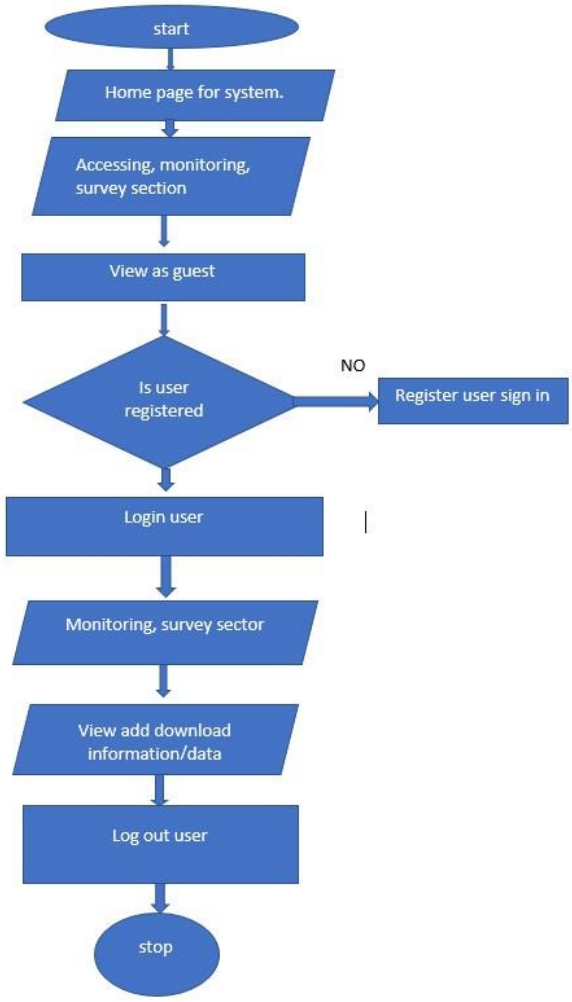


Figure 5: End-User Flowchart

5.3 System Implementation

The implementation environment used to support the disease surveillance system was Microsoft Windows 10 as an operating system, sql database, programming langue such as

HTML, Python, Javascript and Php were for back-end development. Adobe CS6 as an interface design software.

5.3.1 System Development Life Cycle

A disease surveillance system was developed by the help of System Development Life Cycle (SDLC) as it provided the systematic steps to follow to achieve the best final system. Troubleshooting was easily done as all steps followed were outlined by the system development life cycle. Waterfall Model was used in the system development.

5.4 System Testing

Testing of the system was carried out to evaluate and check if the system meets its obligations and objectives. Following testing were done on a system. Unit testing, integration testing, system testing and acceptance testing. This was to ensure that all errors were solved and the system was user friendly and applicable to the end person.

5.5 Presentation of Results

The presentation of the system results was analysed by system interfaces and outputs from the backend of the system. The results were as below

5.5.1 Registration and Login Page

The page provides a graphical user interphase with full details on how to access the system. This is first by registering using the mobile username and password. Using the registered credentials, the user can now log into the system, authentication is clearly done before access to the system. The user can reset his password using the provided link

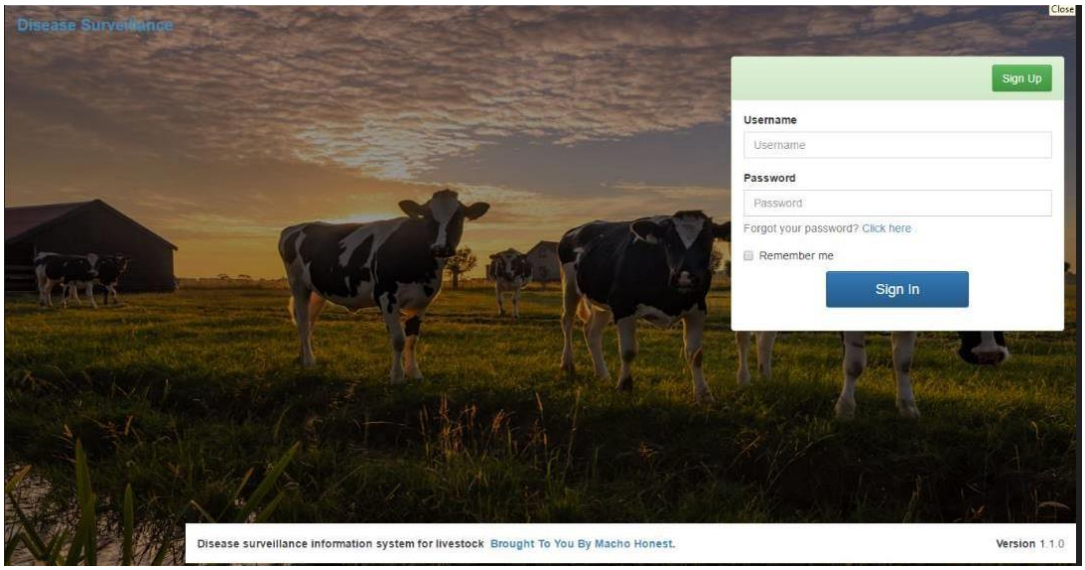


Figure 6: Registration & Login Page

5.5.2 Vet Officer Dashboard

The page provides the access platform for the vet officer. The vet is able to know his details, diseases, results and many more. He is able to do a print or download details in csv files.

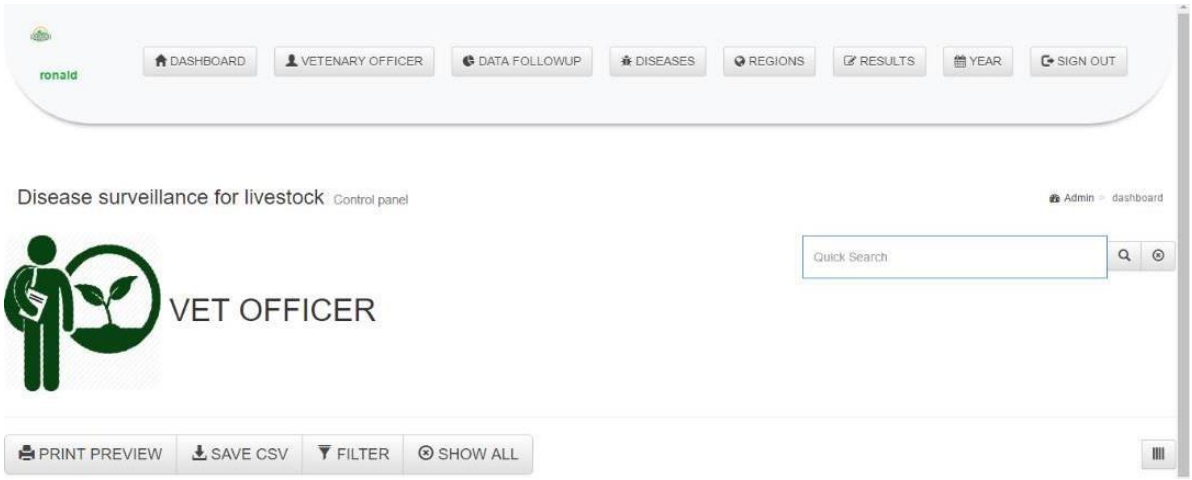


Figure 7: Vet Officer Dashboard

5.5.3 Disease Surveillance Control Panel

The panel shows the summary details of the system. The admin is able to see the number of diseases recorded, how many veritanary officers in the system, the surveyed regions and the calendar showing the records.

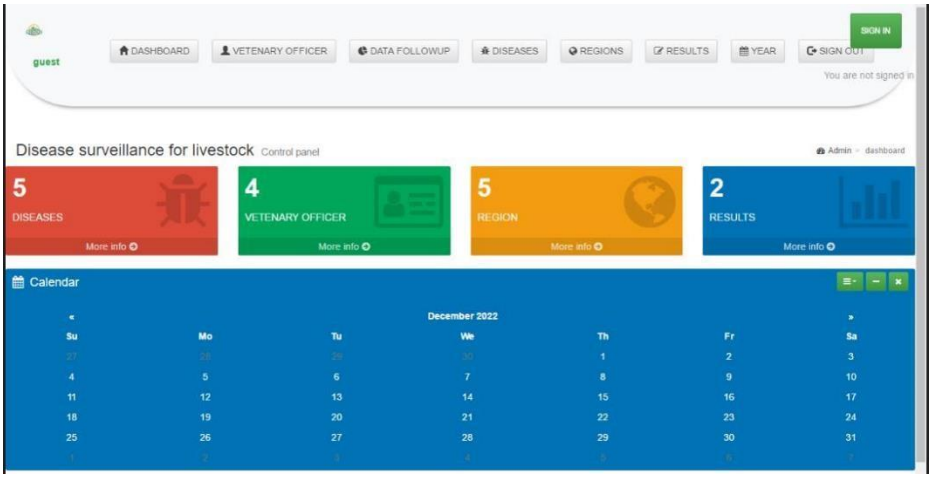


Figure 8: Surveillance System Panel

5.6 Conclusion

In summary, this chapter described the system implementations clearly outlining out the used software and programming languages as well as the model used. It then described various testing types that were used on the system. Lastly, the chapter presented the system results basing on the input and output of the system graphical user interfaces. The chapter introduced Chapter 6 which focused majorly the conclusion and recommendations to be taken. The future studies was also discussed in chapter 6.

CHAPTER SIX: CONCLUSION, RECOMMENDATIONS AND FUTURE STUDIES

6.1 Recap of the Research Problem

This chapter clearly described the discussion of the found results by the researcher, the limitations faced in the development of the project research, the recommendations of the researcher basing on the findings of analysed and interpreted study and the conclusion given.

The main aim objective of this research project was to develop a disease surveillance system for livestock. The developed system was to help the mbale district livestock farmers, agricultural officers and veterinary officers in animal record keeping, animal health management and therefore, the system was to eliminate manual way of recording, interpreting the recorded data. Information will be up to date for all farmers and this will help in control of livestock diseases and any other diseases.

The researcher based on these objectives

i. To investigate the existing literature on disease surveillance information system for livestock in Mbale district.
ii. To identify requirements needed to design a disease surveillance information system for livestock in Mbale district.
iii. To design the disease surveillance information system for livestock in Mbale district.
iv. To implement the disease surveillance information system for livestock in Mbale district.

6.2 Limitations

The researcher and developer faced some challenges in the development of the system and in the project research, and these were;

i. The application required one to have basic technical skills, the computer skills. This clearly meant that lack of skills was a challenge to the use of the system.

ii. Developing the system had some costs as the software were needed and they were expensive. iii. The developed system was only to be used when someone had a smartphone or a computer.

iv. Locating the research respondents was an issue since it was hard to differentiate from those in Mbale City and Mbale District.

v. Farmers' unwillingness to provide information due to fear of information leakage about their livestock rearing skills.

6.3 Recommendations

I recommend the following;

i. The system to be adopted and be put in use as it will help to control various livestock challenges from the farmer.

ii. The researcher who will be interested in this piece of work can convert this system to an application that can be accessible of play store or Appstore.

6.4 Conclusion

The developed system will be the general solution to all the livestock farmers and other stakeholders. The developed system was majorly in line with this research project that focused on the six chapters. The birth of the topic "Livestock Disease Surveillance System" led to the literature review, data collection, analysis, system design and then system development. This was all guided by Chapter 1, 2, 3 ,4, 5 and 6.

REFERENCES

Adam, P & Warren, L. (1996). Information System Management. *Perspectives for Higher Education*.

Barry Boehm (1986), *A Spiral Model of Software Development and Enhancement*.

Boehm, B. W. . (1986). Aspiral Model of Software Development and Enhancement. *SIGSOFT Software Engineering Notes*, 14-24.

Geatland,P. H., Hutman, J. & Wegner,M.M. (2003). Technical Description of RODS: a real time public health surveillance system. *American Medical Informatics*.

Google. (n.d.). *Location of Mbale, Uganda*. Retrieved 6 10, 2019, from google map : https://www.googlemap.com

Houe, H., Nielsen, S. S., Nielsen, L. R., Ethelberg, S., & Mølbak, K. (n.d.). *Opportunities for improved disease surveillance and control intergrated data for animal and human health*. Retrieved 12 12, 2022, from Frontiers: https://www.frontiersin org

Josseran, L., Nicolau, J., Caill`ere, N., Astagneau, P. & Br¨ucker, G. . (2006). Syndromic survillance based on emergency department actvity and crude mortality:. 255-229.

Kasozi, N., Kibwika, P., & Basalirwa, C. (2017). *Analysis of factors influencing intensification of dairy farming in Mbale District, Uganda*. Journal of Agriculture and Environmental Sciences.

M. & DeThomasis, J. (2004). *Evaluation Challenges for syndromic survellance.*

MAAIF. (2017). *The Republic of Uganda, Ministry of Agriculture, Animal Industry and Fisheries.*

Magona, J. W., Walubengo, J., Galiwango, T., Etoori, A., & Mukiibi, G. M. (2017). *Cattle diseases diagnosed at the District Veterinary Office, Mbale*, Uganda: successes and challenges. Onderstepoort Journal of Veterinary Research.

Maguire, M., and B. Delahunt. (2017). *Doing a thematic analysis: A practical, step- by-step guide for learning and teaching scholars*. 1–14.

Maguire, M., and B. Delahunt. . (2007). *Doing a thematic analysis: A practical, Step by step guide for learning an teaching.*

Mariner, J., D. Pfeiffer, S. Costard, L. Knopf, J. Zingeser, D. Chibeu, et al. . (2011). *Surveillance for the present and future. In challenges of animal health information systems and surveillance for animal diseases and zoonoses.* Animal Production and Health Proceeding.

Middleton, F. (2019). *Reliability vs Validity in Research*. Retrieved from https://www.scribbr.com

Mugizi, D. R., & Buyinza, M. (2018). *The contribution of livestock production to household income in Mbale District, Uganda*. Livestock Research for Rural Development.

Mullins, C. S. (2022). *Database management system (DBMS).* Data Management. Retrieved December 9, 2022, from https://www.techtarget.com.

N., Kretzschmar, M. & Koopmans, M. (2011), *Evaluation of syndromic surveillance in the Netherlands: its added value and recommendations for implementation.*', Eurosurveillance 16

Perez, A., Alkhamis, M., Carlsson, U., Brito, B. (2011). *Global animal disease surveillance*. Spatial and spatio- temporal epidemiology. Retrieved December 10, 2022, from https://www.ncbi.nlm.nih.gov.

Rolfhamre, P., Jansson, A., Arneborn, M. & Ekdahl, K. (2006), *SmiNet2: description of an internet-based surveillance system for communicable diseases in sweden*', Eurosurveillance.

Sidel, V., Gould, R. & Cohen, H. (2002), *Bioterrorism preparedness: cooptation of public health?', Medicine & Global Survival* 7(2), 82–89.

Sonesson, C. & Bock, D. (2003), *A review and discussion of prospective statistical surveillance in public health*, Journal of the Royal Statistical Society: Series A (Statistics in Society).

Tolentino, H., Kamadjeu, R. (2007), *Scanning the Emerging Infectious Diseases HorizonVisualizing ProMED Emails Using EpiSPIDER',*

Travers, D., Barnett, C. (2006), *Advances in Disease Surveillance 2, 169*. Timeliness of emergency department diagnoses for syndromic surveillance, in 'AMIA Annual Symposium Proceedings', Vol. 2006, p. 769.

Tsui, F., Espino, J. U., Dato, V. M. (2006), *Handbook of Biosurveillance, first edn*, Academic Press.

Wagner, M. M., Robinson, J. (2003), *Design of a national retail data monitor for public health surveillance*, Journal of the American Medical Informatics Association 10(5), 409–418.

Wong, W. & Moore, A. (2006), *How to formulate a research strategy*. Project Guru.

APPENDICES

Appendix I

Krejcie and Morgan (1970) Sampling Frame

Table for Determining Sample Size from a Given Population

Table 3.1

Table for Determining Sample Size of a Known Population

N	S	N	S	N	S	N	S	N	S
10	10	100	80	280	162	800	260	2800	338
15	14	110	86	290	165	850	265	3000	341
20	19	120	92	300	169	900	269	3500	346
25	24	130	97	320	175	950	274	4000	351
30	28	140	103	340	181	1000	278	4500	354
35	32	150	108	360	186	1100	285	5000	357
40	36	160	113	380	191	1200	291	6000	361
45	40	170	118	400	196	1300	297	7000	364
50	44	180	123	420	201	1400	302	8000	367
55	48	190	127	440	205	1500	306	9000	368
60	52	200	132	460	210	1600	310	10000	370
65	56	210	136	480	214	1700	313	15000	375
70	59	220	140	500	217	1800	317	20000	377
75	63	230	144	550	226	1900	320	30000	379
80	66	240	148	600	234	2000	322	40000	380
85	70	250	152	650	242	2200	327	50000	381
90	73	260	155	700	248	2400	331	75000	382
95	76	270	159	750	254	2600	335	1000000	384

Note: N is Population Size; S is Sample Size *Source: Krejcie & Morgan, 1970*

Note: N = population size
S = sample size

**Educational and Psychological Measurement*, Krejcie & Morgan (1970)

Appendix II

Research Project Questionnaire Questionnaire used in Collecting Data from the field

---

Dear Respondent,

My name is Macho Honest, a student from Uganda Christian University-Mbale Campus doing my final year research on Disease Surveillance Information System focusing on a topic: **Disease Surveillance System for Livestock**; A case study of Mbale District. The research is purely academic and the information you will give me will be treated with the highest level of confidentiality. Any assistance you render me in answering these questions will be highly appreciated. Thank you.

Respondent Signature……

SECTION A: Demographic Data

For this section, tick the appropriate box

1. **Sex:** 1) **Male** ☐ 2) **Female** ☐

2. **Marital Status:** 1) **Single** ☐ 2) **Married** ☐ 3) **Divorced** ☐ 4) **Others** ☐

3. **Position Held: 1**) Agricultural Officer ☐ **2**) Veterinary Staff ☐ **3**) Livestock ☐ Farmer

4. **Work Duration:** 1 year ☐ 2 years ☐ 3 years ☐ 4 years ☐ 5 and more ☐

SECTION B Questionnaire Guide

(Instruction) For each of the following items please tick in the box that best represents your suitable opinion as it is in each statement; (**1)** Strongly Disagree, (**2)** Disagree, (**3)** Not Sure, (**4)** Agree, (**5)** Strongly Agree

S/N	(A) Animal Diseases Detection	1	2	3	4	5
1	Animal identification, registration, traceability and movement control helps in diseases detection in an animal.					
2	Parasites (both internal and external) causes diseases to animals 100%					
3	Well trained farmers can discover diseases very first in the animals					
4	Enough information to a farmer about his animals in very necessary.					
5	Animal Samples and specimens collections helps in diseases detections					

6	Animal clinical examination is necessary to all animals by the farmer.					

S/N	(B) Animal Diseases Transmission	1	2	3	4	5
1	Dumping of xenobiotics into the environment (medicine residue) affects animals					
2	Infectious diseases can be transmitted between domestic and wild animals.					
3	Resistance to antibiotics and traces of medicines in animal products causes infections to an animal.					
4	Animal food scarcity always causes diseases hence transmission					
5	Consumption of wild animals lead to spread of novel Coronavirus (COVID19) outbreak					
6	Non-human animals have infected humans by infectious disease (zoonosis)					

S/N	(C) Animal Diseases Transmission Preventative Measures	1	2	3	4	5
1	Animal balanced diet is highly important on daily animal feeds.					
2	Vaccination and treatment of animals is the best measures of disease control in animals.					
3	Discount on medicines and vaccines for the farmers leads to proper prevention of diseases by majority of farmers.					
4	Good selection of animal breeds reduces the effects of sicknesses in animals.					
5	Proper and well record management about an animal helps in planning					
6	Early disease recognition and control must be practiced by every animal farmers.					

S/N	(D) SURVEILLANCE INFORMATION SYSTEM ON LIVESTOCK	1	2	3	4	5
1	The system enables remote access to information and reports					
2	System is able to monitor the number of times the livestock case being reported					
3	System records, validates and Manages the Livestock data inserted by the user					
4	Farmers can access basic information of livestock on time using the system					
5	System Front end is user friendly to the farmers and other system users.					
6	System supports CIA (Confidentiality, Integrity and Availability)					

Thank* you *for your valued time and support

Appendix III

Data Collection Introduction Letter Letter presented to Mbale Municipal Council before Collecting Data

---

UGANDA CHRISTIAN UNIVERSITY, MBALE UNIVERSITY COLLEGE

FACULTY OF ENGINEERING, DESIGN AND TECHNOLOGY
DEPARTMENT OF COMPUTING AND TECHNOLOGY
A Centre of Excellence in the Heart of Africa

Date: 16th November 2022

To: The District Veterinary Officer Mbale

DR Philip Wakimwere.....

Received
Permission granted

DISTRICT VETERINARY OFFICER MBALE

Dear Sir/Madam,

Re: Academic Research

Christian greetings!

We are honored to introduce to you **Mr. Macho Honest** of Registration Number, **WJ20/MUC/IT/195** pursuing a Masters' Degree in Information Technology. He is required to carry out an academic research/project on the topic: **"Disease Surveillance Information System For Livestock; A Case Of Mbale District"** and thereafter produce three copies (3) of well bound hard cover research report **(black)** in color for Postgraduate students as a University requirement for the award of a masters' degree in the academic discipline that he is pursuing.

We shall be grateful for the help you may offer to him accordingly.

Thank you.

Yours faithfully,

UGANDA CHRISTIAN UNIVERSITY HEAD OF DEPARTMENT 16 NOV 2022 COMPUTING AND TECHNOLOGY MBALE UNIVERSITY COLLEGE

Mutemere Joseph
Ag. Head of Department Computing and Technology
Mbale University College

P. O Box 189, Mbale, Uganda, Tel: +256 454 436 222, E-mail: directormbale@ucu.ac.ug

Appendix IV

Sample Project Codes Backend Codes used in Developing the Waste System

---

Users > charl > Desktop > my desktop app > www > monitor > login.php

```
<?php if(!isset($Translation)){ @header('Location: index.php?signIn=1'); exit; } ?>
<?php include_once("$currDir/header-start.php"); ?>

<?php if($_GET['loginFailed']){ ?>
    <div class="alert alert-danger"><?php echo $Translation['login failed']; ?></div>
<?php } ?>

<div class="row">
    <div class="col-sm-6 col-lg-8" id="login_splash">
        <!-- customized splash content here -->
    </div>
    <div class="col-sm-6 col-lg-4">
        <div class="panel panel-success">

            <div class="panel-heading">
                <h1 class="panel-title"><strong><?php echo $Translation['sign in here']; ?></strong></h1>
                <?php if(sqlValue("select count(1) from membership_groups where allowSignup=1")){ ?>
                    <a class="btn btn-success pull-right" href="membership_signup.php"><?php echo $Translation['sign up']; ?></a>
                <?php } ?>
                <div class="clearfix"></div>
            </div>

            <div class="panel-body">
                <form method="post" action="index.php">
                    <div class="form-group">
                        <label class="control-label" for="username"><?php echo $Translation['username']; ?></label>
                        <input class="form-control" name="username" id="username" type="text" placeholder="<?php echo $Translation['username']; ?>" required>
                    </div>
                    <div class="form-group">
                        <label class="control-label" for="password"><?php echo $Translation['password']; ?></label>
                        <input class="form-control" name="password" id="password" type="password" placeholder="<?php echo $Translation['password']; ?>" required>
                        <span class="help-block"><?php echo $Translation['forgot password']; ?></span>
                    </div>
                    <div class="checkbox">
                        <label class="control-label" for="rememberMe">
                            <input type="checkbox" name="rememberMe" id="rememberMe" value="1">
                            <?php echo $Translation['remember me']; ?>
                        </label>
                    </div>
                    <div class="row">
```

```
</nav>
meta charset="utf-8">
meta http-equiv="X-UA-Compatible" content="IE=edge">
itle><?php echo ucwords(' Disease surveillance information for livestock'); ?> | <?php echo (isset($x->TableTitle) ? $x->TableTitle : ''); ?></title>
!-- Tell the browser to be responsive to screen width -->
meta content="width=device-width, initial-scale=1, maximum-scale=1, user-scalable=no" name="viewport">
link rel="stylesheet" href="bower_components/bootstrap/dist/css/bootstrap.min.css">
!-- Font Awesome -->
link rel="stylesheet" href="bower_components/font-awesome/css/font-awesome.min.css">
!-- Ionicons -->
link rel="stylesheet" href="bower_components/Ionicons/css/ionicons.min.css">
!-- Theme style -->
link rel="stylesheet" href="dist/css/AdminLTE.min.css">
!-- AdminLTE Skins. We have chosen the skin-blue for this starter
    page. However, you can choose any other skin. Make sure you
    apply the skin class to the body tag so the changes take effect. -->
link rel="stylesheet" href="dist/css/skins/skin-green.min.css">

    <link id="browser_favicon" rel="shortcut icon" href="<?php echo PREPEND_PATH; ?>resources/images/live.png">

<link rel="stylesheet" href="<?php echo PREPEND_PATH; ?>resources/initializr/css/bootstrap.css">
<!--[if gt IE 8]><!-->
  <link rel="stylesheet" href="<?php echo PREPEND_PATH; ?>resources/initializr/css/bootstrap-theme.css">
<!--<![endif]-->
<link rel="stylesheet" href="<?php echo PREPEND_PATH; ?>resources/lightbox/css/lightbox.css" media="screen">
<link rel="stylesheet" href="<?php echo PREPEND_PATH; ?>resources/select2/select2.css" media="screen">
<link rel="stylesheet" href="<?php echo PREPEND_PATH; ?>resources/timepicker/bootstrap-timepicker.min.css" media="screen">
<link rel="stylesheet" href="<?php echo PREPEND_PATH; ?>resources/datepicker/css/datepicker.css" media="screen">
<link rel="stylesheet" href="<?php echo PREPEND_PATH; ?>dynamic.css.php">

<!--[if lt IE 9]>
  <script src="<?php echo PREPEND_PATH; ?>resources/initializr/js/vendor/modernizr-2.6.2-respond-1.1.0.min.js"></script>
<![endif]-->
<script src="<?php echo PREPEND_PATH; ?>resources/jquery/js/jquery-1.12.4.min.js"></script>
<script>var $j = jQuery.noConflict();</script>
<script src="<?php echo PREPEND_PATH; ?>resources/jquery/js/jquery.mark.min.js"></script>
<script src="<?php echo PREPEND_PATH; ?>resources/initializr/js/vendor/bootstrap.min.js"></script>
<script src="<?php echo PREPEND_PATH; ?>resources/lightbox/js/prototype.js"></script>
<script src="<?php echo PREPEND_PATH; ?>resources/lightbox/js/scriptaculous.js?load=effects"></script>
<script src="<?php echo PREPEND_PATH; ?>resources/select2/select2.min.js"></script>
```

```html
<!DOCTYPE html>
<html lang="en"><!-- Basic -->
<head>
  <meta charset="utf-8">
    <meta http-equiv="X-UA-Compatible" content="IE=edge">

    <!-- Mobile Metas -->
    <meta name="viewport" content="width=device-width, initial-scale=1">

     <!-- Site Metas -->
    <title>Disease Surveillance information system for Livestock</title>
    <meta name="keywords" content="">
    <meta name="description" content="">
    <meta name="author" content="">

    <!-- Site Icons -->
    <link rel="shortcut icon" href="images/live.png" type="image/x-icon">
    <link rel="apple-touch-icon" href="images/apple-touch-icon.png">

    <!-- Bootstrap CSS -->
    <link rel="stylesheet" href="css/bootstrap.min.css">
  <!-- Site CSS -->
    <link rel="stylesheet" href="css/style.css">
    <!-- Responsive CSS -->
    <link rel="stylesheet" href="css/responsive.css">
    <!-- Custom CSS -->
    <link rel="stylesheet" href="css/custom.css">
  <style>
    #more {display: none;}
    </style>
    <!--[if lt IE 9]>
      <script src="https://oss.maxcdn.com/libs/html5shiv/3.7.0/html5shiv.js"></script>
      <script src="https://oss.maxcdn.com/libs/respond.js/1.4.2/respond.min.js"></script>
    <![endif]-->

</head>
```

```php
<?php if(!isset($Translation)){ @header('Location: index.php?signIn=1'); exit; } ?>
<?php include_once("$currDir/header-start.php"); ?>

<?php if($_GET['loginFailed']){ ?>
    <div class="alert alert-danger"><?php echo $Translation['login failed']; ?></div>
<?php } ?>

<div class="row">
    <div class="col-sm-6 col-lg-8" id="login_splash">
        <!-- customized splash content here -->
    </div>
    <div class="col-sm-6 col-lg-4">
        <div class="panel panel-success">

            <div class="panel-heading">
                <h1 class="panel-title"><strong><?php echo $Translation['sign in here']; ?></strong></h1>
                <?php if(sqlValue("select count(1) from membership_groups where allowSignup=1")){ ?>
                    <a class="btn btn-success pull-right" href="membership_signup.php"><?php echo $Translation['sign up']; ?></a>
                <?php } ?>
                <div class="clearfix"></div>
            </div>

            <div class="panel-body">
                <form method="post" action="index.php">
                    <div class="form-group">
                        <label class="control-label" for="username"><?php echo $Translation['username']; ?></label>
                        <input class="form-control" name="username" id="username" type="text" placeholder="<?php echo $Translation['username']; ?>" required>
                    </div>
                    <div class="form-group">
                        <label class="control-label" for="password"><?php echo $Translation['password']; ?></label>
                        <input class="form-control" name="password" id="password" type="password" placeholder="<?php echo $Translation['password']; ?>" required>
                        <span class="help-block"><?php echo $Translation['forgot password']; ?></span>
                    </div>
                    <div class="checkbox">
                        <label class="control-label" for="rememberMe">
                            <input type="checkbox" name="rememberMe" id="rememberMe" value="1">
                            <?php echo $Translation['remember me']; ?>
                        </label>
                    </div>
                    <div class="row">
```

```php
<?php
    if(ISSET($_REQUEST['file'])){
        $file = $_REQUEST['file'];

        //header("Cache-Control: public");
        //header("Content-Description: File Transfer");
        header("Content-Disposition: attachment; filename=".basename($file));
        header("Content-Type: application/octet-stream;");
        //header("Content-Transfer-Encoding: binary");
        readfile("files/".$file);
    }
?>
```

Appendix V

Research and Project Budget

Cost Analysis of the amount used in research and project development

Source of fund/Income			**Expenditure**	
Item	Amount		Item	Amount
Personal contribution	1,850,000	1	Printing and Stationery	200,000
		2	Transport Expenses	200,000
		3	Research Assistant	300,000
		4	Internet	300,000
		5	Software purchase & updates	400,000
		6	Reading materials	100,000
		7	Binding Final Copy	250,000
		8	Miscellaneous	100,000
TOTAL	**1,850,000**			**1,850,000**