

**BINDURA UNIVERSITY OF SCIENCE EDUCATION**  
**FACULTY OF AGRICULTURE AND ENVIRONMENTAL SCIENCES**  
**DEPARTMENT OF ANIMAL SCIENCE**  
**AN ASSESSMENT OF ANTIBIOTIC USE AND ITS CONTRIBUTION TO**  
**ANTIMICROBIAL RESISTANCE IN POULTRY A CASE OF CHIKOMBA**  
**DISTRICT, CHIVHU ZIMBABWE**



**DZVIMBO GARAUIVE**

**B230422B**

**A RESEARCH PROJECT SUBMITTED TO THE DEPARTMENT OF ANIMAL  
SCIENCE, BINDURA UNIVERSITY OF SCIENCE EDUCATION, IN PARTIAL  
FULFILMENT OF THE REQUIREMENTS OF THE BACHELOR OF SCIENCE  
HONOURS DEGREE IN ANIMAL HEALTH AND PRODUCTION EXTENSION  
(BScHAHPE).**

**JUNE 2026**

**Approval page**

The undersigned hereby certify that they have read and recommended to the Bindura University of Science Education for acceptance a dissertation of a research project entitled: “An assessment of antibiotic use and its contribution to antimicrobial resistance in poultry a case of Chikomba District, Chivhu Zimbabwe”, submitted by Dzvimbo Garauzive (B230422B).

Student

Name: ...Dzvimbo Garauzive..... Signature:  Date: ...30 May 2026...

The thesis was submitted to the department of Animal Science, Faculty of Agriculture and Environmental Science, Bindura University of Science Education in partial fulfilment of requirements for the degree Bachelor of Science Honours degree in Animal Science and Production Extensions.

Approved by:

Name: ... Dr Chabwanda ..... Signature:  Date: ...30 May 2026....

**Chairman**

Name: ... Pagute A ..... Signature:  Date: .....06/09/26.....

## **Abstract**

This study examined antibiotic use practices and their contribution to a AMR among poultry farmers in Chikomba District, Chivhu, Zimbabwe. The study was initiated due to rising worries about the improper use of antibiotics in animal farming and the increasing risk of antimicrobial resistance, which poses a significant danger to both animal welfare and public health. It therefore aims to explore antibiotic usage practices among poultry farmers, assess farmers' awareness of antimicrobial resistance, and identify the determinants of antibiotic misuse associated with poultry farming. A quantitative research design was used, and data were collected in the survey of 50 poultry farmers using structured questionnaires. Data were analyzed using descriptive statistics, reliability analysis, regression analysis, and relationship analysis. Antibiotic usage among poultry farmers was evident in the results of the study, with 96% of respondents admitting to using antibiotics in their poultry production, as well as 80% using antibiotics at regular intervals in each cycle of their production. The study revealed low levels of awareness about antimicrobial resistance, as 58% of the respondents surveyed were unaware of AMR and 61.4% were unaware of how bacteria develop resistance. Similarly, 67.3% of participants did not know the withdrawal periods. The most significant contributors to the misuse of antibiotics were: (a) lack of veterinary guidance (36%) (b) limited knowledge of antibiotics (30%) (c) easy access to antibiotics (20%) and (d) disease outbreaks (14%). Using linear regressions, frequency of antibiotic use and AMR awareness are significantly negatively associated, while limited access to veterinary care significantly positively predicts antibiotic misuse. The study found that inappropriate antibiotic use practices by poultry farmers lead to the risk of antimicrobial resistance. The study suggests improving veterinary extension services, providing farmers with more education around antimicrobial stewardship, ensuring biosecurity, and stricter regulation of antibiotic distribution and use in poultry farming systems.

**Key Words:** Antibiotic, antimicrobial resistance (AMR), poultry farming, withdrawal periods, biosecurity

**Dedication**

This piece of work is dedicated to the Almighty for giving me the strength and wisdom to go through these studies my family for the support they gave me towards the degree programme and for being my inspiration at all times.

**Acknowledgment**

Special thanks to my supervisor Dr Chabwanda for the patience and guidance throughout the research. I would like to thank also all lecturers who have taken me through this course for their assistance.

I am also indebted to my family and friends for their help and support both morally as well as financially.

Special thanks also go to Bindura University of Science Education for granting me an opportunity to learn at their institution if not for them, I would have not further my studies.

## Table of Contents

|                                                                    |      |
|--------------------------------------------------------------------|------|
| Approval page .....                                                | i    |
| Abstract .....                                                     | ii   |
| Dedication .....                                                   | iii  |
| Acknowledgment.....                                                | iv   |
| List of Figures .....                                              | viii |
| List of Tables.....                                                | ix   |
| List of Appendices.....                                            | x    |
| List of abbreviations .....                                        | xi   |
| CHAPTER 1.....                                                     | 1    |
| 1.1 Introduction .....                                             | 1    |
| 1.2 Background .....                                               | 1    |
| 1.3 Problem Statement .....                                        | 3    |
| 1.4 Objectives of the study .....                                  | 3    |
| 1.5 Research Questions .....                                       | 4    |
| 1.6 Research Hypothesis .....                                      | 4    |
| 1.7 Significance of the study .....                                | 4    |
| 1.8 Scope of the study .....                                       | 5    |
| 1.9 Limitations of the study.....                                  | 5    |
| Chapter Summary.....                                               | 5    |
| CHAPTER TWO: LITERATURE REVIEW .....                               | 6    |
| 2.1 Introduction .....                                             | 6    |
| 2.2 Theoretical Framework .....                                    | 6    |
| 2.2.1 One Health Approach.....                                     | 6    |
| 2.2.2 Theory of Planned Behaviour (TPB).....                       | 7    |
| 2.3 Conceptual Framework .....                                     | 8    |
| 2.4 Overview of antibiotic use in poultry production .....         | 9    |
| 2.5 Mechanisms of antibiotic action.....                           | 9    |
| 2.6 Mechanisms of Antimicrobial Resistance (AMR).....              | 10   |
| 2.7 Factors Influencing Antibiotic Misuse in Poultry Farming ..... | 11   |
| 2.8 Impacts of Antimicrobial Resistance in Poultry Production..... | 12   |
| 2.9 Strategies for mitigating antimicrobial resistance.....        | 12   |
| 2.10 Empirical studies on antibiotic use and resistance.....       | 13   |
| 2.10.1 Empirical Evidence from Africa.....                         | 13   |
| 2.10.2 Empirical Evidence from Zimbabwe.....                       | 13   |
| 2.10.3 Global Context .....                                        | 14   |

|                                                                                         |    |
|-----------------------------------------------------------------------------------------|----|
| 2.11 Knowledge Gaps.....                                                                | 14 |
| 2.12 Chapter Summary.....                                                               | 15 |
| CHAPTER 3: RESEARCH METHODOLOGY .....                                                   | 16 |
| MATERIALS AND METHODS .....                                                             | 16 |
| 3.1 Introduction .....                                                                  | 16 |
| 3.2 Study Site .....                                                                    | 16 |
| 3.3 Research Design.....                                                                | 17 |
| 3.4 Target Population.....                                                              | 17 |
| 3.5 Sampling procedure.....                                                             | 17 |
| 3.6 Sample size determination.....                                                      | 18 |
| 3.7 Data collection methods .....                                                       | 18 |
| 3.7.1 Structured and semi-structured questionnaires .....                               | 18 |
| 3.7.2 Observations.....                                                                 | 18 |
| 3.7.3 Secondary Data .....                                                              | 19 |
| 3.10 Data Analysis.....                                                                 | 20 |
| 3.11 Ethical Considerations .....                                                       | 20 |
| 3.12 Summary .....                                                                      | 20 |
| CHAPTER 4 - RESULTS .....                                                               | 21 |
| 4.1 Introduction .....                                                                  | 21 |
| 4.2 Antibiotic usage practices among poultry farmers.....                               | 21 |
| 4.3 Farmers' understanding of antimicrobial resistance .....                            | 23 |
| 4.4 Factors influencing antibiotic misuse in poultry farming .....                      | 24 |
| 4.5 Reliability Analysis .....                                                          | 26 |
| 4.6 Regression Analysis .....                                                           | 27 |
| 4.6.1 Regression between antibiotic use and antimicrobial resistance awareness .....    | 27 |
| 4.6.2 Regression between veterinary access and antibiotic misuse .....                  | 27 |
| 4.7 Summary .....                                                                       | 28 |
| CHAPTER 5 - DISCUSSION .....                                                            | 29 |
| 5.1 Trends and Spatial Differences.....                                                 | 29 |
| 5.2 Insightful Interpretation of Results.....                                           | 29 |
| 5.2.1 Household demography, socio-economic factors and antibiotic use practices .....   | 30 |
| 5.2.2 High Antibiotic Use and Frequent Administration Practices .....                   | 30 |
| 5.2.3 Limited Awareness of Antimicrobial Resistance and Misuse of Antibiotics.....      | 31 |
| 5.2.4 Influence of accessibility of antibiotics and veterinary guidance on misuse ..... | 31 |
| 5.2.5 Public health implications of antibiotic use practices.....                       | 31 |
| 5.2.6 Overall Interpretation of Findings .....                                          | 32 |

|                                                  |    |
|--------------------------------------------------|----|
| 5.3 Generalizations .....                        | 32 |
| 5.4 Exceptions to the Rule.....                  | 33 |
| 5.5 Reasons why things happen .....              | 33 |
| 5.6 Contribution of the Study .....              | 33 |
| 5.7 Chapter Summary.....                         | 34 |
| CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS ..... | 35 |
| 6.0 Introduction .....                           | 35 |
| 6.1 Conclusions .....                            | 35 |
| 6.2 Recommendations .....                        | 36 |
| 6.3 Areas for Further Research.....              | 37 |
| 6.4 Conclusion.....                              | 37 |
| References .....                                 | 38 |
| Annexure A: Research Questionnaire.....          | 40 |

## List of Figures

|                                                                                        |    |
|----------------------------------------------------------------------------------------|----|
| Figure 2. 1: Antimicrobial Resistance – One health approach .....                      | 7  |
| Figure 2. 2: The Theory of planned behaviour .....                                     | 8  |
| Figure 2. 3: The Conceptual framework .....                                            | 8  |
| Figure 2. 4: Main antibiotic modes of action (The Open University, 2025) .....         | 10 |
| <br>                                                                                   |    |
| Figure 3. 1: Map of Chikomba district a place in Zimbabwe under Mashonaland East ..... | 16 |
| <br>                                                                                   |    |
| Figure 4. 1: Antibiotic use among poultry farmers in Chikomba district .....           | 21 |
| Figure 4. 2: Frequency of antibiotic administration in poultry farms .....             | 22 |
| Figure 4. 3: Sources of antibiotics used by poultry farmers .....                      | 23 |
| Figure 4. 4: Awareness of antimicrobial resistance among farmers .....                 | 24 |
| Figure 4. 5: Level of understanding of antimicrobial resistance .....                  | 24 |
| Figure 4. 6: Factors influencing antibiotic misuse .....                               | 25 |
| Figure 4. 7: Knowledge of withdrawal periods among poultry farmers .....               | 26 |

## List of Tables

|                                                                                       |    |
|---------------------------------------------------------------------------------------|----|
| Table 4. 1: Use of antibiotics in poultry farming .....                               | 21 |
| Table 4. 2: Frequency of antibiotic administration.....                               | 22 |
| Table 4. 3: Sources of antibiotics used by poultry farmers .....                      | 22 |
| Table 4. 4: Awareness of antimicrobial resistance.....                                | 23 |
| Table 4. 5: Understanding of how bacteria develop resistance .....                    | 24 |
| Table 4. 6: Factors influencing antibiotic misuse.....                                | 25 |
| Table 4. 7: Knowledge of antibiotic withdrawal periods .....                          | 25 |
| Table 4. 8: Reliability analysis .....                                                | 26 |
| Table 4. 9: Regression coefficients for antibiotic use and AMR awareness.....         | 27 |
| Table 4. 10: Regression coefficients for veterinary access and antibiotic misuse..... | 27 |

## **List of Appendices**

|                                          |    |
|------------------------------------------|----|
| Annexure A: Research Questionnaire ..... | 40 |
|------------------------------------------|----|

**List of abbreviations**

AMR - Antimicrobial Resistance

AMU - Antimicrobial Use

DVS - Department of Veterinary Services

FAO - Food and Agriculture Organization

OIE - World Organisation for Animal Health

SPSS - Statistical Package for Social Sciences

WHO - World Health Organization

$\beta$  - Beta Coefficient

p - Probability Value

Sig - Significance Level

Std. Error - Standard Error

% - Percentage

## **CHAPTER 1**

### **1.1 Introduction**

Agriculture remains an important sector within Zimbabwe's economy, contributing significantly to livelihoods, food security, and household income generation. Poultry production, in particular, plays a critical role in providing animal protein, employment opportunities, and household income for both rural and urban communities. In districts such as Chikomba, poultry farming has increasingly become an important livelihood activity among smallholder and commercial farmers due to rising demand for poultry products and their contribution to household economic stability.

Despite its importance, poultry production faces several challenges that affect productivity and profitability. Disease outbreaks, inadequate animal health management practices, and inappropriate antibiotic use remain among the major challenges affecting poultry production systems. Antibiotics are commonly utilized for the treatment and prevention of diseases, as well as for promoting growth in certain instances. While these practices may improve short-term productivity, inappropriate use of antibiotics has increasingly been associated with AMR, which presents dangers to animal health, human health, and environmental sustainability.

This study seeks to examine antibiotic use practices among poultry farmers in Chikomba District, Chivhu, Zimbabwe, and assess how these practices may contribute to antimicrobial resistance. The findings are expected to contribute toward improved antimicrobial stewardship, informed policy development, and sustainable poultry production practices.

### **1.2 Background**

Antibiotics have gained importance as part of livestock production systems worldwide and, especially in poultry production, they are commonly used for therapeutic, prophylactic and productivity purposes. Continued growth of poultry production systems and higher demand for animal protein also has led to increased antimicrobial consumption worldwide. Although antibiotics may reduce mortality and improve productivity, improper and excessive use of antibiotics has resulted in the development of antimicrobial resistance, which is a global public health issue of extreme importance (World Health Organization, 2017). Antimicrobial resistance denotes as the ability of microorganisms to endure exposure to antimicrobial substances that were once effective in eliminating them (Food and Agriculture Organization,

2019). The emergence of resistance reduces treatment effectiveness, increases disease burden, and creates challenges for both animal and human health systems.

Access to veterinary medicines significantly influences antibiotic use behaviour among poultry farmers. In many developing countries, antibiotics are often available through veterinary suppliers, agro-dealers, and informal markets with limited regulatory oversight (FAO, 2019). Such availability could promote self-medication behaviours, improper choice of medications, inaccurate dosage intake, and unfinished treatment plans. Weak regulatory systems and inadequate control of antimicrobial distribution have been identified as major contributors to antimicrobial misuse within livestock systems (Munengwa et al., 2020).

Production pressures and economic considerations further influence antibiotic use practices. Farmers operating under intensive and semi-intensive production systems frequently administer antibiotics preventively to reduce production losses associated with disease outbreaks. Economic incentives associated with improved productivity and reduced mortality may encourage routine antibiotic administration even when not medically necessary (Jim O'Neill, 2016).

Within Zimbabwe, poultry farming contributes substantially to rural livelihoods, income generation, and household nutrition. However, access to veterinary services remains limited in many rural communities, including Chikomba District. Consequently, farmers may rely on informal knowledge systems or over-the-counter medicines when managing poultry diseases. Limited understanding of withdrawal periods, antimicrobial resistance, and appropriate treatment practices may further increase the risk of misuse (WHO, 2017)

Recent changes within Zimbabwe's poultry sector, including growth of smallholder and semi-commercial production systems, have increased demand for veterinary medicines. At the same time, gaps in veterinary extension services, biosecurity practices, and farmer training may increase reliance on antibiotics as routine disease management tools (O'Neill, 2016). Recognizing these patterns is crucial for formulating strategies that seek to minimize the inappropriate use of antimicrobials and curb the development of resistance.

Therefore, this study seeks to assess antibiotic use practices, farmer awareness, and factors influencing antimicrobial misuse among poultry farmers in Chikomba District.

### **1.3 Problem Statement**

Poultry farming remains an important livelihood activity in Zimbabwe, particularly among smallholder farmers who depend on poultry production for food security and income generation. However, widespread use of antibiotics within poultry production systems has raised concerns regarding inappropriate antimicrobial use and the increasing risk of antimicrobial resistance (FAO, 2019).

Evidence from previous studies suggests that antibiotics are frequently administered without veterinary supervision, appropriate diagnosis, or adherence to recommended dosage and withdrawal guidelines (Munengwa et al., 2020). Such practices could elevate the chances of improper use of antimicrobials and foster the development of resistant microorganisms.

Although studies conducted in other regions have documented associations between antibiotic misuse and antimicrobial resistance, limited district-level evidence exists regarding antibiotic use practices among poultry farmers in Chikomba District (FAO, 2019).. Limited veterinary support, weak regulatory oversight, and restricted farmer awareness may further increase risks associated with antimicrobial misuse (WHO, 2017).

The absence of localized evidence limits the development of targeted interventions and antimicrobial stewardship programmes suitable for poultry production systems within the district. Therefore, there is a need to assess antibiotic use practices and factors associated with misuse among poultry farmers in Chikomba District to support evidence-based interventions aimed at improving poultry health management and reducing antimicrobial resistance risks.

### **1.4 Objectives of the study**

#### **Main Objective**

To assess antibiotic use and its contribution to antimicrobial resistance in poultry farming in Chikomba District, Chivhu, Zimbabwe.

#### **Specific Objectives**

1. To examine antibiotic use practices among poultry farmers in Chikomba District.
2. To assess poultry farmers' understanding of antimicrobial resistance, including mechanisms through which resistance develops.

3. To explore factors influencing antibiotic misuse in poultry farming and their potential relationship with antimicrobial resistance.

### **1.5 Research Questions**

1. What antibiotic use practices are employed by poultry farmers in Chikomba District?
2. What level of understanding do poultry farmers have regarding antimicrobial resistance and resistance development mechanisms?
3. Which factors influence antibiotic misuse among poultry farmers and how might these influence antimicrobial resistance?

### **1.6 Research Hypothesis**

This study is guided by the following hypothesis:

#### **H<sub>0</sub> (Null Hypothesis)**

Antibiotic use practices among poultry farmers in Chikomba District are not significantly associated with antimicrobial resistance awareness and misuse practices.

#### **H<sub>1</sub> (Alternative Hypothesis)**

Antibiotic use practices among poultry farmers in Chikomba District are significantly associated with antimicrobial resistance awareness and misuse practices.

### **1.7 Significance of the study**

The findings of this study may benefit poultry farmers, veterinary authorities, policymakers, and researchers by generating evidence regarding antibiotic use practices and antimicrobial resistance awareness within poultry production systems (Munengwa et al., 2020).

For poultry farmers, the findings may improve understanding of responsible antimicrobial use and encourage adoption of improved disease management practices (Garg, 2024). Policymakers and veterinary authorities may use the findings to strengthen extension services, antimicrobial stewardship programmes, and regulatory systems governing antibiotic distribution and use (FAO, 2019).

The study also contributes to academic literature by generating localized evidence regarding antimicrobial use practices within Zimbabwe's poultry sector, where district-level information remains limited (WHO, 2017).

### **1.8 Scope of the study**

The study focuses on poultry production systems within Chikomba District, Chivhu, Zimbabwe. The research includes both smallholder and commercial poultry farmers and examines antibiotic use practices, antimicrobial resistance awareness, and factors influencing misuse.

The study specifically focuses on poultry farmers and farm managers because they play central roles in disease management decisions and antibiotic administration practices. The investigation considers practices occurring within recent production cycles to capture current antimicrobial use patterns.

### **1.9 Limitations of the study**

The study is limited geographically to Chikomba District, which may reduce generalizability to all poultry production systems in Zimbabwe. Findings should therefore be interpreted within the context of the study area.

Another limitation relates to self-reported information, as respondents may underreport or overreport antibiotic use practices due to concerns regarding regulation, privacy, or social desirability. Despite these limitations, inclusion of both smallholder and commercial poultry farmers was intended to improve representativeness and generate diverse perspectives.

### **Chapter Summary**

This chapter presents the study by detailing the context, articulating the problem statement, defining the objectives, posing the research questions, highlighting its significance, and delineating the scope and limitations. The chapter highlighted increasing concerns regarding antibiotic use practices and antimicrobial resistance within poultry production systems and justified the need for localized evidence from Chikomba District. The next chapter presents a review of literature relating to antibiotic use, antimicrobial resistance, and poultry production systems.

## **CHAPTER TWO: LITERATURE REVIEW**

### **2.1 Introduction**

This chapter reviews literature relating to antibiotic use and antimicrobial resistance (AMR) within poultry production systems. The review examines antibiotic use practices, mechanisms of antibiotic action and resistance development, factors influencing antimicrobial misuse, and consequences associated with antimicrobial resistance. The chapter further explores theoretical and conceptual frameworks underpinning the study, reviews empirical evidence from global, regional, and local contexts, and identifies knowledge gaps relevant to poultry farming in Chikomba District, Zimbabwe.

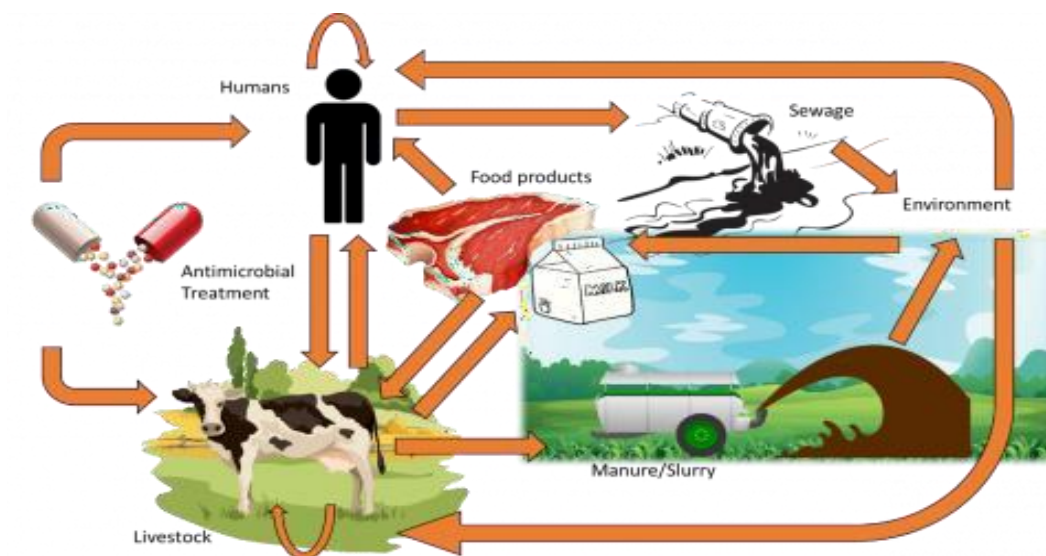
### **2.2 Theoretical Framework**

This research is informed by two interrelated theoretical frameworks: the One Health Approach and the Theory of Planned Behavior (TPB) as proposed by Ajzen (1991). These frameworks provide both systemic and behavioural perspectives for understanding antibiotic use practices and antimicrobial resistance within poultry production systems (WHO, 2017).

#### **2.2.1 One Health Approach**

The One Health Approach acknowledges the interconnectedness of human, animal, and environmental health systems (FAO, 2019). In poultry production systems, the inappropriate use of antibiotics can contribute to the development and dissemination of resistant microorganisms. These pathogens can transfer among animals, humans, and the environment via food systems, direct interactions, and environmental pollution (WHO, 2017).

The framework puts emphasis on a multidisciplinary approach: veterinary, medical, agricultural, and environmental stakeholders must come together for interventional actions to curb and prevent antimicrobial resistance (WHO, 2017). In this study framework, the One Health model is a suitable lens for understanding how poultry production practices might affect broader public health outcomes (Omolo et al., 2024).



**Figure 2. 1: Antimicrobial Resistance – One health approach**

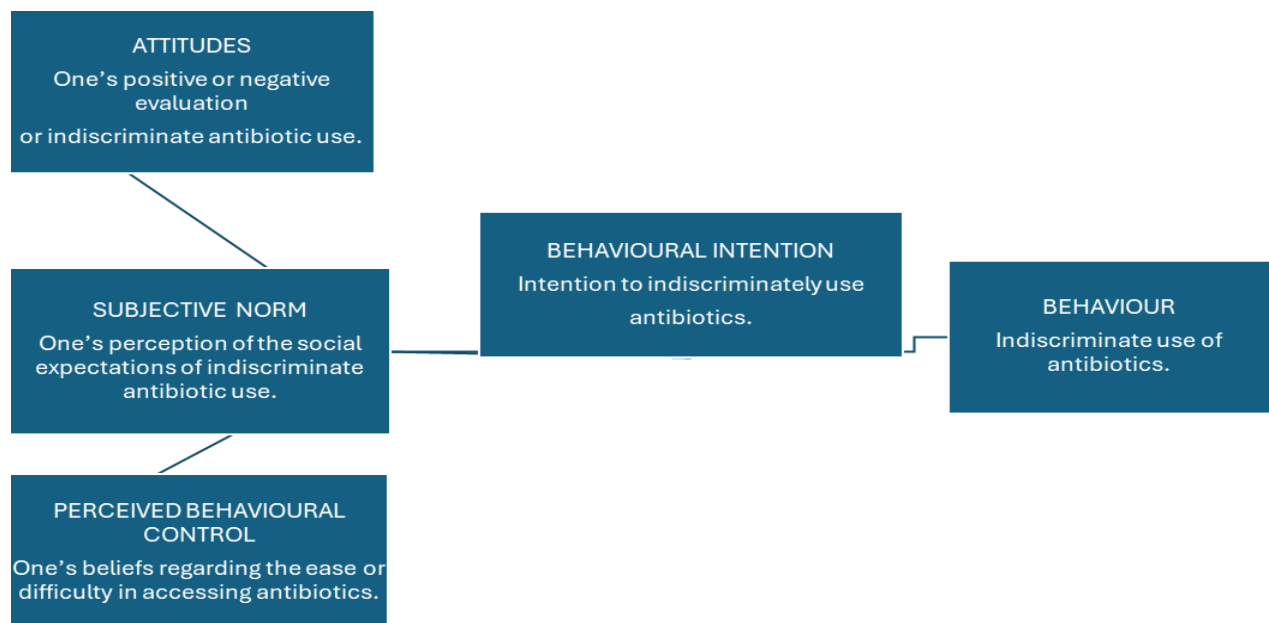
### 2.2.2 Theory of Planned Behaviour (TPB)

The Theory of Planned Behaviour proposed that individual actions are shaped by personal attitudes, social norms, and the perceived ability to control behaviours (Ajzen, 1991). Within poultry farming systems, farmers' decisions regarding antibiotic use may be shaped by perceptions regarding disease prevention, peer practices, production expectations, and access to veterinary support (Omolo et al., 2024).

Under this framework, inappropriate antibiotic use may occur when farmers perceive antibiotics as necessary for productivity, observe routine use among peers, or lack confidence in alternative disease control measures (WHO, 2017). The TPB therefore provides a behavioural explanation for antibiotic use decisions within poultry production systems (Ajzen, 1991).

### Integration of Theoretical Frameworks

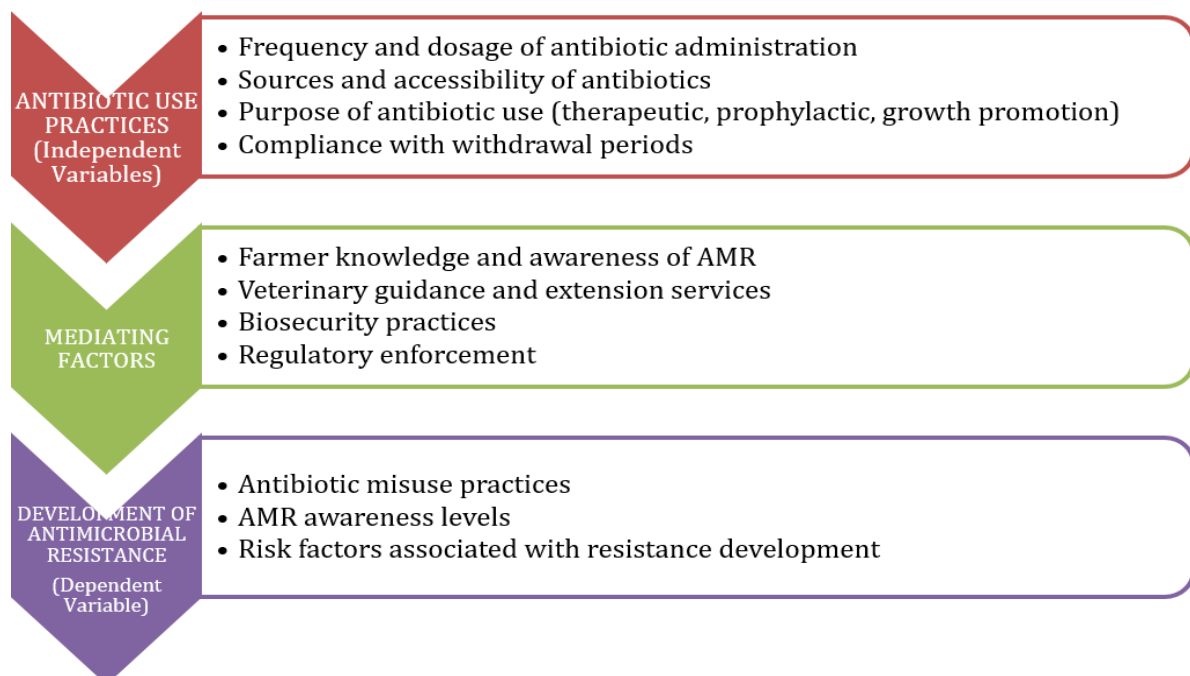
Combining these frameworks provides a more comprehensive understanding of antibiotic use behaviour. The One Health Approach explains broader system-level interactions influencing antimicrobial resistance, while TPB explains individual behavioural drivers influencing antibiotic administration practices.



**Figure 2. 2: The Theory of planned behaviour**

## 2.3 Conceptual Framework

The conceptual framework illustrates relationships between antibiotic use practices, influencing factors, and antimicrobial misuse outcomes within poultry production systems (OIE, 2020).



**Figure 2. 3: The Conceptual framework**

The framework posits that the behaviour surrounding antibiotic usage is shaped not solely by the choices made by farmers, but also by various factors related to institutions, regulations, and production processes.

## **2.4 Overview of antibiotic use in poultry production**

Antibiotics remain important tools within poultry production systems due to their role in disease prevention, treatment, and productivity improvement. Their application typically can be categorized into three main types: therapeutic applications, preventive measures, and enhancement of growth (FAO, 2019).

Therapeutic application refers to the treatment of birds that are clinically ill, while prophylactic application focuses on preventing disease outbreaks, especially in intensive farming operations where higher stocking densities elevate the risk of transmission. Additionally, antibiotics have traditionally been utilized to improve growth rates and feed conversion efficiency (O'Neill, 2016).

Despite these benefits, inappropriate use practices remain widespread. Evidence suggests that antibiotic administration without veterinary guidance, inappropriate dosage selection, failure to adhere to withdrawal times and the administration of antibiotics for non-bacterial conditions contribute substantially to antimicrobial misuse (Omolo et al., 2024). The increasing accessibility of antibiotics through informal markets and over-the-counter distribution systems further increases opportunities for self-medication and inappropriate antimicrobial use practices (OIE, 2020).

## **2.5 Mechanisms of antibiotic action**

Antibiotics function by targeting essential bacterial structures and physiological processes necessary for sustenance and procreation. Their mechanisms of action are generally grouped into four major categories (Woodford and Livermore, 2006):

### **Inhibition of Cell Wall Synthesis**

Certain antibiotics disrupt the synthesis of peptidoglycan, which undermines the integrity of bacterial cell walls and leads to cell lysis.  $\beta$ -lactam antibiotics, including penicillins and cephalosporins, function through this process (Reygaert C., 2018).

### **Inhibition of Protein Synthesis**

Certain antibiotics aim at bacterial ribosomes, inhibiting the synthesis of proteins necessary for the growth and reproduction of bacteria. Tetracyclines and macrolides commonly used within poultry systems act through this pathway (Walsh, 2003).

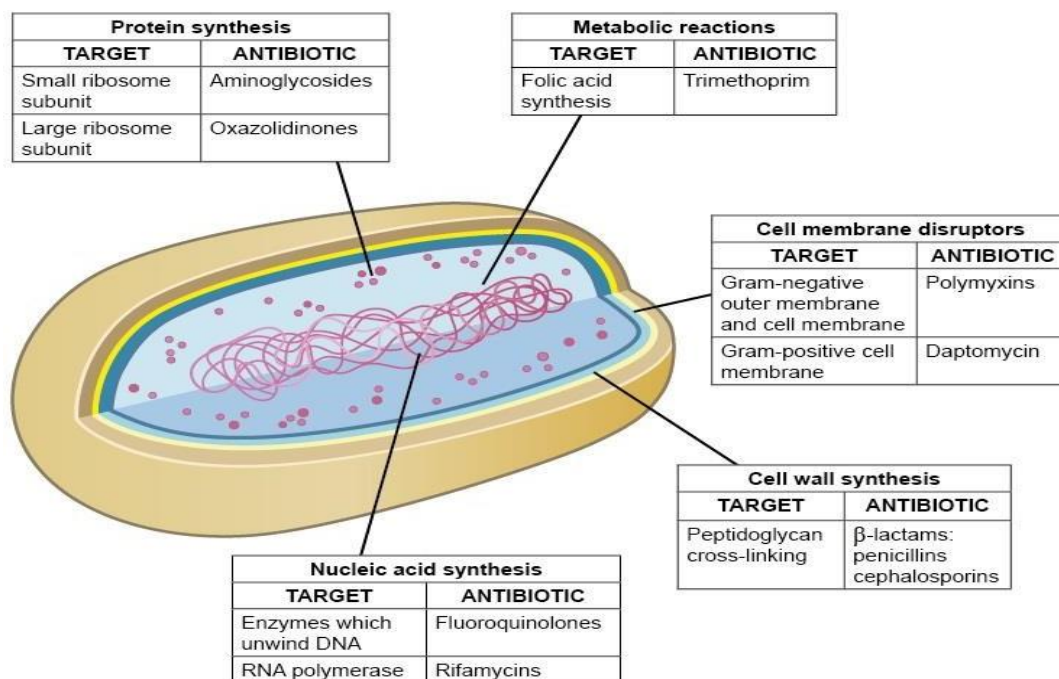
## Disruption of Nucleic Acid Synthesis

Antibiotics, including fluoroquinolones, disrupt the processes of DNA replication and transcription, thereby restricting the reproduction of bacteria (OIE, 2020).

## Disruption of Metabolic Pathways

Sulfonamides and trimethoprim inhibit folic acid synthesis pathways essential for bacterial growth and survival (O'Neill, 2016).

Importantly, antibiotics act specifically against bacterial pathogens and are ineffective against viral diseases. Therefore, use against viral infections increases unnecessary antimicrobial exposure and selection pressure (WHO, 2017).



**Figure 2. 4: Main antibiotic modes of action (The Open University, 2025)**

## 2.6 Mechanisms of AMR

Antimicrobial resistance arises when microorganisms acquire mechanisms allowing survival following antimicrobial exposure. Resistance may arise naturally or emerge through selection pressure created by repeated antimicrobial exposure (Scott D., 2015).

The major resistance mechanisms include (Davies and Davies, 2010):

- Genetic mutation
- Horizontal gene transfer

- Enzymatic degradation of antibiotics
- Target site modification
- Reduced cell permeability
- Efflux pump mechanisms
- Alternative metabolic pathways

Frequent antimicrobial exposure creates favourable conditions for resistant microorganisms to survive, multiply, and spread within poultry populations and surrounding environments (WHO, 2017).

## **2.7 Factors Influencing Antibiotic Misuse in Poultry Farming**

Behavioural, economic and institutional factors shape antibiotic misuse in poultry farming (WHO, 2017). Some of the common forms of misuse are incorrect dosages, use for viral or non-bacterial conditions, and disregard of withdrawal periods, all of these factors play a role in the emergence of antimicrobial resistance (FAO, 2019). One major facilitator of such misuse is inadequate veterinary oversight, especially in a rural setting like Zimbabwe's Chikomba District. On account of limited access to veterinary services along with the high cost of professional consultations, many farmers self-prescribe antibiotics, often relying on advice from agro-dealers or personal experience (Munemo et al., 2021).

Low awareness of antimicrobial resistance (AMR) further exacerbates misuse. Farmers frequently do not recognize that antibiotics do not work against infections caused by viruses nor the potential consequences of inappropriate use for both animal and human health (OIE, 2020). Economic pressures also influence behaviour; since poultry constitute a critical source of income and nutrition, antibiotics are viewed as a cost-effective method for disease prevention and maintaining productivity, especially in environments with poor biosecurity where hygiene and vaccination are inadequate (O'Neill, 2016).

Additionally, widespread over-the-counter availability of antibiotics without prescription and weak regulatory enforcement facilitate self-medication and improper antimicrobial use (WHO, 2017). The lack of robust record-keeping and surveillance systems further undermines monitoring and control efforts, enabling continued misuse and dissemination of resistant bacteria through poultry products and environmental routes (Grace D, 2015)

## **2.8 Impacts of AMR in Poultry Production**

The rise of AMR in poultry presents significant risks to animal welfare, food security, public health, and economic viability. Resistant pathogens reduce the efficacy of commonly used antibiotics, leading to recurring infections, increased bird mortality, and higher production costs as farmers resort to more expensive or potent drugs, which in turn accelerate resistance development (FAO, 2019).

Food safety is compromised as antibiotic-resistant bacteria like *Escherichia coli* and *Salmonella* can contaminate poultry meat and eggs, transmitting resistance genes to humans through consumption and poor handling practices (Munengwa et al., 2020). Furthermore, poultry waste harbouring resistant organisms contaminates soil and water, posing environmental hazards that illustrate the interrelationship between human, animal, and ecological well-being within the framework of the One Health concept (OIE, 2020).

Economically, AMR reduces productivity and increases veterinary treatment costs, potentially limiting market access as consumers and regulators tighten standards for residue-free animal products (O'Neill, 2016). Smallholder farmers in rural zones, highly dependent on poultry for livelihoods and nutrition, are particularly vulnerable to these impacts (Munemo et al., 2021).

Globally, AMR is acknowledged as a significant health threat with projections estimating millions of annual deaths if current trends continue unchecked (O'Neill, 2016). This underscores the urgent need for responsible antibiotic use and enhanced disease prevention in poultry systems.

## **2.9 Strategies for mitigating antimicrobial resistance**

Mitigation of AMR in poultry requires coordinated interventions embracing prudent antibiotic use, improved animal health practices, and strengthened regulations. The One Health Approach provides an important framework for collaboration among various sectors related to human, animal, and environmental health in order to address resistance issues (WHO, 2017; FAO, 2019).

Antibiotic stewardship measures, such as enforcing prescription-only sales, ensuring correct dosages and treatment durations, and adherence to withdrawal periods, are central to reducing

misuse (WHO, 2017). Farmer education and awareness-raising campaigns are critical, particularly in rural areas where understanding of AMR is limited (FAO, 2019). Training of extension workers and agro-veterinary personnel can further improve responsible prescribing and use at the farm level.

Improving biosecurity through sanitation, adequate housing, vaccination, and disease prevention reduces reliance on antibiotics (Munemo et al., 2021). Enhancing veterinary service availability and diagnostic capacity in underserved districts like Chikomba is essential for accurate disease management.

Robust regulatory frameworks governing antibiotic sales and usage must be strengthened to prevent over-the-counter dispensing and enforce compliance. High-quality AMR surveillance systems enable monitoring of antimicrobial use patterns and resistance emergence to inform targeted interventions (OIE, 2020).

Alternative approaches, including use of probiotics, herbal therapies, improved nutrition, and husbandry improvements, hold promise for maintaining poultry health and limiting AMR risk (WHO, 2017).

## **2.10 Empirical studies on antibiotic use and resistance**

Empirical research globally and within Africa confirms that antibiotic misuse in poultry production drives AMR emergence, primarily due to unsupervised use for treatment, prevention, and growth promotion.

### **2.10.1 Empirical Evidence from Africa**

Studies in Nigeria and Kenya highlight prevalent prophylactic antibiotic use without veterinary prescriptions and poor knowledge among farmers, resulting in resistant strains such as *Escherichia coli* and *Salmonella* in poultry populations (Aiyedun et al., 2018; Onyango et al., 2019; FAO, 2019).

### **2.10.2 Empirical Evidence from Zimbabwe**

Zimbabwean studies report frequent unsupervised antibiotic prescriptions to smallholder poultry, dosage non-compliance, and neglect of withdrawal periods causing resistant bacterial strains to emerge in poultry (Munengwa et al., 2020). Low farmer knowledge about AMR

and economic constraints contribute to misuse, alongside poor record-keeping and weak veterinary services (Swiswa et al., 2020).

Research on commercial broiler farms confirms similar patterns, with the widespread occurrence of *Escherichia coli* strains that are resistant to multiple drugs isolates linked to indiscriminate antimicrobial use (Munengwa et al., 2020). National and regional surveillance reports emphasize the escalating AMR threat and the need for enhanced stewardship and regulatory enforcement (Maruve, 2022).

### **2.10.3 Global Context**

The global burden of AMR in livestock is increasingly recognized, with forecasts predicting severe mortality and economic losses by 2050 if current trends persist (O'Neill, 2016). Environmental contamination from antibiotic use in agriculture contributes to resistance gene spread (UNEP, 2023). Developed countries have implemented stewardship programs restricting growth promoters and enforcing prescription regulations, low and middle-income nations such as Zimbabwe encounter difficulties stemming from inadequate surveillance, unregulated drug markets, and restricted veterinary resources (Van Boeckel et al., 2019).

These studies reinforce the essential requirement for coordinated policy, governance, education, and surveillance to curb AMR impacts on poultry production and public health.

### **2.11 Knowledge Gaps**

Existing literature demonstrates widespread antibiotic use and increasing concerns regarding antimicrobial resistance within poultry production systems (Gufe et al., 2024). However, important gaps remain.

First, there is a scarcity of specific evidence at the district level concerning antibiotic usage practices among poultry farmers in Chikomba District (Mdegela et al., 2020). The majority of existing research tends to concentrate on wider national or regional frameworks (Onyango et al., 2019; Aiyedun et al., 2018). Second, insufficient information exists regarding how farmer awareness, veterinary access, and local production systems interact to influence antibiotic use behaviour. Third, surveillance systems monitoring antibiotic use patterns and resistance risks within local poultry systems remain limited, reducing opportunities for targeted interventions (Mubito, 2014).

Addressing these gaps may contribute toward evidence-based antimicrobial stewardship interventions appropriate for Zimbabwean poultry production systems.

## **2.12 Chapter Summary**

This chapter examines the theoretical, conceptual, and empirical literature concerning antibiotic usage and antimicrobial resistance in poultry production systems. The reviewed literature indicates that the misuse of antibiotics is shaped by a combination of behavioural, institutional, and production-related factors, while also emphasizing rising worries about the development of resistance. The forthcoming chapter details the methodological framework employed to explore these relationships in Chikomba District.

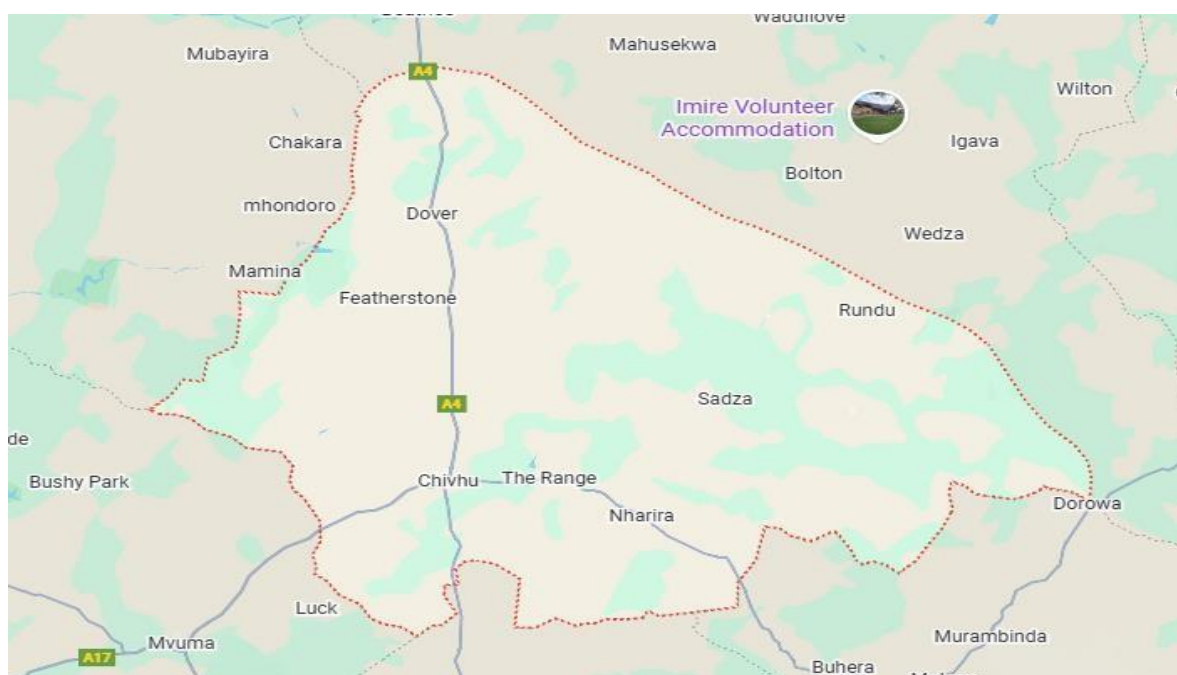
## CHAPTER 3: RESEARCH METHODOLOGY

### MATERIALS AND METHODS

#### 3.1 Introduction

This chapter describes the methodology used to investigate antibiotic use practices and factors associated with antimicrobial resistance (AMR) awareness among poultry farmers in Chikomba District, Chivhu, Zimbabwe. The chapter outlines the study area, research design, target population, sampling procedures, sample size determination, data collection methods, instrument validity and reliability procedures, data analysis techniques, and ethical considerations. The methodological approach was selected to generate reliable and reproducible quantitative evidence regarding antibiotic use practices and farmer awareness of antimicrobial resistance.

#### 3.2 Study Site



**Figure 3. 1: Map of Chikomba district a place in Zimbabwe under Mashonaland East province**

The study was conducted in Chikomba District, located in Mashonaland East Province, Zimbabwe. The district lies within Natural Region III and receives average annual rainfall ranging between approximately 500–800 mm, with temperatures generally ranging from 18°C to 30°C (Vincent and Thomas, 1960). The area experiences periodic dry spells and drought conditions, making mixed farming systems more common than intensive crop production (FAO, 2019).

Livestock production, particularly poultry farming, plays an important role in household livelihoods, food security, and income generation within the district (MLAFWRD, 2020). Poultry production systems include broilers, layers, and indigenous chickens managed under backyard, smallholder, and semi-commercial systems. Dependence on antibiotics for disease prevention and treatment makes the district suitable for investigating antibiotic use practices and factors associated with antimicrobial misuse.

### **3.3 Research Design**

The research utilized a quantitative cross-sectional survey methodology. This approach facilitated the gathering of numerical data at a specific moment, making it suitable for evaluating antibiotic usage practices, awareness of antimicrobial resistance, and the factors contributing to misuse among poultry farmers (Kumar, 2019). The choice of this design was based on its ability to measure frequencies, patterns, and relationships between the study variables while being economically viable and appropriate for studies that involve populations spread across various geographic locations (Kumar, 2019).

### **3.4 Target Population**

The population of interest included individuals engaged in poultry farming involved in broiler, layer, and indigenous chicken production within selected wards of Chikomba District. Both smallholder and semi-commercial poultry farmers were included to capture variation in management systems and antibiotic use practices. Farmers were selected as respondents because they are primarily responsible for decisions regarding poultry health management, disease control, and antibiotic administration practices.

### **3.5 Sampling procedure**

A stratified random sampling approach was used to improve representativeness and reduce sampling bias (Kumar, 2019). Poultry farmers were grouped according to ward location to ensure geographical representation across the district. Within each stratum, simple random sampling procedures were used to select respondents. This approach increased the likelihood that farmers from different production settings and geographical locations were represented within the sample.

### **3.6 Sample size determination**

A sampling frame was obtained from the Department of Veterinary Services (DVS) and AGRITEX records. Sample size estimation followed the standard formula for estimating proportions (Cochran, 1977):  $n = Z^2pq / e^2$

Where:

- $Z = 1.96$  at 95% confidence level
- $q = 1 - p$
- $e =$  margin of error (0.05)
- $n =$  required sample size
- $p =$  estimated proportion of poultry farmers using antibiotics

The calculated target sample size was 120 respondents. However, due to logistical constraints, accessibility challenges, and non-response during fieldwork, only 50 completed questionnaires were obtained and included in the final analysis. Although smaller than originally planned, the achieved sample size was considered adequate for descriptive and exploratory statistical analysis.

### **3.7 Data collection methods**

#### **3.7.1 Structured and semi-structured questionnaires**

Structured and semi-structured questionnaires served as the main tool for data collection. The questionnaire collected information regarding:

- antibiotic types used,
- frequency of administration,
- withdrawal period practices,
- sources of antibiotics,
- antimicrobial resistance awareness, and
- farm management practices.

Structured questions improved consistency across responses, while limited open-ended sections allowed clarification where necessary.

#### **3.7.2 Observations**

Farm visits were conducted to complement questionnaire data. Observations focused on:

- drug storage practices,

- poultry housing conditions,
- hygiene practices,
- biosecurity measures, and
- antibiotic handling procedures.

Observational data were used primarily for triangulation and verification of self-reported information.

### **3.7.3 Secondary Data**

Secondary information was obtained from veterinary records, policy documents, published literature, and available agricultural records to provide contextual information and support interpretation of findings.

### **3.8 Validity of the Research Instrument**

Validity pertains to the degree to which a tool accurately assesses what it is designed to measure (Saunders et al., 2019). Content validity was strengthened by developing questionnaire items using established literature and internationally recognised frameworks relating to antimicrobial resistance and livestock production (Creswell, 2014).

Expert review was conducted by academic supervisors and professionals with experience in veterinary science and livestock production. Feedback obtained from reviewers was employed to enhance transparency, pertinence, and consistency with the goals of the study. A pilot study involving 10 poultry farmers outside the study sample was also conducted to identify ambiguous questions and improve wording before final data collection.

### **3.9 Reliability of the Research Instrument**

Reliability pertains to the uniformity of measurement across respondents and data collection conditions (Cochran, 1977). Several actions were taken to enhance dependability:

- use of standardized questionnaires,
- consistent wording across respondents,
- simplified language to reduce misunderstanding, and
- standardized administration procedures during data collection.

Internal consistency reliability was additionally evaluated through the calculation of Cronbach's Alpha coefficients as part of the data analysis process.

### **3.10 Data Analysis**

Collected questionnaires were reviewed for completeness, assigned codes, and input into the Statistical Package for Social Sciences (SPSS) Version 21 for analysis. The subsequent analytical procedures conducted included:

- descriptive statistics (frequencies and percentages),
- cross-tabulations,
- reliability analysis using Cronbach's Alpha, and
- regression analysis to examine relationships between antibiotic use practices, veterinary access, and AMR awareness.

Results were presented using tables, graphs, and charts to improve interpretation.

### **3.11 Ethical Considerations**

Participation in the study was voluntary, and respondents were informed about study objectives before participation.

Ethical considerations included:

- informed consent,
- confidentiality of responses,
- respondent anonymity,
- voluntary participation, and
- secure handling of collected information.

Permission to conduct the study was obtained from relevant local authorities including district leadership structures and agricultural stakeholders.

### **3.12 Summary**

This chapter described the methodological procedures used to investigate antibiotic use practices and antimicrobial resistance awareness among poultry farmers in Chikomba District. A quantitative cross-sectional design, stratified random sampling, structured questionnaires, observational methods, and statistical analysis techniques were used to generate evidence regarding antibiotic use behaviour and factors associated with misuse. The next chapter presents findings generated from the analysis.

## CHAPTER 4 - RESULTS

### 4.1 Introduction

This chapter presents the findings obtained from field data collected during the study assessing antibiotic use and its contribution to AMR in poultry farming within Chikomba District, Chivhu, Zimbabwe. The findings are presented according to the study objectives and are based on data obtained from 50 valid questionnaire responses collected from both smallholder and commercial poultry farmers. Tables and figures are used to summarise and illustrate the results for ease of interpretation.

### 4.2 Antibiotic usage practices among poultry farmers

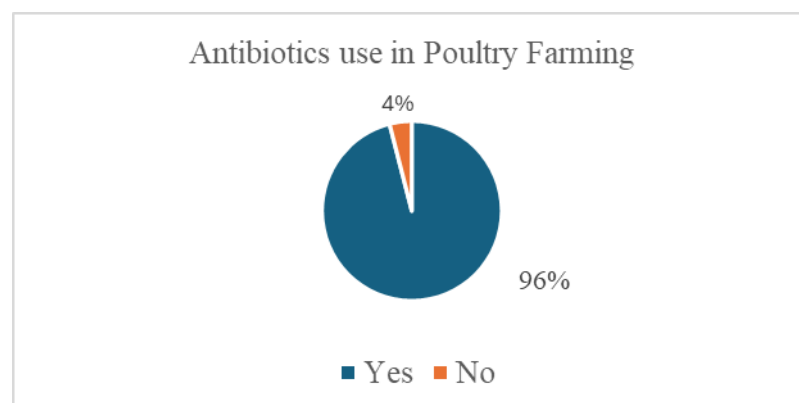
*(Objective 1: To examine antibiotic use practices among poultry farmers in Chikomba.)*

The findings indicate widespread use of antibiotics among poultry farmers within the study area. Most respondents reported administering antibiotics to poultry flocks for disease treatment, disease prevention, and general flock health management.

**Table 4. 1: Use of antibiotics in poultry farming**

| Response     | Occurrence | % (Percentage) |
|--------------|------------|----------------|
| No           | 2          | 4              |
| Yes          | 48         | 96             |
| <b>Total</b> | <b>50</b>  | <b>100</b>     |

The results presented in Table 4.1 indicate that antibiotic use was highly prevalent among respondents, with 48 out of 50 farmers (96%) reporting the use of antibiotics in poultry production, while only 2 respondents (4%) indicated that they did not use antibiotics. These findings suggest that antibiotic administration forms an integral component of poultry production systems within the district.



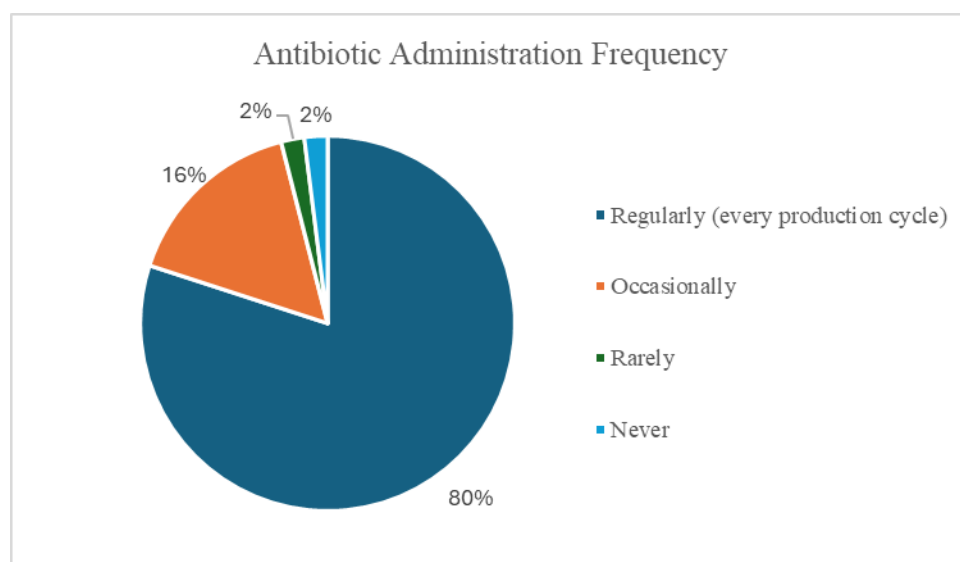
**Figure 4. 1: Antibiotic use among poultry farmers in Chikomba district**

The frequency of antibiotic administration varied among respondents.

**Table 4. 2: Frequency of antibiotic administration**

| Frequency of Use                   | Frequency | Percentage (%) |
|------------------------------------|-----------|----------------|
| Regularly (every production cycle) | 40        | 80             |
| Occasionally                       | 8         | 16             |
| Rarely                             | 1         | 2              |
| Never                              | 1         | 2              |
| <b>Total</b>                       | <b>50</b> | <b>100</b>     |

Results indicate that regular antibiotic administration was common, with 80% of respondents reporting antibiotic use during every production cycle. In comparison, 16% reported occasional use, while only 2% rarely used antibiotics and 2% reported never using antibiotics. The high proportion of routine administration may suggest dependence on antibiotics for disease prevention and flock management.

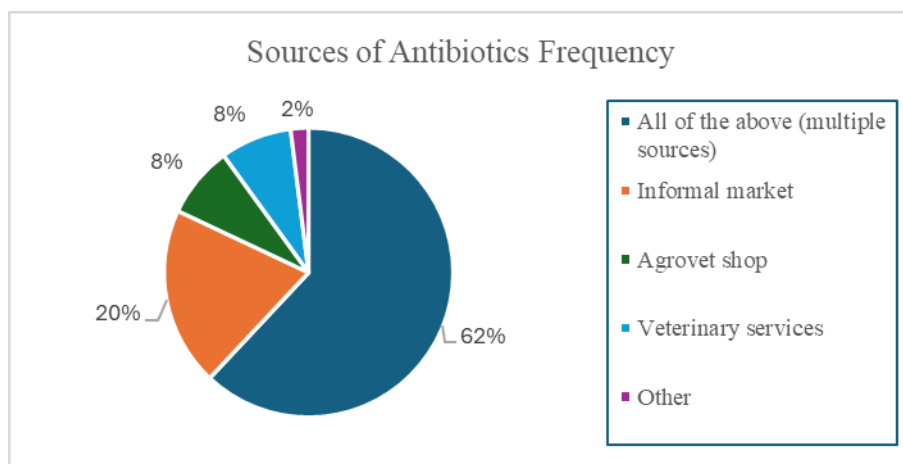
**Figure 4. 2: Frequency of antibiotic administration in poultry farms**

The study further investigated sources from which farmers acquire antibiotics.

**Table 4. 3: Sources of antibiotics used by poultry farmers**

| Source                              | Frequency | Percentage (%) |
|-------------------------------------|-----------|----------------|
| Informal market                     | 10        | 20             |
| Agrovet shop                        | 4         | 8              |
| Veterinary services                 | 4         | 8              |
| Other                               | 1         | 2              |
| All of the above (multiple sources) | 31        | 62             |
| <b>Total</b>                        | <b>50</b> | <b>100</b>     |

Findings indicate that farmers obtained antibiotics from multiple sources. Most respondents (62%) reported using multiple supply channels, including veterinary service providers, agro-dealers, and informal markets. Reliance on multiple sources may increase accessibility to antibiotics but may also contribute to reduced regulation of antimicrobial use practices.



**Figure 4. 3: Sources of antibiotics used by poultry farmers**

### 4.3 Farmers' understanding of antimicrobial resistance

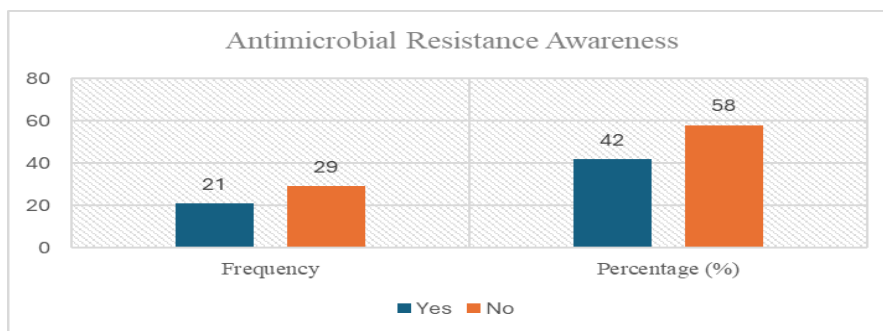
*(Objective 2: To assess poultry farmers' understanding of antimicrobial resistance, including mechanisms through which resistance develops.)*

Farmer awareness of antimicrobial resistance was assessed to determine the level of understanding regarding AMR and resistance development.

**Table 4. 4: Awareness of antimicrobial resistance**

| Response     | Occurrence | % (Percentage) |
|--------------|------------|----------------|
| No           | 29         | 58             |
| Yes          | 21         | 42             |
| <b>Total</b> | <b>50</b>  | <b>100</b>     |

Results show that awareness of AMR was relatively low among respondents. Only 42% of respondents indicated awareness of antimicrobial resistance, whereas 58% reported that they had never heard about AMR. These findings suggest substantial knowledge gaps among poultry farmers regarding antimicrobial resistance.



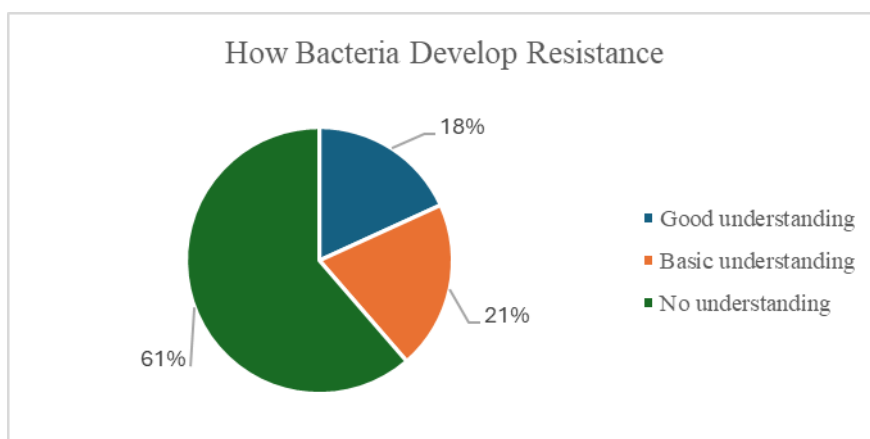
**Figure 4. 4: Awareness of antimicrobial resistance among farmers**

The study also assessed respondents' understanding of how bacterial resistance develops.

**Table 4. 5: Understanding of how bacteria develop resistance**

| Level of Understanding | Frequency | Percentage (%) |
|------------------------|-----------|----------------|
| Good understanding     | 8         | 18.2           |
| Basic understanding    | 9         | 20.5           |
| No understanding       | 27        | 61.4           |
| <b>Total</b>           | <b>50</b> | <b>100</b>     |

The results demonstrate generally low levels of understanding regarding resistance development. Approximately 61.4% of respondents reported having no understanding of resistance mechanisms, while 20.5% demonstrated only basic understanding. Only 18.2% reported good understanding of the concept. This limited understanding may contribute to inappropriate antibiotic use practices.



**Figure 4. 5: Level of understanding of antimicrobial resistance**

#### 4.4 Factors influencing antibiotic misuse in poultry farming

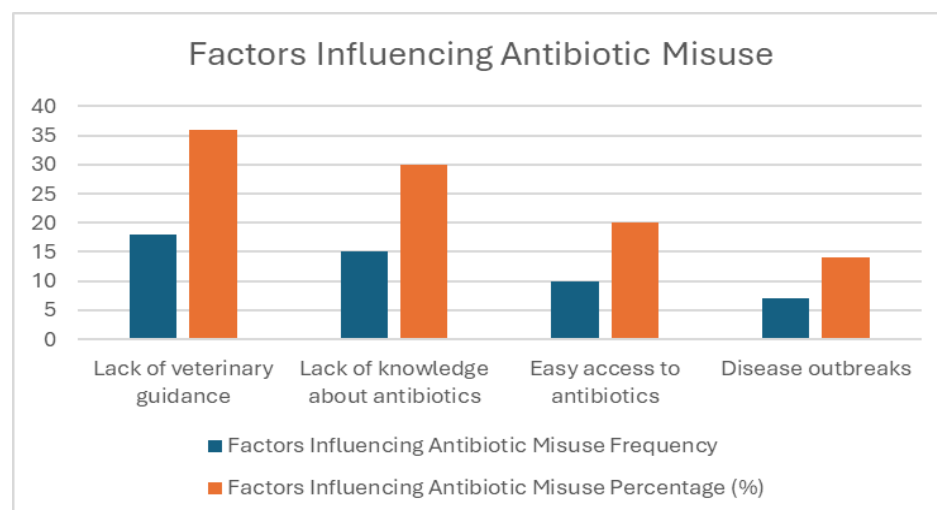
*(Objective 3: To explore factors influencing antibiotic misuse in poultry farming and their potential relationship with antimicrobial resistance.)*

Several factors contributing to antibiotic misuse were investigated.

**Table 4. 6: Factors influencing antibiotic misuse**

| Factor                              | Frequency | Percentage (%) |
|-------------------------------------|-----------|----------------|
| Lack of veterinary guidance         | 18        | 36             |
| Lack of knowledge about antibiotics | 15        | 30             |
| Easy access to antibiotics          | 10        | 20             |
| Disease outbreaks                   | 7         | 14             |
| <b>Total</b>                        | <b>50</b> | <b>100</b>     |

Findings indicate that lack of veterinary guidance was the most commonly reported factor influencing misuse, accounting for 36% of responses. Limited knowledge regarding antibiotics accounted for 30%, while easy accessibility of antibiotics contributed 20%. Disease outbreaks accounted for 14% of responses. These findings suggest that both knowledge-related and structural factors influence antibiotic use behaviour.



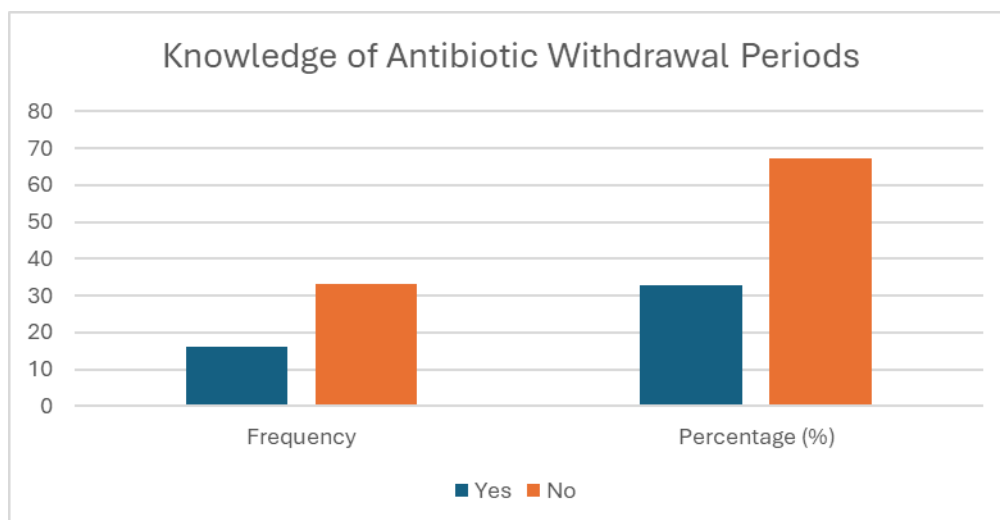
**Figure 4. 6: Factors influencing antibiotic misuse**

Knowledge regarding withdrawal periods was also assessed.

**Table 4. 7: Knowledge of antibiotic withdrawal periods**

| Response     | Occurrence | % (Percentage) |
|--------------|------------|----------------|
| No           | 34         | 68             |
| Yes          | 16         | 32             |
| <b>Total</b> | <b>50</b>  | <b>100</b>     |

The results indicate limited awareness regarding withdrawal periods. Approximately 68% of respondents reported no knowledge of withdrawal periods, while only 32% indicated awareness. Poor understanding of withdrawal periods may increase risks associated with antibiotic residues in poultry products.



**Figure 4. 7: Knowledge of withdrawal periods among poultry farmers**

#### 4.5 Reliability Analysis

Reliability analysis was conducted to determine the internal consistency of questionnaire items measuring antibiotic use practices, antimicrobial resistance awareness, and misuse-related factors. Cronbach's Alpha coefficients above 0.70 were considered acceptable indicators of reliability.

**Table 4. 8: Reliability analysis**

| Variable                              | Cronbach's Alpha |
|---------------------------------------|------------------|
| Antibiotic usage practices            | 0.83             |
| Awareness of antimicrobial resistance | 0.78             |
| Knowledge of withdrawal periods       | 0.74             |
| Access to veterinary services         | 0.81             |
| Sources of antibiotics                | 0.72             |
| Factors influencing misuse            | 0.85             |

Cronbach's Alpha values varied between 0.72 and 0.85 for the constructs evaluated, reflecting a range from acceptable to strong internal consistency. These results imply that the items in the questionnaire effectively measured antibiotic usage practices and awareness of antimicrobial resistance among poultry farmers.

## 4.6 Regression Analysis

Regression analysis was conducted to investigate the connections among antibiotic usage practices, awareness of antimicrobial resistance, and the factors contributing to the improper use of antibiotics.

### 4.6.1 Regression between antibiotic use and antimicrobial resistance awareness

Frequency of antibiotic use was regressed against AMR awareness to determine whether use patterns influenced awareness levels.

**Table 4. 9: Regression coefficients for antibiotic use and AMR awareness**

| Model                       | Unstandardized coefficients (B) | Std error | Standardized coefficients | T     | Sig |
|-----------------------------|---------------------------------|-----------|---------------------------|-------|-----|
| Constant                    | 2.845                           | 0.21      | —                         | 13.55 | 0   |
| Frequency of antibiotic use | -0.356                          | 0.072     | -0.421                    | -4.94 | 0   |

Results indicate that frequency of antibiotic use significantly predicted antimicrobial resistance awareness ( $p < 0.05$ ). The negative regression coefficient ( $B = -0.356$ ) suggests that increased frequency of antibiotic use was associated with lower levels of awareness regarding antimicrobial resistance. The standardized coefficient ( $\beta = -0.421$ ) further indicates a moderate negative relationship between these variables.

### 4.6.2 Regression between veterinary access and antibiotic misuse

Access to veterinary services was analysed as a predictor of antibiotic misuse.

**Table 4. 10: Regression coefficients for veterinary access and antibiotic misuse**

| Model                     | Unstandardized coefficients (B) | Std error | Standardized coefficients | T    | Sig |
|---------------------------|---------------------------------|-----------|---------------------------|------|-----|
| Constant                  | 2.617                           | 0.298     | —                         | 8.78 | 0   |
| Limited veterinary access | 0.438                           | 0.064     | 0.445                     | 6.84 | 0   |

Regression findings demonstrate that limited veterinary access significantly influenced antibiotic misuse ( $p < 0.05$ ). The positive coefficient ( $B = 0.438$ ) indicates that reduced access to veterinary support increased the likelihood of antibiotic misuse among poultry farmers. These findings support descriptive results that identified inadequate veterinary guidance as a major contributor to inappropriate antibiotic use.

#### **4.7 Summary**

This chapter presented findings relating to antibiotic use practices, antimicrobial resistance awareness, and factors influencing antibiotic misuse among poultry farmers in Chikomba District. Results showed widespread antibiotic use and frequent administration practices among farmers. The findings further revealed low levels of awareness and understanding of antimicrobial resistance, together with poor knowledge of withdrawal periods. In addition, limited veterinary support, insufficient knowledge regarding antibiotics, and easy access to antimicrobial products emerged as key factors contributing to misuse. These findings provide the basis for further interpretation and comparison with existing literature in the discussion chapter.

## **CHAPTER 5 - DISCUSSION**

### **5.1 Trends and Spatial Differences**

The findings demonstrate widespread antibiotic use among poultry farmers in Chikomba District, with almost all respondents reporting antibiotic administration and most indicating routine use during production cycles. These findings suggest that antibiotic use has become integrated into routine poultry management practices rather than being restricted to therapeutic interventions. Van Boeckel et al., (2015) reported similar patterns in livestock production systems where antimicrobials are frequently used for disease prevention and productivity enhancement.

A notable pattern emerging from the findings is the imbalance between high antibiotic use and low awareness of antimicrobial resistance (AMR). More than half of respondents reported limited knowledge of AMR and resistance development mechanisms, suggesting that antimicrobial use practices may be driven more by experience, production pressures, and accessibility than by technical understanding. Limited awareness may increase the likelihood of inappropriate antibiotic administration practices (O'Neill, 2016).

Differences in access to antibiotics and veterinary services were also evident. Farmers frequently relied on multiple supply channels, including informal markets, indicating uneven access to regulated veterinary support. Limited access to professional guidance may contribute to inconsistent treatment practices and greater dependence on informal knowledge systems. Swiswa et al., (2022) documented similar patterns in rural livestock systems where geographical and economic barriers reduce access to formal veterinary services.

### **5.2 Insightful Interpretation of Results**

The interpretation of findings provides insight into how behavioural, economic, and institutional factors interact to influence antibiotic use practices in poultry production systems. The findings indicate that antimicrobial use behaviour among poultry farmers is shaped not by a single determinant but by multiple interconnected factors including knowledge levels, veterinary access, production pressures, and disease risk perceptions (Omolo et al., 2024; FAO, 2019).

### **5.2.1 Household demography, socio-economic factors and antibiotic use practices**

Poultry farming in Chikomba District is largely managed by women, who typically handle daily care and antibiotic use, including health decisions. However, limited access to veterinary services and training may hinder their ability to use antibiotics appropriately (Kashangura and Gororo, 2016). Most farmers have low formal education, which may restrict understanding of antimicrobial resistance, withdrawal periods, and dosing (WHO, 2017). Economic dependence on poultry for both income and food likely drives routine antibiotic use aimed at preventing losses and maintaining productivity (O'Neill, 2016).

Variations in poultry type such as indigenous chickens, broilers, and layers introduce diverse management challenges that could increase antibiotic use. According to the One Health framework, these socio-economic and environmental interactions influence antimicrobial resistance risks (WHO, 2017). While causation cannot be confirmed, the findings indicate that addressing gender, education, and economic factors is important for improving antibiotic practices and mitigating resistance in rural poultry systems.

### **5.2.2 High Antibiotic Use and Frequent Administration Practices**

The widespread use of antibiotics observed in this study suggests that antimicrobial administration has become embedded within poultry production systems in Chikomba District. Frequent antibiotic administration across production cycles may reflect efforts by farmers to minimize disease-related losses and maintain productivity under conditions of limited veterinary support and uncertain disease risk (Van Boeckel et al., 2015).

Routine administration raises concerns because repeated antimicrobial exposure creates selective pressure favouring survival of resistant bacterial populations. Previous studies have similarly reported that prolonged and repeated antimicrobial exposure increases opportunities for resistant organisms to emerge and persist within animal production systems (Marshall and Levy, 2011; Economou and Gousia, 2015).

The findings may also reflect the economic realities of poultry farming. Where poultry production contributes significantly to household income, farmers may prioritize interventions perceived to reduce mortality and improve productivity, even when those practices increase antimicrobial exposure (FAO, 2019).

### **5.2.3 Limited Awareness of AMR and Misuse of Antibiotics**

Limited awareness of AMR emerged as an important concern within the study population. Low understanding of resistance mechanisms may reduce farmers' ability to make informed decisions regarding dosage, treatment duration, and appropriate antibiotic selection (WHO, 2017).

The negative relationship observed between antibiotic use frequency and AMR awareness suggests that increased use does not necessarily correspond with improved understanding. This finding may indicate reliance on informal knowledge, routine practice, or experiential learning rather than evidence-based decision-making (Mutua et al., 2020).

Poor awareness also has broader implications because understanding resistance mechanisms influences compliance with recommended practices such as veterinary consultation, withdrawal periods, and responsible medicine use (Mathew et al., 2007).

### **5.2.4 Influence of accessibility of antibiotics and veterinary guidance on misuse**

Antibiotic access and veterinary support have been found to have a significant effect on antimicrobial use behaviour. Farmers who reported limited veterinary access were more likely to identify behaviours attributable to antibiotic misuse, indicating that professional guidance remains critical for promoting responsible antimicrobial use (Auta et al., 2019).

Easy access to antibiotics through multiple distribution channels may increase treatment flexibility for farmers; however, unrestricted access may also encourage self-prescription, incorrect dosing, and inappropriate drug selection. These findings reinforce the importance of strengthening veterinary extension systems and improving regulation of antimicrobial distribution networks (FAO, 2019).

### **5.2.5 Public health implications of antibiotic use practices**

The combination of widespread antibiotic use and limited knowledge regarding withdrawal periods raises concerns regarding food safety and public health. Failure to observe withdrawal periods may increase the risk of antimicrobial residues entering the food chain through poultry meat and eggs (Landers et al., 2012).

In addition to residue exposure, there may be the emergence and spread of resistant bacteria through inappropriate antibiotic use in animal production systems that can be transferred between animals, humans and the wider environment. These findings further support the need for integrated approaches to address antimicrobial use from a One Health perspective (OIE, 2018).

### **5.2.6 Overall Interpretation of Findings**

Overall, the findings indicate that antibiotic misuse within poultry farming systems is influenced by interacting educational, behavioural, institutional, and production-related factors. High levels of antibiotic use, limited AMR awareness, inadequate veterinary guidance, and widespread access to antibiotics collectively create conditions that may favour inappropriate antimicrobial use practices (Swiswa et al., 2022).

The results suggest that interventions focused solely on farmer behaviour are unlikely to be sufficient. Sustainable antimicrobial stewardship may require combined approaches involving farmer education, improved veterinary extension services, stronger regulatory frameworks, and improved disease prevention strategies (Omolo et al., 2024; WHO, 2017).

### **5.3 Generalizations**

Antibiotic use among poultry farmers in Chikomba District was high, with most administering antibiotics regularly despite limited awareness of antimicrobial resistance (AMR). Over half of respondents lacked knowledge about AMR and withdrawal periods. These findings suggest similar patterns may occur in comparable rural poultry systems where antibiotic use is common but technical understanding is limited (WHO, 2017). The negative association between antibiotic use frequency and AMR awareness further supports this inference.

Limited veterinary guidance and easy antibiotic access also appeared to influence misuse. Many farmers reported obtaining antibiotics from informal markets and lacking professional oversight (Caudell et al., 2017). While these findings cannot be generalized beyond the study, reliability metrics suggest cautious extrapolation to similar settings is reasonable.

#### **5.4 Exceptions to the Rule**

Not all farmers demonstrated low awareness or misuse behaviours. Some showed understanding of AMR and withdrawal periods, indicating that education, experience, or veterinary training may shape more responsible antibiotic use (Grace, 2015). Moreover, disease outbreaks were infrequently cited as the main reason for antibiotic use, suggesting other factors like routine practices or economic pressures also play roles. This complexity cautions against oversimplified conclusions about the drivers of antimicrobial resistance in rural poultry systems (O'Neill, 2016).

#### **5.5 Reasons why things happen**

The frequency of antibiotic use may reflect production realities and socio-economic characteristics. Poultry farming as a source of both household nutrition and income likely incentivizes routine antibiotic use to maintain productivity (Van Boeckel et al., 2015). Limited veterinary services in rural Chikomba, due to logistical and financial constraints, appear to encourage self-medication and reliance on informal drug suppliers (Caudell et al., 2017).

Lower technical knowledge and inadequate dissemination of AMR information may further contribute to misuse (Strandell, 2024). Additionally, disease pressure and poor biosecurity, especially in mixed poultry systems, might prompt preventive antibiotic use in place of vaccination or improved hygiene (Graham et al., 2019).

#### **5.6 Contribution of the Study**

This research adds targeted data on AMR awareness and antibiotic use practices among smallholder poultry farmers in rural Zimbabwe, addressing a recognized gap in local-level evidence. It highlights widespread antibiotic use concurrent with low AMR awareness and limited veterinary guidance, emphasizing the need for interventions tailored to these contexts.

The study confirms statistically significant links between antibiotic use frequency, veterinary access, and misuse, reinforcing arguments that AMR is driven by interconnected behavioural, educational, and institutional factors (Lowe, 1982; Manyi-Loh et al., 2018). It suggests that improved veterinary extension and farmer training may reduce inappropriate use.

Future research should explore AMR prevalence in poultry products, antibiotic residues, the impact of education programmes, and alternative disease control methods such as vaccination and biosecurity improvements to support sustainable poultry production and public health.

### **5.7 Chapter Summary**

This chapter discussed study findings in relation to existing literature, confirming that widespread antibiotic use, low AMR awareness, limited veterinary guidance, and unregulated access contribute to misuse in poultry farming. These factors align with prior research and underline the public health risks posed by antimicrobial resistance and residues in animal products. The findings recommend strengthening farmer education, veterinary services, and regulatory frameworks to support responsible antibiotic use. The subsequent chapter presents the study's conclusions and recommendations.

## **CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS**

### **6.0 Introduction**

The chapter provides conclusions based on the study of antibiotic use and its contribution to antimicrobial resistance (AMR) in poultry farming in Chikomba District, Chivhu, Zimbabwe. The implications stem from findings in Chapter 4 and interpretations discussed in Chapter 5. Moreover, the chapter also provides recommendations and suggests aspects where new research is needed. The conclusions are organised according to the objectives of the research and emphasize the study's contribution to understanding antibiotic use practices and antimicrobial resistance within poultry production systems.

### **6.1 Conclusions**

Antibiotic usage was found to be prevalent among poultry farmers in Chikomba District as most respondents claimed to routinely use antibiotics during poultry production cycles. The results indicate that antibiotics are frequently integrated into routine poultry management practices and are not only being used to treat diseases but also for disease prevention and flock management.

Aspects of the findings highlighted in the study further confirm that poultry farmers were less aware of antimicrobial resistance. Most of the responders showed a lack of knowledge about how resistance is developed in the context of antimicrobial resistance and good antibiotic use practices. Under-awareness is likely to lead to inappropriate use practices like self-prescription, incorrect dosing, and failure to follow treatment guidelines.

The study also established that limited veterinary support and easy access to antibiotics were important factors associated with antibiotic misuse. Farmers with reduced access to veterinary guidance were more likely to rely on multiple sources of antibiotics, including informal supply channels. These findings suggest that veterinary extension systems and regulation of antimicrobial access remain important components of responsible antibiotic stewardship.

Knowledge regarding withdrawal periods was also found to be inadequate among many respondents. Limited understanding of withdrawal requirements may increase the risk of antimicrobial residues entering poultry products and may have implications for food safety and public health.

Overall, the findings suggest that antibiotic misuse in poultry farming is influenced by multiple interacting factors, including production pressures, limited awareness of AMR, restricted veterinary access, and widespread antibiotic availability. The study therefore provides district-level evidence that may contribute toward improving antimicrobial stewardship practices within Zimbabwe's poultry sector.

## **6.2 Recommendations**

Based on the findings of this study, the following recommendations are proposed:

### **1. Strengthen Veterinary Extension Services**

Veterinary extension services need enhancement to facilitate better access for farmers to professional guidance regarding disease diagnosis, antibiotic selection, dosage administration, and withdrawal period compliance. Improved veterinary support may reduce reliance on self-medication practices.

### **2. Strengthen Regulation of Antibiotic Distribution**

Government authorities should strengthen regulations governing the distribution and sale of veterinary antibiotics to minimise unauthorized access and reduce circulation of counterfeit or inappropriate products. Improved regulation may encourage responsible antimicrobial use practices.

### **3. Improve Monitoring and Surveillance Systems**

Relevant government institutions and veterinary regulatory authorities should strengthen monitoring systems for antibiotic distribution and use. Enhanced surveillance may improve oversight of antimicrobial use practices and help identify emerging misuse patterns.

### **4. Promote Biosecurity and Preventive Health Practices**

Farmers should be encouraged to adopt stronger biosecurity measures, vaccination programmes, hygiene practices, and improved housing systems to reduce dependence on preventive antibiotic administration.

## **5. Increase Farmer Training and Awareness Programmes**

Regular farmer training programmes and awareness campaigns on antimicrobial resistance, responsible antimicrobial use, and withdrawal periods should be implemented to improve knowledge and encourage behavioural change.

## **6.3 Areas for Further Research**

Further research should investigate the prevalence of antimicrobial-resistant bacteria and antibiotic residues in poultry meat and eggs produced within Chikomba District and other regions of Zimbabwe. Additional studies may also examine the effectiveness of farmer training programmes, alternative disease control strategies, and the economic implications of reducing antibiotic use within poultry production systems.

## **6.4 Conclusion**

This study generated important findings regarding antibiotic use practices and antimicrobial resistance awareness among poultry farmers in Chikomba District. Widespread antibiotic use, limited understanding of AMR, inadequate veterinary support, and easy access to antibiotics emerged as key factors associated with inappropriate antimicrobial use practices. Addressing these challenges through improved farmer education, stronger veterinary extension services, enhanced regulation, and strengthened antimicrobial stewardship programmes may contribute to more sustainable poultry production and improved public health outcomes.

## References

1. Auta, A., Hadi, M.A., Oga, E., Adewuyi, E.O., Abdu-Aguye, S.N., Adeloye, D., Strickland-Hodge, B. and Morgan, D.J. (2019). Global access to antibiotics without prescription in community pharmacies: A systematic review and meta-analysis. *Journal of Infection*, 78(1)
2. Beyene, T. (2016). Veterinary drug residues in food-animal products: Its risk factors and potential effects on public health. *Journal of Veterinary Science and Technology*, 7(1)
3. C Reygaert, W. (2018) 'An overview of the antimicrobial resistance mechanisms of bacteria', *AIMS Microbiology*, 4(3), pp. 482–501. doi: 10.3934/microbiol.2018.3.482.
4. Caudell, M.A., Dorado-García, A., Eckford, S., Creese, C., Byarugaba, D.K. and Afakye, K. (2017). Towards a bottom-up understanding of antimicrobial use and resistance on the farm: A knowledge, attitudes, and practices survey across livestock systems in five African countries. *PLoS ONE*, 12(1), pp.1–21.
5. Economou, V. and Gousia, P. (2015). Agriculture and food animals as a source of antimicrobial-resistant bacteria. *Infection and Drug Resistance*, 8, pp.49–61.
6. Food and Agriculture Organization (FAO). (2019). The FAO Action Plan on Antimicrobial Resistance 2016–2020. Rome: FAO.
7. Garg, R. (2024) 'a Review on Antibiotic Resistance', *Indian Journal of Health Care Medical & Pharmacy Practice*, 5(1), pp. 50–56. doi:
8. Grace, D. (2015). Review of evidence on antimicrobial resistance and animal agriculture in developing countries. London: Department for International Development (DFID).
9. Graham, J.P., Eisenberg, J.N.S., Trueba, G., Zhang, L. and Johnson, T.J. (2019). Small-scale food animal production and antimicrobial resistance: Mountain, molehill, or something in-between? *Environmental Health Perspectives*, 127(9), pp.1–10.
10. Kashangura, M.T. and Gororo, E. (2016). Women participation in smallholder farming systems in Zimbabwe. *Journal of Agricultural Studies*, 4(2), pp.45–56.
11. Landers, T.F., Cohen, B., Wittum, T.E. and Larson, E.L. (2012). A review of antibiotic use in food animals: Perspective, policy, and potential. *Public Health Reports*, 127(1)
12. Lowe, J. (1982) 'Mechanisms of Antibiotic Resistance', *Annual Reports in Medicinal Chemistry*, 17(C), pp. 119–127. doi: 10.1016/S0065-7743(08)60495-9.
13. Manyi-Loh, C., Mamphweli, S., Meyer, E. and Okoh, A. (2018). Antibiotic use in agriculture and its consequential resistance in environmental sources: Potential public health implications. *Molecules*, 23(4), pp.1–48.

14. Marshall, B.M. and Levy, S.B. (2011). Food animals and antimicrobials: Impacts on human health. *Clinical Microbiology Reviews*, 24(4), pp.718–733.
15. Maruve, S. A. and Essack, S. Y. (2022) ‘Knowledge, attitudes, and practices of veterinarians on antibiotic use and resistance and its containment in South Africa’, *Journal of the South African Veterinary Association*, 93(2), pp. 99–108. doi: 10.36303/JSAVA.164.
16. Mathew, A.G., Cissell, R. and Liamthong, S. (2007). Antibiotic resistance in bacteria associated with food animals: A United States perspective of livestock production. *Foodborne Pathogens and Disease*, 4(2), pp.115–133.
17. Mubito, E.P., Shahada, F., Kimanya, M.E., Buza, J.J., Chove, B.E., Madinda, N.F. and Damborg, P. (2014). Antimicrobial use in the poultry industry in Tanzania and public health implications. *American Journal of Research Communication*, 2(4), pp.51–63.
18. Mutua, F., Sharma, G., Grace, D. and Bandyopadhyay, S. (2020). A review of animal health and drug use practices in African livestock systems. *Preventive Veterinary Medicine*, 176, pp.1–10.
19. Nhung, N.T., Chansiripornchai, N. and Carrique-Mas, J.J. (2017). Antimicrobial resistance in bacterial poultry pathogens: A review. *Frontiers in Veterinary Science*, 4, pp.1–17.
20. Omolo, J. O. et al. (2024) ‘Knowledge, Attitudes, Practices on Antimicrobial Use in Animals Among Livestock Sector Stakeholders in Kenya’, *Veterinary Medicine International*, 2024(1). doi: 10.1155/2024/8871774.
21. O’Neill, J. (2016). *Tackling Drug-Resistant Infections Globally: Final Report and Recommendations*. London: Review on Antimicrobial Resistance.
22. Scott, D. (2015) ‘The Mechanics of Antibiotic Resistance’, *Amazing Science*, pp. 1–18.
23. Swiswa, S. et al. (2022) ‘Measurement of antibiotic use on poultry farms in Zimbabwe: Evaluation of a tool and procedures’, (September).
24. Van Boeckel, T.P., Brower, C., Gilbert, M., Grenfell, B.T., Levin, S.A., Robinson, T.P., Teillant, A. and Laxminarayan, R. (2015). Global trends in antimicrobial use in food animals. *Proceedings of the National Academy of Sciences*, 112(18), pp.5649–5654.
25. WHO (2017) *Integrated Surveillance of Antimicrobial Resistance in Foodborne Bacteria: Application of a One Health Approach*, World Health Organization. Available at: <https://apps.who.int/iris/bitstream/handle/10665/255747/9789241512411-e>

## **Annexure A: Research Questionnaire**

My name is Dzvimbo Garauzive, a final-year student at Bindura University of Science Education (BUSE) pursuing a BSc Animal Science (Hons) degree. I am conducting a survey to assess how antibiotic use in poultry contributes to antimicrobial resistance (AMR) in Chikomba District.

The information collected will be used strictly for academic purposes, and your responses will be treated with the highest level of confidentiality. Your participation is voluntary.

Date of Interview: \_\_\_\_\_/\_\_\_\_\_/\_\_\_\_\_

Name of Farm: \_\_\_\_\_

Ward/Village: \_\_\_\_\_

### **Section 1: Demographic Information**

1. Gender: ☐ Male ☐ Female
2. Age group: ☐ Below 20 ☐ 20–35 ☐ 36–50 ☐ 51–65 ☐ Above 65
3. Marital status: ☐ Single ☐ Married ☐ Widowed ☐ Divorced
4. Highest level of education: ☐ No formal education ☐ Primary ☐ Secondary ☐ Tertiary
5. Occupation: ☐ Full-time farmer ☐ Part-time farmer

### **Section 2: Farm Characteristics**

6. How many chickens do you keep per production cycle? ☐ Below 100 ☐ 100–500 ☐ 501–1000 ☐ Above 1000
7. Main purpose of poultry production: ☐ Business ☐ Household consumption ☐ Both
8. Type of poultry raised: ☐ Broilers ☐ Layers ☐ Roadrunners
9. Do you have access to a veterinary officer or animal health worker? ☐ Yes ☐ No
10. How often do they visit your farm? ☐ Weekly ☐ Monthly ☐ Occasionally ☐ Never

### **Section 3: Antibiotic Use Practices**

11. Do you use antibiotics in your poultry flock? ☐ Yes ☐ No
12. If yes, for what purpose? ☐ Disease treatment ☐ Disease prevention ☐ Growth promotion ☐ All the above
13. How often do you administer antibiotics? ☐ Regularly (every cycle) ☐ Occasionally ☐ Rarely ☐ Never
14. Who recommends the antibiotics you use? ☐ Veterinary officer ☐ Agroveter/shop attendant ☐ Other farmers ☐ Self

15. Where do you obtain the antibiotics? ☐ Agroveter shop ☐ Veterinary services ☐ Informal market
16. Do you always follow dosage instructions? ☐ Yes ☐ No ☐ Sometimes
17. How do you administer antibiotics? ☐ In drinking water ☐ In feed ☐ Injection
18. Do you keep records of antibiotic use? ☐ Yes ☐ No
19. Do you observe withdrawal periods? ☐ Yes ☐ No
20. Do you know what a withdrawal period is? ☐ Yes ☐ No
21. How do you observe withdrawal periods?

---



---



---

22. When you give antibiotics to your animals, do you check how many times you must give the medicine? ☐ Yes ☐ No ☐ Sometimes
23. Which antibiotics do you frequently use? ☐ Tylosin ☐ Oxytetracycline ☐ Enrofloxacin  
☐ Amoxicillin ☐ Colistin

#### **Section 4: Knowledge and awareness on antimicrobial resistance (AMR)**

24. Have you ever heard of antimicrobial resistance (AMR)? ☐ Yes ☐ No
25. If yes, what do you understand by AMR? ☐ When antibiotics stop working ☐ Animals become resistant ☐ Not sure
26. Do you believe improper antibiotic use can make treatment fail in future? ☐ Yes ☐ No  
☐ Not sure
27. Have you received training on antibiotic use? ☐ Yes ☐ No
28. If yes, who provided it? ☐ Veterinary officer ☐ NGO ☐ Agroveter ☐ Media ☐
29. Do you think farmers in your area overuse antibiotics? ☐ Yes ☐ No ☐ Not sure
30. What causes misuse of antibiotics? ☐ Lack of veterinary guidance ☐ Easy access to drugs  
☐ Limited knowledge ☐ High disease prevalence

#### **Section 5: Biosecurity and Farm Management**

31. Do you isolate sick birds from healthy ones? ☐ Always ☐ Sometimes ☐ Never
32. Do you disinfect poultry houses after each cycle? ☐ Yes ☐ No
33. Do you use footbaths at poultry house entrances? ☐ Yes ☐ No

34. Do you dispose of dead birds properly (e.g., burial, burning)? ☐ Yes ☐ No

35. Do you think improving hygiene could reduce antibiotic use? ☐ Yes ☐ No ☐ Not sure

### **Section 6: Challenges And Recommendations**

36. What challenges do you face regarding antibiotic use? ☐ High drug costs ☐ Fake drugs

☐ Lack of advice ☐ Poor storage

37. Would you attend training on responsible antibiotic use and AMR? ☐ Yes ☐ No

38. How can antibiotic misuse be reduced? ☐ Stricter regulation ☐ Farmer training

☐ Affordable veterinary services ☐ Integrated drug surveillance systems ☐ All the above

End Of Questionnaire

Thank you for your participation.