UNIVERSITY OF EDUCATION, WINNEBA

# ANTIBIOTICS IN ANIMAL AGRICULTURE ON ANTIMICROBIA RESISTANCE: A CASE STUDY IN THE UPPER EAST REGION AND WESTERN REGION OF GHANA

BY

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NOVEMBER, 2022

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# DECLARATION

**STUDENT DECLARATION**

I, Zuberu Musah declare that this research work, with the exception of quotations and references contained in published works which have all been identified and duly acknowledged, is entire my own original work, and it has not been submitted, either in part or whole, for another degree elsewhere.

**SIGNATURE…………………………………………..**

**DATE…………………………………………………..**

**SUPERVISOR'S DECLARATION**

I hereby declare that the preparation and presentation of this work was supervised in accordance with the guidelines for supervision of thesis/dissertation/project as laid down by the University of Education, Winneba.

**SUPERVISOR'S NAME: DR. DUODU ADDISON**

**SIGNATURE…………………………………………..**

**DATE……………………………………..…………**

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## DEDICATION

This work is dedicated to my lovely, wonderful and supportive wife, Rena, Indogseh Akemposa and my daughter, Karishma, Wemanga Akoliba who have been the major source of encouragement and support to the success of my studies.

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## ABSTRACT

The study was conducted to obtain information about the use of antibiotics on antimicrobial resistance in the Western and Upper East Regions of Ghana. The sampling technique used for the research was multi-stage sampling in all the study areas in the two regions. A total number of one hundred and fifty (150) animal farmers were sampled from the regions for the research. These farmers came from various Districts and municipalities from the regions. A structured questionnaire was designed and used to collect the data from the respondents. Descriptive statistics was used to analysed the data. Statistical Package for Social Scientists [SPSS] and Microsoft Excel (14.0.4734.100.2021) were used. The results indicated that all farmers used antibiotics to raise their animals. From both regions, the most abundant used antibiotic is penicillin and egg formula which represent 37% and 26% respectively from the Western Region. While in the Upper East Region, penicillin and egg formula also recorded 22% and 15% respectively. The farmers from the two regions believed that penicillin is more effective than the other antibiotics. It is undeniable fact that farmers lamented on the ineffective ability of some of the antibiotics. The farmers claimed that the use of some of the antibiotics do not meet the purpose for which they are used. 48% and 23% from Western and Upper East Regions respectively use antibiotics purposely for the treatment of diseases. With respect to where these antibiotics are purchased, 95 respondents from the Western region usually purchased them (antibiotics) from the veterinary stores against 5 respondents who also purchased from drug stores. From the Upper East Region, 39

respondents acquire antibiotics from veterinary store against 11 respondents who purchased from drug stores. 68% farmers from Western Region determine the dosage of the antibiotics base on how they were previously used against 21% who determine the dosage on the label or the inscription on the container. In the Upper East Region, 30% of the farmers also determine the dosage base on previous used and 17% base on the label. Notwithstanding, bad animal management practices such as lack of footbaths, use of clothes for both house and in animal farm, using a pair of wellington boot for everywhere, no proper medical examination before administering drugs, the use of medication base on previous use are very critical on the health of the animals and consequently antimicrobial resistance in animal agriculture in both Western and Upper East Regions of Ghana. It is as a result of these findings that, recommendations such as laws on the sale and acquisition of antibiotics, adequate sensitization to broaden the minds of the farmers, training more veterinary staff etc need to be taken into serious consideration to curb the level at which antibiotics are used.

# CHAPTER ONE

## 1.0 INTRODUCTION

### 1.1 Background of the Study

Livestock including poultry production is an essential feature of Ghana's agriculture, contributing immensely towards meeting food need, providing draft power and generating cash income. The livestock sub-sector contributes largely to Ghana's Gross Domestic Product (GDP). Crops and livestock sub-sector alone contribute as much as 28% to Ghana's Gross Domestic Product (MoFA/DFID, 2002). According to Livestock Development Project Appraisal Reporting (2001), during periods of insufficient crop production, livestock mainly small ruminants and poultry become the main source of food and income for the household.

The report also suggest that small ruminants acts as bank and insurance in times of agent financial needs since it generates immediate cash income to the farmer MoFA/DFID (2002) indicated that most livestock farmers practice mixed farming systems in all sixteen regions of Ghana with a prevalence rate of about 98% Food security in Ghana is defined as good quality nutritious food, hygienically packaged, attractively presented, available in sufficient qualities all year round and located at the right place at affordable prices (Food and Agricultural Sector Development Project, 2003). This similar to what the Food and Agricultural Organization defines as access by all people at all times to enough food for an active, healthy life. This definition covers the four dimensions of food security that is availability, accessibility, utilization and sustainability. A person is said to be food secured if he/she can ensure that all four dimensions are met. Agriculture is predominantly on a small holder basis on family operated farms using rudimentary technology to produce about 80% of the total agriculture production. It is estimated that about 2.74 million households operate a farm or keep livestock in Ghana which is a challenge to food security in Ghana (MoFA/DFID, 2002). A lot of research has been done and showed that a very high percentage of antibiotics are used by livestock farmers in everyday activities of animal agriculture for various reasons. The use of antibiotics in animal agriculture is sturdily increasing especially in developing countries of which Ghana is not exempted (Amivon *et al.,* 2007).

The chlorotetracycline by-product was quickly shown to improve the weight gain of chicks as well as reduce the amount of feed needed to bring broilers to market weight (Ranjan, 2012). The varieties of antibiotics, anticoccidial and the routes of administration and are used to prevent the economically important protozoa and coccidiosis. The more antibiotics are give to livestock, the more the emergence and spread of antibiotics resistant bacteria in a microbial environment shared by animals and people (Marshall and Levy, 2011; Spellberg *et al.,* 2016).

### 1.2 Problem Statement

In spite of the benefits associated with antibiotics used in animals‟‟ agriculture, there have been several calls on its effects on antimicrobials resistance which may encourage the emergence and spread of antibiotic resistant bacteria in both animals and humans (Alterby *et al*., 2019).. Many poultry farmers do not have formal education and others are semi literates. Information regarding antimicrobial resistance is shown to be scanty and potential mode of development and spread are not elucidated. There is the need to investigate the use of antibiotics in livestock production among farmers and potential influence on resistance development. Some works of this nature has been done in other regions but not in northern and western sectors of the country. It is therefore necessary for an empirical study to be conducted in order to determine the prevalence and the use of antibiotics in animal production on antimicrobial resistance in the Western and Upper East Regions of Ghana.

### 1.3 Main Objectives

This research was conducted to determine the effect of antibiotics use in animal agriculture on antimicrobial resistance in the Western and Upper East Regions of Ghana.

#### 1.3.1 Specific Objectives

The specific objectives of the research were to;

1. Determine the prevalence rate and use of antibiotics in animal agriculture among animal farmers in the Western and Upper East Regions of Ghana
2. Determined the efficacy of antibiotics in animal agriculture in the Western and Upper East Regions of Ghana
3. Identify some of the causes of antimicrobial resistance in animal agriculture in the Western and Upper East Regions of Ghana.

### 1.4 Research Questions

Three main research questions have been formulated to address the objectives of the research. Subsequently, sub-research questions have been designed under each main question which will answer issues raised in the main questions.

### *1.4.1 Research question one (1)*

What is the prevalence rate of antibiotics used in animal agriculture in the Western and Upper East Regions of Ghana?

1. What is the perception of animal farmers on antibiotics used in the Western and Upper East Regions of Ghana?
2. What is the rate of antibiotics use in animal agriculture in the Western and Upper East Regions?
3. What is the level of awareness of animal farmers on antibiotics used in animal agriculture in Regions?

### *1.4.2 Research Question two (2)*

What are the effects of antibiotics used in animal agriculture in the Western and Upper East Regions of Ghana?

1. What positive effects are realized after administering antibiotics among the animals?
2. What negative effects are encountered after administering the antibiotics?

### *1.4.3 Research Question 3*

What might be the causes of antimicrobial resistance in animal agriculture in the Western and Upper East Regions of Ghana?

1. How are the antibiotics administered considering the dosage?
2. How are the antibiotics acquired?
3. What are the husbandry practices on the various farms?

## 1.5 Significance of the study

The study will help farmers realized the effects of using antibiotics in raising farm animals. The study will also help the government of Ghana, Ministry of Food and Agriculture, Food and Drug Authorities, Non-Governmental Organizations into animal agriculture and the general public in formulating intervention or policies that will take into consideration factors or policies to curb or control the use of antibiotics in animal culture in other to deal with antimicrobial resistance in animal agriculture in the Upper East and Western Regions of Ghana. The findings will also help the ministry of Food and Agriculture to design appropriate training packages for the use of antibiotics in animal agriculture in the country.

The results of this study will also prompt the ministry on constant monitoring of animal farmers on the use of antibiotics and animal husbandry practices to deal with antimicrobial resistance. The study will also add to the body of knowledge and serve as a foundation material for further research in the same study area elsewhere.

# CHAPTER TWO

# 2.0 LITERATURE REVIEW

## 2.1 Antibiotics

The term "antibiotics"" refer to naturally produced substances of various microorganisms such as bacteria and fungi, which are able to inhibit the growth of other microorganisms and destroy their cells (Konstantopoulou, 2016). With the production of semi synthetic derivatives in modern era, the term "antibiotics" have been replaced by the term "antimicrobials" which refer to the natural, semi synthetic substances capable of inhibiting the proliferation of microbes and thus leading them to apoptosis (Faoulakis, 2016).

Before the emergence of antibiotics, man was almost completely exposed to infections. Diseases such as pneumonia, meningitis or tuberculosis were treated very difficult or not at all. Humanity lived under the fear of major epidemics. Specializations such as surgery, pediatrics and heamatology had high mortality rates as a consequence of infections (Monios *et al.,* 2017). Since then and for many years, medicine has changed form. Without the stress of infection, physicians were able to broaden and advance their research. Special areas such as surgery and heamatology flourished. Moreover, for several decades, mankind has been relieved of the fear of major pandemics (e.g plague and syphilis) and disease-spots such as tuberculosis have been effectively treated. Over time, dozens of new antimicrobial agents have been discovered, with various mechanisms of action, and it is well documented that the current arsenal provides complete protection against all pathogens (Antoniadis, 2006). Nowadays, antimicrobials are widely used drugs not only in medical practices, but also in agriculture, livestock farming, and fish farming, as growth enhancers or as growth-protective agents (Sarmah, 2006). It is important to specify at this point that, those chemotherapeutic drugs acting against bacteria and have been produced from living organisms are called antibiotics, while those produced artificially in the laboratory are called antimicrobials (Patrikis, 2011).

Antimicrobial drugs begun in the 1890s when two German researchers, Rudolph Emmerich and Oscar Low, discovered the first antibiotic, Pyocyanase, derived from the cultivation of the microbes *Pseudomonas aeruginosa*, with dubious effectiveness and safety in patients population used against cholera and typhus ("https://en.Wikidepia.org/wiki/pyocyanase"). However, the milestone in the development of antimicrobial drugs was the discovery of penicillin by Alexander Flemming in 1928, which is used until today in clinical therapies (https://en.wikipedia.org/wiki/Alexander Flemming). The discovery of penicillin can be described as "a child of war". Its discovery was regarded as miracle, as penicillin could treat all types of infections caused by staphylococci and streptococci. Alexander Flemming postulation of penicillin in 1928 suggested that, the penicillin is a molecule produced by certain bacteria when he noticed the spores of a green mold, penicillin chrysogenum, on his culture plates. He observed that the presence of the mold killed or stopped the growth of the bacteria. Flemming therefore, postulated that the mold must secrete an antibacterial substance which is named penicillin.

In the year 2014, Factsheet for Expects also suggested that antibiotics are antimicrobial substances which is detrimental to bacteria and is considered the most important type of antimicrobial agents for fighting bacterial infections and are widely used in treatment and prevention of such infections. Also, Nordquist (2018), said antibiotics also known as antimicrobials are medications that destroy or slow down the growth of bacteria. Antibiotics include a range of powerful drugs and are used to treat diseases caused by bacteria. These antibiotics either kill bacteria or keep them from reproducing. Center for Disease Control and Prevention (2018), said antibiotics are powerful medicines that fight certain infections and can save lives when properly used. Before bacteria can multiply and cause symptoms, the immune system can typically kill them. White Blood Cells (WBCs) attack harmful bacteria and even if symptoms do occur, the immune system can usually cope and fight off the infection (CDCP, 2018).

Centre for disease control and prevention added that, there are different types of antibiotics which work in one of the following ways:

- ✓ A bactericidal antibiotic, such as penicillin, kills the bacteria. These drugs usually interfere with either the formation of the bacterial cell wall or its cell contents
- ✓ A bacteriostatic stops bacterium from multiplying.

## 2.2 Use of Antibiotic in Animal Agriculture

Antibiotics use in animal production dates as far back as the 1910 when due to shortage of meat products, workers carried out protest and riots across America (Ogle, 2013). Scientist at that time started looking for means of producing enough meat at relatively affordable cost; hence the use of antibiotics and other antimicrobial agents (Dibner, Richards, 2005). Feeding domestic animals, small amounts of antibiotics (subtherapeutic) increase growth rate (Thomas, 1949). Antibiotics are not only used as growth promoters, but also to treat diseases (therapeutic) as well as increase feed efficiency.

Over hundred antibiotics in the United States have been used in production to treat and control pathogens such as *E. coli, staphylococcus aureus, and streptococcus pneumoniae* (Hoa *et al.,* 2014), antibiotics can increase animal performance. In the 1940s, farmers noticed higher performance in pigs administered antibiotics. Upon investigation, Hewes (1955) recorded a significant difference in weight gain among animals treated with Chlortetracycline. In 1951, Food and Drugs Association approved antibiotics for growth promotion for food animals (Hao *et al.,* 2014). Studies have been contacted to ascertain why antibiotics increase growth. However, common assumptions in relation to the growth improvement with the use of antibiotics in animal production could be the following:

a) Reduction in pathogenic bacteria in the intestinal track of chicks
b) Decrease the thickness of mucous membrane, leading to more absorption of nutrients and reduced fermentation.
c) Directly neutralizing the host immune response. All these modes of action manipulate host intestinal flora, intestinal physiology, and immune system which contributes to the prevention of disease and changes in microbiome equilibrium (Newwold, 2007)

There is considerable controversy over the use of human antibiotics to promote growth in animals raised for food (Philips *et al.,* 2004). The World Health Organization, the America Medical Association have urged a ban on growth promoting antibiotics (GPAs), urging that their use leads to increase in antibiotic resistant infection in humans. In contrast, commercial interest has argued that their removal will have a significant impact on the cost of production and it is unlikely to affect the risk to humans from antibiotic-resistant infections (Casewell *et al.,* 2003; Smith, 2002). The use of antibiotics to enhance growth and feed efficiency and reduce mortality in broiler production was introduced without rigorous as to efficacy some fifty years ago (Libby *et al.,* 1955).

As mentioned above, improvement in growth due to antibiotic was first described in the mid-1940s, and within five years the addition of GPAs became common practice (Moore, *et al.,* 1946). During this initial period, it was hypothesized that the antibiotic growth effect was due to the reduction of pathogenic bacterial in the intestinal tract of poultry (Jacob *et al.,* 1953). In one test of this hypothesis, researchers raised chickens in a hygienic environment and demonstrated that there were little differences in growth between chicks fed a diet with GPAs Vs. chicks receiving a diet without GPAs (Stokstad *et al.,* 1958). Currently several mechanisms of action are attributed to antibiotics but no clear understanding has been achieved (National Research Council, 1999). Studies have shown that the use of GPAs contributes to the contamination of flocks and food products by antibiotic resistant pathogens, including *Compylobacter, Salmonella, Enterococcus* and *Escherichia coli* and thereby increase risk of human infections by these and other resistant pathogens (Feinman, 1979). The European Union, in 1999 banned the use of most antibiotics for growth promotions to preserve the effectiveness of important human drugs (Caswell *et al*., 2003). United States have not adopted this broad policy but in 2004 the United States food and drug Administration banned enrofloxacin (a fluoroquinolone applied for therapeutic uses, not growth promotion) in food animals on the grounds that its use contributed to fluoroquinolone resistance on human pathogens. In recent times, more antibiotics are used on animals than humans (Janjan, 2012). The WHO (2005) claimed that more than half of the global antibiotics production is used on farm animals. In the last thirty-one (31) years, the use of penicillin – typed drugs in farm animals have increased by 60% and of tetracycline by 15%. In the United States, more than 70% of its antibiotics are fed to meat animals; not to treat diseases, but to promote growth and release stress, as well as improving sanitary conditions (Ranjan, 2012).

While the quantity of antimicrobials used in agriculture globally is not known precisely, the amount used for food-animal production is significantly higher as compared to human use. Based on 2012 data from United States food and Drug Administration, eighty percent (80%) of antimicrobials are sold or distributed for use in animals (Teillant *et al.,* 2015). An analysis conducted for the Organization for Economic Cooperation and Development (OECD) estimated that antimicrobials used in food- animal production will grow globally from sixty-three thousand (63,000) tones by 2013 (can increase of 67%) (Laxminarayan *et al,* 2015). As of 2013, antibiotic classes used in food-producing animals are; Aminocoumarins, aminoglycosides, amphenicols, diaminopyridines, fluoroquinolones, glycolipids, lincosamides, macrolides, penicillin, pleuromutilins, polymyxins, polypeptides, quinoxalines, streptogramins, sulfonamides (sulfas), tetracyclines penstrip etc (FDA, 2013). The world health organization (WHO) considers Cephalosporins

(3rd / 4th generation), fluoroquinolones, and Macrolides of "highest priority critical important", aminoglycosides and polymyxins "critical important" and amphenicols, cephalosporins (1st/2nd generation), lincosamides, penicillin, pleuromutilins, streptogramins, sulfonamides, and tetracyclines "highly important" to human health (WHO, 2011). In 1975, the U.S Food and Drug Administration (FDA) formed an advisory committee to study the consequences of Sub-therapeutic use of antibiotics in animal agriculture (Ahart, 1977).

In the 1980s and 1990s, many groups, including the Institute of Medicine and the Council for Agriculture Science and Technology, push for the suspension of antibiotics in animal feeds. However, these groups" arguments were based on conceptual risk, not proven risk (Dibner and Richard, 2005). It was not until 1996 that the National Antimicrobial Resistance Monitoring System was founded as collaboration between the centres for Disease Control and Prevention (CDC), FDA and the United States Department of Agriculture (USDA) (Margaret, 2006).

The program monitors susceptibility and resistance of selected bacteria by establishing base lines and monitoring trends. *Salmonella spp*. was the original bacteria monitored through human, animal and later retail meat sampling. This was later expanded to *camphlobacter* in 1998 and *E. coli* in 2000 (White, 2007). Internationally, Sweden was the first to ban antibiotics as growth promoters in 1986 (Aarestrup, 2003). In the following twelve years, bans throughout the European Union prohibited some antibiotics in animal feed over concern of resistance in human medicine. Avoparcin, glycopeptide, was banned in Denmark and Germany over concerns of glycopeptide resistance; spiramycin, macrolide, was prohibited in Finland due to human use; Virginiamycin, and streptogramin, ware prohibited in Denmark because some streptogramins were clinically important in human medicine (Castanon, 2007). Denmark banned all non-prescription use of growth promoters in animal feed in 2000 (DANMAP, 2013). In 2003, the E.U, as a whole, banned the use of antibiotics as growth promoters in regulation 1831/2003 (European Parliament, 2003).

### 2.3 Antimicrobial Resistance

Antimicrobial resistance is the ability of microorganisms such as bacteria, fungi or protozoans to grow despite exposure to microbial substances designed to inhibit their growth OR antimicrobial resistance (AR) can also be defined as the ability of an organism to resist the killing effects of an antibiotic to which it was normally susceptible (Madigan, 2014) and this has become an issue of global interest (WHO, 2014). Magiorako (2011) also suggested that Bacteria are classified as antibiotic resistance when they are non-susceptible to at least one antibiotic class. Multidrug resistance (MDR) includes bacteria that are resistant to three or more antimicrobial class. Pan drug resistance (PDR) is bacteria not susceptible to any antimicrobial categories. The emergence and dissemination of antimicrobial resistance among human and animal poses an enormous threat to people around the world (Wittum *et al.,* 2012).

According to a report from the World Health Organization (WHO 2014), the magnitude of antimicrobial resistance in many parts of the world has reached alarming levels and clearly suggests that a „post antibiotic era" may be a real possibility for the 21st century. The importance of this growing problem can be illustrated by the emergence of plasmidmediated colistin resistance among human, animal and zoonotic pathogens. Colistin or polymixin E is a potent polycationic polypeptide that possesses both hydrophilic and lipophilic properties (Li *et al.,* 2006), which can effectively disorganize the outer membrane of a wide spectrum of Gram-negative bacteria. Until recently, only chromosomally mediated resistance to colistin was observed (Cheng *et al.,* 2010). However, in 2016 the first plasmid-mediated colistin resistance was reported among several species of the Enterobacteriaceae family (Liu, 2016).

Besides the use of colistin for human treatments, this antibiotic has been heavily used in veterinary practice, especially as an additive in feed for promoting growth of food animals in many parts of the world (Wertheim *et al.,* 2013). It has been hypothesized that the industrial-scale incorporation of colistin as a growth promoter for food animals has had a significant contribution to the emergence of colistin resistance (Liu *et al.,* 2016). This hypothesis is further supported by the fact that initially a high prevalence of the mobilized colistin resistance *(mcr-1)* genes was found among colistinresistant isolates originating from animals compared to a small prevalence of the colistin resistant isolates originating from humans (Liu *et al.,* 2016). Examples of the emergence and spread of colistin resistance suggests that research studies designed to investigate the impact of livestock practices on the emergence of antibiotic resistance in the livestock settings and their transfer to the environment are urgently needed.

## 2.4 Mechanism of Antibiotic Resistance Development

Development of antibiotic resistance occurs via two major pathways; (i) vertically through *de novo* mutations and (ii) horizontally via the introduction of antibiotic resistance genes.

### *2.4.1 Vertical acquisition of antimicrobial resistance*

Once a population of bacteria is exposed to lethal, sub lethal or even low concentrations of antibiotic, a selective pressure starts to act on the bacterial population (Kruse, 1994). Any mutation that will provide a full or partial resistance to a particular antibiotic will be preserved and vertically transmitted to progeny cells, further providing a survival or growth advantage (i.e., it depends on antibiotic concentration) to mutated cells compared to that of non-mutated (i.e., parental) cells. *De novo* mutations may generate bacterial resistance to a specific antibiotic exclusively, or to a class of antibiotics, when target-site gene mutation/s occur for that specific antibiotic. An example of *de novo* mutations that exclusively generate a resistance to a specific antibiotic or class of antibiotics can be found among fluoroquinolone-resistant isolates.

The fluoroquinolones, a potent, broad-spectrum class of antibiotics, target bacterial type II topoisomerases, primarily DNA gyrase (GyrA and GyrB) in Gram-negative and DNA topoisomerase IV (ParC and ParE) in Gram-positive bacteria. This drug binds the GyrA or ParC enzymes at their substrate (i.e., DNA) target site (Laponogov *et al.,* 2013), resulting in dysfunctional topoisomerase II enzymes, which are able to cleave chromosomal DNA, but unable to re-ligate the chromosome (Redgrav, 1989). This interaction of the drug and bacterial type II topoisomerases causes a fragmentation of chromosomal DNA, which subsequently leads to cellular death (Walter, *et al.,* 1989). Non-synonymous mutations that arise in the *gyrA* and *parC* genes, specifically in a short DNA region known as the quinolone resistancedetermining region (QRDR), alter the substrate structure (i.e., DNA) of the GyrA or ParC (Yoshida *et al.,* 1990V). These target-site amino acid substitutions lead to a reduced binding affinity of fluoroquinolone to mutated GyrA and ParC enzymes (Yoshida *at el.,* 1990) further providing an exclusive resistance to fluoroquinolone class of antibiotics. Besides mutations that provide exclusive resistance to a specific antibiotic or class of antibiotics, most commonly, de novo mutations generate resistance to a diverse group of functionally unrelated antibiotics.

Mutations that cause the overexpression of genes encoding efflux-pump proteins usually lead to the development of multidrug resistance (MDR) (Vidovic, An, Rendahl, 2019) in bacteria. For instance, the AcrABTolC, a member of the resistance-nodulation division (RND) family of efflux pumps, may provide MDR to Gram-negative bacteria via de novo mutations that occur in the promoter region of the AcrAB (Hartog *et al.,* 2008), mutations that occur in regulators of the AcrAB efflux pump *marA* (Mcmurry *et al.,* 1998), *soxS* (Ruiz, and Levy, 2014) *rob* (Rosenberg, *et al*., 2003), and *acrR* (Olivia *et al.,* 2004) as well as mutations that affect the repressor *ramR* (Vidovic, An, Rendahl, 2019), (Udekwu *et al.,* 2007) of the AcrAB efflux. Efflux-pump associated mutations can not only lead to the development of MDR, but they can also cause a significant alteration in antibiotic susceptibility, developing a resistance to certain classes of antibiotics while conferring increased susceptibility to other classes of antibiotics (Blair *et al.,* 2015). It has been shown that de novo mutations simultaneously cause the overexpression of MDR pumps and significant down regulation of the major porins OmpF and OmpC (Vidovic, An, Rendahl, 2019), consequently leading to a reduced influx and an increased efflux of a mutated bacterial cell. In addition, decrease of porin-mediated permeability may occur during extracytoplasmic stress, via the $\sigma^E$ regulatory loop (Medihala *et al.,* 2018), which upregulates small regulatory RNAs, MicA, RybB, and MicL that consequently antagonize synthesis of outer membrane proteins (Guo *et al.,* 2014), (Papenfort *et al.,* 2006), (Udekwu *et al.,* 2007).

One of the adaptive strategies employed by prokaryotes during antimicrobial treatment is the development of the small colony variant (SCV), a phenotype characterized by a slow growth rate. It has been shown that the SCV-conferring mutations occur in a part of the genome that affects the electron transport and thymidine biosynthesis of bacteria (Von *et al.,* 2005), (Sadowska *et al.,* 2002) ultimately compromising ATP production and the electrochemical gradient across the cytoplasmic membrane (John *et al.,* 2015). These studies showed that the electron-transport an thymidinebiosynthesis defective SCVs mutants could be reversed to a normal (i.e., wild type) phenotype by supplementation with growth factors (i.e., menadione, hemin, and thymidine). The reversion of the SCV to a wild type phenotype by supplementation with growth factors clearly illustrates the auxotrophic nature of these SCV mutants. The acquisition of the SCV phenotype by pathogenic bacteria can have profound clinical consequences for an infected patient. The slow growth rate renders antibiotics less effective (Von *et al.,* 2005), promoting enhanced antimicrobial resistance among SCV bacteria, which often results in recurrent infections (Spanu *et al.,* 2005). In recent years, it has become clear that SCVs play an important role in the development of chronic and antibiotic resistant infections, further contributing to an increased mortality rate of patients affected by infectious diseases (Kahl, Becker, Loffer, 2016).

### *2.4.2 Horizontal Acquisition of Antimocrobial Resistance*

Unlike vertically acquired antimicrobial resistance, horizontal acquisition of antimicrobial resistance occurs via horizontal transfer (e.g., conjugation, transformation and transduction) of mobile antibiotic resistant genetic elements from a donor to a recipient bacterial cell. Plasmids and conjugative transposons (i.e., a small region of bacterial chromosome that encodes enzymes for its translocation) are common and important vehicles for intra and inter species or genera (Von Wintersdorff *et al.,* 2016) dissemination of antimicrobial resistance. The origins of antimicrobial resistant genes are commonly identified among different environmental bacterial genera including *Kluyvera* (Canton and Coque, 2006), *Shewanella* (Piorel *et al.,* 2012), and *Vibrionaceae* (Liard *et al.,* 2005). The horizontal acquisition of antimicrobial resistance provides an effective transfer of antimicrobial resistance traits from different ecological niches to the clinically relevant species that subsequently can result in the emergence of not only multidrug resistant strains, but even pan-drug resistant strains.

Another effective vehicle for horizontal transfer of antimicrobial resistance between various bacterial species, specifically between Gram-negative bacteria, are various types of integrons (Gillings, 2014). These genetic elements are gene acquisition platforms that contain three genetic features necessary for the proper function of any integron, (i) *intl* gene that encodes an integron integrase, (ii) an integron-associated recombination site, *attl*, and (iii) an integron-associated promoter, Pc (Curvy *et al.,* 2016). According to the literature, there are five classes of integrons that confer resistance to clinically relevant antibiotics (Gillings, 2014). The class 1 integrons are the most commonly found among clinical isolates, while classes 2 and 3 are also recovered from clinical isolates, albeit at lower frequencies compared to that for the class 1 integrons (Gillings, 2014). Another two classes of integrons, class 4 integrons are recovered from the human pathogen, *Vibrio cholera*, while class 5 integrons are found on the pRSV1 plasmid originated from *Alivibrio salmonicida* (Gillings, 2014). It has been estimated that these integrons carry about 130 different resistance gene cassettes, whose phylogeny and vast diversity indicate that these antibiotic resistance genes have been periodically captured from various genetic backgrounds (Partridge *et al.,* 2009). It is believed that integrons play a major role in the spread of antibiotic resistance worldwide (Gillings, 2014). Driven by strong selective pressure, it can be expected to see an emergence and spread of integrons that confer resistance to different classes of antibiotics, antiseptics, and other harsh chemicals.

### *2.4.3 Brief explanation of mechanism of vertical and horizontal transmission in bacteria.*

The mechanisms of vertical and horizontal transmission in bacteria are briefly explained below.

A. During replication, the bacteria can transfer a resistance gene contained in a plasmid from a parent cell to the next generation (vertical transmission).

B. The horizontal transmission in bacteria can be mediated by three principal mechanisms: transformation (uptake of the free DNA), transduction (virus-mediated gene transfer) and conjugation (transfer of DNA through a close contact between donor and recipient bacteria).

The two processes or pathways are summarised in Figure 1 below.

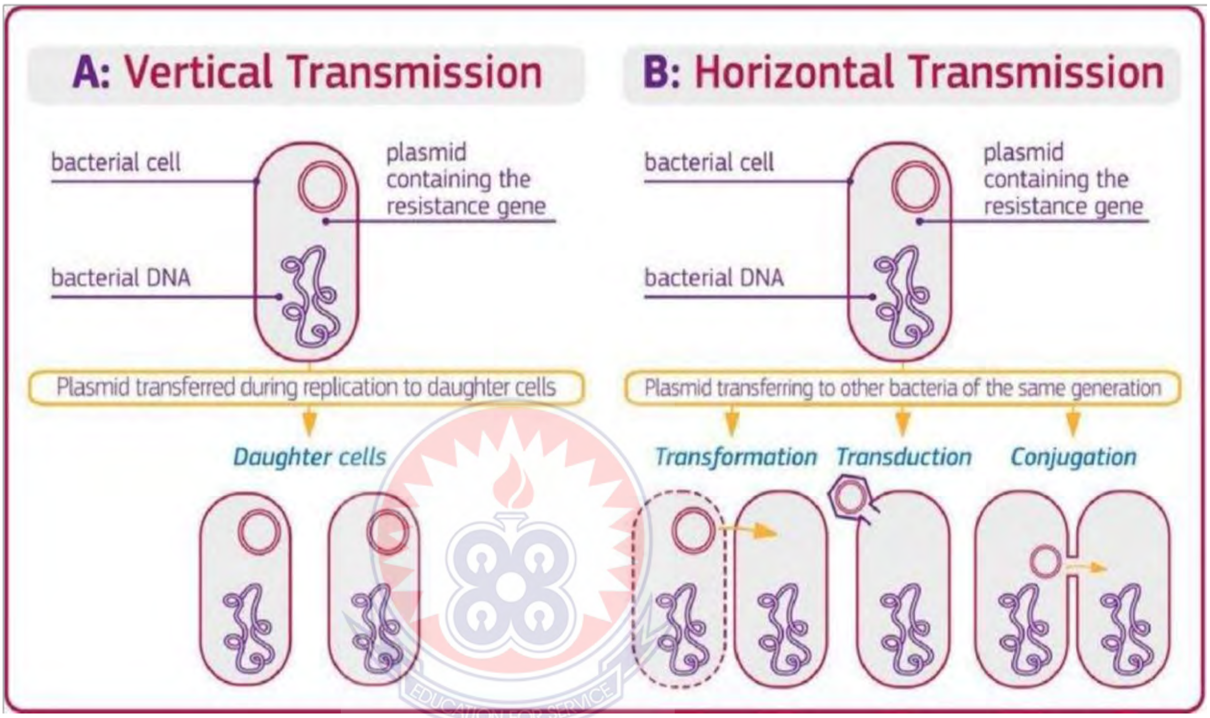



**Figure 2.1 Vertical and horizontal acquisition of antimicrobial resistance**

***SOURCE:*** *State of the Art on the Contribution of Water to Antimicrobial Resistance*

## 2.5 Antimicrobial Resistance Transmission Between Animals, Humans, and Environment.

Transmission routes of antimicrobial resistant bacteria to humans are often extremely complex and hard to predict. In general, there are two major routes; i) direct acquisition of antimicrobial resistance through contact with the food-producing animals or human carriers and ii) indirect acquisition of antimicrobial resistance through the food chain or via exposure to niches of high antimicrobial resistance pollution (e.g., hospitals, nosocomial acquisition, manure, waste water and agriculture land). Numerous studies, examining the transmission of antimicrobial resistant bacteria from animal to humans, reported the high prevalence rate of antimicrobial resistant bacteria among individuals that have a direct contact with animals, specifically farm workers [Nadimpalli *et al.,* 2008) and veterinarians (Jackson, Villarroel, 2012). Among the first authors, Levy and colleagues (Levy *et al.,* 1976) reported a direct transmission of multidrug resistant *E. coli* from animals to animals and also from animals to humans. This research group used *E. coli* strains that harbored R plasmid which expressed resistance to multiple families of antibiotics including chloramphenicol, tetracycline, sulphonamides and streptomycin. Once, multidrug resistant *E. coli* strains were introduced into the intestine of four chickens, and each infected chicken was caged with 50 uninfected chickens. In addition, two groups of chickens were fed on a tetracycline-supplemented feed, whereas another two groups of chickens were fed on antibiotic free feed.

The authors of this study found the multidrug resistant *E. coli* strain with the test R plasmid only in chickens that were fed on a tetracycline supplemented feed. Interestingly, over the duration of this experiment (e.g., a two month period), R plasmid was detected in the fecal samples of human individuals that worked or lived on this particular farm. The authors of this study clearly demonstrated the importance of the zoonotic transmission route in acquisition of antimicrobial resistant bacteria. This study also highlighted the importance of the use of antibiotics as growth promoters in the spread of multidrug resistant phenotypes. Besides the existence of selective pressure, the high densities of food-producing animals, living in close quarters to one another, may also significantly contribute to the dissemination of antimicrobial resistant bacteria. A research group (Vidovic and Korber, 2006) that examined the ecology of enterohemorrhagic *E. coli* in numerous feedlot operations observed a statistically significant ($p = 0.003$) positive correlation between the density of cattle and the prevalence rate of this zoonotic pathogen. Taken together, it can be assumed that the use of antibiotics in agriculture, specifically the massive use of antibiotics for growth promotion, can lead to the emergence of antibiotic resistant bacteria. Once antibiotic resistant bacteria emerged among the food-producing animals, this phenotypic trait will be preserved by the same selective pressure and quickly spread to other animals and humans due to the high conductivity of such environments (e.g., high animal densities in the confide areas [feedlots and barns]).

Indirect acquisition of antimicrobial resistant bacteria is usually more complex compared to direct acquisition. It is known that a considerable amount of antibiotics used in agriculture, human and animal medicine reaches the environment in their active forms (Thanner, Drissner, Walsh, 2016). Subsequently, the presence of active antibiotic compounds in the environment imposes a selective pressure that may result in the emergence of antibiotic resistant phenotypes among various microbial species that naturally occupy this niche. If the antibiotic resistance phenotype emerges on a mobile genetic element, it can be horizontally transmitted to human, animal or zoonotic pathogens, which may pose a considerable public health threat. This environmental transmission route has been well documented. For instance, the origin of the $bla_{CTX}$M genes, which are a clinically important culprit of antibiotic treatment failures, emerged from environmental Gram-negative bacteria *Kluyvera* spp. (Canon and Coque, 2006).

Also, the OXA-48-type carbapenem-hydrolyzing β-lactamase genes, an important cause of antimicrobial treatment failures as well, originated from the marine bacteria family *Shewanellaceae* (Poirel, Potron, Nordmann, 2005). Aerosols generated from areas of high antimicrobial resistance pollution represent another important vehicle that can indirectly transmit antimicrobial resistant bacteria to humans, animals and the environment in general. More evidence of the spread of antimicrobial resistance to humans through animals/ food is listed in Table 2.1.

**Table 2.1: Evidence of antibiotic resistance transmitted to humans from Animals/Food.**

| Species tracked | Animal/Food | Resistance | Evidence | Reference |
|---|---|---|---|---|
| *E. coli* | U.S. chickens | Tetracycline | Antibiotic-resistant strains of *E. coli* with transferable plasmids were found in the caretakers' gut flora when tetracycline was introduced in the farm. | (Levy, 1976) |
| Carbapenemase producing *E. coli/Klebsiella pneumoniae* (CPE/K) | Cambodia swine, Poultry | MDR | Same ESBL genes and mcr1/2 were detected in humans and livestock. | (Atterby *et al.,*2019) |
| MRSA | Greece raw milk, cattle, sheep and goat | MDR | Presence of *mecA* gene in the farmer was strongly associated with greater intensity of animal contact | (Papadopoulos *et al.,* 2019) |

| | | | | | |
|---|---|---|---|---|---|
| MRSA MRSA ST398 | ST93 | Australian swine | MDR | Resistant strains were detected from farm workers, pigs, and farm | (Abraham *et al.,* 2017) |
| *E. coli* | | Chinese swine, chicken | Apramycin | Detection of aac(3)-IV apramycin resistance gene in humans, with 99.3% homology to that in animal strains. | (Zhang, 2009) |
| *E. coli* | | Spanish chicken | Ciprofloxacin | Certain resistant human isolates closely resembled chicken isolates by RAPD and PFGE analysis. | (Johnson *et al.,* 2006) |
| Nalidixic acid resistant *Salmonella* | | Cauca chicken sandwich | Ciprofloxacin | Phenotypic and genotypic analyses confirmed the association | (Diaz *et al.,* 2011) |

| | | | | |
|---|---|---|---|---|
| | | | between bacteria isolated from patients and food. | |
| Salmonella | Chinese pork | MDR | People mcr-1-positive strains were clustered together with the pork strains. | (Zeng, 2019) |
| *E. coli, Klebsiella pneumonia* | Algerian sandwich | MDR | ESBLs/AmpC are a source of direct transfer to the human gut. | (Haenni, 2017) |
| *E. coli* | Turkey chicken, and beef retail meats | Cefuroxime, nalidixic acid, tetracycline, streptomycin, trimethoprim sulfamethoxazole | Food was seriously contaminated by ESBLs strains, which poses high risks to human health. | (Pehlivanlar, 2015) |

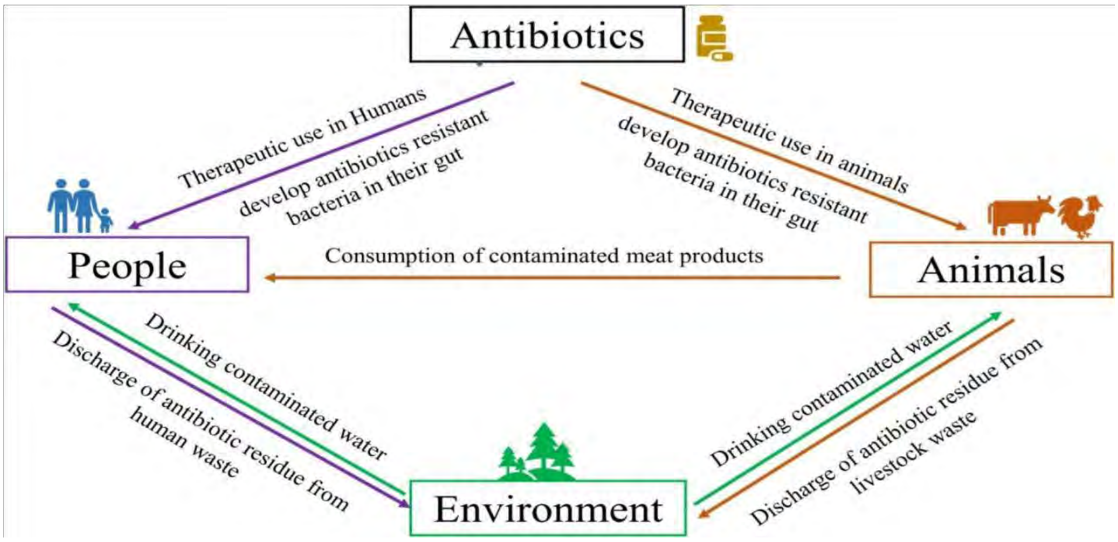



***Figure 2.2 Mechanism of antibiotic resistance transmission***

**SOURCE**: Antibiotic Resistance Threats in the United States, (2013).

### 2.6 Preventive Strategies to Combat Antimicrobial Resistance

Several countries have restricted or banned the use of antimicrobials in food animals as growth promoters. One of the first bans on AGP use was imposed on tetracycline by the European Common Market in the mid-1970s (Castanon, 2007). After the ban on incorporation of tetracycline in animal feeds for nutritive purposes, the proportion of tetracycline-resistant strains in pigs and human subjects declined (Van Leeuwen, 1986). In 1997, the EU banned all agricultural use of avoparcin due to the prevalence of vancomycin-resistant Enterococcus (VRE) in patients in Europe. Later in 1999, the EU imposed a ban on the use of bacitracin, spiramycin, tylosin, and virginiamycin as AGPs because they were also used in human medicine. By 2006, the EU has banned all AGPs (European Commission, 2019). In the mid-1990s, increased virginiamycin use in broilers was correlated with a rise in resistant *E. faecium* prevalence, from 27% to 70%.

Following the 1995 ban on avoparcin, several surveys found that VRE incidences in Denmark declined, from 73%–80% to 5%–6% (Bager *et al.,* 2001). The FAO, the World organization for Animal Health (OIE), and WHO are cooperating to control antimicrobial use in animals (Maron, 2013). Global monitoring systems such as the National Antimicrobial Resistance Monitoring System (NARMS) for Enteric Bacteria and the European Antimicrobial Resistance Surveillance Network are making efforts to collect information on antimicrobial consumption and antimicrobial resistance (Grundmann *et al.,* 2011). The theme for World Health Day 2011 was "combating drug resistance: no action today, no cure tomorrow," which was meant to urge all countries around the world to take more proactive steps against bacterial resistance. Further, in the World Health Assembly 2015, a global action plan was adopted to tackle antimicrobial resistance. Moreover, the 2016 UN High-Level Meeting on antimicrobial resistance and the G20 Summit in Hangzhou have made strong commitments to control antimicrobial resistance (Qu *et al.,* 2019).

Conclusively, antimicrobial resistance is a global public health concern. The use of antimicrobials is a powerful selector for resistance (Acar, 2012). Accumulating evidence suggest that the misuse and overuse of antibiotics in animals are major contributors to antimicrobial resistance. To mitigate the issue, AGPs should be banned, and guidelines need to be established for using antimicrobials in animals for treatment. By improving animal health conditions and finding the reasonable ways to treat animals for pain, economic losses can be reduced. However, in most cases, veterinary antibiotics need to be used rationally through therapeutic preventive measures to reduce the misuse. Integrated farming groups should reduce the use of antimicrobials by using vaccines, veterinary herbal medicine, enzyme preparations and other means. The state should strengthen supervision over the production, distribution, and use of antimicrobials and support the development of new antibiotics. Simultaneously, regular training on the rational use of antimicrobials, enhancement of antimicrobial stewardship, and strict infection control measures are also needed. In particular, reduce the use of unnecessary antimicrobial agents may help prevent the emergence and spread of drug resistant bacteria. Last but not least, the use of alternatives to antimicrobials have been extensively studied and some of them have been found to be useful (Pearlin, 2020), and may promote the animal breeding industry.

## 2.7 Animal Production

Animal production contributes positively and significantly to household income, family nutrition and manure to farmers (Birthal, 2015) in Ghana especially in the two study areas. The author also found that animal production contribute to employment and reduces the uncertainties in the food crop sub-sector. Also, animal production play a socio-cultural function and prestige are attached to the number of livestock owned (Adams *et al.,* 2014 and Bettencourt *et al*., 2015). Animal production makes a significant contribution to most economies (Bettencourt *et al*., 2015). The incorporation of crops and livestock schemes can offer some significance sustainable benefits for the farmer through nutrient utilization and adding economic worth to the structure by grazing on crop remains which would otherwise be underutilized (Mansoor, 2011). Furthermore, animal production offers an enticement to plant nitrogen-fixing crops or forages which function to increase soil fertility and reduce soil erosion. The significant contribution of animal production to the traditional sector adds to countryside standard of living and mainly the deprived are more recognized (Mude, 2009 and upton *et al.,* 2004). According to Organization for Economic Co-operation and Development (OECD) (2010), investment in livestock sector can reduce poverty and increase food security as well as ignite economic growth through consumption and production spill-over effects. Livestock has been well understood by Ghanaians as a major venture that helps the poor individuals to improve their livelihood (Alvary *et al.,* 2011 and Bashir *et al.,* 2012).

# CHAPTER THREE

## 3.0 METHODOLOGY

### 3.1. Introduction

This chapter deals with the research methodology employed in gathering information for the study. The study area, the population and sampling procedures as well as the instruments used in collecting the data are all described. The research was started March, 2021 and ended in December, 2021.

### 3.2 The Study Area

The researcher carried out this study in two regions. These are Upper East Region of Ghana and Western Region of Ghana.

#### *3.2.1 Upper East Region*

Upper East Region is located in the north east part of Ghana and is the ninth ($9^{th}$) smallest region among the sixteen (16) administrative regions in Ghana. The Region occupies a total land surface of eight thousand, eight hundred and forty-two (8,842) square kilometers or 2.7 percent of the total land area of Ghana with a population of 1,301,221, representing 4.2% of the total population of the country (GSS, 2021). The Upper East Regional capital is Bolgatanga, sometimes referred to as Bolga. Other major towns in the region include; Navrongo, Paga, Bawku, Zebilla and Sandema. The region shares boundaries with Burkina Faso to the north, Togo to the East, Upper West Region to the west and Northern Region to the south. The soil in this region is developed from granite, which is generally low in fertility. The annual mean rainfall falls between 800 mm and 1100 mm. The Region is characterized by uni-modal rainfall regime, which usually begins in May and ends in

September. The predominant occupation of the people is agriculture employing over 80% of the population, and the main crops they cultivate are millet, groundnut, maize, beans, rice, onions and sorghum. The region is known for the production of animals such as poultry and other ruminant animals. Most of the farmers practice semiintensive method of keeping their animals.

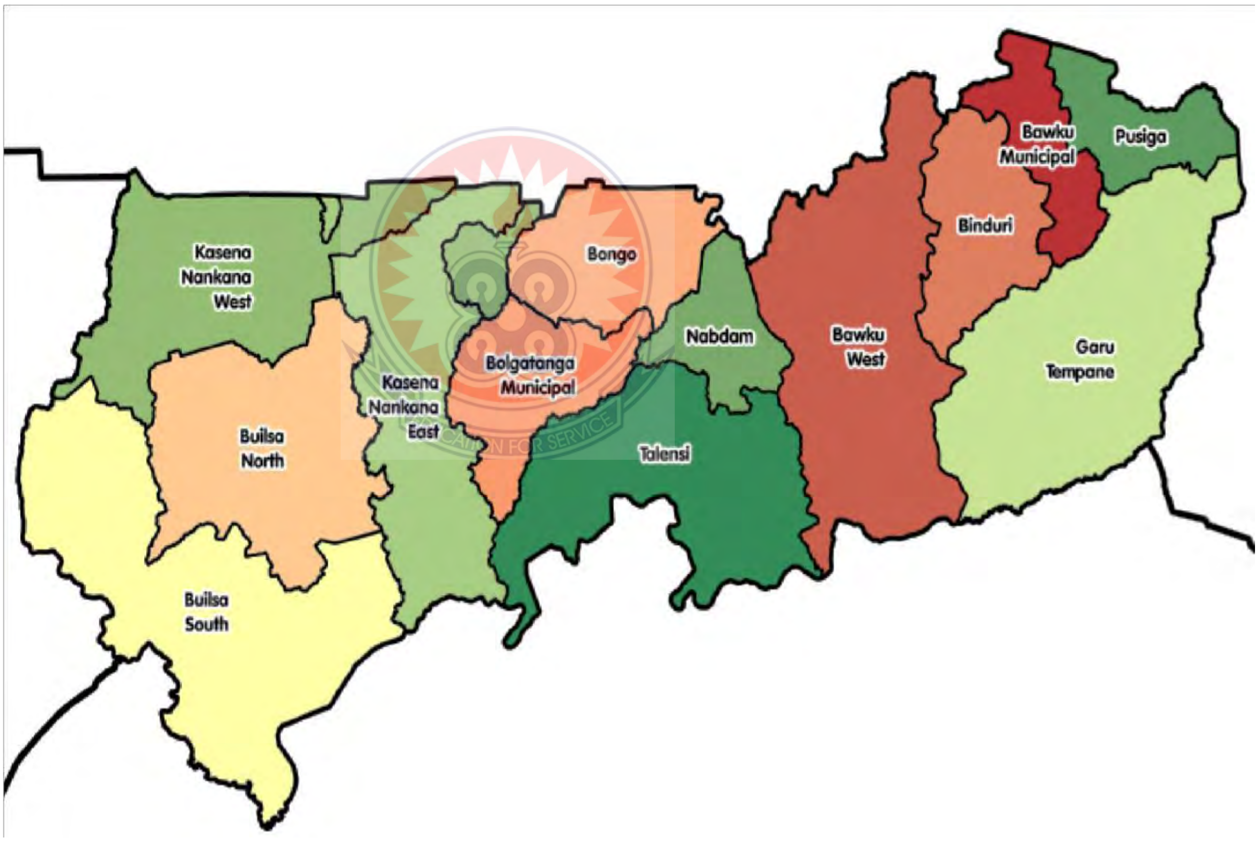



**Figure 3.1 Map of Upper East Region of Ghana**

***SOURCE***: *https://www.resaerchgate.net*

### *3.2.2 Economic activities in the region*

Agriculture is the main activity in the region. Most of the government workers in the region are teachers and health workers. Farmers in the region keep poultry but it is done on a minor scale but livestock production especially sheep and goats are basically reared but on free range system of management.

The major food crops that cultivated in the region are: maize, cowpea, millet, groundnut, sorghum, rice and Bambara beans. These crops are cultivated for subsistence basis. The surplus is being sold out to earn some money to buy family needs and pay school fees of wards.

#### *3.2.3 Western Region*

The Western Region is located in South Ghana, spreads from the Ivory Coast in the West to the Central Region in the East, and includes the capital and large twin of Sekondi-Takoradi on the Coast, Coastal Axim, and a hilly inland area including Elubo. The region covers an area of 23,921 square kilometers, and had a population of 2,057,225 (G.S.S.,2021). Before the regional demarcation in December 2018, (Kaledzi, 2019), the region had twenty-three (23) Metropolitan, Municipal and District Assemblies. Therefore, as part of this reorganization, nine MMDA"s were removed from the Western Region and formed into a new Western North Region with its new capital at Wiaso (Kaledzi, 2019). The list of MMDAs in the Western Region are, Wassa East District, Shama District, Mpohor District, Sekondi-Takoradi Meteropolitan, Effia-Kwesimintsim District, Essikado-Keten Municipal, Tarkwa-Nsuaem, Prestea-Huni Valley Municipal, Ahanta West Municipal, Ellembele District, Jomoro Municipal, Nzema East Municipal, Wassa Amenfi West Municipal, Wassa Amenfi District. With respect to vegetation, the region has about 75% of its vegetation within the highest zone of Ghana and lies in the equatorial climate zone that is characterized by moderate temperatures. It is the wettest part of Ghana with an average rainfall of 1600 mm per annum.


**Figure 3.2: Map of Western Region of Ghana 4**

***SOURCE***: *https://www.resaerchgate.net*

### *3.2.4 Economic activities*

The region is endowed with considerable natural resources which give it a significant economic importance within the context of national development. It is the longest producer of cocoa, rubber, coconut and one of the major producers of oil palm. As a top-up, the discovery of oil in commercial quantities of which drilling has started. The rich tropical forest makes it one of the largest producers of raw and sawn timbers as well as processed wood products. A wide variety of minerals, including gold, bauxite, iron, diamond and manganese are either being exploited or are potentially exploitable.

### 3.3 Population and Sampling Procedure in the Western Region and Upper East Region of Ghana

In the Western Region, multi-stage sampling was employed in the study. There are fifteen MMDAs in the Western Region of Ghana. Due to large number of districts and municipals in the region, the researcher put them into four (4) zones depending on the closeness of the districts or municipals. In each district, a simple random sampling technique was used to select animal farmers. However, in some districts, due to a smaller number of animal farmers, the researcher administered the questionnaire to all the farmers seen. In districts or municipals where there are many farmers, simple probability sampling technique was employed in sampling some animal farmers who use antibiotics in managing their animals. Hence, the total sample in the western region was hundred (100). However, in the Upper the same multi-stage sampling was used. There are three (3)municipals and eleven (11) districts in the Upper East Region of Ghana. Though, the districts and municipals are not numerous, the researcher categorized them into three zones base on proximity. Due to a smaller number of poultry farmers in the region, all farmers identified for keeping poultry were selected and the researcher administered the research questionnaire. The total sample in the Upper East Region was fifty (50). In sum, one hundred and forty (150) farmers from the two regions were sampled in the study as respondents.

### 3.4. Methods of Data Collection

A structured questionnaire was designed to obtain information on background of farmers, types of animals kept, production scale and stock level, types of antibiotics used, reason (s) for using the antibiotics, effectiveness of antibiotics used on the farm, ways of disposing off poultry droppings, use of footbaths on the farm, clothing use by farmer on the farm were all probed using the questionnaire. Google platform was also created to assist in the collection of the data. This became necessary since it was difficult to reach some of the farmers who were identified poultry farmers. Therefore, the major tools used to collect the data were questionnaires and google platform.

### 3.5 Data Entry and Analysis

I. The data collected were coded and entered into Microsoft excel and analyzed with statistical package for social scientists (SPSS, 2017, Version 25).

II. Frequencies and percentages presented using tables, graphs, bar charts and pie charts were used to analyze the entire data.

# CHAPTER FOUR

## 4.0 RESULTS AND DISCUSSIONS

This chapter displays the results of the study conducted in Western Region of Ghana.

### 4.1 Districts and Respondents

Table 4.1 displays the districts and municipals in the two selected regions of Ghana (Western Region and Upper East Region) used in the research.

**Table 4.1: Districts and Respondents in Western Region**

| District | Number | Percentage |
|---|---|---|
| Tarkwa Nsuaem Municipal | 15 | 15.0 |
| Prestea Huni Valley Municipal | 7 | 7.0 |
| Ahanta West | 8 | 8.0 |
| Wassa East | 7 | 7.0 |
| Shama | 10 | 10.0 |
| Mpohor Wassa East | 7 | 7.0 |
| Sekondi Metro | 15 | 15.0 |
| Kwesimintim | 7 | 7.0 |
| Essikado Municipal | 7 | 7.0 |
| Ellembelle | 7 | 7.0 |
| Amenfi Central | 1 | 1.0 |
| Amenfi East | 3 | 3.0 |
| Amenfi West | 6 | 6.0 |
| **Total** | **100** | **100.0** |

**Table 4.2: Districts and Respondents in Upper East Region**

| District | Number | Percentage |
|---|---|---|
| Kassena Nankana West | 6 | 12.0 |
| Kassena Nankana Municipal | 12 | 24.0 |
| Builsa North | 3 | 6.0 |
| Bolga Municipal | 14 | 28.0 |
| Talensi | 3 | 6.0 |
| Bawku west | 5 | 10.0 |
| Bawku municipal | 7 | 14.0 |
| **Total** | **50** | **100.0** |

The total numbers of respondents were obtained from thirteen (13) districts in the Western Region while in the Upper East Region, the number of respondents were obtained from seven districts out of 14 districts. The respondents were cut across most of the districts in each of the regions to ensure that responses from the regions reflect the actual situation in the regions. From the Western Region, 15 respondents each were drawn from 2 districts, 7 respondents from 6 districts, 8 respondents also drawn from 1 district and 10 respondents from 2 districts. In the Upper East Region, 7 out of 15 districts were used in the research. 12 respondents from 1 district, 6 respondents from 1 district, 14 particicpants also from 1 district, 3 respondents from 2 districts, 5 respondents were selected from 1 district and finally, 7 respondents from 1 district. The number of respondents per districts in all the two regions are shown in the Tables 4.1 and 4.2. It could be observed that few of the districts in the region had little or no poultry farms especially in the Upper East Region, with those having poultry farms are done small scale.

### 4.2 Bio-Data of Respondents

Table 4.3 represents the Bio-Data of the various respondents used in the research.

**Table 4.3: Bio-data of respondents**

**WESTERN REGION**

| Bio data | Frequency | Percentage |
|---|---|---|
| **Age Cohort** | | |
| 26-30 4 | 4 | 4 |
| 31-35 29 | 29 | 29 |
| 36-45 51 | 51 | 51 |
| 46 and above | 16 | 16 |
| **Gender** | | |
| Female | 11 | 11 |
| Male | 89 | 89 |
| **Marital Status** | **Marital Status** | |
| Divorce | 11 | 11 |
| Married | 78 | 78 |
| Single | 11 | 11 |
| **Educational Qualification** | | |
| J.H.S/Middle | 33 | 33 |
| Secondary | 39 | 39 |
| Tertiary | 28 | 28 |

| Bio data | Frequency | Percentage |
|---|---|---|
| | **Age Cohort** | |
| 26-30 | 2 | 4 |
| 31-35 | 16 | 32 |
| 36-45 | 25 | 50 |
| 46 and above | 7 | 14 |
| **Gender** | | |
| Female | | |
| | 4 | 8 |
| Male | 46 | 92 |
| Divorce | 36 | 72 |
| Married | 36 | 72 |
| Single | 9 | 18 |
| **Educational Qualification** | | |
| J.H.S/Middle | 19 | 26 |
| Secondary | 18 | 36 |
| Tertiary | 13 | 38 |

It could be observed from Table 4.3 that, 89 respondents from Western Region were males and only 11 were females while in the Upper East Region, 46 of the participants were males and 4 were females. A probable reason for small number of the female respondents in the two Regions could be the intensive care that is attached to these animals aside that, most of the women prefer going into trading rather than rearing. Also, the small number of females could be related to the traditional belief that women in this part of the country, most especially in the Upper East Region are not property owners. Another reason could be that, poultry rearing is perceived to be the responsibility of only men since they have to provide care, protection, and food for the family. This could also be attributed to the fact that most women are doing various kinds of businesses and with the few who engage in any form of agriculture, it was mainly crop production as compared to animal production.

Tables 4.3 further shows that the youth with age ranging from 36-45 representing 51% of the total respondents in the Western Region were actively involved in poultry production while in the Upper East Region, 25 respondents fall in the age range of 3645 and 7 respondents, 46 years and above. Few aged, 46 and above involved in animals rearing depicts the level if difficulty in keeping these animals, especially when it comes to husbandry management activities such as provision of water, feed, removal of litter etc. In most recent times, due to the difficulty of obtaining white-collar jobs the youth rather prefer to engage themselves in rearing of poultry instead of being ideal with a long hope of getting permanent employment from the government. This resulted in high number of the youth engaged in rearing based on the research gathered from the study.

The results from the Western Region also found most respondents to be married (78 respondents) as against 11 respondents that were single, likewise, divource while in the Upper East Region, 46 out of 50 respondents were married and 4 divorce while 9 were single. Logically, the number of respondents who divource will obviously affect their production in terms of labour.

Significant proportion of the respondents (39%) in the Western Region obtained secondary education while 33% had JHS/middle education. 28% had education up to tertiary. But in the Upper East Region, 19 respondents are educated up to JHS/middle, while 18 respondents obtained secondary education. A small number of 13 respondents had tertiary education. From the results above, Western Region had a better number of respondents who obtained secondary and tertiary education hence will be able to read inscriptions on drugs label. Access to formal education is an important determinant of livestock production technology adaptation (Zipora *et al.,* 2011; Sezgin *et al*., 2011) to the extent that it has a positive influence on technology adaptation.

**4.3 Types of Animals Kept by Farmers**

Table 4.4 represents the various types of animals kept by the respondents in Western and Upper East Regions.

**Table 4.4: Shows the types of animals kept by farmers**

**WESTERN REGION**

| Animal | Frequency | Percentage |
|---|---|---|
| Chicks | 96 | 96 |
| Ducks | 3 | 3 |
| Guinea Fowl | 1 | 1 |
| **Grand Total** | **100** | **100** |

**UPPER EAST REGION**

| Animal | Frequency | Percentage |
|---|---|---|
| Chicks | 30 | 60.0 |
| Ducks | 1 | 2.0 |
| Guinea Fowl | 17 | 34.0 |
| Turkey | 2 | 4.0 |
| **Grand Total** | **50** | **100.0** |

It is undeniable fact that ruminant production in the southern part of Ghana is problematic. This is as a result of inadequate space and acquisition of land as well as management system of these animals. The situation in the Western Region is not different as a very significant number of the respondents representing 96% are into poultry production, rearing mainly chickens while 3% rear ducks and only 1% rearing Guinea fowl. However, the situation in the Upper East Region is quite different as 30 respondents rear chickens against a significant number of 17 respondents rearing Guinea fowl. 1 respondent rears ducks while 2 rear Turkey. The possible reason for the few number of respondents rearing Guinea fowl in the

Western Region could be the fact that these birds are wild and difficult to make them become docile. The respondents confirmed that rearing chickens is very easy because management system is quite easy than other birds like Guinea fowls. Guinea fowl in the Upper East Region play a very significant role in the traditional make up. This is because Guinea fowl is used as bride price in almost every community. As a result, it has become a norm that every family has a number of Guinea fowl.

## 4.4 Production Scale of Farmers in the Western and Upper East Regions of Ghana.

Figure 4.1 represents production scale of respondents.

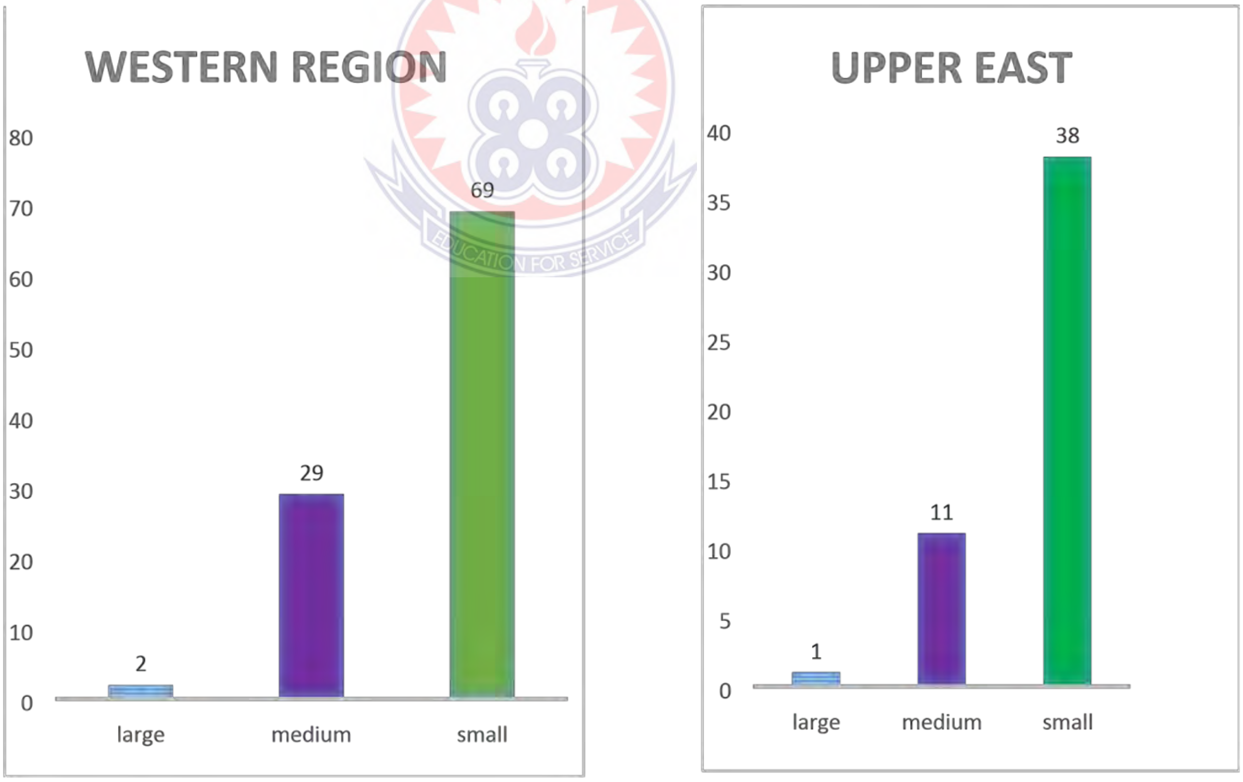



**Figure 4.1: Production scale of farmers**

As population is gradually increasing, raising livestock on a large scale will help meet the nutritional needs of the large growing population. It is rather unfortunate that most farmers keep their animals especially poultry on a small scale. This smallscale farming could be as a result of unavailability of lands, low or inadequate capital, high level of disease outbreak, high cost of production and acquiring starters. Brempong (2003) enumerated the same reasons above as why most farmers engaged in small scale rearing. It was observed from the research that most of the farmers engaged in small scale farming which could backed by reasons enumerated by Brempong (2003). There is no significant difference in the responses gathered from the two regions.

While in the Western Region, a meaningful number of 69 respondents out of 100 rear their animals in a small scale against 38 respondents out of 50 in the Upper East Region. 29 respondents out of 100 in the Western Region rear their animals in a medium scale against 11 respondents out of 50 in the Upper East Region who also keep their animals in medium scale. In the Western Region, only 2 respondents have a large scale animals and in the Upper East, also just 1 respondent. This indeed, is a worrying situation as it defines the profit margin of farmers towards embarking on other productive ventures. Andy (2004), categorically stated that farmers have to engage in large scale production since that can reflects in high income level of the farmers.

### *4.4.1 Stock Levels of Farmers in Western and Upper East Regions*

Figure 4.2 represents the stock levels of respondents used in the research

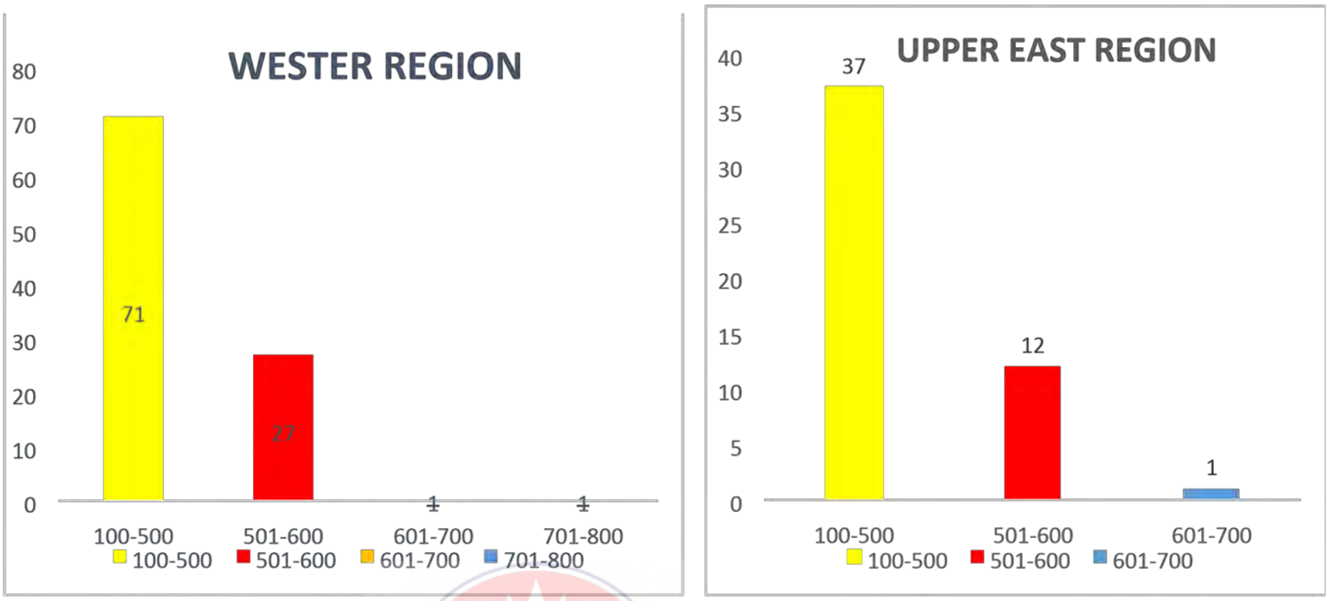



**Figure 4.2: Stock levels of Farmers**

During periods of insufficient crop production, livestock mainly small ruminants and poultry become the main source of food and income for the household (Appraisal Report, 2001). The report also suggested that small ruminants and poultry acts as bank and insurance in times of agent financial needs since it generate immediate cash income to the farmer. Brempong (2003) says small stock level is due to low level of income, high cost of feed, cost of acquiring starters. The responses from the two regions confirm all these ideas as most of the farmers engaged in rearing few animals which threatens the availability of food in the country. According to the research, 71 respondents from the Western Region keep animals from 100-500, 27 respondents keep 501-600 animals with a mica number of 2 respondent keeping animals ranging from 601-700 and 701-800 respectively. In the Upper East Region, 37 out of 50 respondents keep animals ranging from

100-500 and 12 respondents keeping 501-600 animals while only 1 respondent keeps 601-700 animals.

### 4.5 The Use of Antibiotics on Farm in Western and Upper East Regions.

Figure 4.3 represents the number of respondents that use antibiotics on farms.

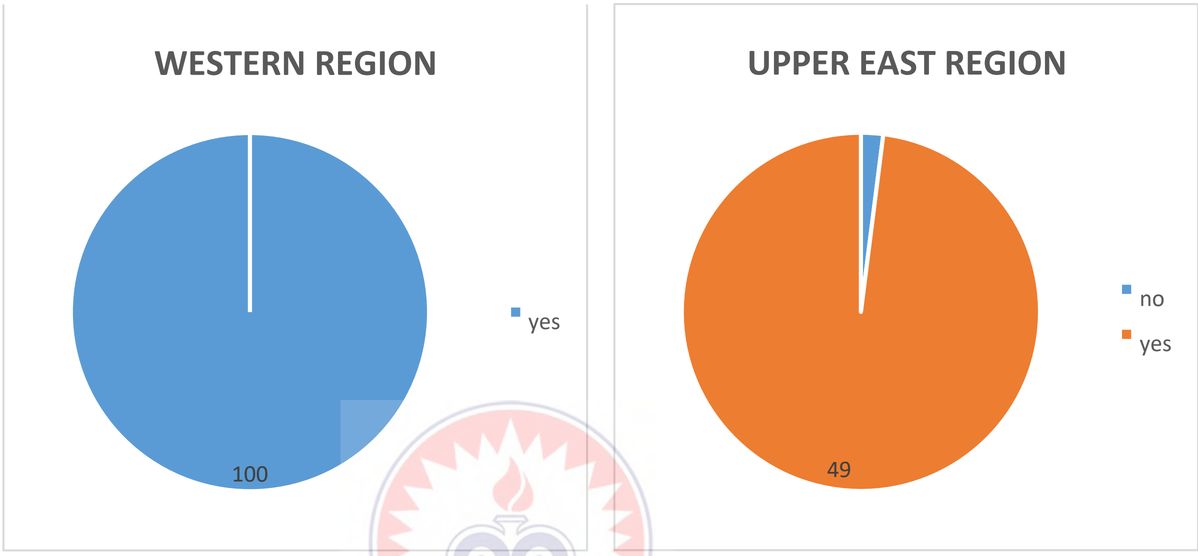



**Figure 4.3: Antibiotics used on farm animals**

Antibiotics are medications that destroy or slow down the growth of bacteria and hence, increase in production (Nordquist, 2018). These antibiotics can also cause a decrease in production since microorganisms can resist the killing effect of these antibiotics to which it was normally susceptible (Madgan, 2014). The response gathered from the field indicate that all the farmers from the Western and Upper East Regions of Ghana use antibiotics in keeping their animals. This is probably the believed that antibiotics help increase in production (Nordquist, 2018).

### *4.5.1 Types of antibiotics used by farmers in the western and upper east regions.*

Figure 4.4 represents the types of antibiotics used by respondents.

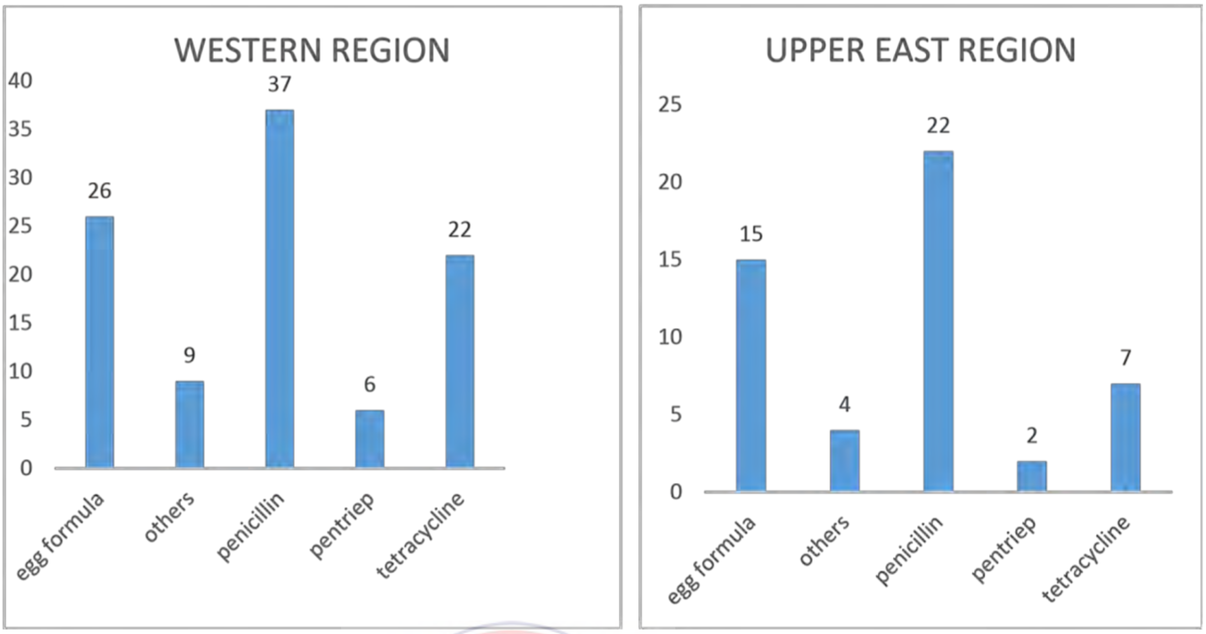



**Figure 4.4: Types of antibiotics used**

The types of antibiotics used by farmers largely depend on the availability in the market or largely depend on those that are commonly known to the farmers, as well as those they can easily afford. According to the responses gathered from the research, Various types of common antibiotics are used. Penicillin recorded the highest (37%) in terms of number of farmers using it in the Western Region, followed by egg formula of 26%. From figure 4.4, tetracycline recorded 22% as the third highest antibiotic used by. Other antibiotics such as Mariceryl, multiamino-M, antibact 3x etc are being used by 9 respondents. The Types of antibiotics used in the farms in the Upper East Region is not different from those that farmers used in the Western, according to the responses from the Upper East Region represented in the Figure 4.4, 22 respondents use penicillin against 15 responses as number of farmers who used egg formula.

Tetracycline again obtained the third highest antibiotic used by farmers. The least antibiotic used by farmers in the two regions was penstrep which recorded 2 responses. As a result of high prevalence and wild use of penicillin, it is highly possible that antimicrobial resistance could come from penicillin and tetracycline which is also a component of egg formula.

### *4.5.2 Purpose for the use of antibiotics in Western and Upper East Regions.*

Figure 4.5: represents the purpose for the use of antibiotics on farms

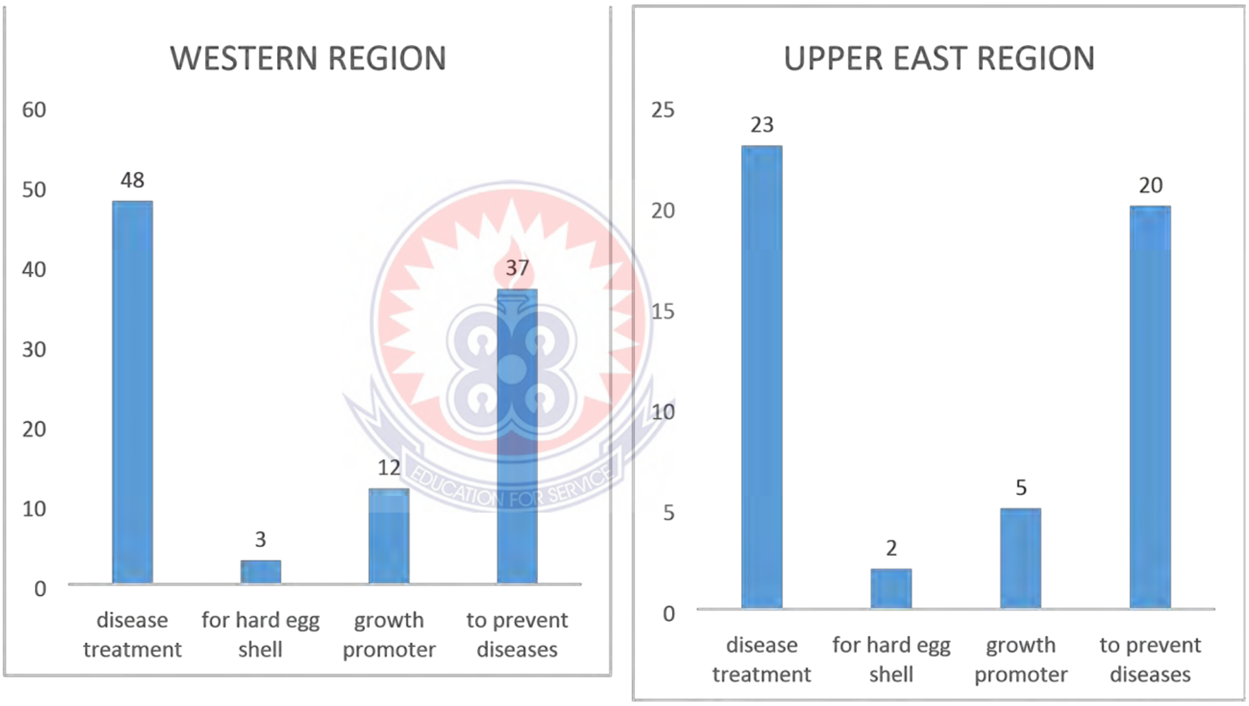



**Figure 4.5: Purpose for using antibiotics**

Antibiotics used in farm animals are very important as far as meeting the nutritional needs of the growing population is concern. Antibiotics are used to ensure fast growth of animals, prevention of diseases, and treatment of diseases. Though, antibiotics help increase production, research have also shown that these antibiotics used for farm animals have been correlated to the emergence and spread of antibiotic resistance worldwide (Drlica *et al.,* 2009). According responses gathered from famers in the Western Region, 48 and 37 farmers use antibiotics to treat diseases and prevent diseases respectively. 12 of the respondents indicated using antibiotics as growth promoter and 3 farmers use antibiotics for hard egg shell. The case is not different in the Upper East Region as 23 respondents use antibiotics to treat diseases in animals and 20 respondents use the antibiotics to prevent diseases. 5 respondents use antibiotics as growth promoter and 2 respondents use for hard egg shell.

### *4.5.3 Outlets for antibiotics acquisition in Western and Upper East Regions.*

Figure 4.6 represents the various outlets of antibiotics acquisition by respondents.

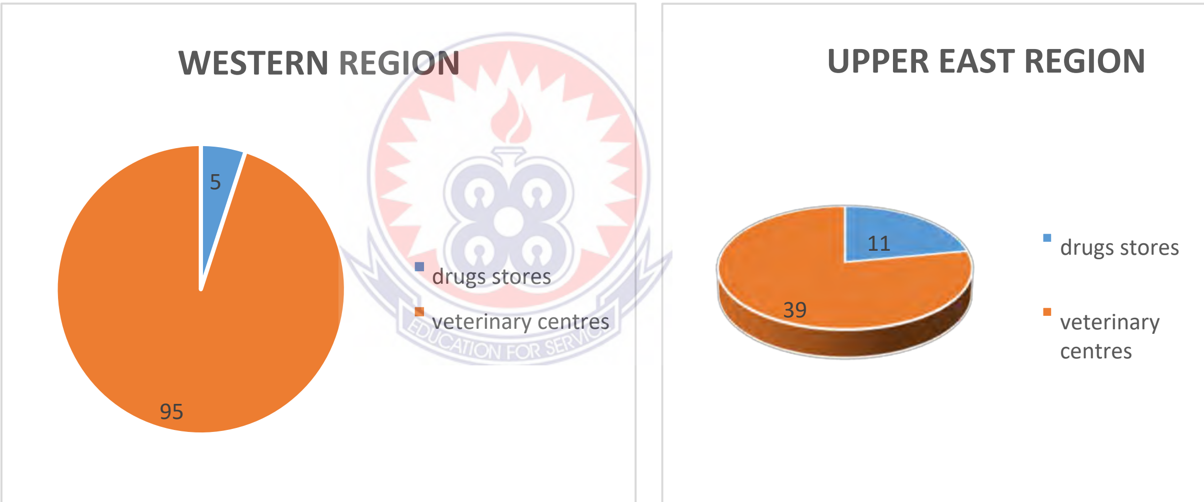



**Figure 4.6: Outlets for the acquisition of antibiotics**

From Figure 4.6, the total numbers of respondents in the Western Region who purchase their antibiotics from veterinary stores are 95 while 5 respondents purchase their antibiotics from drug stores. In the Upper East Region, 39 respondents also obtain their antibiotics in veterinary centres against 11 respondents who purchase from drug stores. Despite the fact that the number of respondents who purchased their antibiotics from veterinary stores is a bid encouraging, there is still the need to educate farmers to patronise veterinary centres as the best venues to purchase antibiotics as well as obtaining better information on the health of their animals. It is worth knowing that drug stores are purposely for the sale of medicines meant for humans. Therefore, antibiotics bought at drug stores may rather pose negative effects on animals due to the chemical composition of such antibiotics and will be more likely to cause antimicrobial resistance among animals.

### *4.5.4 Determination of dosage of antibiotics to animals in Western and Upper East Regions.*

Figure 4.7 represents how dosage is determined by respondents when administering antibiotics.

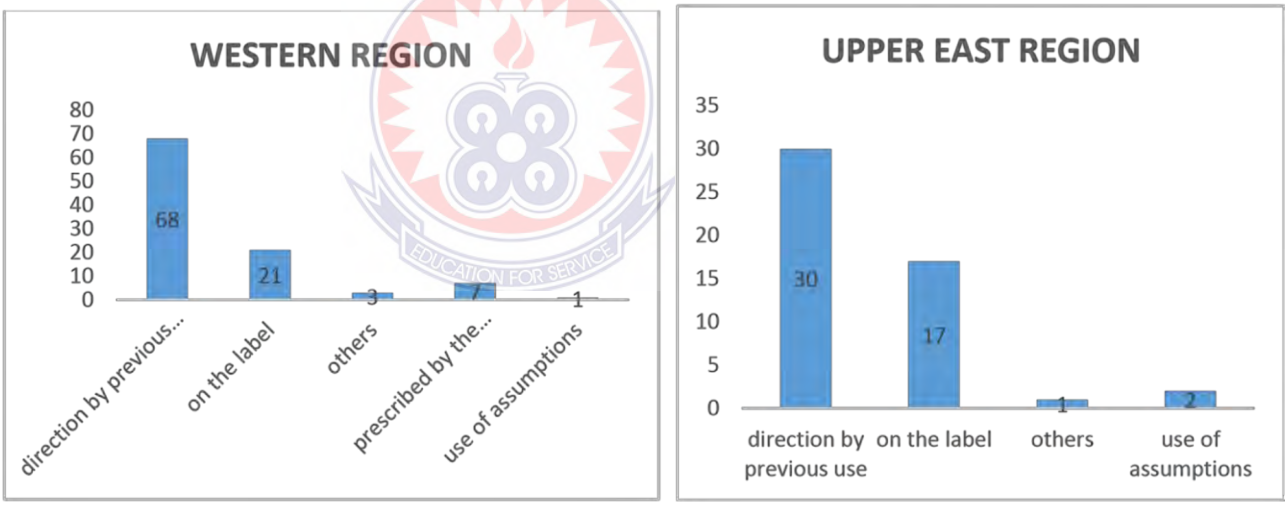



**Figure 4.7: Determination of dosage of antibiotics**

Per the responses gathered from the research shown in Figure 4.7, 66 farmers in the Western Region administer the antibiotics based on direction of previous use of the antibiotics. 19 respondents rely on the inscription on the label of the respective antibiotic. 7 respondents also adhered to prescription by the seller while 1 respondent use his/her own assumption in administering the antibiotics. In the Upper East Region, 30 respondents administer antibiotics based on direction used previously while 17 respondents usually use the prescription on the label. 2 respondents use their own discretion to administer the antibiotics. Andy (2004), suggested that farmers who seek advices from veterinary officers have high possibility of keeping their animals safe.

Andy‟s suggestion meant that, veterinary advices on medication and other management practices are very imperative. When farmers stick to using their own prescription in administering antibiotics, the likelihood of antimicrobial resistance will be very high.

### 4.6 Prevalence of Poultry Diseases in Western and Upper East Regions

Table 4.5 represents prevalence of poultry diseases in two regions

**Table 4.5: Prevalence of poultry diseases in Western and Upper East Region.**

| WESTERN REGION | | | UPPER EAST REGION | | |
|---|---|---|---|---|---|
| Disease | Frequency | Percentage | Disease | Frequency | Percentage |
| Coccidiosis | 89 | 89 | Coccidiosis | 42 | 84 |
| Gumboro | 3 | 3 | Gumboro | 3 | 6 |
| Newcastle | 8 | 8 | Newcastle | 5 | 10 |

There are various diseases that affect poultry farms across the country of which Western and Upper East Regions are not exception. According to the responses gathered from the respondents shown on the Table 4.5, 89 of the respondents lamented the prevalence of coccidiosis among their animals while 8 of the respondents also complained of Newcastle being worrisome to their animals. 3 respondents mentioned gumboro as the third prevalence disease. The situation is not different in the Upper East Region as 42 of the respondents complained about coccidiosis being the most prevalence disease followed by Newcastle representing 10% and gumboro being 6%. Prevalence of the diseases might be due to the geographical location of which the research was conducted.

### 4.7 Efficacy of Antibiotics

Figure 4.8: represents efficacy levels of various antibiotics on the farm.

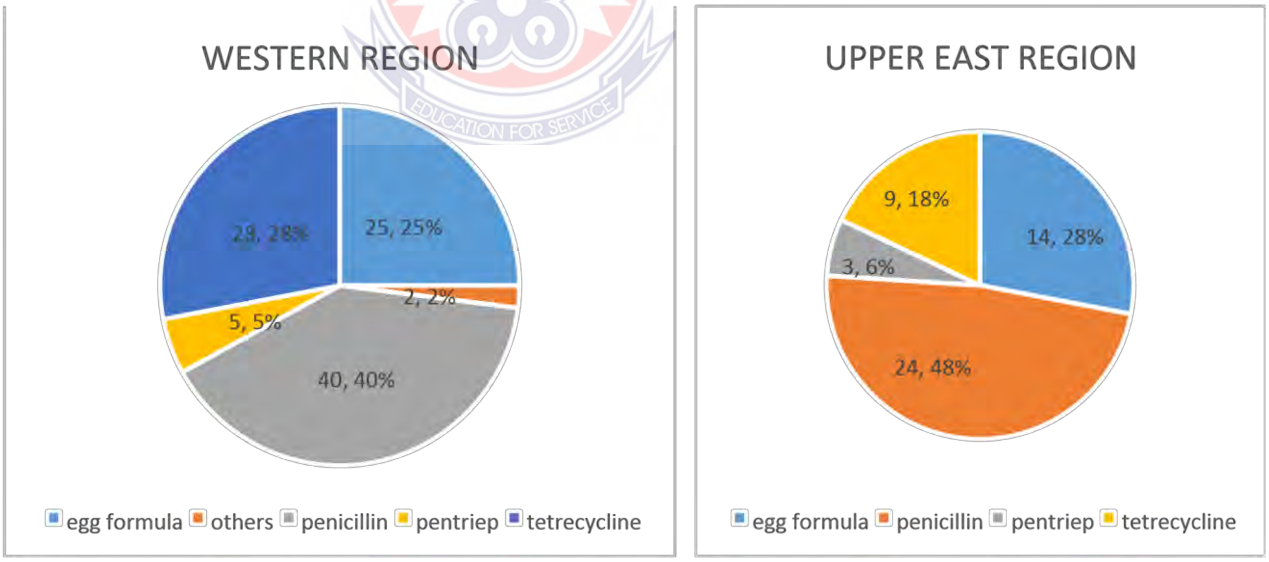



**Figure 4.8: Efficacy of antibiotics**

According to responses gathered from the research, 40% of the respondents from the Western Region believed that penicillin is very effective as compared to tetracycline which recorded 28%. Egg formula (25%), penstrep being the least with a percentage of 5 indicated non-effectiveness according to the responses at the time of the research as shown in Figure 4.8. While in the Upper East Region, penicillin still recorded the highest percentage (48%) being the most effective antibiotic followed by egg formula (28%), tetracycline being 18% and penstrep (6%) recorded the most noneffective antibiotic. Though, penicillin recorded the highest as the most effective antibiotic used by farmers in the two regions, its potency has reduced as compared to previous years. The farmers expressed their discontent on how these antibiotics are gradually becoming less effective. The continuous usage of these antibiotics coupled with route of administration and prescription may probably be the possible cause of the resistance. Numerous studies, examining the transmission of antimicrobial resistant bacterial from animals to humans, reported the high prevalence rate of antimicrobial resistant bacterial among individuals that have a direct contact with animals, specifically, farm workers (Nadimpalli *et al.,* 2018) and veterinarians (Jackson *et al.,* 2012).

### 4.8 Ways of Disposing off Poultry Droppings in Western and Upper East Regions.

Figure 4.9 ways of disposing off poultry droppings.

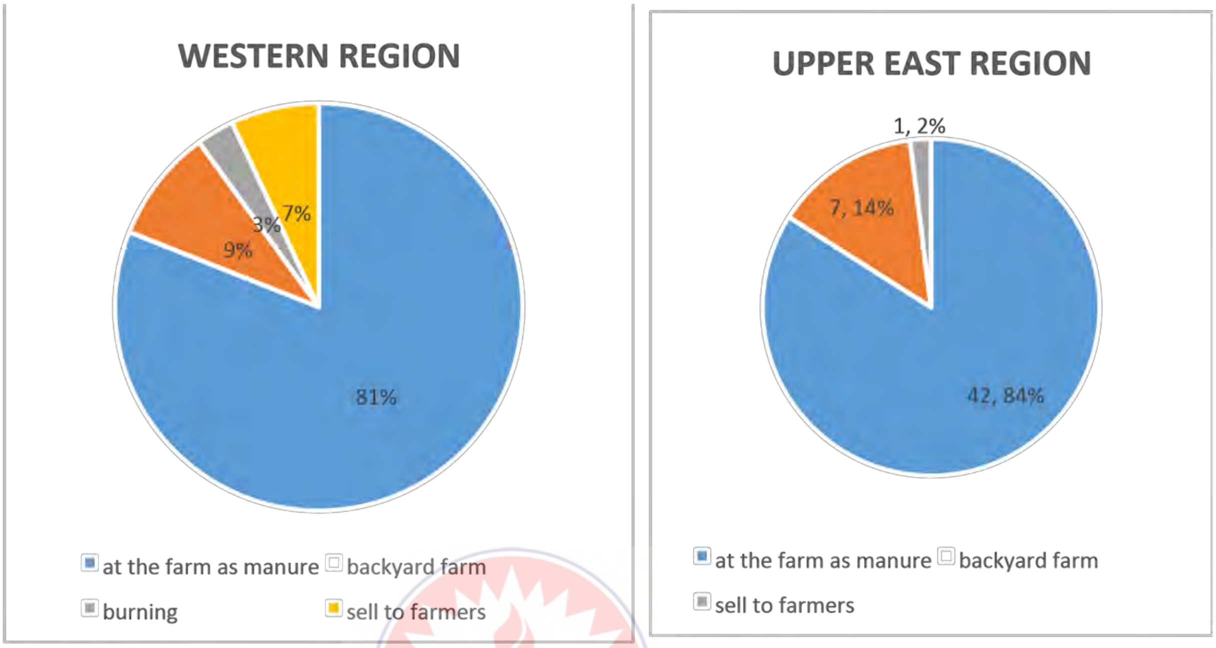
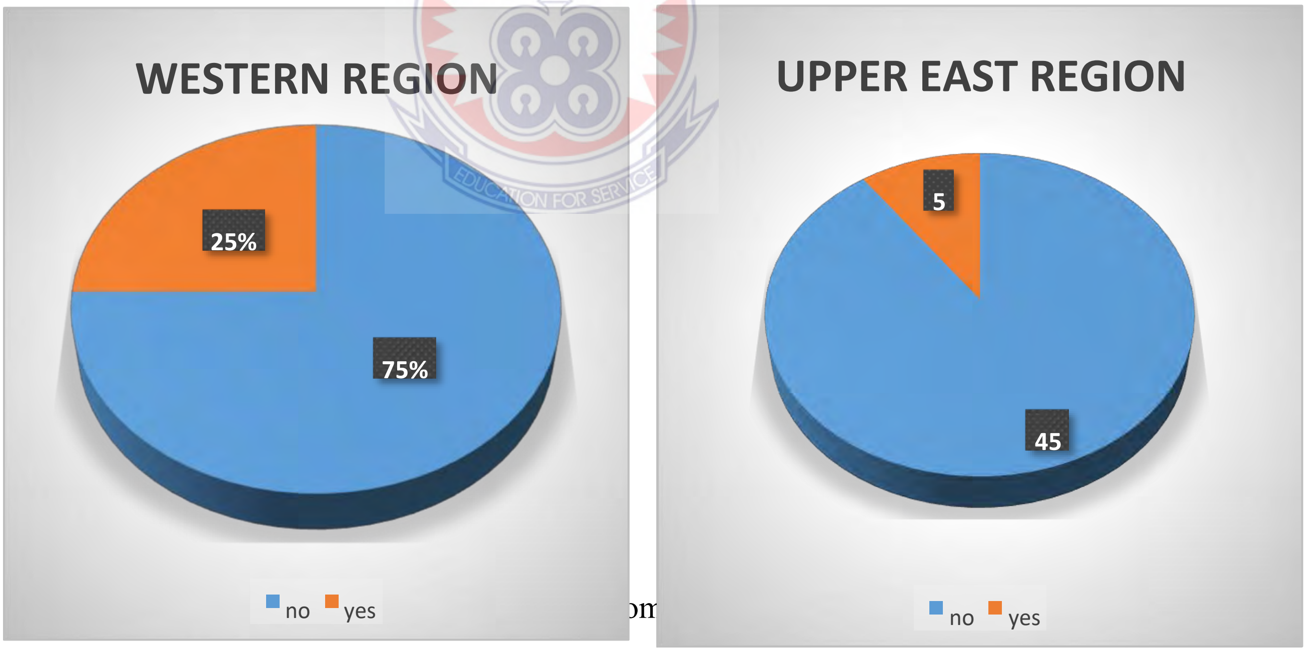



**Figure 4.9 : ways of disposing off poultry droppings**.

Droppings disposal is an acute problem and it is increasing day by day as a result of the increasing number of poultry farms (Abdullah-Al-Amin *et al.,* 2009). It is a real problem for aesthetic, public septic and environmental point of view. So, it is high time to take some necessary steps for better droppings disposal. However, poultry droppings are very essential in the production of crops and rearing of fish. In crop production, these droppings can be used as organic manure which will help crops have better yield without causing environmental pollution. This is not different from the responses gathered from the field, as 81% of the respondents in the Western Region use their poultry droppings at their farms as manure. This is an indication that beside animal husbandry, farmers also engage in crop production. 3% of the farmers also burn them while 9% use the droppings in their backyard farms. 7% of the respondents who are not into crop production usually sell the droppings to crop farmers. This is also an indication that aside getting benefit from the animals, their droppings are also a means of acquiring money to support their farms. Also, in the Upper East Region, 42 respondents use the droppings in their farms while only 1 farmer sell to farmers and 7 respondents used it at their backyard farms. The use of poultry droppings in crop production and aquaculture can be a mechanism of vertical or horizontal acquisition of antimicrobial resistance (Marshall *et al.,* 2011).

**4.9 Availability of Other Farms**

Figure 4.10 represents availability of other farms in the Western and Upper East Region




fact that there are also other farms in the area against 75% who said they do not have any farms other animal farms around their vicinity. In the Upper East Region also, 5 respondents said there are other farms in the area while 45 respondents said there are no farms closer to their farms. Some of the farmers said this is due to the outbreak of diseases in the area some years ago which destroyed a lot of their animals.

### *4.9.1 Distance to other farms*

Table 4.6 represents distance to other farms in Western and Upper East Regions.

**Table 4.6: Distance to other farms**

**WESTERN REGION**

| Distance | Frequency | Percentage |
|---|---|---|
| 2km | 2 | 2 |
| 3km | 2 | 2 |
| 4km | 9 | 9 |
| 5km | 8 | 8 |
| above 5km | 4 | 4 |
| N/A | 75 | 75 |
| **Total** | **100** | **100** |

**UPPER EAST REGION**

| Distance | Frequency | Percentage |
|---|---|---|
| 3km | 1 | 2.0 |
| 4km | 2 | 4.0 |
| above 5km | 3 | 6.0 |
| N/A | 4 | 88.0 |
| **Total** | **50** | **100** |

According to the Table 4.6 for Western Region, 2 respondents have other farms at a distance of 2km, 2 respondents also have farms at a distance of 3km. At a distance of 4km, 9 respondents also have other farms with them while 8 respondents have other farms at a distance of 5km. 4 respondents equally have other farms closer to their farms at a distance above 5km. The rest of the respondents representing 75% from the Western Region were not eligible to answer this question due the response given in the previous question. Data gathered from the respondents from the Upper East Region shows that 1 farmer has other farms closer to his farm at a distance of 3km and 2 respondents also have farms with a distance of 4km. Also, 3 respondents have other farms closer to their farms at a distance of above 5km. 44 respondents were not eligible to answer this question due to response from the previous question.

### 4.10 Assistance to Other farms

Figure 4.11 represents whether farmers assist each other.

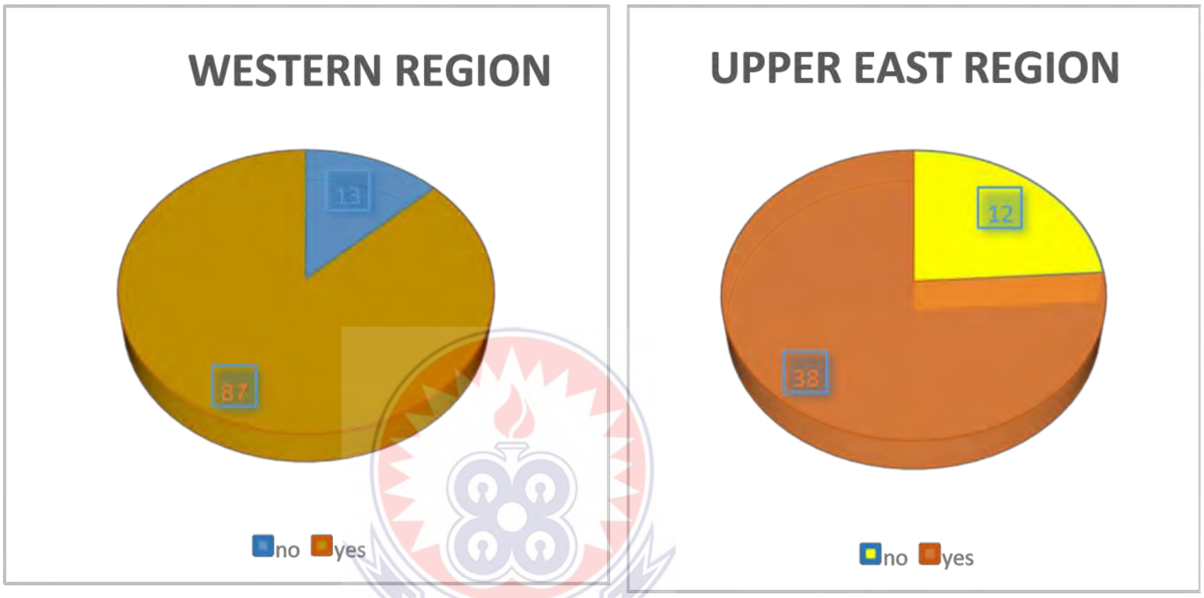
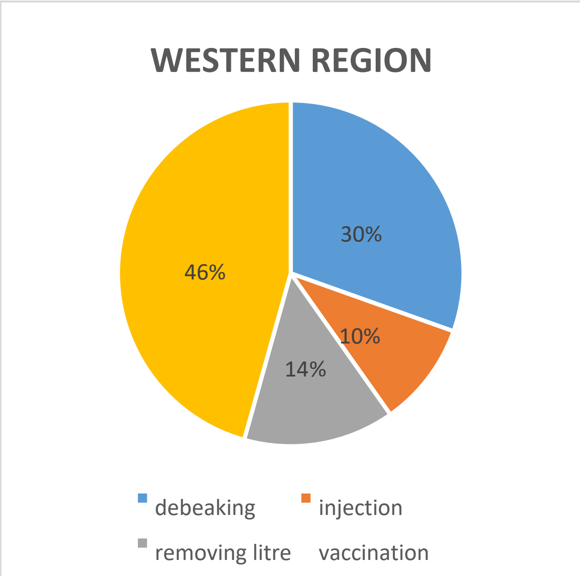



**Figure 4.11: Assistance to other farms**

From the responses gathered from the research, it could be observed in Figure 4.11 that 87 respondents from the Western Region render various forms of services to other farms while 13 respondents do not assist other farms. However, in the Upper East Region 38 respondents said they assist others farms in varied ways against 12 respondents who do not render any form of help to other farms. It is undisputable fact that, those farmers who assist their colleague farmers will continue to gather or learn new ways of handling their animals as they learn from other farmers. Besides, there is also a possibility of transfer of disease from one farm to the other.

### *4.10.1 Assistance offered to other farmers*

Figure 4.12: represents the types of assistance offered at other farms.



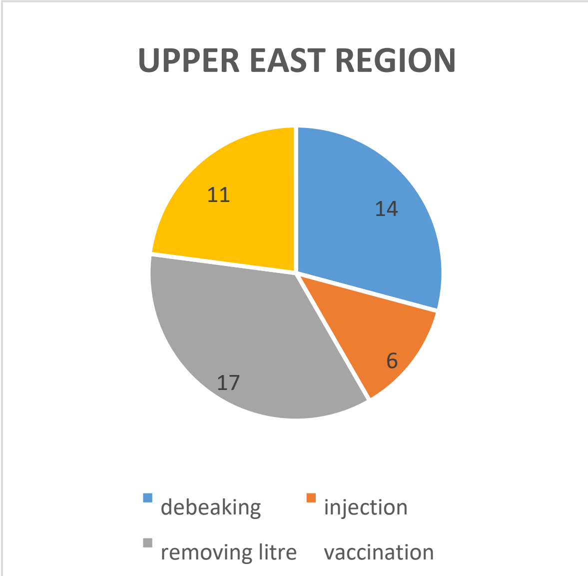




**Figure 4.12: Assistance offered at other farms**

As the popular saying goes "part of being a person is about helping others". The Ghanaian society believed in the principle that helping one another shows a great maximum level of love. From Figure 4.12, farmers responded to helping each other in various forms at the farm. Farmers usually assist each in activities such as; vaccination, debeaking, injection as well as removal of litter. According to the responses gathered from the field in Western Region, 46 respondents assist each other when it comes to vaccination, 30 respondents for debeaking, 14 responses for removal of litter as well as 10 respondents for injection. The results gathered from the Upper East Region seem a bit different from that in Western Region. Out of 50 respondents from the Upper East Region, 17 of them render services to their friends in terms of removing of litter, 14 for debeaking, 11 help their friends when it comes to vaccination and 6 respondents assists in injection. This is a good trend as it reduces the time needed to carry out these activities by individual farmer. The most important concern here is to ensure that the animals are not prone to antimicrobial resistant bacteria.

### 4.11 Presence of Footbath at Farms in the Western and Upper East Regions.

Figure 4.13 represents the percentage of farms using footbath.

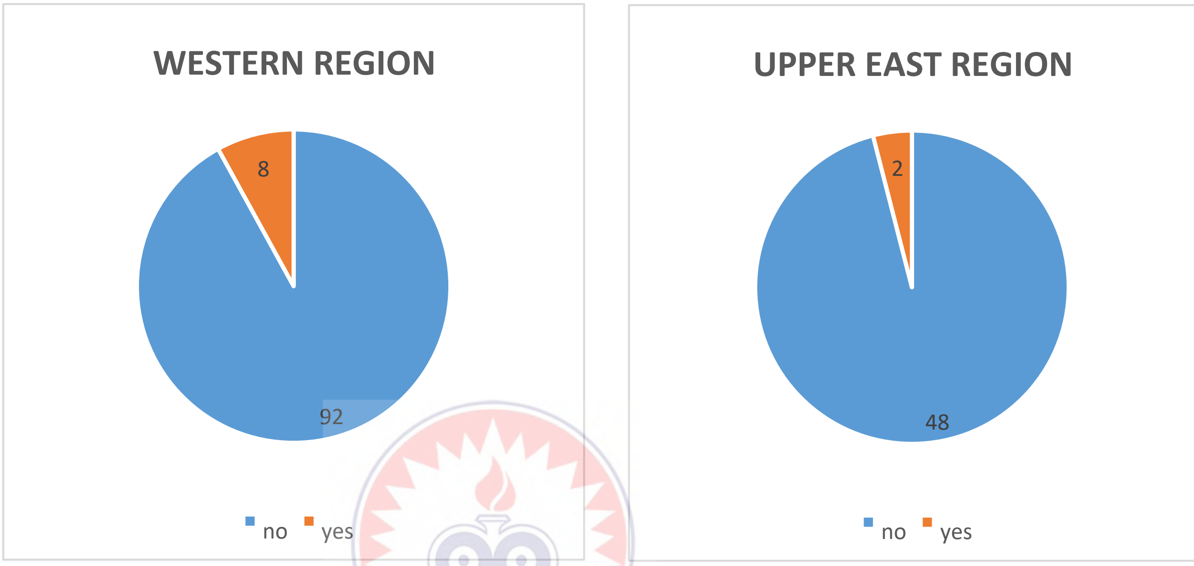



**Figure 4.13: Presence of footbath at farms**

Footbaths are very essential component of the overall management of poultry and livestock. For a footbath to be situated in a poultry farm, a good location is very paramount for its effective usage. Also, when planning the location for footbath, it is also necessary to choose a site where all animals must pass through. It is disturbing and challenging to know that from the data gathered on the field, 92 respondents do not have footbaths available on their farms as against 8 respondents in the Western Region. The situation is not different in the Upper East Region as 48 respondents out of 50 do not also have footbaths in their farms as against 2 respondents who have.

Based on the information in Figure 4.13, it is very imperative for all responsible institutions to come together and create awareness and also sensitize the farmers to become aware of the need to consider footbaths when establishing their farms.

### *4.11.1 Chemicals used for footbath in Western and Upper East Regions.*

Figure 4.14 represents types of chemicals used as footbath.

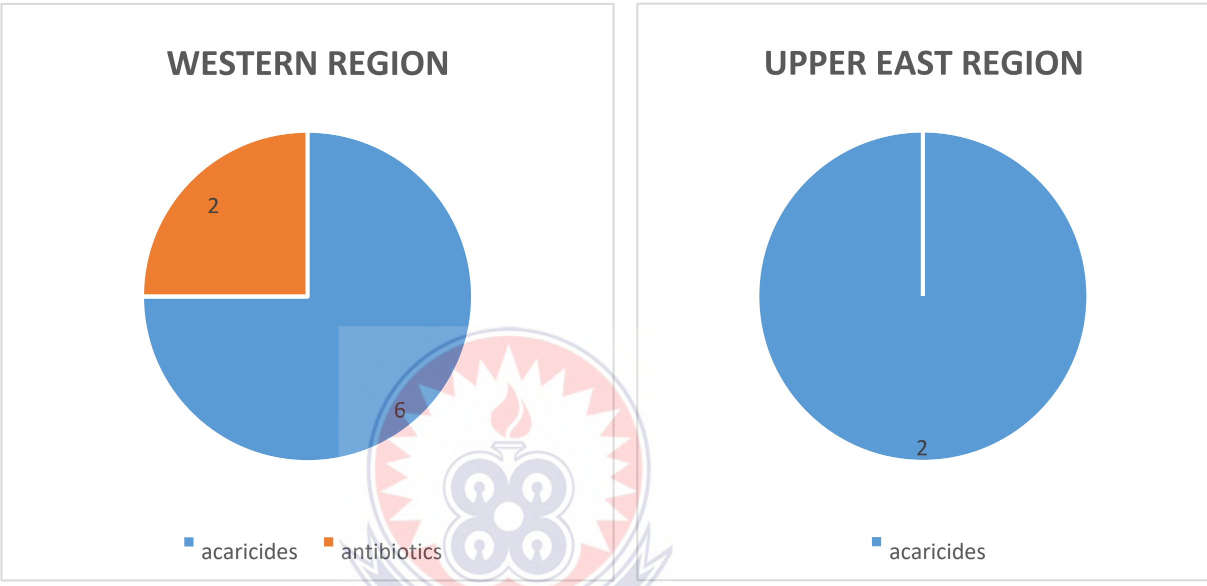



**Figure 4.14: Chemicals used for footbath**

An acceptable footbath must contain the necessary chemicals to be able to protect birds from being infected with various kings of diseases. It however meant that if a footbath does not have disinfectants, the animals will be exposed to different kinds of bacteria and virus. It is therefore important to disinfect the footbath with chemicals to keep the birds safe. From Figure 4.14, 6 farmers out of 100 use acaricide chemicals to disinfect their footbath in the Western Region of Ghana as against 2 who use antibiotics. In the Upper East Region of Ghana, only 2 respondents have footbaths using acaricides as disinfectants.

### 4.12 Treatment of Working Gear

Table 4.7 represents how farmers treat working gear

**Table 4.7 Treatment of Working Gear**

**WESTERN REGION**

| Cloths used on the farm | Frequency | Percentage |
|---|---|---|
| Different cloth only used at work | 10 | 10.0 |
| Same cloth for poultry and home | 37 | 37.0 |
| Wellington boots used only at farm | 5 | 5.0 |
| Wellington boots use everywhere | 48 | 48.0 |

**UPPER EAST REGION**

| Cloths used on the farm | Frequency | Percentage |
|---|---|---|
| Different cloth only used at work | 6 | 12.0 |
| Same cloth for poultry and home | 18 | 36.0 |
| Wellington boots used only at farm | 22 | 44.0 |
| Wellington boots use everywhere | 4 | 8.0 |

Improvement in the level of biosecurity should be an essential cornerstone in the effort to reduce antimicrobial use in poultry. Research and field experiments showing that improvement in the biosecurity status is beneficial for farm performance and that it could be economically feasible were described therefore as being of utmost importance in convincing farmers according to several authors (Casa *et al.,* 2007; Valeeva *et al.,* 2011; Laaneen *et al.,* 2014).

Farmers are usually educated on how to ensure animals get the best hygiene that they need. This table (Table 4.7) is limited to how cloths and wellington boots are being used at farms. The essence of this is to prevent the spread of any possible diseases that may be contracted on the farm into the home and from home on to the farm. From the data gathered from the field, it is worrying to know that, a reasonable number of 48 respondents in the Western Region use their wellington boots both at the farm and home, 37 respondents also use same cloths at the farm and home. Also, 10 respondents use different cloths at the farm and home. Whilst, only a small number of 5 respondents also use wellington boots only at the farm. The results from the Upper East Region are not different as 22 respondents use wellington boots at home and farm. 18 respondents also use the same cloths for poultry and home whilst 6 respondents use different cloths only at the farm. 4 respondents also use their wellington boots only at the farm. These results from the two regions confirm the data from Levy and colleagues (Levy *et al.,* 1976) who reported a direct transmission of multidrug resistant *E. coli* from animals to animals and also from animals to humans.

### 4.13 Bio-Security Against Vehicles

Figure 4.15 represents bio-security against vehicles coming to the farm

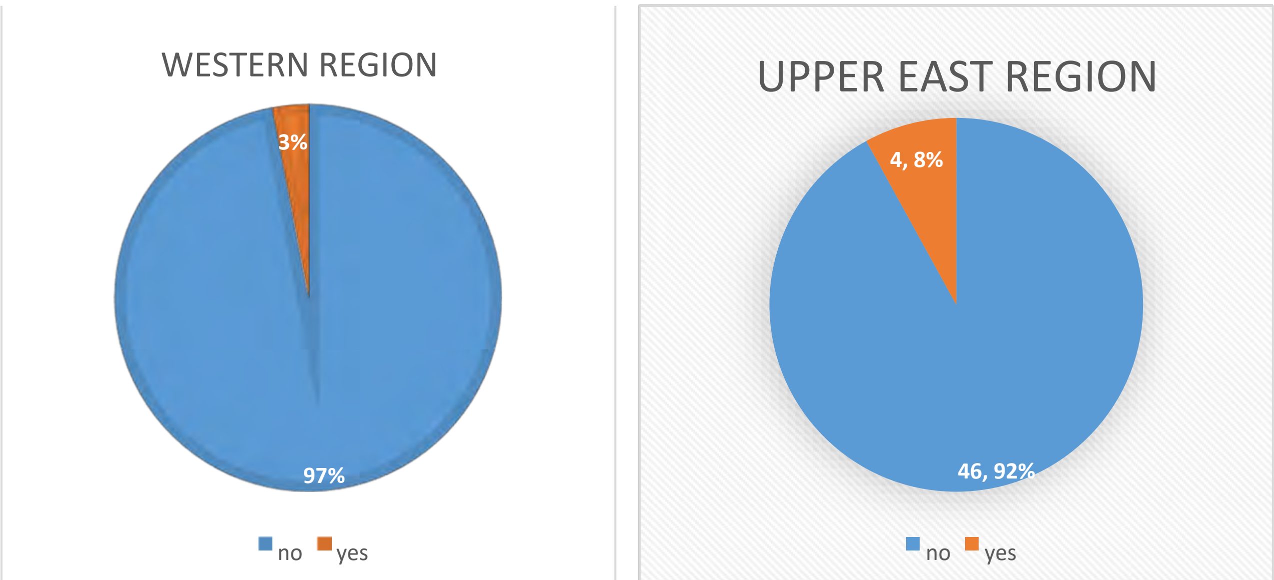



**Figure 4.15: Bio-security against vehicles**

Farmers do not always perceive improvement in biosecurity as feasible or cost effective, mainly because they lack information about the cost and in particular the revenues (Fraser *et al.,* 2010; Laanen *et al.,* 2014). From the responses gathered Western and Upper East Regions of Ghana, 97 and 92 respondents respectively said have bigger trucks moving onto their farms. Whiles 3 and 4 respondents respectively have bigger trucks moving in their farms. The few percentages of respondents not having bigger trucks moving onto their farms could be attributed to the fact that their farms are found at the outskirt of town and also due to the small farm size. Suddenly, those farmers having bigger trucks moving onto their farms never attempted to do something to protect their farm which seems worrying since that could lead to emergence of diseases thereby leading to high expensive cost of production and subsequently antimicrobial resistance. The information obtained clearly suggest that there are serious issues with the poultry farmers as perceived by Fraser *et a.,* (2010).

# CHAPTER FIVE

## 5.0 CONCLUSION AND RECOMMENDATIONS

### 5.1 Introduction

This chapter reveals the summary of the research and gives conclusions and recommendations base on the data gathered from the research which will inform and alert those responsible to take pragmatic measures in poultry production.

### 5.2 Summary of Findings

With regards to the use of antibiotics in animal agriculture among animal farmers in the Western and Upper East Regions of Ghana, the research revealed that all the respondents (100%) in the two regions use antibiotics in their animal farms. According to the respondents, the use of these antibiotics largely depends on affordability and accessibility. It is undeniable fact that the commonest antibiotic that is easily accessible is penicillin. According to the data gathered from the respondents, penicillin and egg formula recorded the highest (37 and 26 respectively) antibiotics mostly used by farmers in the Western Region while in the Upper East Region, 22 and 15 respondents also use penicillin and egg formula respectively. From the findings obtained from the research in the two regions (Western and Upper East Regions), the major reason or purpose for the use of antibiotics is for disease treatment which obtained 48 and 23 respondents for Western and Upper East Regions respectively. Farmers have full trust in the use of penicillin which they believe is more effective enough to treat diseases of their animals. The least antibiotic farmers believed it is less effective was penstrep as it recorded 6 and 2 in the Western and Upper East Regions respectively.

Concerning outlets for the acquisition of antibiotics, majority of the farmers (95 and 38) from Western and Upper East Region respectively, purchase their antibiotics from the veterinary centres which is very laudable and acceptable. However, there is still a lot to be done so that farmers will realize the need of veterinary services in livestock production. The results also showed that majority of the respondents (68 and 30) for Western and Upper East Regions respectively determine the dosage base on the previous dosage used.

The data also showed that 89 and 42 respondents from Western and Upper East Regions respectively are usually faced with coccidiosis disease as compared to gumboro which recorded 3 respondents each from the two regions (Western and Upper East). With respect to how farmers dispose-off poultry droppings, it was identified that 81 and 42 respondents from Western and Upper East Regions respectively use droppings to apply on their farms as organic manure which helps improve crop yield. The rest of the respondents form the two regions (Western and Upper East) who are not into crop production sell their poultry droppings to other farmers which add to them, additional income. 87 and 38 respondents from Western and Upper East Regions respectively render various kinds of assistance to their friends and relatives who also have animal farms base on the findings from the research.

Biosecurity in terms of footbaths is very essential in animal production. However, the results gathered from the research do not support this as 92 and 48 respondents from Western and Upper East Regions respectively do not have footbaths in their farms.

In addition, biosecurity in relation to how farmers treat their working gear, the findings do not also support this as farmers use the same cloth and boots both at home and in the farms. The results revealed that 48 and 22 respondents from the two regions (Western and Upper East Regions respectively) use the same wellington boots in their farms and at the house which can lead to disease manifestation in the farm.

### 5.3 Conclusion

As long as antibiotics are continually used in animal agriculture without critical diagnoses of the animal's to determine the accurate dosage to be used, antimicrobial resistance will always be in the increase. The results from the research confirmed this assertion as all respondents in the Western and Upper East regions use antibiotics with inaccurate dosage. In terms of the efficacy of the antibiotics, penicillin ranked first as 40 and 28 respondents from western and upper east regions respectively confirmed. The second most efficacious antibiotic recorded in the two regions was egg formula which recorded 25 and 14 respondents from western and upper east regions respectively. 92 and 48 respondents from the western and upper east regions respectively never had footbaths in their farms. In addition, regarding to how farmers treat their cloths at the farm and home, it was realized that a meaningful number of 37 and 18 respondents from western and upper east regions respectively use the same cloths for both poultry work and home. From the information above, it could be clearly be noticed that the inability of some farmers to properly identify the appropriate dosage as well as using the same cloths for both poultry work and home are possible ways of antimicrobial resistance among animals.

## 5.4 Recommendations

Base on the findings from the research and the conclusion enumerated, the following recommendations were made:

i. Laws on selling and acquiring antibiotics must be placed by the Food and

Drugs Authority.

ii. Adequate sensitization should be given to farmers to broaden their knowledge on the importance of patronizing veterinary services instead of seeking for services from people who do not have the requisite knowledge on keeping farm animals. The Animal Production Division of Ministry of Food and Agriculture should enforce strict policies to ensure or regulate the use of antibiotics.

iii. Ministry of Food and Agriculture in collaboration with the veterinary service need to realise the fact that organising seminars will be an avenue for farmers to obtain enough knowledge on husbandry practices such as setting footbaths in the farms, use of different cloths and footwear for home and the farms.

iv. More veterinary staff should be trained so that farmers in every district will be able to reach them for any assistance that they may need.

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