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# COMPARATIVE ASSESSMENT OF KNOWLEDGE, ATTITUDES AND PRACTICES REGARDING ANTIMICROBIAL USE AND RESISTANCE AMONG CATTLE FARMERS UNDER EXTENSIVE PRODUCTION SYSTEMS IN KOINADUGU AND FALABA DISTRICTS, SIERRA LEONE

**Sesay Emkay Mahmud[1]*, Dr. Bagla Patrick Victor[2], Dr. Kanu Saidu[3], Prof. Sanpha Kallon[4]**

***Correspondence:** Sesay Emkay Mahmud

[1,2,4]Department of Animal Science, School of Agriculture and Food Sciences Njala University, Sierra Leone.

[3]Dean of Postgraduate Studies, Central University, Silicon Hills, Sierra Leone.

## ABSTRACT

Antimicrobial resistance (AMR) threatens animal health and food safety, yet evidence on livestock farmers' antimicrobial use in Sierra Leone remains limited. This study compared knowledge, attitudes and practices (KAP) regarding antimicrobial use and AMR among cattle farmers in extensive production systems in Koinadugu and Falaba Districts. A comparative cross-sectional survey was conducted among 358 farmers (Koinadugu, n=187; Falaba, n=171) using an interviewer-administered questionnaire. Data were summarised descriptively, and district differences were assessed using chi-square or Fisher's exact tests, Holm-adjusted p values and Cramér's V. Both districts showed weak knowledge, particularly regarding antibiotic specificity, differentiation of antibiotics from other medicines, disease recognition and AMR mechanisms. Attitudes differed markedly: all 13 testable items remained significant after Holm adjustment (adjusted p<0.001); 12 showed large effects, while willingness to pay for veterinary consultation showed a moderate effect (V=0.443). However, the clearest finding was that stronger stewardship attitudes rarely translated into appropriate practice. Veterinary consultation occurred at least sometimes among 75.40% of Koinadugu respondents and 45.03% of Falaba respondents, but no respondent in either district consistently completed prescribed treatment courses. Withdrawal periods were observed at least sometimes by only 5.88% in Koinadugu and none in Falaba, while treatment record-keeping was virtually absent. District-specific strengths were observed in vaccination, expiry checking, disposal, diagnosis, consultation, isolation, hygiene and administration. Overall, the findings demonstrate a knowledge–attitude–practice gap shaped by limited veterinary access, medicine literacy and weak stewardship systems. District-specific interventions combining farmer education, mobile veterinary services, prescription control, pictorial treatment and withdrawal guidance, diagnostic referral and antimicrobial use surveillance are recommended.

## 1.0. INTRODUCTION

### 1.1. Background.

### 1. Background.

Antimicrobial consumption is increasing globally at an alarming rate (Majumder 2021). Two-thirds of global antimicrobial consumption occurs in the animal industry (Cully, M 2014). This increase corresponds to more cases of antimicrobial resistance (AMR), which negatively affects the economy, human health, food security, and other socio-economic parameters (Organisation for Animal Health (OIE) 2019). According to WHO (2018), “Antimicrobial resistance (AMR) is the ability of a microorganism (like bacteria, viruses, and some parasites) to stop an antimicrobial (such as antibiotics, antivirals and anti-malarias’) from working against it. As a result, standard treatments become ineffective, infections persist and may spread to others”. According to CDC (2019), AMR causes an estimated 1.2 million deaths annually and is associated with 5 million deaths in 2019 alone (Lancet, 2022). In sub-Saharan Africa, the burden is severe, and in West Africa, the resistance decay rate is 27.3 deaths per 100,000 due to AMR (Chekwuema Muanya, 2022). It is estimated that by 2050 there might be 10 million deaths. Worldwide, human diets have shifted toward animal protein, increasing demand for animal products and, consequently, the use of antimicrobials in animals, especially livestock (Godfray et al., 2010; Van Boeckel et al., 2015). Proper and wise use of antimicrobials for the prevention and treatment of ill health reduces production costs and increases profit (Robinson et al., 2016). However, poor handling of antimicrobials results in the development of AMR (World Health Organisation, 2022). Recognising the risks posed by AMR from livestock production, WHO, FAO, and OIE developed the Global Action Plan on AMR in 2015 with five strategic goals, including optimising antimicrobial use in animal health care. The OIE strategy on AMR through prudent use of antimicrobials and the FAO action plan on AMR highlight the importance of surveillance, monitoring, and record-keeping associated with antimicrobial use in animals. In Sierra Leone, the Ministry of Health and Sanitation (MOHS), Ministry of Agriculture and Forestry (MAF), and the Environmental Protection Agency (EPA) released the national strategic plan for tackling AMR in 2018. It adopted the goals of the Global Action Plan on AMR and adapted them to the country's context, including improving oversight, surveillance, and education to optimise antimicrobial use. The Livestock and Veterinary Services Division of the Ministry of Agriculture and Forestry uses the Integrated Animal Disease Surveillance and Reporting (IADSR) System to collect data on antimicrobial use. According to Leno et al. (2021), district reporting was very poor, district- and sub-district-level treatment forms were completely inconsistent, and staffing shortages persisted from 2016–2019. According to Bangura et al. (2022), one-quarter of the livestock had an infectious disease, and a quarter of the sick animals had been given an antimicrobial drug. Most animals were treated with antimicrobials classified as "veterinary critically important" according to the World Organization for Animal Health. This shows an improvement in the animal health surveillance system but calls for improved antimicrobial stewardship to avoid misuse of antimicrobials that are crucial for animal and human health. However, this report does not indicate the use or misuse of these antimicrobials, leaving a gap in understanding farmers' knowledge, attitudes, and practices regarding antimicrobial use in cattle production.

### 1.2. Statement of Problem.

i. As per the Sierra Leone National Strategic Plan for Combating Antimicrobial resistance (2018-2020), the following gaps, among others, have been revealed:
ii. Insufficient diagnostic laboratories for antimicrobial resistance (AMR).
iii. The Strategic plan for National Health Laboratory System (2016-2020) does not cover antimicrobial resistance (AMR).
iv. Inadequate qualified and experienced Lab Technicians on Antimicrobial resistance (AMR).
v. No monitoring of the usage of antimicrobial agents in humans and animals.
vi. Few published scientific studies on antimicrobial resistance (AMR) in Animals.

Furthermore, Sierra Leone is an agricultural country in which most farmers engage in livestock production, specifically cattle, small ruminants, swine, and poultry. The country lacks veterinary professionals, and the livestock farming sector is largely informal, with the majority of livestock farmers rearing their animals in traditional settings where veterinary services (personnel) are scarce and the cost of drugs and treatment is high. These factors have forced many farmers who lack information about various animal diseases to use drugs to cure their animals. This has led to poor adherence to treatment regimens, inadequate diagnosis, incorrect drug dosages, and a poor surveillance programme for AMR in the livestock department in the Ministry of Agriculture and Food Security. However, the extent to which these practices affect antimicrobial use knowledge, attitudes, and practices among cattle farmers remains unclear.

1.3. Aim.

The main objective of this study is to assess knowledge, attitudes, and practices regarding antimicrobial use, and to determine the AMR patterns in extensively raised cattle in the Koinadugu and Falaba districts of Sierra Leone.

**Specific Objectives.**

1. To determine the level of knowledge amongst cattle farmers regarding the use of antimicrobials and antimicrobial resistance in cattle production in the Koinadugu and Falaba districts.
2. To assess the attitudes of cattle producers towards antimicrobial use, antimicrobial resistance, and prudent antimicrobial use in cattle farming.
3. To identify antimicrobial use practices among cattle farmers in extensive cattle farming systems in Koinadugu and Falaba Districts.

**1.4. Research Questions.**

1. How knowledgeable are cattle farmers in Koinadugu and Falaba Districts, Sierra Leone, about antimicrobial use?

2. What are the attitudes of cattle farmers toward antimicrobial usage and antimicrobial resistance in Koinadugu and Falaba Districts, Sierra Leone?

3. What antimicrobial usage practices are used in cattle farming systems in Koinadugu and Falaba Districts, Sierra Leone?

**1.6 Research Hypotheses**

The hypotheses were tested at the 5% level of significance ($\alpha = 0.05$).

$H_0$: There is no statistically significant relationship between knowledge, attitude, and practice on antimicrobials use and consumption and antimicrobial use behaviors of cattle by livestock farmers in the Koinadugu and Falaba Districts.

$H_a$: There is a statistically significant relationship between knowledge, attitude, and practice on antimicrobials use and consumption and antimicrobial use behaviors of cattle by livestock farmers in the Koinadugu and Falaba Districts.

**1.7 Geographical Scope**

This study was carried out in the Koinadugu and Falaba Districts of Sierra Leone. These districts were purposively selected for their role in cattle production and their predominant traditional livestock management practices. Cattle production in these districts is dominated by extensive and communal grazing, seasonal herd movements in search of grazing and watering points, the use of common watering points, and contact between cattle, other livestock, livestock farmers, wildlife, and the environment. These circumstances create ecological conditions relevant to the transmission of antimicrobial-resistant bacteria.

The study involved selected chiefdoms in the Koinadugu and Falaba Districts, with livestock farmers and cattle as the main study subjects. The study area was geographically diverse to enable comparison of antimicrobial use practices, cattle management systems and prevalence of antimicrobial resistance, while addressing the limited evidence on these issues in the districts.

**2.1 Study Area**

This study was done in Wara Yagala, Wara Wara Bafodia, Sengbe, Kasunko, and Bonkibo kayaka in Koinadugu, and in Dembelia Musaia, Dembelia Sinkonia, and Mannah Falaba districts in Northern and North Western Sierra Leone, which are all important locations in ruminant production. There is the presence of mixed rural livestock system where the raising of cattle takes place through extensive and semi-extensive management where the animals graze and share water points communally. This makes this area an ideal site for the epidemiological study of resistant enterobacteria since they thrive and spread in this environment.

MAP OF SIERRA LEONE LOCATING MY STUDY AREAS

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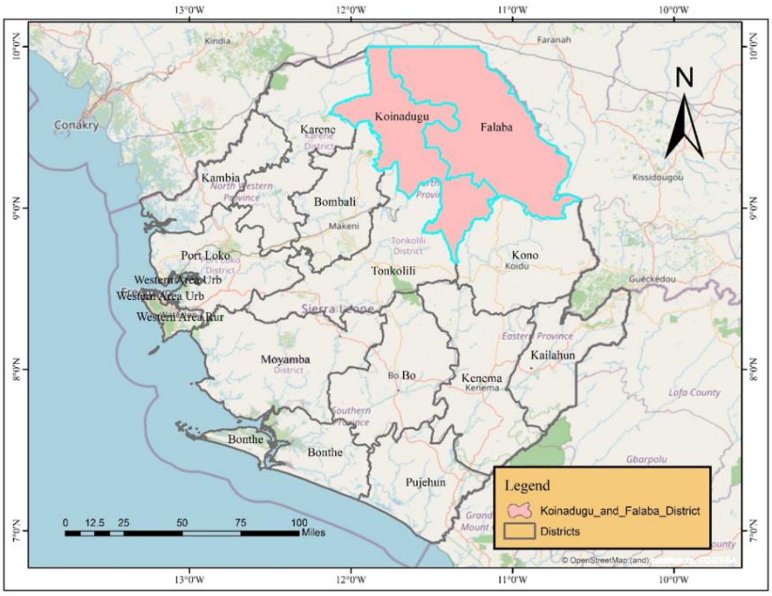


## 2.2. Study Design.

Purposive sampling strategy was adopted in order to select the respondents. In the selected communities, the respondents were identified through the Mama Afro Koinadugu U-TURN Livestock Cooperative in Kabala and the District Livestock Office.

## 2.3 Study Population.

The target population was cattle farmers who owned and managed cattle herds and also provided animal health services without veterinarians.

## 2.4. Eligibility Criteria

### 2.4.1. .Inclusion Criteria:

The study population included the cattle farmers of 18 years and above who were involved in cattle farming and providing animal health services in Koinadugu and Falaba districts. The participants should have at least six months of involvement in the respective occupations and should have been residing and practicing in the area.

### 2.4.2. Exclusion Criteria:

Persons below 18 years old, persons with fewer than six months' experience in the handling of cattle, non-residents of the study area, persons who would not be able to engage in the interview process and those who declined to give their consent to participate in the research were all excluded from the study. Persons included in the pre-testing of the questionnaire were excluded from the actual survey.

## 2.5. Sample Size Determination.

The proper and accepted sample size formula for the KAP survey for a finite population of 400 registered livestock farmers is the Cochran formula with finite population correction (FPC).

Step 1: Calculation of Initial Sample Size (Cochran, 1977)

n_0= (Z^2 pq)/e^2

Where: n_0 = initial sample size

Z= Z-value for the confidence level required (1.96 for 95%)

p=proportion (when p is not known)

q= 1 − p (0.5) e= margin of error (0.05)

Substituting:

n_0= ((1.96) ^2 (0.5) (0.5))/ (0.05) ^2. n_0= (3.8416×0.25)/0.0025 n_0=384.16

Step 2: Use the FPC formula

Since the entire population is just 400 registered livestock farmers, the sample size needs to be calculated through:

n=n_0/ (1+ (n_0-1)/N) Where: n= corrected sample size. n_0= 384. N= 400, n=384/ (1+383/400). n=384/1.9575. n=196.2. n≈196

Step 3: Make Non-Response Correction for 10% of non-responses: n_adj =

n_adj=217.8. n_adj≈218

Recommended Sample Size

A sample size of 218 people was suggested for the KAP survey among 400 registered livestock farmers, taking into consideration a non-response rate of 10%.

**2.6. SAMPLING TECHNIQUE.**

Data collection involved the use of a well-structured questionnaire adopted from the WHO KAP questionnaire on antimicrobial resistance (World Health Organisation, 2019), with necessary adjustments made to suit the current scenario. This questionnaire was divided into the following parts:

Part A – Sociodemographic information (gender, age, level of education, occupation, experience in farming, farm size).

Part B – Information about the farm and the animals' health status (animals kept, diseases experienced recently, health practices).

Part C – Knowledge of antimicrobials and AMR (14 questions, comprising yes/no and multi-response questions on the understanding of AMR and how to prevent it).

Part D – Attitude towards antimicrobial use (10 questions with five-point Likert scale of agreement and concern).

E — Practices with regard to antimicrobial use (14 items on sources, reasons, frequency, prescribing, quality assurance, administration route, duration, record keeping, diseases treated and disposal).

F — Sources of information and learning preferences (6 items on the source of information about news, entertainment and agriculture).

Data collection took place face to face, using both individual interviews and focus group discussions. For those who could not speak English, interviews were done in their native language by trained interviewers who would immediately translate the questions from the questionnaire. Out of the 358 respondents, 98% completed the questionnaire in their native language.

**2.7. Data Collection Materials**

Data collection tools used were efficient in capturing information from study participants in an accurate and standardised way. A structured questionnaire was developed to get information on the socio-demographic characteristics, knowledge, attitude and practices of antimicrobial use and resistance among respondents. Mobile phones with the Kobo Toolbox application were used to enter data electronically, which allowed for immediate entry, validation and storage of collected information. Pens and notepads were used for writing down the observations, field notes and information if needed, because of unavailability of the electronic data entry. Internet connectivity facilitated synchronization of the collected information on mobile phones to the Kobo Collect server for data back up and storage.

**2.8. Data Collection.**

A structured questionnaire was developed, and hosted on the Kobo Collect tool box to collect information on AMU and AMR among livestock farmers.

**2.9. Data Management and Analysis.**

The collected data was imported into spreadsheets and then analyzed using statistical packages, such as SPSS. Differences between Districts were determined through chi-square or Fisher's exact tests. The logistic regression was employed to identify the relationships between resistance and the following explanatory variables: site, district, age, gender, antimicrobial exposure and hygiene indicators. The statistical significance level of $p < 0.05$ was chosen.

**3.0. RESULTS AND DISCUSSION. (COMPARATIVE RESULTS AND DISCUSSION).**

### 3.1. Analytical approach

There were 358 livestock farmers analyzed in this research, 187 from Koinadugu and 171 from Falaba districts. The survey questions on knowledge and attitude were formulated in terms of five-point agreement scale. Practice items were formulated as Never, Rarely, Sometimes, Often and Always. Attitude was defined as a positive response, i.e., Agree or Strongly Agree a priori. The Fisher-Freeman-Halton exact test using Monte Carlo estimation was performed to test district differences in the full five-level attitude distributions if there were any because of sparse or even zero frequencies in many cells. Family-wise error rate control was provided using Holm's approach. The effect size (Cramer's V) is also reported (<0.30 small, 0.30-0.49 moderate, >=0.50 large). The percentages presented in the practice section are descriptive statistics reflecting how frequently the respondents undertook the desirable action at least sometimes. This threshold is only employed to compare district practices and should not be regarded as objective criterion of good stewardship. The wording of questions and completeness of the responses were verified before the analysis. One attitude item of Falaba district, related to the confidence issue, had 170 valid responses. The lack of data was found for the Koinadugu government regulation question transcription and no inferential analysis could be performed for it.

### 3.2. Principal comparative findings

It can be seen that foundational knowledge of the farmers in both districts was insufficient, particularly regarding the definitions and characteristics of antibiotics and diseases identification. All the 13 testable attitude items differed after Holm correction (adjusted $p < .001$); 12 effects were large and 1 was moderate. Koinadugu district showed more positive attitude to conventional stewardship issues, while Falaba district expressed readiness to pay for consulting services, alternative treatments and group responsibility. Both districts displayed serious gaps in such practices as treatment completion, withdrawal period observing, monitoring of treatment outcome and stewardship training. The above mentioned results illustrate the attitude-practice gap, which means that farmer education will not affect their antibiotic consumption behavior in case they lack veterinary, diagnostics and regulatory services.

### 3. 3 Comparative Results

#### 3.3.1 Knowledge of antibiotic use and antimicrobial resistance

First of all, it should be noted that the knowledge of farmers in both districts was rather poor. In Koinadugu district, 70% of farmers disagreed that they know what antibiotics are, 66.85% disagreed that antibiotics treat only bacterial infections and 74.87% strongly disagreed that they could distinguish antibiotics from other veterinary drugs. Positive responses on the above mentioned items constituted only 2.67%-3.74%. In Falaba district, similar problems were detected: 58.48% strongly disagreed that they understand what antibiotics are, 73.10% disagreed that antibiotics work only against bacteria and the available response options reflected 81.87% disagreement on the ability to distinguish antibiotics from other drugs.

The second piece of knowledge related to disease diagnosis. According to the results obtained in the Koinadugu district, 58.83% of respondents did not agree that they know how to recognize the symptoms of bacterial disease and 64.17% did not agree that not all the sick animals require antibiotics. As for Falaba district, 58.48% of respondents strongly disagreed with the disease diagnosis item, and only very few chose the most positive option of disease diagnosis items. This suggests that farmers resort to empirical treatment prior to differentiation of the bacterial diseases from the diseases caused by viruses, parasites, improper nutrition or metabolism.

**Table 1. Comparative interpretation of major knowledge domains**

| Domain | Koinadugu | Falaba | Interpretation |
|---|---|---|---|
| Basic antibiotic concept | ~70% disagreement; 3.74% strongly agreed | 58.48% strongly disagreed | Weak in both districts |
| Bacterial specificity | 66.85% disagreed; 2.67% strongly agreed | 73.10% disagreed; 5.26% strongly agreed | Substantial misconception |
| Distinguish antibiotics from other drugs | 74.87% strongly disagreed | 81.87% disagreed in available counts | Critical medicine-literacy gap |
| Recognize bacterial disease | 58.83% disagreed | 58.48% strongly disagreed on the stated item | Diagnostic uncertainty |
| Operational stewardship knowledge | Several items recorded 100% strong agreement | Highly polarized across item wording | Report item-by-item; avoid one global score |
| Prevention and biosecurity | 100% strong agreement on the stated biosecurity item | 53.80% disagreed with prevention/biosecurity; 49.12% disagreed prevention is more economical | Falaba requires stronger prevention education |

*Source: Field survey provided by the researcher. Falaba coding is regarded to be final. Knowledge rows of the source table include some incomplete frequencies; conclusions must be based on reported figures and response options only.*

Secondly, operational knowledge was significantly higher than conceptual knowledge. Koinadugu district gave uniformly positive responses in relation to different stewardship items, including veterinary prescription, antibiotic choice, dosing, administration, duration of treatment, withdrawal, AMR, growth promotion, and label reading. In turn, Falaba gave clearly polarized responses – positive regarding antibiotic choice, withdrawal, AMR, and growth promotion avoidance, while veterinary prescription, dosing, administration, treatment duration, willingness to treat until full recovery and label reading responses were negative according to finalized coding. Internal inconsistency increases reliability of item-based analysis compared to overall estimation of 'good knowledge.'

### 3.3.2 Attitudes toward prudent antibiotic use

Attitudes also differed significantly. After adjustment according to Holm correction, 13 of 13 attitude questions which demonstrated response variability demonstrated statistically significant difference between the districts (adjusted $p < .001$). Of these, twelve items demonstrated a large effect size (Cramer's V >= 0.50), while willingness to pay for veterinary consultation demonstrated a moderate effect ($V = 0.443$). The training attitude question could not be tested as all respondents agreed in both districts.

**Table 2. Positive attitudes towards prudent antibiotic use by district**

| Attitude statement | Koinadugu % | Falaba % | Cramer's V \| Effect |
|---|---|---|---|
| For veterinary prescription only | 100.00 | 0.00 | 1.000 \| Large |
| Prefer hygiene/vaccination | 38.50 | 0.00 | 1.000 \| Large |
| Misuse contributes to AMR | 30.48 | 0.00 | 0.904 \| Large |
| Will pay for veterinary consultation | 32.09 | 58.48 | 0.443 \| Moderate |
| Complete the treatment course | 10.16 | 0.00 | 0.845 \| Large |
| Observe withdrawal periods | 100.00 | 0.00 | 1.000 \| Large |
| Avoid growth-promotion use | 87.17 | 0.00 | 1.000 \| Large |
| Personal responsibility for AMR | 79.68 | 0.00 | 1.000 \| Large |
| Adopt alternative prevention | 27.81 | 100.00 | 1.000 \| Large |
| Keep treatment records | 100.00 | 0.00 | 1.000 \| Large |
| Confidence in veterinary instructions | 82.89 | 0.00* | 0.860 \| Large |
| Unnecessary use wastes money | 94.65 | 0.00 | 1.000 \| Large |
| Participate in prudent-use training | 100.00 | 100.00 | Not estimable |
| Collective responsibility | 90.37 | 100.00 | 0.666 \| Large |

*Positive = Agree + Strongly Agree. All estimable items have Holm-adjusted $p < .001$. *Falaba confidence in veterinarian item: 170 valid responses, no positive responses. Government regulation was not included due to the ambiguities in frequency transcription of Koinadugu.*

The most positive attitude items in Koinadugu are associated with prescription, withdrawal, treatment records keeping, training, economical implications, avoidance of growth promotion, confidence in veterinarian instructions and personal responsibility. The problem in this district is the treatment completion with 10.16% of positive responses and 67.91% neutral answers. In Falaba, the profile of positive attitudes is confined to the following issues: willingness to use alternative prevention (100%), training participation (100%), collective responsibility (100%) and willingness to pay for veterinarian consultation (58.48%).

Figure 2. Comparative attitude profile

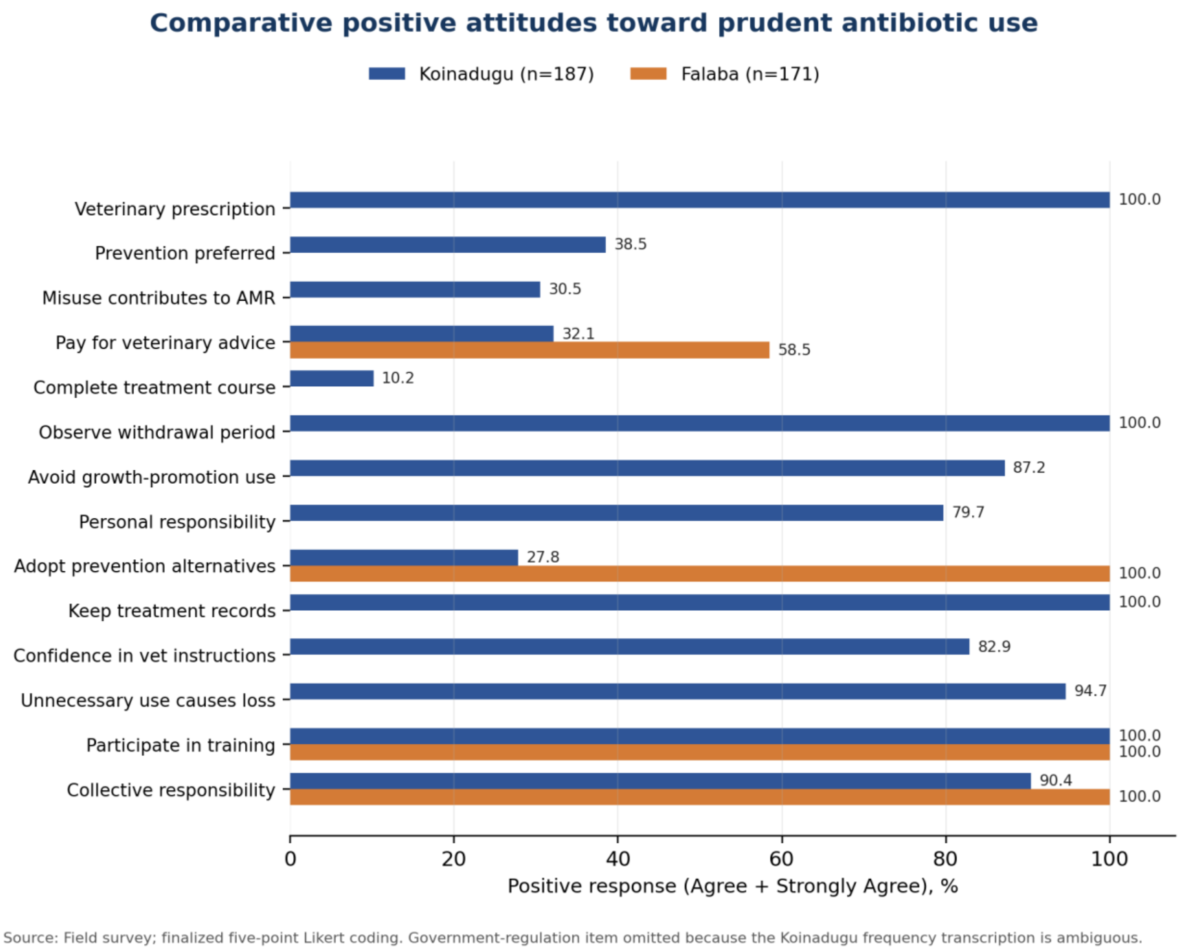


Figure .2. Comparison of positive attitudes towards responsible antibiotic use

*Source: Field survey. Positive replies = Agree + Strongly Agree. The figure represents 14 analyzable descriptive items excluding government regulation item.*

It depicts extremely divided district results. Koinadugu had higher proportions of positive replies to 10 out of 14 surveyed questions, Falaba had higher proportions to 3 questions, but the two districts were equally inclined to engage in training. No item in Falaba got any positive replies, while three items received 100 percent of positive replies from all respondents. Nevertheless, in view of the validation of the coding, one can safely say that it is a meaningful grouping of the replies rather than reverse coding, although, the clustering around the end point of the response scale is possible.

The government regulation was described descriptively. In Falaba, 81.87% strongly disagreed, 12.28% were neutral, while 5.85% strongly agreed. The source Koinadugu narrative indicates majority approval (about 66.3%) but with overlapping positive frequencies, therefore, conducting the test would be misleading. It may be concluded that regulatory acceptance is unlikely to be higher in Falaba until the comparison of the Koinadugu row with the raw data is performed.

### 3.3.4 Antibiotic use and disease prevention practices

Practices have been weak in both districts, despite the presence of different strengths. Table 4.10 contains the percentage of people who are engaged in desirable practices sometimes or often. It helps to understand how well each district performs; nevertheless, this table should not be treated as an indicator of adherence to the recommended practice, since 'sometimes' is not enough to administer prescribed medications, dosages, make withdrawal and keep records.

**Table 3 Desirable practices that occurred at least Sometimes**

| Desirable practice | Koinadugu % | Falaba % |
|---|---|---|
| Gå til en veterinær før du... | 75.40 | 45.03 |
| Use only on professional advice | 54.55 | 0.58 |
| Take the medication as per recommendations | 0.00 | 4.09 |
| Finish your course of treatment | 0.00 | 0.00 |
| Observe withdrawal periods | 5.88 | 0.00 |
| Read antibiotic labels | 0.00 | 7.02 |
| Keep treatment records | 0.00 | 1.17 |
| Check expiry dates | 47.06 | 61.99 |
| Dispose of medicines safely | 0.00 | 48.53 |
| Isolate sick animals | 100.00 | 91.23 |
| Vaccinate according to schedule | 3.74 | 64.32 |
| Maintain hygiene/biosecurity | 43.85 | 9.36 |
| Avoid growth-promotion use | 70.05 | 0.00 |

| | | |
|---|---|---|
| Seek laboratory diagnosis | 0.00 | 21.05 |
| Use the correct administration route | 94.65 | 2.92* |

Neither of the districts finished a treatment course and neither of them monitored treatment failures. Koinadugu did not report any label reading, record keeping, proper storage, safe disposal and laboratory diagnosis; nobody in Koinadugu attended training sessions. Very rarely. Falaba did not conduct prescription-based treatment, did not keep any records, did not give drugs in the right way; nobody of the participants avoided sharing antibiotics, leftover, monitoring treatment results and training.

Koinadugu performed better in such desirable practices as seeking advice from a veterinarian, professional recommendation, isolation, hygiene, avoiding growth promotion and proper route of administration while Falaba was stronger in checking expiration date, safe disposal, vaccination and laboratory diagnosis. However, isolated advantages cannot serve as justification of universal weakness in finishing treatment courses and absence of withdrawal period observation.

## 4.0 Discussion

### 4.1 Foundational knowledge and diagnostic uncertainty

Weaknesses in basic knowledge of two districts coincide with the empirical evidence of AMR from LMILS. For example, Pham-Duc et al. (2019) discovered that only 18% of 392 livestock and aquaculture producers in Vietnam had positive attitudes regarding the use of antibiotics and prevention of AMR; antibiotic treatment was more preferable than hygiene or quarantine in response to disease symptoms. The example of Northern Sierra Leone adds another evidence in support of the idea about the combination of deficiency of knowledge of bacterial specificity and high degree of confidence in using drugs. At the same time, Caudell et al. (2020) revealed significant differences in knowledge and attitude levels across different production systems: 70% of households had knowledge and attitude score in poultry system compared to only 40% among Tanzanian pastoralists; only 12% of households almost always bought antimicrobials with a prescription; veterinary inputs were rare; cost, distance and lack of access were mentioned as important barriers. This evidence helps to explain why favourable intention of Koinadugu could not turn into practice based on prescription and why 54.97% of respondents in Falaba never consulted a veterinarian before giving treatment to animals.

Ethiopia was the subject of the study conducted by Gemeda et al. (2020), with the findings of low knowledge levels among many extensive smallholders and an emphasis on professional supervision, withdrawal period training, and measurement. In line with these results, Gebeyehu et al. (2021) reported that 80.2% of 571 animal producers had low knowledge levels, 85.3% were characterized by negative attitudes, and 78.5% displayed improper practices; moreover, 46.1% acquired antimicrobials without prescriptions, while 39.4% used drugs independently. Consequently, the poor conceptual knowledge scores seen in Northern Sierra Leone are not exceptional cases, while highly polarized operational scores (0% or 100%) seen in Falaba are more extreme than in most distributions of published KAP.

### 4.2 Veterinary advice, prescription and willingness to pay

In Koinadugu, 100% of respondents have positive attitudes towards prescriptions, contrasting 54.55% of those who had recommendations of using antibiotics at least sometimes. Meanwhile, Falaba represents another trend: there are no positive attitudes to the prescription statement, but 58.48% of respondents are ready to pay for veterinary advice and 45.03% actually use it at least sometimes. This suggests that willingness to use, access to advice and beliefs are different concepts. A training program that mixes up these concepts is unlikely to be effective.

Thus, the policy implication includes combining education with provision of services. Mobile veterinary days, community animal health referral systems, standard treatment cards and monitoring of agro-veterinary outlets would make willingness an action. Education is important to let the farmers know that an improvement in symptoms does not equate to treatment completion and that consultations should be undertaken before the first dose of antibiotics is administered.

**4.3 The attitude-practice gap**

The main insight from this analysis is the existence of discrepancy between willingness to take an action and real behavior. In Koinadugu, 100% of respondents supported withdrawal period and record-keeping, but only 5.88% observed withdrawal at least sometimes, while nobody recorded treatments. Although all respondents were ready to undergo training, few took part in it. In Falaba, everybody was ready to apply the alternative approaches, but 90.64% never maintained hygiene and biosecurity, and only 64.32% vaccinated their animals at least sometimes. This means that willingness is a necessary but insufficient condition for a rational use of antibiotics. Such a pattern is supported by the data from Africa. Caudell et al. (2020) reported the correlation coefficients of about 0.36 and 0.30 between knowledge-attitude and attitude-practice, respectively, but only in one out of five countries knowledge predicted practice. In Sierra Leone, 70% of the respondents had adequate knowledge and positive attitudes, but these were not observed in the practice. Bangura et al. (2022) reported that one-fourth of sick livestock was given antibiotics, and the critical antimicrobials for both veterinary and human health were being used in this area. Thus, there is a need to combine farming with the monitoring and stewardship of antimicrobial use. Further research supports this non-linear pattern. Tufa et al. (2023) found that 94% had poor knowledge and 97% had negative attitudes towards antibiotic resistance in Ethiopia, but 80% of the respondents meet the criterion of good behavior. In addition, Hirwa et al. (2024) reported that 52.6% had correct knowledge, 56.0% had good attitudes, and 52.8% had correct practices among 441 cattle producers in Rwanda; the correlation between knowledge and practice was 0.080, whereas the attitude-practice correlation was 0.338. Risky behaviors were widespread: 83.9% bought antimicrobials from friends/neighbors, 61.9% used them for growth promotion, and 48.1% did not follow the treatment regimen.

Most recent publications support this empirical evidence. In Tanzanian layer farms, 95.6% do not observe the withdrawal periods, according to Mdemu et al. (2025), while mean knowledge, attitude and practice scores are 55.5%, 69.1% and 50.9%. In Zambia, Mumbula et al. (2026)

reported that 64.34% of respondents had positive attitudes, but 59.97% had inappropriate practices; 95.62% agreed with veterinary prescriptions, yet 66.45% thought treatment could be stopped upon symptom improvement. The attitude-practice correlation was weak (rho = 0.18), and the knowledge-practice correlation was insignificant (rho = 0.02). Therefore, the case of Koinadugu is just an extreme example of the regional trend.

**4.4 Treatment completion, withdrawal periods and food safety.**

Universal non-completion of treatment in both districts is the most evident immediate challenge in stewardship. Firstly, it makes treatment failures more likely, while adding to suboptimal bacterial exposure to the treatment regimen. Not any less dangerous is adherence to withdrawal period: 94.12% of Koinadugu and 100% of Falaba respondents indicated they Never or Rarely followed this requirement. Non-adherence at 95.6% level in 2025 Tanzania demonstrates that the problem is regional and not isolated. Intervention strategy should incorporate product-specific withdrawal cards, dosing date marking and market-level verification rather than raising awareness only.

**4.5 Implications for Antimicrobial Stewardship**

Big district effects suggest that one universal programme will not work. In Koinadugu, intervention strategy should capitalise on existing positive predispositions and make practices out of them: supervised dosing, completion of treatment, registering of withdrawal period, treatment registry, vaccinations and referrals for diagnostics. In Falaba, intervention strategies should work simultaneously on changing of norms and delivery of services related to veterinary prescription, AMR causes, withdrawal periods, avoidance of growth promotion, record keeping and proper treatment. Willingness of 58.48% to pay for advice and full willingness to use alternative medications and to undergo training can serve as starting point for community-based programmes.

Intervention strategies at system level can be formulated as follows: (1) mobile clinics; (2) implementation of prescription-only policy combined with training and supervision of agro-veterinary sellers; (3) pictorial treatment and withdrawal cards appropriate for illiterate population; (4) specimen referral and affordable diagnosis; and (5) mandatory AMU reports on regular basis along with animal health surveillance. Although Konteh et al. (2023) described certain improvements in Sierra Leone livestock surveillance system, they also outlined existing challenges with laboratory AMR testing and detailed treatment registration. This study, thus, has identified specific farm practices which should be addressed within surveillance and laboratory efforts.

**5.0 Study limitations and publication cautions**

The cross-sectional research design allows association and comparison but not causal inference. Self-reported knowledge, attitudes and practices can be influenced by recall, social desirability and interviewer effects. Clustering of Falaba responses at extremes scale might indicate actual polarisation but response style bias could also persist regardless of coding validation.

The district test has not taken into consideration clusters of chiefdoms or possible confounders of demographic factors; multilevel and/or ordinal regression models could be used if individual level data is available.

**6.0 Conclusion**

In both studied districts, livestock keepers demonstrated weak foundational knowledge and widespread misuse of antibiotics; however, there was a significant difference in the attitude profile of the two groups. Koinadugu showed higher favorability for all stewardship components, but still had a significant gap in implementation. Falaba demonstrated negative or ambiguous attitudes toward all traditional stewardship strategies, but extremely positive attitudes toward being ready to training and collective actions and alternative ways of disease prevention. All differences in the attitude profile of the participants, measured in the study, were highly statistically significant, and large, despite multiple-testing correction. Data obtained from 2019 until 2026 proves that the KAP discrepancy is a common phenomenon among livestock enterprises and is determined by the access and conditions of production, veterinarians and regulation.

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**Data availability**

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## Declarations

**Ethics approval and consent to participate**

The author(s) declare that it is not applicable.

**Consent for publication**

The author(s) declare that this is not applicable.

**Competing interests**

The author(s) declare that they have no competing interests.

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