Archives of Life Sciences Research
eISSN:3052-3850

Research article

Assessment of livestock owners' knowledge, attitudes, and practices regarding the use and resistance of antimicrobials in Ethiopia

Zinash Woldemichael[1], Kidist Jifar[2], Kedir Yusuf[3*] and Yemiserach Negash[4]

[1] Halaba Zone Agricultural Office, Central Ethiopia
[2] Epidemiology Directorate of the Ministry of Agriculture, Addis Ababa, Ethiopia
[3] Melka Belo Woreda Agricultural Offices, East Hararghe Zone, Oromia, Ethiopia
[4] Tula Sub-City Chefe Agricultural Office, Sidama Region, Southern Ethiopia

Article History:
Received: 3-Apr-2025
Accepted: 5-May-2025

***Correspondence author:**
Kedir Yusuf
kedayusuf@gmail.com

Abstract

Antimicrobial resistance (AMR), which refers to the reduced effectiveness of antimicrobial agents against microorganisms, is a growing concern primarily driven by improper and excessive antimicrobial use (AMU), especially in animal production, where usage surpasses that in human health sectors. This study aimed to assess the knowledge, attitude, and practice (KAP) of livestock owners regarding AMU and AMR in Kulito Town, Halaba Zone, Central Ethiopia. A cross-sectional survey was conducted in five selected kebeles, collecting data from 384 livestock owners through structured, face-to-face interviews. The findings revealed that 60.2% of respondents used antibiotics for their livestock, often from informal sources. Educational status was significantly associated with knowledge (OR=1.30, 95% CI=1.04–1.62, p<0.05) but not with attitude or practice. Most participants were not aware of the causes and solutions for AMR, although 44.8% recognized poor awareness as a major contributing factor. Complementary treatments were often viewed as effective alternatives to reduce antibiotic use and resistance. The study highlights the need for increased awareness and targeted interventions to promote responsible AMU and combat AMR among livestock owners in the region.

Keywords: Animal owners, Antimicrobial use, Antimicrobial resistance, Questionnaire, and Halaba kulito

Citation: Woldemichael, Z., Jifar, K., Yusuf, K., and Negash, Y. 2025. Assessment of livestock owners' knowledge, attitudes, and practices regarding the use and resistance of antimicrobials in Ethiopia. Arch. Life. Sci. Res. 1 (1): 23–36. https://doi.org/10.51585/alsr.2025.1.0004

Introduction

Antimicrobials are the drugs of choice for treating infections in both humans and animals, exhibiting a variety of chemical and biological properties. Additionally, antimicrobials are used for chemotherapeutic and prophylactic purposes, as well as promoting growth and improving feed efficiency in animals. Since their invention, antimicrobials have saved millions of human and animal lives and enhanced their quality of life. Antimicrobial use (AMU) in the livestock sector is increasing daily due to the livestock revolution, particularly in middle- and low-income countries, driven by the rising demand for animal-source food and livestock farmers' desire for quicker growth to maximize profits (Hossain et al., 2022).

Antimicrobial use in the agricultural sector is projected to increase by 67% by 2030, potentially further compromising the effectiveness of medicines for both animal and human health. The interconnectedness of antimicrobial use in agriculture and public health makes antimicrobial resistance (AMR) the "quintessential One Health issue" of our time, requiring collaboration across disciplines, sectors (public and private), and scales (locally, globally) to better manage AMR in people, animals, and the environment (Caudell et al.,

2020). Globally, AMR can pose serious threats to public health systems and the economy. It is projected that 10 million lives could be lost by 2050 due to AMR (Muhummed et al., 2024). In many high-income countries, monitoring and AMU stewardship programs are implemented. In low- and middle-income countries (LMICs), relatively little is known about AMU and the factors influencing it. LMICs face several institutional challenges in implementing AMU stewardship measures in animal production. Inconsistent policies governing AMU in animal production, the absence of AMU regulations that restrict access to critically important antimicrobials without a prescription, and the lack of systematic post-market quality surveillance of veterinary antimicrobials are the most critical challenges. In addition to these institutional challenges, the prudent use of antimicrobials also depends on farmers' behavior, and it has been noted that a lack of AMR awareness and risk perception is essential (Tufa et al., 2023).

Many factors, particularly excessive and inappropriate use of antibiotics, contribute to the development of resistance. Misdiagnosis, patient demand, socio-cultural differences, and people's knowledge, beliefs, expectations, and attitudes toward antibiotics also facilitate the emergence and spread of antibiotic-resistant microorganisms. In addition, several misapplications by patients have been reported, including failure to complete treatment, skipping doses, reusing residual drugs, misusing antibiotics for viral infections, and using non-rational antibiotics, such as self-treatment (Ozturk et al., 2019). AMR is a significant concern for most African countries, particularly those with low and middle incomes, which are associated with poverty, a high prevalence of infectious diseases, and uncontrolled antimicrobial use in animals and humans. There is little information regarding AMU and AMR in Ethiopia. A few studies conducted in the country revealed the presence of antimicrobial residues in animal-origin food and poor AMU practices among food animal-rearing communities (Bulcha et al., 2024).

Human health can be affected by drug residues in food of animal origin, potentially causing direct side effects or, indirectly, through the selection of antibiotic resistance determinants that may spread human pathogens. Resistant microorganisms can reach humans either through direct contact or indirectly via milk, meat, and/or eggs. Clearly, the use of antibiotics in livestock production is associated with the development of human antibiotic resistance. It has been documented that human develop drug-resistant bacteria, such as *Salmonella, Campylobacter*, and *Staphylococcus*, from food of animal origin (Yusuf and Abrahim, 2023).

The United Nations (UN), the WHO, the United Nations Food and Agriculture Organization (FAO), the World Organization for Animal Health (OIE), the World Bank, the World Economic Forum, and several other international organizations recognized AMR as a serious public health threat and global priority. As the world moves toward post-millennium development to sustainable development goals (SDGs), food safety is a critical element in improving and strengthening global health security and ensuring sustainable development (Founou et al., 2021). The global rise of AMR is linked to higher mortality rates as well as the spread of resistant strains within and between healthcare facilities. This has also created a greater demand for limited patient care resources. Despite efforts to raise awareness and implement antimicrobial management policies, the prevalence of resistant strains causing community-associated infections continues to grow, while the development of new antimicrobials remains limited. Furthermore, AMR pose a severe threat to the well-being of the general public and have resulted in adverse outcomes like serious illness, prolonged hospital stays, persistent disability, increasing healthcare expenditure, an overburdened public healthcare system, increased costs of alternative medications and treatments, ineffectiveness, and increased mortality rates (Atalay et al., 2024).

The FAO's assessment of the AMR is presented in the document for 2022–2023; only 34% of countries reporting through the AMR Country Self-Assessment Survey stated that they systematically collected and reported AMR surveillance data for food-producing terrestrial animals, aquatic animals, and plants. Fewer than 20% had established a national system of AMR surveillance for priority foodborne pathogens and/or relevant indicator bacteria that followed quality assurance processes aligned with intergovernmental standards. Approximately 63% of countries reported using antimicrobial consumption data to adjust national strategies or inform decisions decision-

making. Furthermore, 47%, 25%, 11%, 17%, and 24% of countries, respectively, reported taking these actions for the terrestrial animal health, aquatic animal health, plant health, food production, and food safety sectors (FAO, 2024).

An estimated 4.95 million deaths were associated with bacterial AMR in 2019, according to a systematic analysis of the global burden of bacterial AMR. Sub-Saharan Africa had the highest all-age death rate attributable to or associated with AMR at 23.7 deaths per 100,000 people. A higher burden of AMR has been reported in countries where people have inadequate knowledge about it (Woldegeorgis et al., 2023). A growing amount of evidence shows that farmers' high AMU is associated with their knowledge, attitudes, education level, and farming experience. Studies conducted in East Africa on the knowledge, attitudes, and practices (KAP) of cattle farmers have highlighted the association between KAP and AMU at the farm level and the possible emergence of AMR (Hirwa et al., 2024).

Ethiopia is believed to have the largest livestock population in Africa. This livestock sector has been contributing a considerable portion to the country's economy. The livestock population of Ethiopia is estimated to be 70 million cattle, 42.9 million sheep, 52.5 million goats, 8.1 million camels, and 57 million chickens (Yusuf et al., 2024). A meta-analysis study of antimicrobial resistance in Ethiopia showed that the pooled prevalence of AMR in bacteria from food-producing live animals was 20%. In milk, food handlers, and environmental samples, the rate was 29%, and in meat, it was 28%. Another recent meta-analysis also revealed the presence of high MDR in most bacterial species from humans, animals, food, and environmental sources in the country (Kallu et al., 2024).

In Ethiopia, both the public and private sectors are involved in providing veterinary services. Veterinarians and para-veterinarians are expected to use the Standard Veterinary Treatment Guidelines (SVTG) to diagnose and treat diseases. They should also use the Essential Veterinary Drug List (EVDL) to select appropriate drugs and keep written records of cases encountered at clinics. The country has district veterinary clinics (types B and C), animal health posts (type D clinics at the village administration level), and livestock extension agents. There are also community animal health workers (CAHWs) with a limited level of training who assist with the delivery of animal health services in remote pastoral areas. Despite several reforms and efforts to improve animal health care and access to veterinary pharmaceuticals, the quality of veterinary services in the public sector in Ethiopia remains substandard. In response to the global threat posed by AMR to both human and animal health, Ethiopia has also established its third strategic plan (2021–2025) to prevent and contain AMR by adopting the One Health approach, with strategic objectives to optimize AMU in veterinary practice and agriculture (Tufa et al., 2024).

Ethiopia's livestock regulations on AMU and AMR are poorly enforced, with farmers having easy access to veterinary drugs. Trained veterinarians do not supervise the use of drugs, and the knowledge, attitudes, and practices of livestock owners are not adequately assessed. The study aims to explore the knowledge, attitudes, and practices of livestock owners in Kulito town regarding antibiotic use and resistance. The primary objective of this study is to assess the knowledge, attitudes, and practices of livestock owners in Kulito Town, Halaba Zone, regarding AMU, AMR, and antimicrobial residues. Specifically, the study aims to evaluate livestock disease management practices, examine livestock owners' awareness and understanding of AMU and AMR, and identify the perceived causes of antimicrobial resistance as well as potential solutions to address it.

Materials and methods

Study area

The study was conducted from May 2023 to July 2023 in the Halaba Zone. Kulito town is located in the Central Ethiopia Region (CER), at a distance of 85 km from Hawassa town and 245 km from Addis Ababa, the capital city of Ethiopia. The district has 12 kebeles. The study site is found within an altitude range of 1554 to 2149 m above sea level. Kulito town is generally characterized by dry climatic conditions with about 86% mid-land (Weinadega) and 14% low-land (Kola) zones. The mean annual rainfall of the study area ranges from 857 to 1085 mm, while the mean annual temperature varies from 17 to 20°C, with a mean value of 18°C. The livestock populations of the town are bovine (66,421), poultry (88,903), goats (19,456), sheep (14,517), equines (10,897), and dogs (2,120) (not

including stray dogs).

Study design

A cross-sectional survey study was conducted among eligible livestock owners from May to July 2023. A total of 384 animal owners participated by answering targeted questions regarding their socio-demographic traits, livestock disease management techniques, and their understanding, perspectives, and behaviors regarding the use of antibiotics and antibiotic resistance.

Sampling

The sample size for assessing KAP towards AMU and AMR was calculated based on the suggestions of (Barlett et al., 2001). Barlett and his research team suggested that for every type of cross-sectional survey, the following formula is more appropriate than others.

N=(1.96)^2 P exp (1-P exp)/d^2

Where:

N = required sample size

P exp=expected prevalence

D = desired absolute precision

1.96 = z-value for 95% confidence interval

Since no study was done about the KAP of livestock owners towards AMR and AMU in the study area, 50% for the p-value, 95% (1.96) for the z-value, and 5% for the e-value were taken. As a result, the sample size was calculated as follows.

N=(1.96)^2 0.5 (1-0.5)/(0.05)^2 = 384 samples for the assessment

Respondents were selected throughout the municipality using a multi-stage sampling technique. The initial five kebeles, Mehal Arada, Denebe Fame, Wanja, Lendabere, and Murasa, were selected at random from Kulito town. From these kebeles, 384 livestock owners from the study area were carefully chosen. A simple random sample technique was then used to select research participants after individuals were allocated proportionately to each kebeles based on their respective populations. Livestock owners are predisposed to meeting particular prerequisites, including admission, consent to fill out the questionnaire, and residency in the district for a minimum of six months prior to the study's start. Volunteer livestock owners who live in a community that fits the prerequisites and are above 20 years old were included in the assessment of KAP of the community, which involved a questionnaire survey. Likewise, those who were reluctant to participate but had been in the selected area residence for more than six months during the study period were excluded.

Data collection tools and procedures

The researcher created a structured questionnaire with three sections: socio-demographic information, knowledge, attitudes, and practices regarding antibiotic use and resistance.

Data quality control, validation, management, and analysis

The data was entered and examined using STATA version 13 statistical analysis, which included logistic regression and chi-square analysis. The completed questionnaires were manually reviewed for data quality prior to coding. Lastly, a summary of descriptive statistics was provided, including percentages and frequency distributions. 10% of the study population who were excluded from the final study were given paper-based questionnaires to pretest in order to confirm the questionnaire's uncomplicatedness. The pilot survey's results were used to modify the paper-based questionnaire's contents slightly, and comments from a variety of sources were incorporated. The researcher regularly trained and observed the data collectors.

Results

Socio-demographic characteristics of the surveyed population

Socio-demographic information analyzing demographic factors revealed that 48% of respondents were between the ages of 31 and 40. Male participants outnumbered female participants by a margin of 59.9% to 40.1%. Males' exposure to meetings, training, and the media in the research area may be the cause of this. The majority of livestock owners (31.5%) had raised cattle, a small percentage of participants (10.4%) had raised poultry, and 27.6% of respondents had raised only food animals. Only cattle, sheep, goats, and poultry are used as food animals in the research area. Other animal species are prohibited from being consumed in the study region due to cultural and

religious reasons. 39.1% of the 384 respondents indicated their level of education is in high school, and 29.9% have a diploma or degree. Of the respondents, 5.7% are illiterate, and 25.3% are in primary school. Participants were involved in questionnaires from five kebeles, ranging from 18.8% to 22.7% (Table 1).

Table 1: Socio-demographic characteristics of livestock owners (N=384).

Characteristics	Categories	Respondents' responses (n:384)	
		Numbers	Percent
Age	20-30	54	14.1
	31-40	184	47.9
	41-50	111	28.9
	>50	35	9.1
Gender	Male	230	59.9
	Female	154	40.1
Education Level	Diploma or degree	115	29.9
	High school (grades 9-12)	150	39.1
	Primary school (1-8)	97	25.3
	Illiterate	22	5.7
Residence	Mehal arada	75	19.5
	Denebe fame	87	22.7
	Wanja	74	19.3
	Lendabere	76	19.8
	Murasa	72	18.8
Animals reared	Cattle	121	31.5
	Sheep	52	13.5
	Goat	65	16.9
	Poultry	40	10.4
	All animal types	106	27.6

Livestock disease management practices

The majority of livestock owners (58%) experience one to three animal illnesses annually, and 77.3% of respondents reported visiting a government animal health center when their animals became sick. Every respondent (100%) explained what animal vaccination is. Vaccines are used to prevent animals from getting sick, cure sick animals, and prevent and cure sick animals (both), according to more than 65% of respondents. Livestock owners who were questioned about the diseases and animal species for which vaccinations are available immunized their animals against the following primary livestock diseases: Of the respondents, 43.5% were aware of anthrax for all animals, 23.2% were aware of Peste des petits ruminants (PPR) for sheep and goats, 19.5% were aware of Newcastle disease (NCD) for poultry, and 13.8% were aware of lumpy skin disease (LSD) and Blackleg for bovine disease.

The majority of respondents were able to identify the common illnesses that their animals face, as well as the name of at least one antibiotic (medication) they had used on their animals. Most responders could name at least one antibiotic (medication) they were familiar with and primarily used for their animals, along with the prevalent infections they encountered. Twenty-five percent say oxytetracycline is good for pneumonia, coughing, and depression; 20.3% believe penstreps and tetracycline are effective for anthrax; and 18% say ivermectin and albendazole are beneficial for ectoparasites and endoparasites. Multivitamins are mentioned by 14.6% of respondents for loss of appetite and by 13% for diarrhea and emaciation (albendazole and sulfa medications). 8.9% of cases show signs of mastitis (Penstrep and fortified procaine penicillin (PPF). Eighty-one percent of livestock owners faced various challenges when caring for their animals. Of them, 35.4% claimed that medications are costly, and 41.4% claimed that they were ineffective in treating their animals. The rest are mentioned in Table 2.

Table 2: Livestock disease management practices.

Characteristics	Categories	Respondents' responses (n:384)	
		Numbers	Percent
How frequently, on average, did any of your animals get sick? Annually	1-3 times/year	222	57.8
	more than 4 times/year	162	42.2
Are you aware of what an animal vaccination is?	Yes	384	100.0
	No	0	0
What are vaccinations?	Prevent animals from becoming sick	250	65.1
	Cure sick animals	45	11.7
	Both above	89	23.2
When treating animals, have you encountered any recurrences or challenges?	Yes	314	81.8
	No	70	18.2
What difficulties do you encounter when caring for your animals?	No medicines available	66	17.2
	Medicines are expensive	136	35.4
	Medicines are not working to treat the disease.	182	47.4

The knowledge of livestock owners towards AMU and AMR

69.8% of survey participants heard about or were aware of antibiotic resistance from various sources, and 81.3% of respondents (livestock owners) understood what antimicrobials meant. Since antibiotics can be used to treat sick animals, 60.7% of respondents gave the right answer (Table 3). Over 12% of those surveyed said antibiotics are used to keep animals healthy, and 27.3% said they are used to both prevent and treat illness in animals. Not a single respondent (100%) was aware that antibiotics should be used to promote animal growth. When asked if they were aware of antimicrobials used for purposes other than their current use, 62.8% of respondents said they were (Table 3).

When asked to describe antibiotic resistance, 31.5% of respondents stated that antibiotics do not cure sick animals, 21.6% mentioned that drugs of poor quality (contraband) do not cure sick animals, and 16.7% noted that inappropriate use of antibiotics could result in AMR. According to 52.9% of participants, using antibiotics carelessly in animal production can result in adverse externalities for society, such as AMR (Table 3).

More than half of the respondents had a good knowledge level. Only educational level was significantly associated with the knowledge level of the livestock owners ($p<0.05$) (Table 4).

The attitude of livestock owners towards AMU and AMR

The respondents' attitudes toward AMU and AMR were assessed using two modalities (agree and disagree) for all attitude-related questions. 51.8% of respondents stated that "good farm hygiene and proper feeding could be a solution to cure AMR," and 85.2% indicated that "seeking advice from veterinarians or AHCP regarding their animal health management and AMU is relevant" (Table 5). 22.7% of respondents agreed with the assertion that "using the wrong antimicrobials cannot cure sick animals," and over 24.7% disagreed with the idea of creating new medications as a potential remedy for AMR (Table 5). It was also evaluated how the farmers perceived the reasons behind "antimicrobials not working properly or unable to cure sick animals." The findings showed that only a small percentage of farmers thought that animal overpopulation and poor farm hygiene (51.8%), owner self-prescription (60.7%), AMR cause antimicrobials unable to cure sick animals (61.2%), incorrect use of antibiotics (77.3%), poor adherence to proper treatment (31.8%), and improper feeding practices (97.3%) were potential causes (Table 5). It was also determined how farmers viewed the AMR solution. 55.2% of the individuals raised awareness of AMR, which could be the key to lowering it (Table 5). 48.4% appropriate identification and treatment of disorders may help lower AMR. 33.3% of appropriate waste disposal systems might be the answer to lowering AMR (Table 5). According to 66.7% of respondents, a suitable waste disposal system might not be the answer to lowering AMR (Table 5). According to 69.3% of respondents, following the suggested drug withdrawal period could be an AMR approach (Table 5). More than half of the livestock owners had a good attitude towards AMU and AMR. All demographic variables are insignificantly associated with the attitude towards AMU and AMR of the livestock owners ($p>0.05$) (Table 6).

Table 3: The Knowledge of livestock owners towards AMU and AMR.

Characteristics	Categories	Respondents' responses (n:384)	
		Numbers	Percent
Do you know what antimicrobials mean?	Yes	312	81.3
	No	72	18.8
What antimicrobials do?	Cure sick animals	233	60.7
	Prevent animals from becoming sick	46	12.0
	Both above	105	27.3
Do you board antimicrobials for later use other than the current use?	Yes	241	62.8
	No	143	37.2
Do you know that antimicrobials that are used to treat infections in animals may not work if not used properly?	Yes	203	52.9
	No	181	47.1
Have you heard /know about antimicrobial resistance?	Yes	268	69.8
	No	116	30.2
If yes, would you explain it? About antimicrobial resistance?	Medicines are not working to treat diseases	121	31.5
	Antimicrobials not appropriately used lead to antimicrobial resistance	64	16.7
	The use of contraband medicines does not treat diseases	83	21.6

Table 4: Factors associated with community knowledge of AMU and AMR of livestock owners.

Characteristics	Category	Knowledge		Chi-quare	p-values
		Good	Poor		
Age	20-30	38(9.90%)	16(4.17%)	3.4795	0.323
	31-40	107(27.86%)	77(20.05%)		
	41-50	70(18.23%)	41(10.68%)		
	>50	19(4.95%)	16(4.17%)		
Gender	Male	147(38.28%)	83(21.61%)	2.1332	0.144
	Female	87(22.66%)	67(17.45%)		
Education level	Diploma or degree	66(17.19%)	49(12.76%)	9.6479	0.022
	High school (grades 9-12)	52(13.54%)	45(11.72%)		
	Primary school (1-8)	97(25.26%)	53(13.80%)		
	Illiterate	19(4.95%)	3(0.78%)		
Residence	Mehal arada	52(13.54%)	23(5.99%)	3.6222	0.460
	Denebe fame	48(12.50%)	39(10.16%)		
	Wanja	46(11.98%)	28(7.29%)		
	Lendabere	45(11.72%)	31(8.07%)		
	Murasa	43(11.20%)	29(7.55%)		
Animal type they reared	Cattle	70(18.23%)	51(13.28%)	3.0147	0.555
	Sheep	35(9.11%)	17(4.43%)		
	Goat	42(10.94%)	23(5.99%)		
	Poultry	21(5.47%)	19(4.95%)		
	All animal types	66(17.19%)	40(10.42%)		

Table 5: The Attitude of livestock owners towards AMU and AMR.

Characteristics	Categories	Respondents' responses (n:384)	
		Numbers	Percent
It is important to get a consultation from a veterinarian before giving antimicrobials to animals (Yes/Agree).	Yes	327	85.2
	No	57	14.8
AMR can cause antimicrobials to be unable to cure sick animals (Yes/Agree)	Yes	235	61.2
	No	149	38.8
Poor adherence to treatment can cause antimicrobials to be unable to cure sick animals (Yes/ Agree)	Yes	122	31.8
	No	262	68.2
Poor quality medicine can cause antimicrobials not to work properly (Yes/Agree)	Yes	327	85.2
	No	57	14.8
Using the wrong antimicrobials cannot cure sick animals (Yes/Agree)	Yes	297	77.3
	No	87	22.7
Poor farm hygiene and animal overcrowding can contribute to antimicrobials not working properly (Yes/Agree)	Yes	168	43.8
	No	216	56.3
Poor animal feeding practices can cause antimicrobials not to cure sick animals (Yes/Agree)	Yes	306	79.7
	No	78	20.3
Animal owners' self-prescription may cause antimicrobials not to work properly (Yes/Agree)	Yes	233	60.7
	No	151	39.3
Good awareness of AMR might be a solution to curb AMR (Yes/Agree)	Yes	212	55.2
	No	172	44.8
Good farm hygiene and proper feeding could be solutions to curb AMR (Yes/Agree)	Yes	199	51.8
	No	185	48.2
Proper disease diagnosis and treatment might be a solution to curb AMR (Yes/Agree)	Yes	186	48.4
	No	198	51.6
A proper waste disposal system could be a solution to curb AMR (Yes/Agree)	Yes	128	33.3
	No	256	66.7
Adhering to the recommended drug withdrawal period could be a solution to curb AMR (Yes/Agree)	Yes	118	30.7
	No	266	69.3
Developing new medicine could be a solution to curb AMR (No /disagree)	Yes	289	75.3
	No	95	24.7

Table 6: Factors associated with community attitudes of AMU and AMR of the livestock owners.

Characteristics	Category	Attitudes		Chi-quare	p-values
		Good	Poor		
Age	20-30	26(6.77%)	28(7.29%)	1.6437	0.650
	31-40	96(25.00%)	88(22.92%)		
	41-50	54(14.06%)	57(14.84%)		
	>50	21(5.47%)	14(3.65%)		
Gender	Male	111(28.91%)	119(30.99%)	2.1232	0.145
	Female	86(22.40%)	68(17.71%)		
Education level	Diploma or degree	66(17.19%)	49(12.76%)	3.0748	0.380
	High school (grades 9-12)	47(12.24%)	50(13.02%)		
	Primary school (1-8)	75(19.53%)	75(19.53%)		
	Illiterate	9(2.34%)	13(3.39%)		
Residence	Mehal arada	39(10.16%)	36(9.38%)	2.0206	0.732
	Denebe fame	49(12.76%)	38(9.90%)		
	Wanja	39(10.16%)	35(9.11%)		
	Lendabere	37(9.64%)	39(10.16%)		
	Murasa	33(8.59%)	39(10.16%)		
Animals reared	Cattle	58(15.10%)	63(16.41%)	1.7101	0.789
	Sheep	27(7.03%)	25(6.51%)		
	Goat	37(9.64%)	28(7.29%)		
	Poultry	19(4.95%)	21(5.47%)		
	all animal types	56(14.58%)	50(13.02%)		

The practice of livestock owners towards AMU and AMR

Eleven practice-related questions were used to assess the animal owners' AMU and AMR practices (Table 7). "To treat sick animals or infection treatment" (52.9%) was the main reason for AMU on their farms. "Infection prevention or prophylaxis" (10.7%) and "both infection prevention and treatment" (14.3%) were the next most common reasons. Farmers' evaluation of the sources of antimicrobials revealed that they were self-selected (11.7%), prescribed by AHCP (61.5%), and suggested by neighbors or coworkers (4.7%). The majority of livestock owners reported obtaining antimicrobials via human pharmacies (6.8%), veterinary clinics (60.4%), and veterinary pharmacies or drug vendors (32.8%). More than 77.9% of all

respondents used antibiotics for their animals at least once (36.2%), two to five times (30.7%), more than five times (7.3%), and only when their animals were ill during the one month before the interview. Additionally, this survey found that 11.7% of all respondents self-prescribed, 61.5% received prescriptions from medical professionals, and 4.7% suggested antimicrobials to their neighbors. According to the response to the question about whether or not farmers stop giving their animals antibiotics before the prescribed length of therapy, 44.8% of them do so. The main reasons were that the antimicrobials did not heal sick animals (22.7%), that the animal was thought to be disease-free (15.6%), and that the medication was saved for later use (6.5%). Additionally, farmers were questioned about how they administered a whole dose of antimicrobials for the recommended duration. According to their response, 64.3% of them did not give the sick animals their entire dosage of medication. The primary reasons for this were that they thought the treatment was adequate (22.4%), that they did not have enough money to purchase the remaining medication or pay for veterinary care (9.4%), and that they had been instructed to do so by others (3.9%). More than half of the livestock owners had good practices towards AMU and AMR. All demographic variables are insignificantly associated with the practices towards AMU and AMR of the livestock owners (p> 0.05) (Table 8).

Table 7: The practice of livestock owners towards AMU and AMR.

Characteristics	Categories	Numbers	Percent(n:384)
Have you ever used antimicrobials for your animals in the last month?	Yes	299	77.9
	No	85	22.1
If yes, why do you use antimicrobials? Because I wanted to?	Treat a sick animal	203	52.9
	Preventing being sick	41	10.7
	Both	55	14.3
If yes to Q15, were the medicines used?	prescribed by a healthcare provider	236	61.5
	self-selected	45	11.7
	Recommended or given by neighbors	18	4.7
How frequently do you use antimicrobials over 1 1-month period?	Once	139	36.2
	2-5 times	118	30.7
	more than 5 times	28	7.3
	Only when animals are sick	99	25.8
What are the sources of antimicrobials you used?	Vet pharmacies	126	32.8
	Human pharmacies	26	6.8
	Veterinary clinics	232	60.4
Have you ever self-prescribed antimicrobials for your or your neighbors' sick animals?	Yes	114	29.7
	No	270	70.3
Do you administer the full dose and course of the antimicrobials as recommended?	Yes	247	64.3
	No	137	35.7
If No to Q23, why not?	Have insufficient money	36	9.4
	Believed that it is sufficient	86	22.4
	Advised by others	15	3.9
Do you ever stop giving antimicrobials before you are supposed to?	Yes	172	44.8
	No	212	55.2
If yes to Q25, why did you stop giving antimicrobials?	To save for later use	25	6.5
	Because the antimicrobials do not work	87	22.7
	Believed that the animal has improved or cured	60	15.6
If the antimicrobials in your hands or those for some reason are expired, what do you do with them?	Will use them when needed	47	12.2
	Will not use them	106	27.6
	Throw away	173	45.1
	Return to where you bought	58	15.1

Association of demographic data with the KAP of animal owners

The educational status of the animal owners in this study was significantly associated with their knowledge (OR =1.300265, 95% CI=1.041549-1.623246, p<0.05) and an insignificant association with attitude and practice towards AMU and AMR. Except for educational status in the case of knowledge, all other demographic variables (gender, residence, age, and animal type) were not associated with the KAP of animal

producers. The educational status of the animal owners in this study was significantly associated with their knowledge (OR =1.300265, 95% CI=1.041549-1.623246, p<0.05) and an insignificant association with attitude and practice towards AMU and AMR. Except for educational status in the case of knowledge, all other demographic variables (gender, residence, age, and animal type) were not associated with the KAP of animal producers.

Table 8: Factors associated with community practices of AMU and AMR of the livestock owners.

Characteristics	Category	Practices		Chi-quare	p-values
		Good	Poor		
Age	20-30	27(7.03%)	27(7.03%)	3.8751	0.275
	31-40	103(26.82%)	81(21.09%)		
	41-50	72(18.75%)	39(10.16%)		
	>50	20(5.21%)	15(3.91%)		
Gender	Male	127(33.07%)	103(26.82%)	1.5836	0.208
	Female	95(24.74%)	59(15.36%)		
Education Level	Diploma or degree	69(17.97%)	46(11.98%)	2.0350	0.565
	High school (grades 9-12)	60(15.63%)	37(9.64%)		
	Primary school (1-8)	82(21.35%)	68(17.71%)		
	Illiterate	11(2.86%)	11(2.86%)		
Residence	Mehal arada	33(8.59%)	42(10.94%)	9.4952	0.050
	Denebe fame	53(13.80%)	34(8.85%)		
	Wanja	48(12.50%)	26(6.77%)		
	Lendabere	49(12.76%)	27(7.03%)		
	Murasa	39(10.16%)	33(8.59%)		
Animal type they reared	Cattle	61(15.89%)	60(15.63%)	8.4658	0.076
	Sheep	30(7.81%)	22(5.73%)		
	Goat	47(12.24%)	18(4.69%)		
	Poultry	22(5.73%)	18(4.69%)		
	All animal types	62(16.15%)	44(11.46%)		

Discussion

The current study assessed the knowledge, attitudes, and practices of AMU and AMR and factors associated with knowledge among livestock owners in Kulito town, Central Ethiopia. Of the 384 total participants in this study, the majority of animal producers (69.8% and 81.3%) were knowledgeable about AMU and AMR in animal production, respectively. Knowledge, attitudes, and practices concerning AMU and AMR are critical for combating global antimicrobial resistance (Bharti et al., 2020). The reduction of AMR in the animal industries sector requires intervention from all stakeholders (e.g., veterinary students, para-vets, drug and feed sellers, and farmers), and especially from veterinarians (Kalam et al., 2022).

Inappropriate use of antimicrobials, especially antibiotics shared between humans and animals, plays a vital role in the emergence of AMR. Livestock diseases are a priority problem for livestock keepers throughout Ethiopia and other low-income countries that have a substantial livestock population and diversified climatic conditions that favor the presence of pathogens. Antimicrobials are widely used to manage various diseases. The livestock keepers' access to, use of, and satisfaction with animal health services significantly vary across livestock production systems, geographic locations, socioeconomic strata, and service providers. Varied resistance levels of drug-resistant bacteria have also been reported in livestock, farm environments, and among farm employees, posing serious public health threats in low-income countries, including Ethiopia. Hence, monitoring AMU in livestock provides valuable information for policy development to mitigate AMR risks (Tufa et al., 2023).

In addition, many antimicrobials are used by farmers, particularly livestock producers (Founou et al., 2021). In keeping with this, the assessment of livestock producers' KAP, on the other hand, is the foundation for raising awareness and developing appropriate legislation regarding antimicrobial use and resistance, as Ethiopia has the most significant livestock production in Africa (Gebeyehu et al., 2021). The cost of veterinary services is one of the most critical factors leading farmers to use antibiotics without consulting a veterinarian. A study from India showed that only one-third of farmers apply to a veterinarian to reduce veterinary costs (Chauhan et al., 2018). On the other hand, in many countries, farmers can easily buy antibiotics without the need for a prescription (Chauhan et al., 2018; Redding et al., 2013).

In this study, when we see the disease

management practice, more than 65% (250/384) of the respondents correctly explained the use of vaccines for disease prevention. 34.9% do not understand why and when they use vaccines. Most respondents could identify common diseases affecting their animals and the brand name of at least one antibiotic they primarily administered; 25% pneumonia, coughing, depression (oxytetracycline), 20.3% Anthrax (pen-strep and tetracycline), 18% ectoparasites and endoparasites (ivermectin and albendazole), 14.6% inappetence-multivitamin, 13% emaciation and diarrhea (albendazole and sulfa drugs), and 8.9% mastitis (penstrep and PPF). These diseases cause high mortality and decrease animal productivity; most of them pose risks to public health and lower domestic and international marketability (Tadesse Birhanu, 2014).

The antibiotics oxytetracycline, penstrep, and penicillin, anti-helminthics, sulfa drugs, and multivitamins were the most widely used antimicrobials by livestock owners to manage livestock diseases. Ethiopian farmers can get access to these antimicrobials without a prescription. This finding is comparable to the findings in Ethiopia (Tufa et al., 2018; Gemeda et al., 2020; Geta and Kibret, 2021). The primary reason for AMU among livestock producers on their farms in the present study was "to treat sick animals" (52.9%), followed by "prophylactic use" (10.7%) and both (treat sick animals and prophylactic use) at 14.3%. In this study, when we examine the knowledge of livestock owners regarding AMU and AMR, 81.3% of the livestock owners understand what antimicrobials mean, and 62.8% of those surveyed have heard about or know of antibiotic resistance from various sources. Additionally, 60.7% responded correctly that antibiotics can be used to treat sick animals. More than 12% of the respondents stated that antibiotics are used to prevent animals from becoming ill, while 27.3% indicated they are used to both prevent and cure illnesses.

All the respondents (100%) were unaware that antibiotics should be used to promote growth in animals. 62.8% of respondents were asked if they knew of any antimicrobials used outside their current applications. When asked to explain antibiotic resistance, 31.5% of respondents indicated that antimicrobials do not treat sick animals, 21.6% mentioned that low-quality (contraband) products do not treat sick animals, and 16.7% stated that improper use of antibiotics in animal drugs could lead to AMR. Additionally, 52.9% of participants recognized that their reckless use of antimicrobials in animal production can have negative implications for society in the form of AMR.

Antimicrobials are very precious resources for the prevention and control of infectious diseases. Maintaining their efficacy must be among the top priorities of activities in the human, agriculture, and environmental sectors. The development of resistance by disease-causing organisms is the main threat that affects the effectiveness of antimicrobials. The misuse and overuse of antimicrobials accelerate it. Farmers' access to sufficient advice from animal health experts about how to use veterinary drugs will minimize the misuse of antimicrobials on farms. In the current study, most respondents agreed on the importance of getting a consultation from AHCPs before using antimicrobials on animals (85.2%). Comparable to our findings, the study was conducted on livestock producers in Vietnam (95%) (Pham-Duc et al., 2019).

A large proportion (69.3%) of the participants in the present study didn't have complete information about the withdrawal period of antimicrobials from animals. Larger than our finding, 97% of animal producers in Vietnam (Pham-Duc et al., 2019) were knowledgeable about the withdrawal period and its relationship with AMR formation. The majority of livestock owners (77.9%) in this study used antibiotics for their animals in the previous month for different reasons. Most livestock owners obtained antimicrobials from veterinary clinics (60.4%), veterinary pharmacies or drug vendors (32.8%), and human pharmacies (6.8%). This study also noted that 11.7% of the total respondents self-prescribed, health care providers prescribed 61.5%, and 4.7% recommended antimicrobials for their neighbors. Their response indicated that 64.3% did not give a full dose of drugs to the sick animals, with the main reasons being (22.4%) that they believed the treatment was sufficient, (9.4%) the absence of sufficient money to buy the remaining drugs or to pay for veterinary services, and (3.9%) advice received others. Farmers in many countries can easily obtain antibiotics without a prescription (Chauhan et al., 2018; Redding et al., 2013) to reduce the cost of veterinary services and use their prior experience to use the antibiotics, which supports our findings.

According to an Indian study, only one-third of farmers seek the assistance of a veterinarian to reduce veterinary costs (Chauhan et al., 2018). Although a number of measures have recently been

implemented to limit antibiotic use in human medicine in order to combat antibiotic resistance, their application to the field of animal health is moving slowly and insufficiently. As a result, animal farm owners can still easily obtain antibiotics from veterinary clinics without a prescription. In the study area, 77.3% of the respondents take sick animals to veterinary clinics or consult animal health professionals for their drugs, 13.3% go to nearby veterinary pharmacies and buy medicine, and 9.4% use alternative traditional medicines.

In general, our study indicates that the AMU behavior of farmers in a resource-poor country with a large livestock population, such as Ethiopia, could be highly influenced by poor knowledge and undesired attitudes about AMU, antibiotic residues, and AMR. These findings support that the report of misuse or overuse of antimicrobials in animals (Tufa et al., 2024) and lack of knowledge about prudent antibiotic use and AMR (Castro-Sánchez et al., 2016) are the most critical factors for the development and spread of AMR. This suggests the need to improve the farmers' KAP regarding prudent AMU in livestock farming systems to minimize the risks of AMR.

The pretend variables of educational level (primary, secondary, and tertiary) are negatively interrelated with the knowledge of animal producers (OR = 1.36, 0.86, and 0.86, respectively). Contrary to this finding, the study done in Vietnam (Pham-Duc et al., 2019) showed that the educational level of the farmers was positively interrelated with the knowledge of farmers (OR = 4.7). Like the knowledge of the animal producers, their educational status was negatively interrelated with their attitude towards AMU and AMR in animal production. This finding is comparable to the findings in China (Dyar et al., 2020). Comparable to the present study, the study in central Ethiopia (Tufa et al., 2018) revealed that the AMU and AMR practices of the livestock producers were negatively correlated with their educational level.

In the present study, the gender, residence, age, and animal type reared of animal owners are insignificantly associated with their knowledge, attitude, and practice towards AMU and AMR, and also positively interrelated with both farmers' knowledge and practice. The reason why male animal owners were more knowledgeable about AMU and AMR than females might be due to the exposure of males to meetings, training, and media in the study area. Likewise, the study conducted in Shandong province, China (Dyar et al., 2020) showed that gender is associated with the knowledge and practice of AMU and AMR (males had more knowledge than females).

Limitations

The cross-sectional study design can influence the cause-and-effect relationship between the predictor variables and the dependent variables (knowledge, attitude, and practice) of the animal livestock owners. The role of potentially relevant explanatory factors, such as household structures (family size and economic status), was not considered in this study. The general data could serve as a baseline or reference for further research and to monitor the efficiency of future interventions.

Conclusions and recommendations

Our findings show that a significant number of livestock owners have inadequate knowledge, negative attitudes, a lack of awareness toward antibiotic use and resistance, and poor antibiotic use practices. This study provides baseline data on KAP of livestock owners regarding antibiotic use and resistance, which may be helpful to authorities in developing strategies to combat antibiotic resistance using a One Health approach.

Based on the findings of this study regarding livestock owners' knowledge, attitudes, and practices toward AMU and AMR in animal production, the following recommendations are proposed:

1. Continuous awareness and educational campaigns should be conducted for livestock owners and the wider community to promote responsible AMU and increase understanding of AMR.
2. Both governmental and non-governmental organizations (GOs and NGOs) should prioritize efforts to prevent the inappropriate use of antimicrobials and combat AMR in animal production systems.
3. Veterinary services should be strengthened and made more accessible to support proper diagnosis, treatment, and guidance on AMU.
4. A coordinated and integrated AMU governance framework should be implemented, involving all stakeholders, regardless of geographic location or economic status, to ensure unified action against AMR.

Further research should be carried out to explore additional factors influencing AMU and AMR and

to inform evidence-based interventions.

Article Information

Funding. This work received no funding.

Conflict of interest. The author declared no conflict of interest.

Authors contribution. Z.W.: Data curation, methodology, writing - original draft, investigation; K.J.: Supervision, Writing - Review & Editing; Y.N.: Conceptualization, Visualization; K.Y.: Formal analysis, resources, validation, software/ programming, interpretation of data.

Acknowledgment. Our gratitude goes to the epidemiology directorate of the Ministry of Agriculture for adjusting this program and giving me a chance. The authors would like to thank livestock owners who participated in this study. I extend my thanks to Dr. Kidist Jifar (my mentor), zone agriculture office head (Haji Nuriye), animal production and health department head (Dr. Alemu Kejamo), Biniyam Yiheyise (Brooke Ethiopia project team leader), and also thanks to the data collectors. They were Temesgen Abera, Sultan Nasir, and Tesfagent Desalgne.

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