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# ANTIBIOTIC PRACTICES AND RISK AWARENESS AMONG FISH FARMERS IN KANO METROPOLIS, KANO STATE, NIGERIA

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***ABSTRACT***
*This study assessed antibiotic practices, awareness, information access and risk knowledge among 170 fish farmers in Kano Metropolis using standard methods. Socio-demographic analysis revealed a dominance of male farmers (70%) within the 31–40 years age group (30%), with most having secondary (30%) or tertiary (25.7%) education, and 40% possessing 1–5 years of farming experience. Patterns of antibiotic application showed that water-based administration was most common (25.7%), while self-administration was the predominant mode (35.7%). Awareness of antibiotic use was generally high, with 50% strongly agreeing they understood their role in aquaculture, and 55.7% recognizing misuse as harmful to fish health. Information access was facilitated through veterinarians (75.7%) and media platforms (71.4%), with 65–75% of respondents actively seeking and supporting improved labeling. Knowledge and practices were mixed: 35.7% strongly agreed they used antibiotics before veterinary consultation, while positive practices included stopping treatment once fish improved (14.3%). Knowledge of antibiotic risks was high, with 81.4% acknowledging the transfer of antibiotic resistance to humans and 80% recognizing environmental pollution. The findings highlight the need for targeted training and regulation to improve safe antibiotic use and risk mitigation in aquaculture.*

**Keywords**: Antibiotic application, Fish farmers, Information availability, Risk awareness, Kano Metropolis.

## INTRODUCTION

Nigeria's fisheries sector is a vital component of the agricultural economy, having contributed between 3.5-4% to national GDP during 2008-2012—roughly 10% of agricultural output alone (Oladimeji, 2017). As global aquaculture continues its rapid expansion, offering tremendous potential for meeting protein demands (Issa *et al.*, 2022), Nigeria finds itself in a paradoxical situation. Despite favorable conditions for fish production, domestic supply barely reaches 0.7 million metric tons annually, falling drastically short of the 1.4 million metric ton national demand (Onyekuru *et al.*, 2019). This gap necessitates importing approximately 0.7 million metric tons yearly, costing the nation around $500 million in foreign exchange (Issa *et al.*, 2022).

Globally, aquaculture has emerged as the dominant force in aquatic food production. The Asian region alone accounts for over 91% of world production, and developing nations collectively produce more than 95% of farmed aquatic products—a stark contrast to terrestrial agriculture where developed countries maintain production dominance (FAO, 2019). With annual growth rates averaging 6.13% and total production values exceeding US$250 billion, the sector has evolved into a highly diverse industry encompassing numerous aquatic species. This expansion comes at a critical time when rising global populations are driving unprecedented demand for quality animal protein.

For Nigeria specifically, fish importation has become an economic burden. Annual expenditures exceed 288 billion naira (CBN, 2017), with import volumes surpassing 750,000 metric tons. Beyond the immediate financial drain of spending over USD 600 million in hard currency, this dependency effectively exports thousands of potential jobs (USAID, 2010; FMARD, 2016; USDA, 2016). Multiple constraints hinder aquaculture development, particularly low productivity of available fish breeds and inadequate input supply. Fish farmers grapple with fingerling scarcity, feed shortages, and economic pressures that compromise operational efficiency (Oluwatayo and Adedeji, 2018).

Within this challenging context, antibiotics have become both solution and problem. These compounds offer fish farmers a powerful tool for controlling bacterial diseases and maintaining stock health (Rico *et al.*, 2014), yet their application carries significant risks. Whether derived from natural sources or synthesized chemically, antibiotics designed to prevent bacterial proliferation are now ubiquitous in human medicine, livestock production, and aquaculture (Mehdi *et al.*, 2018). This widespread use has created a global health crisis. Between 2000 and 2015 alone, antibiotic consumption surged by 65%—from 21.1 to 34.8 billion defined daily doses—with consumption rates per capita climbing 39% (Klein *et al.*, 2018). Troublingly, this increase concentrates heavily in low and middle-income countries, including much of Africa.

Research has documented diverse consequences of antibiotic use in cultured fish. Effects range from altered growth patterns (Zhou *et al.*, 2018) to physical deformities, disrupted gut microbiota, and compromised immune function (Limbu *et al.*, 2018, 2020). More concerning are reports of oxidative stress, organ toxicity, and DNA damage (Botelho *et al.*, 2015). Recent studies have even identified direct human health risks from consuming antibiotic-treated fish, particularly affecting children (Limbu *et al.*, 2018). The practice of metaphylactic treatment—dosing entire fish populations when only a fraction shows disease symptoms—remains

common in aquaculture (Okocha *et al.*, 2018). This approach creates ideal conditions for resistance development, as sick fish typically refuse medicated feed while healthy fish receive sub-therapeutic doses (Fair and Tor, 2014).

Regulatory frameworks governing antibiotic use in aquaculture differ widely across countries. In nations with established aquaculture industries, veterinary prescriptions and proper documentation are typically required. In contrast, Nigeria faces weak regulatory enforcement, with antibiotics readily accessible through feed outlets and often used without adequate professional oversight (Manyi-Loh et al., 2018). Critically important antibiotics, including tetracyclines and oxolinic acid, are commonly applied despite their relevance to human medicine, raising concerns about antimicrobial resistance and public health.

Within this context, understanding how fish farmers access and interpret information on antibiotic risks is essential. Inadequate knowledge and poor communication can promote misuse, accelerate resistance development, and endanger aquatic ecosystems and consumers. Ensuring that farmers and other stakeholders have accurate information is therefore crucial for sustainable aquaculture.

The study aimed to evaluate the patterns and modes of antibiotic use among fish farmers in Kano Metropolis, assess their awareness and knowledge of antibiotic applications, examine the availability of relevant information, and determine their understanding of the associated risks to both fish and consumers. By analyzing socio-demographic factors alongside antibiotic practices, the study sought to identify gaps in knowledge and risk perception that may influence sustainable and safe aquaculture practices.

## MATERIALS AND METHODS

### Study Area

The study was conducted in Kano Metropolis, the capital of Kano State, Nigeria, located between latitudes 11°50′–12°07′ N and longitudes 8°22′–8°47′ E (Mohammed, 2015). The metropolis comprises several local government areas, a major population and commercial centre in northern Nigeria and an important hub within the West African Hausa plain. The study was conducted between January and June, 2025.

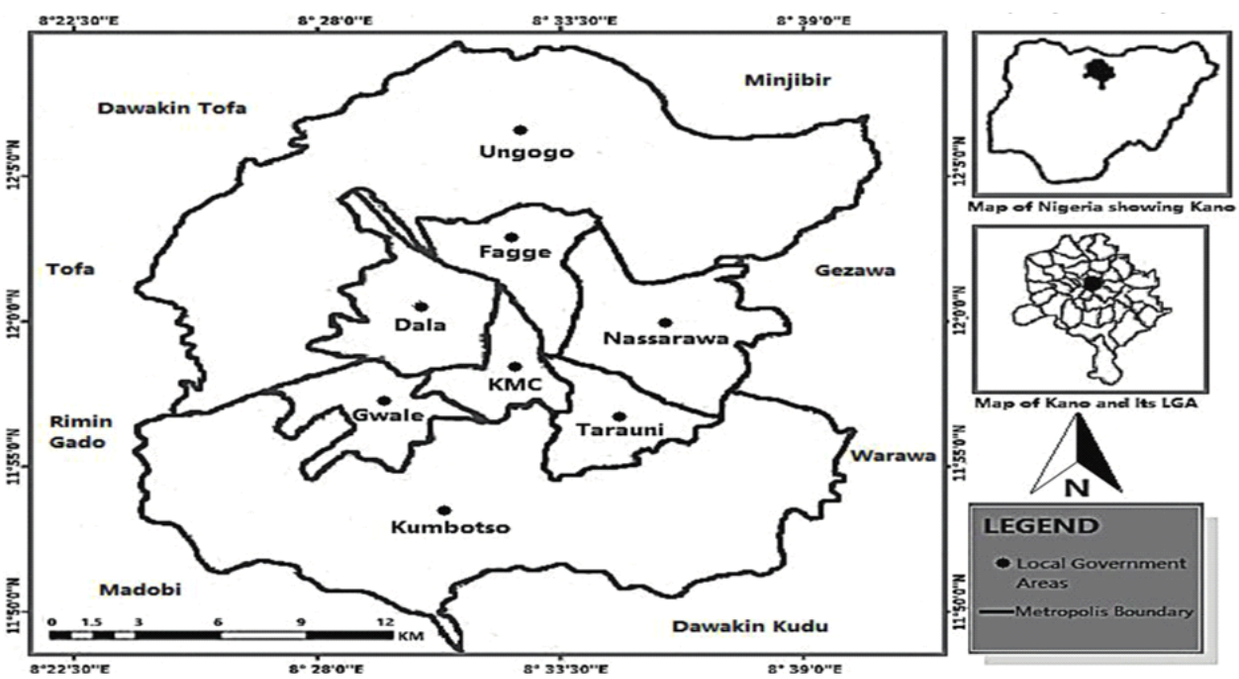


**Figure 1:** Map of Kano Metropolis and its surrounding Local Government Areas

### Sampling Techniques

The sampling frame for the data collection consists only fish farmers in 8 local government of Kano metropolis in Kano State. The list of registered fish farmers was obtained from the Kano State Ministry of Agriculture and Natural Resources. Multistage sampling was used for sampling respondents in the study area. The first stage involved purposive selection of local government in the study area on the basis of relative abundance of fish farmers. On that basis, Tarauni local government area was first selected followed by Kumbotso Local Government Area, then Ungogo Local Government Area followed by Dala Local Government Area, Kano municipal, Fagge local government and Nasarawa local government area. Within each LGA, a simple random sampling technique was used to select individual fish farmers.

One hundred and seventy (170) questionnaires were distributed to the targeted respondents in the study areas. However, at least 20 each of fish farmers in each local government were used. The distribution of these respondents within the study area was based on proportion

of the respondents in the site. The number of respondents per LGA was as follows: Tarauni (25), Kumbotso (25), Ungogo (25), Dala (25), Kano Municipal (20), Fagge (25) and Nasarawa (25).

**Data Collection**

Primary data was used for this research. The data were collected with the aid of structured questionnaire administered to the randomly 170 selected respondents. The data on availability of information on risk associated with antibiotics application within selected fish farm in the study area. The questionnaire contained section (A): demographic characteristics, (B): antibiotics application (C): General awareness on antibiotics, (D) knowledge level of participants on the antibiotics usage (E): Information availability and (F) knowledge on risk of antibiotics to fish health and to human health. The questionnaire was pre-tested among 10 fish farmers outside the study area and revised accordingly. It was administered in English and Hausa, depending on the respondent's preference, by trained research assistants.

**Ethical Considerations**

The study protocol was approved by the Bayero University Kano Health Research Ethics Committee, and informed consent was obtained from all participants. Confidentiality and anonymity of respondents were maintained throughout the study.

**Statistical Analysis**

The data collected was analyzed and presented using simple descriptive statistics frequency, percentage, and mean presented in tables with the aid of SPSS software version 20. Data were checked for completeness and consistency before analysis. Missing data were excluded from analysis.

**RESULTS**

**Socio-Demographic Characteristics**

The socio-demographic characteristics of fish farmers in Kano Metropolis (Table 1) indicate that aquaculture activities are largely dominated by economically active adults and males. The highest proportion of respondents was within the **31–40 years age group (30%),** followed by **21–30 years (25.7%),** while only **10%** were below 20 years, suggesting that fish farming is mainly practiced by mature individuals in their productive years. Gender distribution shows a clear dominance of **male farmers (70%),** compared with **30% females**, indicating that aquaculture in the area is largely male-driven. In terms of education, most respondents had at least some level of formal education, with **secondary education accounting for 30%, tertiary education 25.7%,** and **primary education 20%,** while **14.3%** had no formal education. This suggests a relatively moderate literacy level among fish farmers, which may influence access to technical information and improved practices. Regarding farming experience, the majority had **1–5 years of experience (40%)**, followed by **6–10 years (25.7%),** indicating that many farmers are still relatively new entrants into the aquaculture sector in Kano Metropolis.

**Table 1:** Socio-demographic characteristics of fish farmers in kano metropolis (n=170)

| Variable | Category | Frequency (n) | Percentage (%) |
|---|---|---|---|
| Age (Years) | Below 20 | 17 | 10 |
| | 21–30 | 44 | 25.7 |
| | 31–40 | 51 | 30 |
| | 41–50 | 34 | 20 |
| | Above 50 | 24 | 14.3 |
| Gender | Male | 119 | 70 |
| | Female | 51 | 30 |
| Educational Level | No formal education | 24 | 14.3 |
| | Primary | 34 | 20 |
| | Secondary | 51 | 30 |
| | Tertiary | 44 | 25.7 |
| | Other | 17 | 10 |
| Fishing Experience (Years) | Less than 1 | 24 | 14.3 |
| | 1–5 | 68 | 40 |
| | 6–10 | 44 | 25.7 |
| | More than 10 | 34 | 20 |
| | **Total** | **170** | **100** |

**Pattern and Mode of Antibiotics Application**

Table 2 shows the patterns and modes of antibiotic application among 170 respondents. For application patterns, the most common method was via water (44 respondents, 25.7%), followed by in feed (34, 20%), while injection alone, combined in feed/injection, and water/injection each accounted for 24 respondents (14.3%). A small proportion (20, 11.4%) did not respond. Regarding the mode of application, self-administration was the most frequent (61, 35.7%), with trained personnel and combined self/trained use both at 44 respondents (25.7%), while 22 (12.9%) did not respond. This indicates a mix of practices, with reliance on self-administration and water-based delivery being predominant.

**Table 2:** Pattern and mode of antibiotics application among respondents (n = 170)

| Category | Variable | Frequency (n) | Percentage (%) |
|---|---|---|---|
| Pattern of Antibiotics Application | Water | 44 | 25.7 |
| | In feed | 34 | 20 |
| | Injection | 24 | 14.3 |
| | In feed/Injection | 24 | 14.3 |
| | Water/Injection | 24 | 14.3 |
| | No response | 20 | 11.4 |
| | **Total** | **170** | **100** |
| Mode of Antibiotics Application | Self | 61 | 35.7 |
| | Trained personnel | 44 | 25.7 |
| | Self/Trained | 44 | 25.7 |
| | No response | 22 | 12.9 |
| | **Total** | **170** | **100** |

**Awareness of Antibiotic Use in Fish Farming**

Table 3 indicates generally high awareness of antibiotic use among fish farmers in Kano Metropolis. A majority of respondents were aware of antibiotics used in aquaculture, with 50% strongly agreeing and 30% agreeing. Similarly, knowledge of their role was high (45.7% SA; 35.7% A). Awareness of misuse risks was also strong, as 50% strongly agreed that misuse poses risks, while 55.7% strongly agreed that incorrect use harms fish health. However, knowledge gaps exist; only 30% strongly agreed they knew correct administration. Perception-related items showed good understanding, with 60% disagreeing that all antibiotics cure fish and 60% rejecting equal effectiveness, indicating relatively informed but not comprehensive awareness.

**Table 3:** Awareness of antibiotic use in fish farming in Kano Metropolis

| S/N | Item | SA | A | D | SD | Remark |
|---|---|---|---|---|---|---|
| 1 | Aware of antibiotics used in fish farming | 35 (50%) | 21 (30%) | 10 (14.3%) | 4 (5.7%) | High awareness |
| 2 | Know role of antibiotics in aquaculture | 32 (45.7%) | 25 (35.7%) | 10 (14.3%) | 3 (4.3%) | Good knowledge |
| 3 | Know therapeutic vs preventive use | 28 (40%) | 21 (30%) | 14 (20%) | 7 (10%) | Moderate awareness |
| 4 | Familiar with common antibiotics | 25 (35.7%) | 25 (35.7%) | 14 (20%) | 6 (8.6%) | Adequate knowledge |
| 5 | Know risks of misuse in aquaculture | 35 (50%) | 18 (25.7%) | 14 (20%) | 3 (4.3%) | Good awareness |
| 6 | Incorrect use harms fish health | 39 (55.7%) | 18 (25.7%) | 10 (14.3%) | 3 (4.3%) | Strong awareness |
| 7 | Know correct antibiotic administration | 21 (30%) | 25 (35.7%) | 18 (25.7%) | 6 (8.6%) | Fair knowledge |
| 8 | All antibiotics cure fish | 14 (20%) | 14 (20%) | 21 (30%) | 21 (30%) | Correct perception |
| 9 | All commercial antibiotics equally effective | 10 (14.3%) | 18 (25.7%) | 25 (35.7%) | 17 (24.3%) | Correct perception |
| 10 | Aware of risks and benefits of antibiotics | 32 (45.7%) | 21 (30%) | 10 (14.3%) | 7 (10%) | Good awareness |

**Keys:** SA: Strongly Agree, A: Agree, D: Disagree, SD: Strongly Disagree

**Information Availability on Antibiotics**

The results on Table 4 show that respondents generally have adequate access to antibiotic information in fish farming, as most items were accepted. A majority agreed that antibiotic information is easily accessible (65.7%) and that risk information is available (65.7%). Access through media platforms was also high, with 71.4% acknowledging TV, radio, and internet as key sources. Notably, 75.7% reported actively seeking information when needed, while 75.7% expressed strong interest in antibiotic-related information. Similarly, 80% supported improved labeling and advertisement of antibiotics. However, some respondents still perceived limited access (60%), indicating gaps in information dissemination. Overall, veterinarians were recognized as important information sources (75.7%), highlighting their role in knowledge transfer.

**Table 4:** Information availability on antibiotics in fish farming in Kano Metropolis

| S/N | Item | SA | A | D | SD | Remark |
|---|---|---|---|---|---|---|
| 1 | Easy access to antibiotic info | 21 (30) | 25 (35.7) | 14 (20) | 10 (14.3) | Accepted |
| 2 | Risk info on antibiotics available | 18 (25.7) | 28 (40) | 14 (20) | 10 (14.3) | Accepted |
| 3 | Access via media (TV, radio, internet) | 25 (35.7) | 25 (35.7) | 10 (14.3) | 10 (14.3) | Accepted |
| 4 | Current info access is effective | 18 (25.7) | 21 (30) | 18 (25.7) | 13 (18.6) | Accepted |
| 5 | Seek info when needed | 28 (40) | 25 (35.7) | 10 (14.3) | 7 (10) | Accepted |
| 6 | Aware of govt/NGO programs | 25 (35.7) | 21 (30) | 14 (20) | 10 (14.3) | Accepted |
| 7 | Interested in antibiotic info | 32 (45.7) | 21 (30) | 10 (14.3) | 7 (10) | Accepted |
| 8 | Limited access to antibiotic info | 21 (30) | 21 (30) | 18 (25.7) | 10 (14.3) | Accepted |
| 9 | Improve antibiotic labeling/ads | 35 (50) | 21 (30) | 7 (10) | 7 (10) | Accepted |
| 10 | Vets important for info sharing | 28 (40) | 25 (35.7) | 10 (14.3) | 7 (10) | Accepted |
| 11 | Trust info from news/blogs | 18 (25.7) | 21 (30) | 18 (25.7) | 13 (18.6) | Accepted |
| 12 | Antibiotic info is clear | 25 (35.7) | 21 (30) | 14 (20) | 10 (14.3) | Accepted |

**Keys:** SA: Strongly Agree, A: Agree, D: Disagree, SD: Strongly Disagree

**Antibiotic Use**

Table 5 reveals varying levels of knowledge and practices regarding antibiotic use among fish farmers. A considerable proportion reported poor practices, such as using antibiotics before veterinary consultation (35.7% SA, 25.7% A) and not consulting vets before use (30% SA, 30% A). Misconceptions were evident, with 25.7% strongly agreeing that antibiotics treat all diseases. Risky attitudes were also noted, as 40% strongly agreed they were comfortable administering antibiotics. Conversely, some positive practices emerged, including stopping treatment once fish improve (14.3% SA, 25.7% A) and avoiding dosage increase (10% SA, 25.7% A).

**Table 5:** Participants' knowledge on antibiotic use

| S/N | Item | SA | A | D | SD | Remark |
|---|---|---|---|---|---|---|
| 1 | Use antibiotics before vet consultation | 25 (35.7) | 18 (25.7) | 14 (20) | 13 (18.6) | Poor practice |
| 2 | Do not consult vet before use | 21 (30) | 21 (30) | 14 (20) | 14 (20) | Poor practice |
| 3 | Antibiotics treat all diseases | 18 (25.7) | 21 (30) | 21 (30) | 10 (14.3) | Misconception |
| 4 | Comfortable administering antibiotics | 28 (40) | 21 (30) | 14 (20) | 7 (10) | Risky attitude |
| 5 | Do not read drug instructions | 21 (30) | 18 (25.7) | 21 (30) | 10 (14.3) | Improper usage |
| 6 | Weekly antibiotic use | 14 (20) | 18 (25.7) | 25 (35.7) | 13 (18.6) | Better practice |
| 7 | Ignore vet advice on timing | 18 (25.7) | 21 (30) | 18 (25.7) | 13 (18.6) | Poor compliance |
| 8 | Stop treatment once fish improve | 10 (14.3) | 18 (25.7) | 21 (30) | 21 (30) | Good practice |
| 9 | Increase antibiotic dosage | 7 (10) | 18 (25.7) | 21 (30) | 24 (34.3) | Safe practice |
| 10 | Antibiotics are painkillers | 10 (14.3) | 14 (20) | 21 (30) | 25 (35.7) | Correct knowledge |

**Keys:** SA: Strongly Agree, A: Agree, D: Disagree, SD: Strongly Disagree

**Antibiotic Risks to Fish and Consumers**

The results on Table 6 show that most respondents had good knowledge of the risks of antibiotic use in fish farming. High agreement was observed for items on resistance transfer to humans (81.4%), environmental pollution (80%), and improper use causing resistance (80%). Similarly, residues causing human allergies and health risks were acknowledged by 75–76% of respondents. Only one item, "Benefits outweigh human health risks," showed moderate knowledge (55.7%), indicating some underestimation of potential hazards.

**Table 6:** Knowledge of antibiotic risks to fish and consumers

| S/N | Item | SA + A | D + SD | Decision |
|---|---|---|---|---|
| 1 | Improper antibiotic use causes resistance | 56 (80%) | 14 (20%) | Good knowledge |
| 2 | Resistance can transfer to humans | 57 (81.4%) | 13 (18.6%) | Good knowledge |
| 3 | Misuse weakens fish immunity | 53 (75.7%) | 17 (24.3%) | Good knowledge |
| 4 | Expired/substandard drugs increase mortality | 53 (75.7%) | 17 (24.3%) | Good knowledge |
| 5 | High doses cause fish toxicity | 53 (75.7%) | 17 (24.3%) | Good knowledge |
| 6 | Antibiotics pollute the environment | 56 (80%) | 14 (20%) | Good knowledge |
| 7 | Residues can trigger human allergies | 53 (75.7%) | 17 (24.3%) | Good knowledge |
| 8 | Residues pose consumer health risks | 53 (75.7%) | 17 (24.3%) | Good knowledge |
| 9 | Benefits outweigh human health risks | 39 (55.7%) | 31 (44.3%) | Moderate knowledge |
| 10 | Concerned about environmental impacts | 56 (80%) | 14 (20%) | Good knowledge |
| 11 | Contributes to human antibiotic resistance | 57 (81.4%) | 13 (18.6%) | Good knowledge |

**Keys:** SA: Strongly Agree, A: Agree, D: Disagree, SD: Strongly Disagree

## DISCUSSION

The socio-demographic profile of fish farmers in Kano Metropolis reflects patterns commonly reported in Nigerian aquaculture studies, where economically active adults dominate production and males are the primary participants. This aligns with observations by Moruf *et al*. (2025) and Dickson and Okundaye (2025), who noted that fish farming is largely male-driven and concentrated among individuals in their productive age. The moderate level of formal education among respondents, spanning primary to tertiary levels, is consistent with previous findings (Adeyemi *et al*., 2025), suggesting that literacy may influence adoption of improved farming practices and access to technical information. The predominance of relatively inexperienced farmers indicates a growing but still developing aquaculture sector, highlighting the need for capacity-building programs.

The patterns and modes of antibiotic application suggest a mix of practices, with water-based administration and self-application being predominant. Similar trends have been reported by Mufwambi and Mohamed (2024), who observed that small- to medium-scale aquaculture operators often rely on self-administered antibiotics without strict adherence to veterinary guidance. While some farmers engage trained personnel, the reliance on self-administration raises concerns about improper dosing, which can contribute to antimicrobial resistance in aquaculture systems.

Awareness and knowledge regarding antibiotics were generally high, reflecting an understanding of misuse risks and potential impacts on fish health. However, gaps exist in correct administration and disease-specific use, mirroring findings by Kemp *et al.* (2021) that, despite awareness, practical application often remains suboptimal. This underscores the need for targeted training to translate knowledge into safe practices.

Information access among farmers was largely facilitated through media and veterinarians, consistent with previous studies highlighting the role of extension services in knowledge transfer (Moruf *et al*., 2025). Nevertheless, perceived gaps in information dissemination indicate that some farmers still struggle to obtain reliable guidance, suggesting the necessity for more structured outreach and labeling interventions.

Knowledge of antibiotic risks to fish, humans, and the environment was relatively strong, reflecting recognition of resistance development and residue-related hazards. However, some underestimation of long-term health risks aligns with reports by Wang *et al*. (2024), emphasizing that awareness does not always translate into risk-averse behavior, highlighting the ongoing challenge of promoting responsible antibiotic use in aquaculture.

## CONCLUSION

Fish farming in Kano Metropolis is primarily undertaken

by educated, economically active men, many of whom are relatively new to aquaculture. Antibiotic use is widespread, often involving water-based application and self-administration. While most farmers are aware of antibiotics and the risks associated with their misuse, significant gaps remain in their knowledge of correct administration and the importance of veterinary consultation. Information on antibiotic use is generally accessible, with veterinarians and media as primary sources, though coverage is not comprehensive. Despite awareness of health risks, unsafe practices and misconceptions persist. Targeted training, improved extension services, and enhanced regulatory oversight are essential to promote responsible antibiotic use and protect public health.

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