



Antibiotic usage practices in farmed fish and associated factors in Sokoto Metropolis, Nigeria

By

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Abstract

Aquaculture plays a vital role in Nigeria's food security and economic diversification. Nonetheless, the unregulated use of antibiotics in aquaculture presents substantial threats to production efficiency, food safety, public health, and ecological stability. This study assessed antibiotic usage practices in farmed fish and identified associated risk factors within Sokoto Metropolis, Nigeria. Data were collected from 25 respondents using structured questionnaires and analyzed using descriptive statistics. Findings revealed a widespread antibiotic use, with 88% of farmers reporting usage, primarily oxytetracycline and amoxicillin, often without professional prescription or supervision. The use of multiple antibiotics and preventive applications were common, raising concerns about antimicrobial resistance (AMR) and drug residues in fish products. Although most farmers (92%) were aware of AMR and withdrawal periods, misuse remained common. Encouragingly, 96% expressed willingness to adopt alternative disease control methods, including improved management, vaccination, and probiotics. Despite relatively high awareness, misuse and overreliance on antibiotics persist due to weak regulatory enforcement and limited veterinary oversight. Strengthening farmer education, veterinary involvement, and policy implementation is essential to promoting responsible antibiotic use and safeguarding sustainable aquaculture in Sokoto Metropolis.

Keywords: Antibiotic use, Antimicrobial resistance, Fish farming, Risk factors.

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Introduction

Aquaculture is one of the fastest-growing sectors in global food production, providing a sustainable source of high-quality animal protein and contributing significantly to food security (Zhang *et al.*, 2022). In Nigeria, aquaculture is not only vital for food security but also serves as a key component of economic diversification beyond the oil-based economy, generating income and employment opportunities (Okocha *et al.*, 2021).

The intensification of aquaculture has been accompanied by increased reliance on antibiotics to prevent and treat fish diseases. In developing countries like Nigeria, antibiotics are frequently used without veterinary supervision or regulatory oversight (Okon *et al.*, 2023; Adelowo & Okunlola, 2019). Indiscriminate use, including self-prescription and multiple antibiotic applications, as well as prophylactic and metaphylactic applications, has been linked to the generation of antimicrobial-resistant bacteria (AMRB) and accumulation of antibiotic residues in fish and fish products, thereby posing serious public health risks (Okon *et al.*, 2022). Furthermore,



antibiotic residues and resistant bacteria discharged from aquaculture systems into surrounding environments can alter microbial communities and facilitate the spread of antimicrobial resistance (AMR) to humans, animals, and ecosystems (Okon *et al.*, 2022).

Despite these risks, information on antibiotic usage practices among fish farmers, including types of antibiotics used, frequency of use, and influencing factors, remains limited (Madara, 2022). Factors that may influence antibiotic use include socio-demographic characteristics (e.g., age, education, and farming experience), economic factors (e.g., farm size, income, and market demand), knowledge and perception of risks and benefits, environmental factors (e.g., water quality, fish health, and access to veterinary services), and institutional or policy factors (e.g., regulatory frameworks, extension services, and access to credit).

Given the increasing demand for fish and fish products, a recent study has reported indiscriminate use of antibiotics in farmed fish in Sokoto State, Nigeria (Abdulrashid *et al.*, 2025), to prevent disease and boost growth. This indicates that indiscriminate use of antibiotics in farmed fish has persisted after it was reported in neighboring Katsina State, Nigeria, by Dauda and Ibrahim (2015) over a decade ago, and this constitutes a potential public health risk. This study was therefore conducted to evaluate antibiotic usage practices among farmed fish in Sokoto Metropolis, Nigeria. Specifically, it sought to identify the types and sources of antibiotics used, factors influencing their application, and the association between these factors and antibiotic usage. It also assessed farmers' knowledge and attitudes toward antibiotic use and antimicrobial resistance. The findings of this study are expected to inform strategies for promoting responsible antibiotic use and sustainable aquaculture in the region.

Materials and Methods

This study was conducted within Sokoto Metropolis, the capital of Sokoto State in Northwestern Nigeria, which covers an area with a radius of approximately 20 km from Shehu Kangiwa Square (Latitude 12°58'N–13°40'N; Longitude 5°10'E–5°18'E) and has an average elevation of 272 meters above sea level. The metropolis comprises Sokoto North and Sokoto South Local Government Areas and portions of Dange Shuni, Kware, Bodinga, and Wamakko LGAs (Sani *et al.*, 2023).

Data were collected using a structured questionnaire designed to capture information on farm characteristics, antibiotic use and practices, as well as farmers' knowledge and attitudes toward antimicrobial resistance. The questionnaire included both closed- and open-ended questions, it was pre tested with 10 respondents from the study area to ensure clarity and relevance. Modifications were made based on feedback from the pretest before the final administration.

A total of 25 respondents, including farm owners, managers, and workers, were recruited through a combination of volunteer-based convenience sampling and snowball sampling. Face-to-face interviews were conducted, and

respondents were provided with brief explanations and examples of antimicrobial drugs used in aquaculture when necessary to obtain informed consent. Only one questionnaire was administered per farm. Information collected comprised demographic characteristics of respondents, species cultured, culture methods, types of antibiotic(s) used, frequency and purpose of use, dosage determination, source of drugs, and awareness of potential risks associated with antibiotic use.

Collected data were coded, checked for consistency, and analyzed using Microsoft Excel (Microsoft Excel, 2013). Descriptive statistics, including frequencies and percentages, were used to summarize socio-demographic characteristics, antibiotic usage patterns, and knowledge of antimicrobial resistance among respondents.

Results

Figure 1 presents data on sociodemographic characteristics of respondents in the study area. A total of 25 fish farms within Sokoto Metropolis participated in the study. Out of all the respondents, 14 (56%) were farm owners, 8 (32%) served as farm managers, while only 3 (12%) worked as laborers. Respondents were mainly young to middle-aged adults, where 10 (40%) respondents were within the age of 31–40 years, followed by those within the age range of 20–30 years, who were 8 (32%), while 5 (20%) and 2 (8%) respondents were aged 41–50 years and above 50 years, respectively. No respondents were under 20 years of age. The majority (72%) had tertiary education, while 24% had secondary education and 4% had no formal education. Household sizes varied, with 64% of respondents reporting 1–10 persons per household, followed by those within 11–20 which was 4 (16%), then household sizes of 21–30 and above 50 had 2(8%), while only 1 (4%) fell within 31–40 household size. This reflects diverse family sizes among farmers.

Farming experiences among respondents shows 48% of the respondents had been engaged in fish farming for 1–5 years, 20% for 6–10 years, and 16% each for less than a year or more than 10 years. Fish farming was primarily for commercial purposes (56%), followed by income supplementation (40%) and household consumption (4%). Monoculture was the dominant production system (80%), with catfish being the most commonly cultured species (68%). Tilapia was farmed by 12% of respondents, while 20% cultured both species. Concrete ponds were the most common production structures (36%), followed by plastic/tarpaulin ponds (20%), earthen ponds (12%), and combinations of different pond types (8%) (Figure 1).

Pond water was mainly sourced from boreholes (56%), followed by wells (24%) and streams/rivers (8%), while 12% used multiple sources. Most farmers (80%) treated water before use, primarily with chlorine (44%) or lime (20%), with some using a combination of both (16%). Waste water from farms was either used for crop and vegetable farming (44%) or released into the environment (48%), while 8% employed a combination of both practices.

The antibiotic use in selected fish farms in Sokoto metropolis was presented in Figure 2. Antibiotic use was widespread, with 22 (88%) of respondents using antibiotics on their farms, while only 3 (12%) reported not using antibiotics in their farms. Oxytetracycline was the most frequently used antibiotic, reported by 8 (32%) of the farmers, amoxicillin was used by 5 (20%), while multidrug (such as amoxicillin, oxytetracycline, erythromycin, and sulfonamides) application were reported by 10 (40%) of the respondents. A small percentage, 2 (8%) used other unspecified antibiotics. Bacterial infections were identified as the most common disease affecting fish, as responded by 16 (64%), 1 (4%) indicated fungal infections, 2 (8%) identified other unspecified disease types, while none reported viral diseases. Mixed infections, including bacterial and fungal, were also noted by 6 (24%) of the respondents. About 8 (32%) of farmers acknowledged that there are side effects associated with antibiotic use, while the majority, 17 (68%) did not.

Out of the respondents, 9 (36%) of them primarily used antibiotics to treat diseases, 1(4%) uses antibiotic for growth promotion and enhance feed efficiency, also 1 (4%) do not use antibiotic at all. A larger portion of the respondents, 14 (56%) uses antibiotics for a combination of purposes. Most respondents 16 (64%) uses antibiotics as a preventive measure against disease outbreaks, while 9 (36%) did not engage in such preventive use.

From this study, 19 (76%) of the farmers responded that they do not use antibiotics often. However, 4 (16%) indicated they always use antibiotics, while 2 (8%) never used antibiotics. The frequency of antibiotic usage shows 11 (44%) used antibiotics three times a year, 6 (24%) used antibiotics twice, and 5 (20%) used them more than three times per year. The duration of usage shows 13 (52%) of the farms used antibiotics for several days, 6 (24%) for weeks, and 4 (16%) for months, while a small portion 2 (8%) did not specify the duration.

The results from antibiotic prescription and dosage (Figure 3) indicates, 28% of respondents obtained antibiotics through veterinarians, 16% through fish health specialists, 12% practiced self-prescription, 4% sourced from feed dealers, while majority, 32% received guidance from multiple sources. Dosage determination was guided by veterinary instructions (36%), label instructions and personal experience (12% each), or a combination of label and experience (28%). Training on antibiotic use was reported by 68% of respondents, while 32% had no formal training. Awareness of antimicrobial resistance and withdrawal periods was high, with 92% understanding these concepts, while 2 (8%) did not understand the concept of AMR and withdrawal period. Moreover, 19 (76%) of respondents were aware of regulations governing antibiotic use in fish farming in Nigeria, while 6 (24%) were not aware. From the survey, 24 (96%) of the respondents expressed willingness to adopt alternative disease management strategies on their farms.

Discussion

This study provides valuable insight into antibiotic usage practices, awareness levels, and perceptions among fish farmers in Sokoto Metropolis, revealing patterns that have significant implications for aquaculture productivity and public health. The demographic profile showed that fish farming is largely male-dominated, consistent with earlier reports that fisheries activities in Nigeria are often concentrated among men (Olaoye *et al.*, 2013). Most respondents were young to middle-aged and possessed tertiary education, suggesting that the sector is driven by an economically active and literate population capable of adopting improved management practices.

Catfish was the dominant species cultured, this support earlier reports in the study area (Dalhatu and Ala, 2010; Saba *et al.*, 2025). This reflects catfish's hardiness, market preference, and good adaptability to the semi-arid environment of Sokoto. Reliance on borehole water was expected due to the region's arid climate, and the widespread practice of water treatment with chlorine or lime indicates a moderate understanding of biosecurity. However, frequent use of chemicals for water treatment also raises concerns about long-term ecosystem sustainability.

Antibiotic usage was highly prevalent in the study area with the vast majority of farmers reporting regular use, and this support earlier report by Abdulrashid *et al.* (2025) Oxytetracycline and amoxicillin were the most common antibiotics, likely due to their accessibility and broad-spectrum activity. Similar patterns have been reported in other parts of Nigeria and West Africa (Agoba *et al.*, 2017; Adelowo & Okunlola, 2019; Akeem *et al.*, 2025). This has serious implications in area of antimicrobial resistance, not only in fish, but in other species where oxytetracycline is abused. In a survey of susceptibility of bacterial isolates from fishes tested by Oladele *et al.* (2015), many of the bacteria were not susceptible to oxytetracycline. In a four-year survey of susceptibility of bacterial isolates from birds to antibiotics, over 5,000 bacterial isolates were found to have developed resistance to Oxytetracycline according to Oladele *et al.* (2024). The frequent use of multiple antibiotics, often without proper diagnosis or prescription, underscore a major gap in antimicrobial stewardship and increases the risk of antimicrobial resistance (Hernández Serrano, 2005). Preventive use of antibiotics was also common, despite global recommendations discouraging prophylactic and metaphylactic applications in aquaculture due to its strong link with resistance development (FAO, 2020).

Sources of antibiotic prescription varied widely, with many farmers relying on fish health specialists, feed dealers, or personal judgement, rather than veterinarians. This informal acquisition pathway mirrors findings from studies from neighboring states of Kaduna and Katsina, where lack of veterinary oversight was a major driver of misuse (Jibril *et al.*, 2024; Akeem *et al.*, 2025). Although most respondents reported some training on antibiotic use, the persistence of

misuse suggests that the training may be insufficient, inconsistent, or poorly implemented.

Awareness on antimicrobial resistance and withdrawal periods was generally high, and most farmers acknowledged the risks associated with misuse. These findings contrast with earlier studies in northern Nigeria showing lower awareness among livestock farmers (Awosan *et al.*, 2018). The improvement may reflect increased sensitization efforts and growing national attention to AMR. However, awareness of relevant regulations was lower, indicating that policy frameworks such as NAFDAC and fisheries guidelines are not being effectively communicated or enforced.

Encouragingly, nearly all farmers expressed willingness to adopt alternatives such as probiotics, vaccines, improved hygiene, and better biosecurity. This represents a significant opportunity for intervention since previous studies have highlighted poor uptake of non-antibiotic measures as a major barrier to reducing antibiotic reliance in aquaculture (Henriksson *et al.*, 2018; Okon *et al.*, 2022). Strengthening extension services, farmer education, and access to veterinary support would therefore be critical in translating knowledge into practice.

Conclusion

Antibiotic use in fish farming is widespread in Sokoto Metropolis, driven by disease pressure, limited veterinary oversight, and easy access to multiple antibiotic types. While awareness of antimicrobial resistance and withdrawal periods is relatively high, inappropriate use, including prophylactic administration, multiple antibiotic combinations, and informal prescription sources; remains common. These practices pose substantial risks to fish health, environmental integrity, and public health through potential antimicrobial residues and spread of resistant pathogens and genes.

The findings underscore an urgent need to strengthen veterinary involvement, improve farmer training, ensure enforcement of existing regulations, and promote safer alternatives to antibiotics. Given the high willingness among farmers to adopt alternative management strategies, coordinated efforts from government, regulatory agencies, and extension services could significantly reduce antibiotic misuse and enhance sustainable aquaculture practices in the region.

References

1. Abdurashid, B., Ibrahim, H., Usman Garba Rambo, U. G., & Abdullahi, S. M. (2025). Assessment of Antibiotics Usage in Aquaculture in Sokoto State, Nigeria. *Direct Research Journal of Public Health and Environmental Technology*, 10(3): 83-87.
2. Adelowo, O. O., & Okunlola, I. O. (2019). Field assessment of antibiotic use in fish farms in Southwestern Nigeria. *Revue d'élevage et de médecine vétérinaire des pays tropicaux*, 72(4): 187–191. doi: 10.19182/remvt.31472
3. Agoba, E. E., Adu, F., Agyare, C., & Boamah, V. E. (2017). Antibiotic use and practices in selected fish farms in the Ashanti region of Ghana. *Journal of*

4. Akeem, B., Dauda, A. S. N., Oshoke, J. O., Salele, H. A., Odetokun, I. A., Ghali-Mohammed, I., Bello, M., & Dasuki, A. (2025). Antibiotics use and awareness of risks associated with antimicrobial resistance among fish farmers in Katsina State, Nigeria. *Tropical and Subtropical Agroecosystems*, 28, Art. No. 003.
5. Awosan, K. J., Ibitoye, P. K., & Abubakar, A. K. (2018). Knowledge, risk perception and practices related to antibiotic resistance among patent medicine vendors in Sokoto metropolis, Nigeria. *Nigerian Journal of Clinical Practice*, 21(11), 1476–1483.
6. Dalhatu, M. and Ala, A. L. (2010). Analysis of Fish Demand in Sokoto Metropolis, Sokoto, Nigeria. *Nigerian Journal of Basic and Applied Science*, 18(2): 154-159.
7. Dauda, A. B., & Ibrahim, H. I. (2015). Prevalence of fish diseases in fish farms in Katsina State, Nigeria. *Bulletin of Animal Health and Production in Africa*, 63, 495–503.
8. FAO. (2020). *Responsible use of antibiotics in aquaculture*. Rome: Food and Agriculture Organization of the United Nations.
9. Henriksson, P. J., Rico, A., Troell, M., Klinger, D. H., Buschmann, A. H., Saksida, S., & Zhang, W. (2018). Unpacking factors influencing antimicrobial use in global aquaculture and their implication for management: A review from a systems perspective. *Sustainability Science*, 13, 1105–1120.
10. Hernández Serrano, P. (2005). *Responsible use of antibiotics in aquaculture* (FAO Fisheries Technical Paper No. 469). Rome: FAO.
11. Jibril, A. H., Mukhtar, U., Uhuami, A. O., Muhammad, F., & Ballah, Y. A. (2024). Antimicrobial usage knowledge, attitude and practice among aquaculture farmers in Kaduna State. *International Journal of Science for Global Sustainability*, 10(2): 48-53. <https://doi.org/10.57233/ijsgs.v10i4.735>
12. Madara, E. (2022). Antimicrobial use and practice in aquaculture production systems in Nairobi, Kenya. A Research thesis submitted to the University of Nairobi Fraternity. <https://doi.org/10.17037/PUBS.04668057>
13. Okocha, R. C., Olatoye, I. O., Alabi, P. I., Ogunnoiki, M. G., & Adedeji, O. B. (2021). Aquaculture management practices associated with antimicrobial residues in Southwestern Nigeria. *Aquaculture*, 533, 736195. <https://doi.org/10.1016/j.aquaculture.2020.736195>
14. Okon, A. J., Chibuzor-Eke, U. E., Oka, I. A., Eyam, L. E., Akpan, M. I., & Inah, S. A. (2023). Knowledge, practices, and antibiotics use patterns among animal production farmers in Calabar Metropolis. *International Journal of Public Health*

- Science*, 12(4): 1647–1655.
<http://doi.org/10.11591/ijphs.v12i4.23266>
15. Okon, E. M., Okocha, R. C., Adesina, B. T., Ehigie, J. O., Alabi, O. O., Bolanle, A. M., Matekwe, N., Falana, B. M., Tihamiyu, A. M., Olatoye, I. O., & Adedeji, O. B. (2022). Antimicrobial resistance in fish and poultry: Public health implications for animal source food production in Nigeria, Egypt, and South Africa. *Frontiers in Antibiotics*, 1, 1043302.
<https://doi.org/10.3389/frabi.2022.1043302>
 16. Oladele, O. O., Olarinmoye, A. O., Ntiwunka, U. G., & Akintomide, T. O. (2015). Survey of bacterial isolates from cases of fish disease outbreaks and their antibiotic susceptibility patterns. *Nigerian Journal of Fisheries*, 12(2): 901-906.
 17. Oladele, O. O., Ameji, N. O., Agweche, O. S., Bitrus, A. A., Jambalang, A. R., Adanu, A. W., Nnadi, N. E., Durkwa, H. U., Magaji, A. D., Haruna, A. M., & Lombin, L. H. (2024). Prevalence of *Escherichia coli* and antibiogram of bacterial isolates from avian disease cases investigated in Jos, Nigeria: A retrospective study. *Journal of Research in Veterinary Sciences*, 3(4): 123-133. DOI:10.5455/JRVS.20240520085341
 18. Olaoye, O. J., Ashley-Dejo, S. S., Fakoya, E. O., Ikeweinwe, N. B., Alegbeleye, W. O., Ashaolu, F. O., & Adelaja, O. A. (2013). Assessment of socio-economic analysis of fish farming in Oyo State, Nigeria. *Global Journal of Science Frontier Research Agriculture and Veterinary*, 13(9), 45–55.
 19. Oyebanji, B., & Oyebisi, A. (2018). Use of antibiotics and knowledge of antibiotics resistance by selected farmers in Oyo Town, Nigeria. *Uganda Journal of Agricultural Sciences*, 18(1), 43–56.
 20. Saba, A.O., Eyo, V.O., Elegbede, I.O., Fakoya, K.A., Ojewole, A.E., Dawodu, F.O., Rashidat Adebola Adewale, R.A., and Amal, M.N.A. (2024). Sustaining the blue bounty: Fish food and nutrition security in Nigeria's evolving blue economy. *AIMS Agriculture and Food*, 9(2): 500-530. doi: 10.3934/agrfood.2024029
 21. Sani, M., Muazu, Z., & Danggaladima, H. (2023). An assessment of the physiochemical quality of drinking water from tube wells and its effects on human health in Sokoto metropolis. *CaJoST*, 5(2), 132–139.
 22. Zhang, W., Belton, B., Edwards, P., Henriksson, P. J. G., Little, D. C., Newton, R., & Troell, M. (2022). Aquaculture will continue to depend more on land than sea. *Nature*, 603(7900): E2–E4.
<https://doi.org/10.1038/s41586-021-04331-3>