

## Antimicrobial Usage Knowledge Attitude and Practice Among Aquaculture Farmers in Kaduna State

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### ABSTRACT

The use of antimicrobials in aquaculture is a widespread practice to prevent infections, promote growth, and reduce mortality. However, this has raised concerns about antimicrobial resistance (AMR), environmental pollution, and human health risks. This study assessed the knowledge, attitudes, and practices (KAP) of aquaculture farmers in Kaduna State, Nigeria, regarding antimicrobial use and identified associated factors. A stratified random sampling method was utilized, distributing 60 validated questionnaires across four agricultural zones, yielding 51 responses. The pretested questionnaires ensured validity and reliability, with a Cronbach's  $\alpha$  of 0.700. Data analysis revealed key demographic insights: 84.3% of respondents were male, 76.5% had tertiary education, and 51% had 2–5 years of aquaculture experience. Catfish farming dominated (90.1%), with most farmers also raising poultry (62.7%). Findings highlighted a reliance on antibiotics (68.63%), primarily for infection treatment (64.71%). Antimicrobials were obtained through veterinary prescriptions (56.86%), self-prescription (23.53%), or over-the-counter purchases (19.61%). Occasional administration (41.18%) was most common. The prevalence of fungal (52.94%) and bacterial (33.33%) diseases emphasized the need for improved biosecurity, which 88.24% of farmers deemed very important. Challenges included waste disposal practices, water quality management, and the misuse of antimicrobials for prophylaxis and growth promotion. This study highlights the urgent need for targeted interventions, including farmer education, stringent regulatory frameworks, and alternative disease management strategies, to mitigate AMR, safeguard public health, and ensure sustainable aquaculture in Kaduna State.

**Keywords:** Antimicrobials, aquaculture, antimicrobial resistance (AMR), knowledge, attitude.

### 1.0 INTRODUCTION

The use of antimicrobials in aquaculture is a common practice aimed at preventing bacterial infections, enhancing growth rates, improving feed efficiency, and reducing mortality rates (Milijasevic *et al.*, 2024). However, this widespread usage poses significant challenges, including the emergence of antimicrobial resistance (AMR), environmental pollution, and risks to human health. Several factors influence antimicrobial use in aquaculture, such as disease prevalence and severity, water quality, farm size and type, regulatory frameworks, and the knowledge and attitudes of farmers (Okon *et al.*, 2022).

Despite the undeniable benefits of antimicrobials, their overuse and misuse, particularly for prophylactic purposes, have led to serious consequences (Byrne *et al.*, 2019). In 2015, the World Health Assembly adopted the Global Action Plan (GAP) on AMR, promoting multisectoral national action plans with a One Health approach. The GAP was later endorsed by the United Nations Environment Program, the Food and Agriculture Organization of the United Nations (FAO), and the World Organisation for Animal Health (WOAH). This global initiative aims to tackle AMR

collaboratively across sectors (WHO, 2022). Mitigating these risks requires adopting integrated disease management (IDM) strategies, implementing vaccination programs, enhancing biosecurity, and ensuring proper water quality management (ICARS, 2024). Regulatory organizations emphasize the importance of responsible antimicrobial use through monitoring, education, and the promotion of alternatives like vaccines, probiotics, and plant-based antimicrobials (WHO, 2012). Looking forward, effective solutions include the development of advanced vaccines, improved diagnostic tools, stronger biosecurity measures, and global collaboration to address these multifaceted challenges (WHO, 2012).

The overuse and misuse of antimicrobials in aquaculture have emerged as pressing public health concerns, particularly due to their role in driving AMR, a global threat that jeopardizes treatment efficacy in both humans and animals. Specific farming practices, including feeding methods, disease diagnosis, and antibiotic administration, are strongly linked to AMR development (McKernan *et al.*, 2021). Despite this, there is limited information on the knowledge, attitudes, and practices (KAPs) of aquaculture farmers

regarding antimicrobial usage, particularly in Kaduna State, highlighting the need for further research (Ojo *et al.*, 2015).

This study is critical for promoting the responsible use of antimicrobials in aquaculture to protect public health, enhance sustainability, inform policy development, address existing research gaps, and improve economic outcomes for farmers and the industry. By examining current antimicrobial usage practices in Kaduna State, this research seeks to identify areas for improvement and develop targeted interventions that reduce AMR, promote sustainable aquaculture, and ensure the economic viability of aquaculture operations. The study aims to assess the knowledge, attitudes, and practices of aquaculture farmers regarding antimicrobial usage and identify factors influencing their usage patterns. Specific objectives include evaluating the KAPS of aquaculture farmers and analyzing their antimicrobial usage practices in Kaduna State.

## 2.0 MATERIALS AND METHODS

### 2.1 Study Area

Kaduna State, located in northwestern Nigeria, lies between latitudes 09°02'–11°23' N and longitudes 06°15'–08°60' E. Covering approximately 45,567 km<sup>2</sup> with an estimated population of 6,066,562 in 2006. The state comprises 23 Local Government Areas (LGAs) within three senatorial zones. Its tropical climate features distinct wet and dry seasons, with an average rainy season lasting about five months and annual rainfall of approximately 1,016 mm. Agriculture, practiced by about 80% of the population, is a key economic activity.

### 2.2 Design and Administration of Questionnaire

The questionnaire was pretested on a small group of farmers to assess its validity and reliability. Validity was confirmed by experts through a review ensuring the survey addressed relevant topics comprehensively, while reliability was measured using Cronbach's alpha to confirm internal consistency.

### 2.2.1 Validity Testing

Field experts reviewed the questionnaire to ensure content validity, verifying that it included a representative set of items reflecting the concept under study.

### 2.2.2 Reliability Testing

Cronbach's alpha was used to evaluate the internal consistency and stability of the questionnaire items over time.

### 2.3 Study Design and Sample Distribution

The study utilized stratified random sampling to ensure representative data collection across Kaduna State's four agricultural zones: Birnin Gwari, Lere, Samaru Katab, and Maigana. A total of 60 questionnaires were distributed evenly, with 15 allocated to each zone. Questionnaires were administered randomly within accessible local governments in each zone to provide a comprehensive understanding of the agricultural landscape. However, only 51 responded.

### 2.4 Statistical Analysis

Responses were compiled in Microsoft Excel 2016 and analyzed descriptively. Jamovi Software was used to calculate the Cronbach's alpha. Data were summarized in tables displaying variables, frequencies, and percentages, categorized into four primary tables with multiple informative subsets for comprehensive analysis.

## 3.0 RESULTS

### 3.1 Pre-Testing of Questionnaire and Internal Consistency Assessment

Following the development of the questionnaire, the questionnaires were distributed for pre-testing. Once the questionnaires were completed, the responses were coded and used to assess internal consistency. Below is Table 1, which summarizes the assessment of internal consistency.

**Table 1: Summary of internal consistency assessment**

	Mean	Standard deviation	Cronbach's $\alpha$	McDonald's $\omega$
Scale	1.71	0.258	0.700	0.746

### 3.2 Demographic Information of Aquaculture Farmers

Among the 51 respondents in this study, 43 (84.3%) were male, while 8 (15.7%) were female. The majority, 39 (76.5%), were within the 20–30 age category and had attained a higher level of education. Additionally, 26 (51%) of the farmers had 2–5 years of experience in aquaculture, as presented in Table 2.

**Table 2: Demographical Information of Aquaculture Farmers in Kaduna State, Nigeria**

Parameters	Frequency (n=51)	Percentage (%)
<b>Gender</b>		
Male	43	84.3
Female	8	15.7
<b>Level of Education</b>		

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Primary	0	0
Secondary	6	11.8
Tertiary	39	76.5
Informal	6	11.8
<b>Age categories</b>		
20-30	27	52.9
31-40	22	43.14
41-50	2	3.9
50 Above	0	0
<b>Years of Experience</b>		
Less than 2 years	13	25.5
2- 5 years	26	51.0
5- 10 years	10	19.6
Above 10 years	2	3.9

### 3.3 Aquatic Production Systems

The majority of fish farmers (46; 90.1%) reared catfish, while a smaller proportion (5; 9.8%) focused on tilapia. Regarding familiarity with aquaculture farming, 30 (58.8%) were very familiar, 19 (37.3%) were somewhat familiar, and 2 (3.9%) were not familiar. Additionally, many farmers also raised other livestock, including poultry (32; 62.7%), cattle (5; 9.8%), sheep/goats (6; 11.8%), and others (8; 15.7%), as detailed in Table 3.

**Table 3: Aquatic Production system among Aquaculture Farmers in Kaduna State, Nigeria**

Parameters	Frequency (n=51)	Percentage (%)
<b>Type of fish reared</b>		
Tilapia	5	9.8
Catfish	46	90.1
<b>Familiarity with Aquaculture</b>		
Very familiar	30	58.8
Somewhat familiar	19	37.3
Not familiar	2	3.9
<b>Other livestock reared</b>		
Poultry	32	62.7
Cattle	5	9.8
Sheep and Goats	6	11.8
Others	8	15.7
None	0	0

### 3.4 Management Systems Among Aquatic Farmers

The study revealed that most farmers (60.7%) dispose of waste on farmland, while 37.25% opt for offsite disposal, and 1.96% release waste into hatching ponds. Chemicals were identified as the primary factor influencing water quality by 56.86% of respondents, followed by biological factors (39.22%), with 3.92% citing unspecified factors.

Disease prevalence in aquaculture was a significant issue, with fungal diseases affecting 52.94% of farms, bacterial diseases impacting 33.33%, and ammonia toxicity and viral diseases reported at 7.84% and

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5.88%, respectively. Encouragingly, 88.24% of fish farmers considered biosecurity very important, while 11.76% rated it as important. This is summarized in Table 4 as shown below.

**Table 4: Management Systems Among Aquatic Farmers in Kaduna State, Nigeria**

Parameters	Frequency (n=51)	Percentage (%)
<b>Waste disposal</b>		
Release to farm land	31	60.78
Release to hatching pond	1	1.96
Outside disposal	19	37.25
<b>Factors Influencing Water quality</b>		
Chemical	29	56.86
Biological	20	39.22
Others	2	3.92
<b>Diseases affecting aquaculture</b>		
Fungal	27	52.94
Bacterial	17	33.33
Viral	3	5.88
Ammonia toxicity	4	7.84
<b>Important of biosecurity</b>		
Very important	45	88.24
Important	6	11.76
Somewhat important	0	0.00
Not important	0	0.00

### 3.6 Antimicrobial Usage Pattern among Aquaculture Farmers

The study highlighted that the majority of farmers (60.7%) dispose of waste on farmland, while 37.25% prefer offsite disposal, and 1.96% discharge waste into hatching ponds. Regarding water quality, chemicals were the leading concern (56.86%), followed by biological factors (39.22%) and unspecified factors (3.92%).

Disease prevalence is notable, with fungal infections affecting 52.94% of farms, bacterial diseases 33.33%, ammonia toxicity 7.84%, and viral infections 5.88%. Encouragingly, 88.24% of farmers rated biosecurity as very important, while 11.76% considered it just important. Details are summarized in Table 5.

**Table 5: Antimicrobial Usage Pattern among Aquaculture Farmers in Kaduna State, Nigeria**

IJS GS FUGUSAU VOL. 10 (2)			WEBSITE: <a href="https://fugus-ijsgs.com.ng">https://fugus-ijsgs.com.ng</a>
Parameters	Frequency (n=51)	Percentage (%)	
<b>Types of antimicrobial used</b>			<p>to promote responsible antimicrobial use and mitigate the risks of AMR in the aquaculture industry. However, issues such as illiteracy and lack of awareness remain significant barriers to addressing AMR effectively. Although a majority of aquaculturists in this study had formal education, which could potentially enhance their awareness of AMR through various channels, gaps in proper antimicrobial use persist. Notably, even those with formal education often fail to consult veterinarians for appropriate prescriptions. Veterinary consultation tends to occur only when establishing fish farms or in response to fish mortality events, rather than as part of routine farm management.</p> <p>The predominance of male respondents (84.3%), the majority falling within the 21–30 age group (52.9%), and most having 2–5 years of experience in aquaculture farming (51.0%) indicate active engagement in fish farming as a key source of food and income within the demographic area. This trend aligns with findings from other studies like Ayelaja <i>et al.</i>, 2022, which indicate that men predominantly engage in fish farming in northern Nigeria, in contrast to the southern regions, where women are more actively involved in aquaculture activities. The findings, which show that most respondents have five years or less of experience in fish farming, suggest that aquaculture is still an emerging business venture in the region. Nonetheless, the industry holds significant potential for expansion as more people turn to fish as a healthier and more sustainable alternative.</p> <p>Although poultry farming remains the dominant business in the region, as reflected in the high number of respondents involved in it, catfish farming stands out as the most commonly practiced form of aquaculture in northern Nigeria (FAO, 2024). This finding aligns with previous studies. However, catfish farming is increasingly confronted with significant challenges related to AMR.</p> <p>The predominant disposal methods, including the release of fish wastewater onto farmland, outside disposal, and discharge into hatching ponds, can facilitate the spread of antimicrobial residues and metabolites, creating an environment that promotes the emergence of resistant microbial strains (Manyi-Loh <i>et al.</i>, 2018). Over time, these resistance genes can transfer to other microorganisms, compounding the problem and potentially degrading water quality. This not only impacts fish health but also poses significant risks to public health, as evidenced in this study, where chemical and biological contaminants were identified as the primary factors affecting water quality in aquaculture systems (Samreen <i>et al.</i>, 2021).</p> <p>Antibiotics remain among the most misused drugs contributing to antimicrobial resistance (AMR) (WHO, 2023). In this study, approximately 68.63% of farmers reported using antibiotics, followed by 21.57% using</p>
Antibiotics	35	68.63	
Antifungal	11	21.57	
Antiviral	0	0.00	
Others	5	9.80	
<b>Purpose of antibiotics usage</b>			
Treatment of infection	33	64.71	
Prevention	13	25.49	
Growth promotion	4	7.84	
Others	1	1.96	
<b>Source of the antimicrobials</b>			
Veterinary prescription	29	56.86	
Self prescription	12	23.53	
Over the counter	10	19.61	
<b>Frequency of administration</b>			
Daily	2	3.92	
Weekly	11	21.57	
Monthly	9	17.65	
Occasionally	21	41.18	
Rarely	8	15.69	
<b>Common antimicrobials used</b>			
Procaine penicillin	24	47.06	
Penstrep	15	29.41	
Oxytet	5	9.80	
Potassium permanganate	7	13.73	

#### 4.0 DISCUSSION

Over the years, the global rise in AMR has drawn significant attention, yet its implications for aquaculture often remain underappreciated. Many aquaculture farmers misuse and overuse antimicrobial drugs, frequently employing them to promote animal growth rather than strictly for the prevention or treatment of infections (Caputo *et al.*, 2022). This misuse can be attributed to several factors, including limited knowledge, ignorance, and non-adherence to proper guidelines.

A contributing factor is that some farmers lack formal education in aquaculture-related disciplines, relying instead on practical experience accumulated over time. Moreover, the short production cycles typical in aquaculture where fish are sold relatively quickly may mask the immediate consequences of AMR, making the issue less apparent to these farmers.

Fish farming is the predominant activity among aquaculturists in northern Nigeria. In contrast, aquaculture in the southern region encompasses a broader spectrum, including crustacean and shellfish farming (FAO, 2024). This regional variation highlights the need for targeted education and training

antifungals, a trend consistent with findings from other studies of Nhadi *et al.*, 2023. The use of these drugs is often attributed to reasons such as treating infections, preventing diseases, and promoting growth. However, misuse is prevalent due to inconsistent adherence to instructions and the lack of stringent regulations governing their use. While the majority of respondents claimed they used antibiotics occasionally, this may not accurately reflect actual practices. Procaine penicillin, used by 47.06% of farmers in this study, was identified as the most commonly administered antimicrobial, likely due to its affordability and over-the-counter availability. This highlights a critical gap in regulatory oversight and enforcement.

The widespread misuse of antibiotics underscores the urgent need for targeted sensitization programs and the implementation of robust regulations to address AMR. This issue extends beyond aquaculture, impacting the environment, humans, and other animals, both directly and indirectly, necessitating a holistic approach to mitigate its far-reaching consequences.

## 5.0 CONCLUSION

This study provides valuable insights into the antimicrobial usage patterns and management practices of aquaculture farmers in Kaduna State, Nigeria. The findings indicate that the majority of farmers engage in the use of antibiotics, with the primary purposes being treatment and prevention of infections. However, there is notable concern about the overuse of antibiotics for non-therapeutic purposes, such as growth promotion, which contributes to the growing threat of AMR. The study also highlights that farmers rely on various sources for antimicrobial procurement, including veterinary prescriptions, self-prescription, and over-the-counter purchases.

## DECLARATION

### Conflict of interest

All authors of this manuscript declare no conflict of interest.

## ETHICAL APPROVAL

Not applicable

## RESEARCH INVOLVING HUMAN AND/OR ANIMAL PARTICIPANTS

This article does not contain any studies with human participants or animals performed by any of the authors.

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