Geneva Health Forum

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Geneva Health Forum 2026

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A ONE HEALTH PERSPECTIVE ON ANTIMICROBIAL RESISTANCE IN THE NIGER RIVER, MALI

Implications for Irrigated Agriculture, Environmental Health, and Community Protection

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#37

1. BACKGROUND

- AMR is a major global health threat, with 4.95 million deaths in 2019 (1.27 million directly attributable).
- Aquatic environments can act as reservoirs and pathways for resistant bacteria.
- In Mali, the Niger River supports drinking water, irrigated agriculture, fisheries, livestock, and community livelihoods, but environmental AMR surveillance remains limited.

This study assessed antimicrobial-resistant bacteria recovered from the Niger River and examined their implications for environmental health, food safety, irrigated agriculture and community protection.

OBJECTIVE

To characterize bacterial contamination and antimicrobial resistance in the Niger River and identify potential AMR hotspots relevant to agriculture, environmental health, and communities.

3. STUDY SETTING





Niger River – Bamako, Mali
6 strategic sampling sites

4. METHODS

- River water sampling
- Bacterial isolation
- Biochemical identification
- 16S rRNA confirmation
- Antimicrobial susceptibility testing
- MDR / ESBL / MAR analysis
- Site-level comparison

5. ANTIBIOTICS TESTED

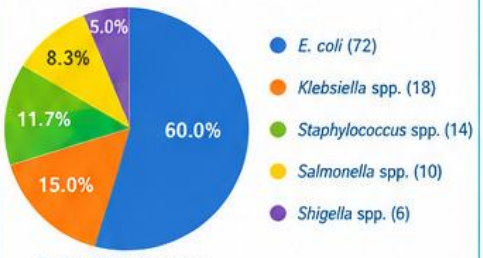
Antibiotic	Class
Ampicillin	β-lactam
Amoxicillin/clavulanic acid	β-lactam/β-lactamase inhibitor
Ceftriaxone	3rd-generation cephalosporin
Cefotaxime	3rd-generation cephalosporin
Ciprofloxacin	Fluoroquinolone
Gentamicin	Aminoglycoside
Tetracycline	Tetracycline
Trimethoprim-sulfamethoxazole	Folate pathway inhibitor

9. CONCLUSION

- The Niger River harbours a substantial burden of antimicrobial-resistant bacteria, with implications for environmental health, irrigated agriculture, food safety and community protection. Integrating environmental AMR surveillance into Mali's national AMR response could strengthen early detection and guide targeted interventions.

2. RESULTS

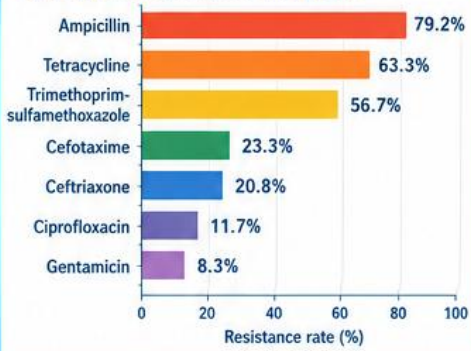
Figure 1. Distribution of bacterial isolates



Total: 120 isolates

E. coli represented 60% of all recovered isolates, indicating substantial fecal contamination of the sampled river environment.

Figure 2. Antimicrobial resistance profile



Highest resistance was observed for ampicillin, tetracycline and trimethoprim-sulfamethoxazole.

Figure 3. AMR burden



Nearly 4 in 10 isolates were resistant to multiple antimicrobial classes.

ESBL-producing bacteria can compromise treatment options for serious infections.

Higher MAR suggests exposure to environments with stronger selective pressure.

6. RESISTANCE IN KEY SPECIES

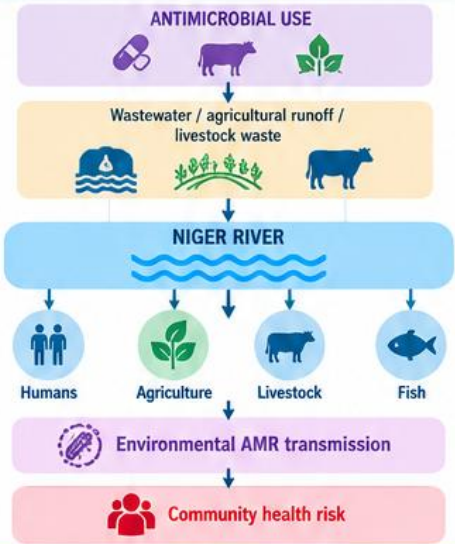
E. coli
- Ampicillin: 86.1%
- Tetracycline: 70.8%

Klebsiella spp.
- Ampicillin: 100%

Third-generation cephalosporins
- Cefotaxime: 23.3%
- Ceftriaxone: 20.8%

These findings indicate resistance extending beyond commonly used older antibiotics and highlight the importance of monitoring β-lactam resistance.

10. ONE HEALTH PATHWAY



7. AMR HOTSPOTS



Significant difference in MDR prevalence across sites ($\chi^2 = 11.8$; $p = 0.037$). Sites 3 and 4 showed higher MDR prevalence.

8. ONE HEALTH IMPLICATIONS

HUMAN HEALTH
Contaminated water and food.

IRRIGATED AGRICULTURE
Irrigation water and contaminated soils or crops.

LIVESTOCK
Shared water sources and environmental contamination.

FISHERIES
Persistence and dissemination in aquatic ecosystems.

ENVIRONMENT
The river acts as a reservoir and pathway for AMR dissemination.

9. KEY FINDINGS

- **120** bacterial isolates
- **60.0%** *E. coli*
- **79.2%** ampicillin resistance
- **12.5%** ESBL
- **MAR = 0.34** (range: 0.28–0.40)
- **Sites 3–4** significant hotspot ($\chi^2 = 11.8$; $p = 0.037$)

11. CONCLUSION

The Niger River harbours a substantial burden of antimicrobial-resistant bacteria, with implications for environmental health, irrigated agriculture, food safety and community protection. Integrating environmental AMR surveillance into Mali's national AMR response could strengthen early detection and guide targeted interventions.

12. RECOMMENDATIONS

- ✓ Routine environmental AMR monitoring.
- ✓ Assess risks in agriculture and food safety.
- ✓ Monitor livestock and shared water points.
- ✓ Strengthen One Health collaboration.
- ✓ Extend surveillance to major irrigated areas (Office du Niger).

Healthy ecosystems → Safe food → Healthy communities → A One Health future

Analytical/simulated dataset