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# International Symposium on Marine Litter and Coastal Ecosystem Nexus (MariNEX)

29-31 January, 2025

# BOOK OF ABSTRACTS

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## OP 19 Chemical Use and Its Determinants in Commercial Tilapia Farming in Bangladesh: A Cross-sectional Study

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Chemicals used in aquaculture, including antibiotics, disinfectants, biocides, and other therapeutic agents, can significantly affect the surrounding environment and disrupt the interconnected One Health sectors, encompassing human, animal, and environmental health, as well as food safety. However, there is limited understanding of the extent and key factors influencing chemical use in aquaculture farms in Bangladesh. To address this knowledge gap, we conducted a retrospective cross-sectional study in November 2022, surveying 116 commercial tilapia farms in Mymensingh, a major tilapia production hub in Bangladesh. The pond-level questionnaire was deployed to collect data from one randomly chosen pond per farm where tilapia farming was conducted during the last production cycle. A total of 68.1% of farmers reported 251 instances of aquamedicine administration involving 61 different products, with the majority (54.6%) being antimicrobial agents, including antibiotics, antiparasitics, and disinfectants, applied in the selected ponds. Approximately 46.6% of the farmers interviewed experienced fish mortality in their ponds and the two primary causes of fish mortality identified by respondents were water quality issues (85.2%) and pathogen infections (66.7%). Univariate logistic regression analysis revealed that the likelihood of using any chemical inputs was approximately twenty-four times higher (OR 23.8, 95% CI: 4.9-116.3, $p<0.05$) on the ponds where clinical signs of illness were present and five times higher in polyculture commercial tilapia farming techniques (OR 5.3, 95% CI: 1.1-26.2, $p<0.05$). Frequent use of chemical products, particularly antimicrobial agents, could have significant risks to both environmental, animal and human health. This practice may contribute to the development of antimicrobial resistance (AMR) and the contamination of aquatic ecosystems with harmful residues. To mitigate these impacts, it is essential to promote preventive measures such as improved water quality management and biosecurity practices, while ensuring the responsible and judicious use of antimicrobials in aquaculture.




# Chemical Use and Its Determinants in Commercial Tilapia Farming in Bangladesh: A Cross-sectional Study

Shafiq Rheman*, Laura Khor, Sabrina Hossain, Jérôme Delamare-Deboutteville and David Verner-Jeffreys

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**International Symposium on Marine Litter and Coastal Ecosystem Nexus (MariNEX)**
**January 29-31, 2025**
**Khulna University, Khulna, Bangladesh**

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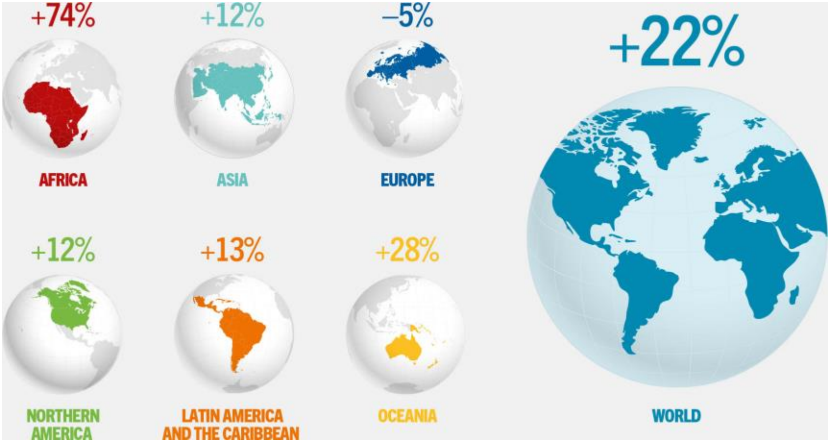
# Introduction

❖ Global population will rise to 9.7 billion by 2050

❖ Requires a 22% increase to maintain a per capita aquatic animal consumption of 20.7 kg

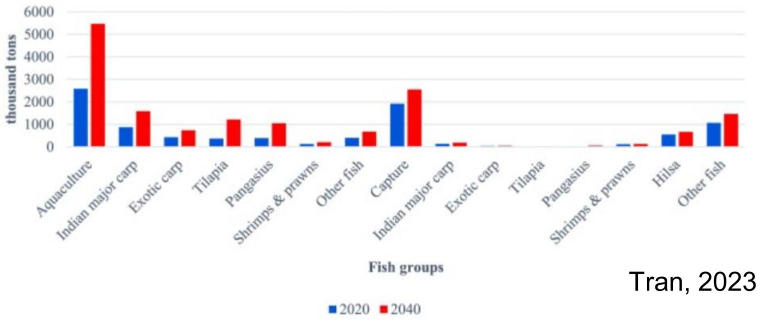



FAO, 2024

Business-as-usual scenario in Bangladesh (Tran, 2023)

❖ 25.8 million tons in 2020 to 54.6 million tons t tons in 2040

❖ Average growth rate 3.8% per year



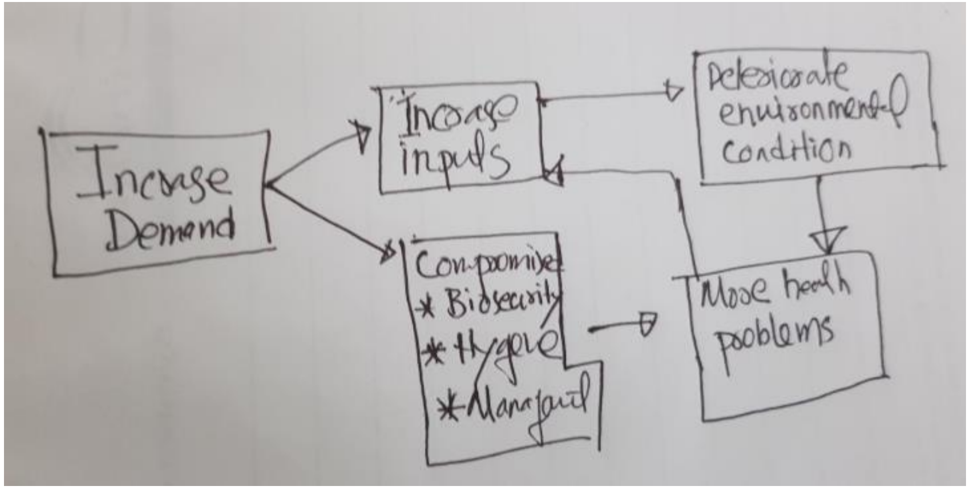

Tran, 2023

# Introduction

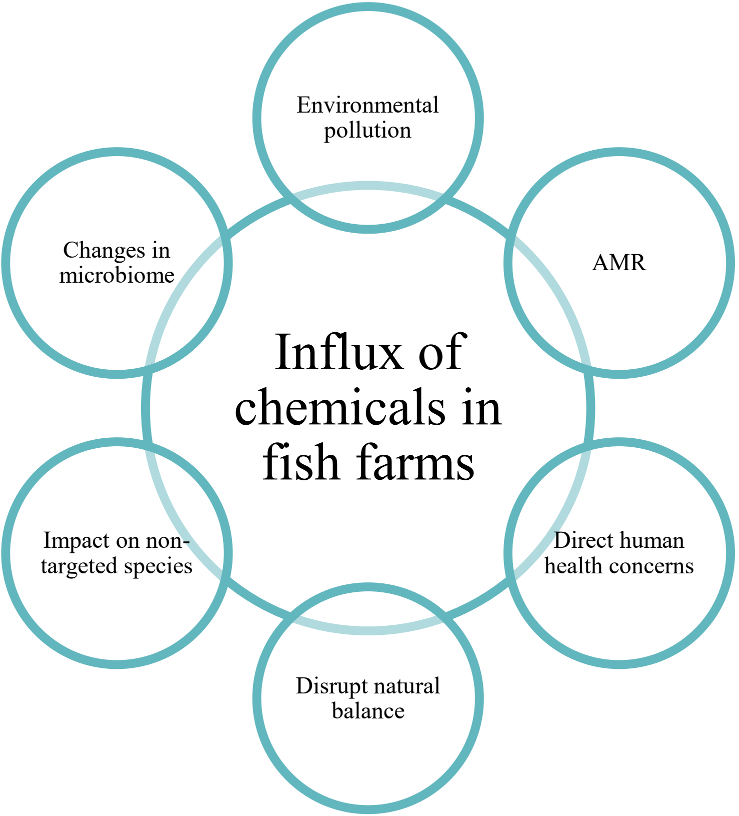
- Aquaculture in Bangladesh is intensifying to meet the growing demand for animal protein

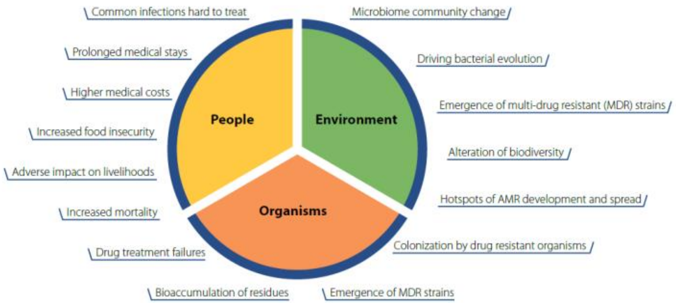
- Production is prioritized over biosecurity, hygiene, and effective management practices

- Often focus on maximizing yields by maintaining high stocking densities and supplementing inputs including chemicals to boost productivity



# Introduction




Limited information on the extent of chemical use and the practices driving its use in commercial fish farms

The study aimed to

- Assess the extent of chemical use in commercial tilapia farms, with a focus on the driving factors and practices influencing the usage of chemicals.

# Methodology: study area & study design

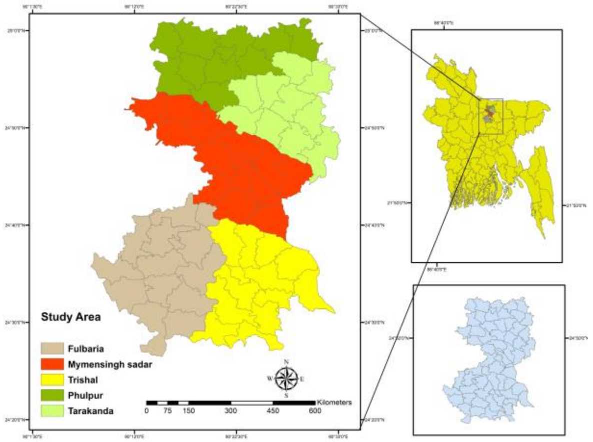
Retrospective cross-sectional study 2022

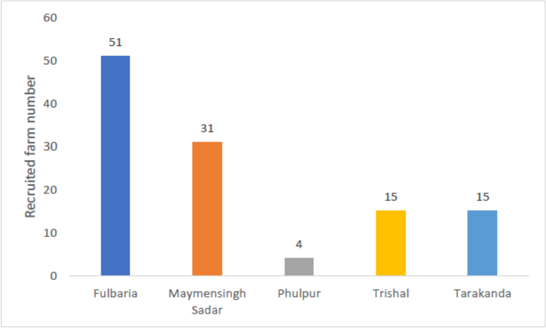
**Study area**

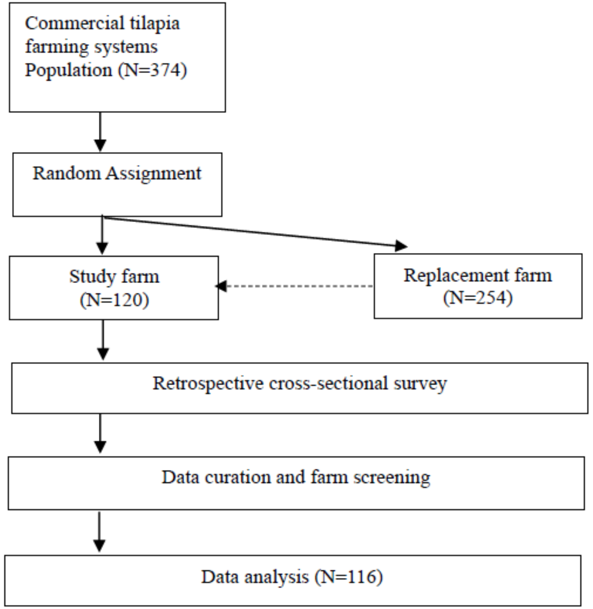
- 5 upazilas in Mymensingh district

**Farm selection criteria**

- Currently practicing tilapia production
- Completed tilapia production in recent past
- Farms must be commercial in nature



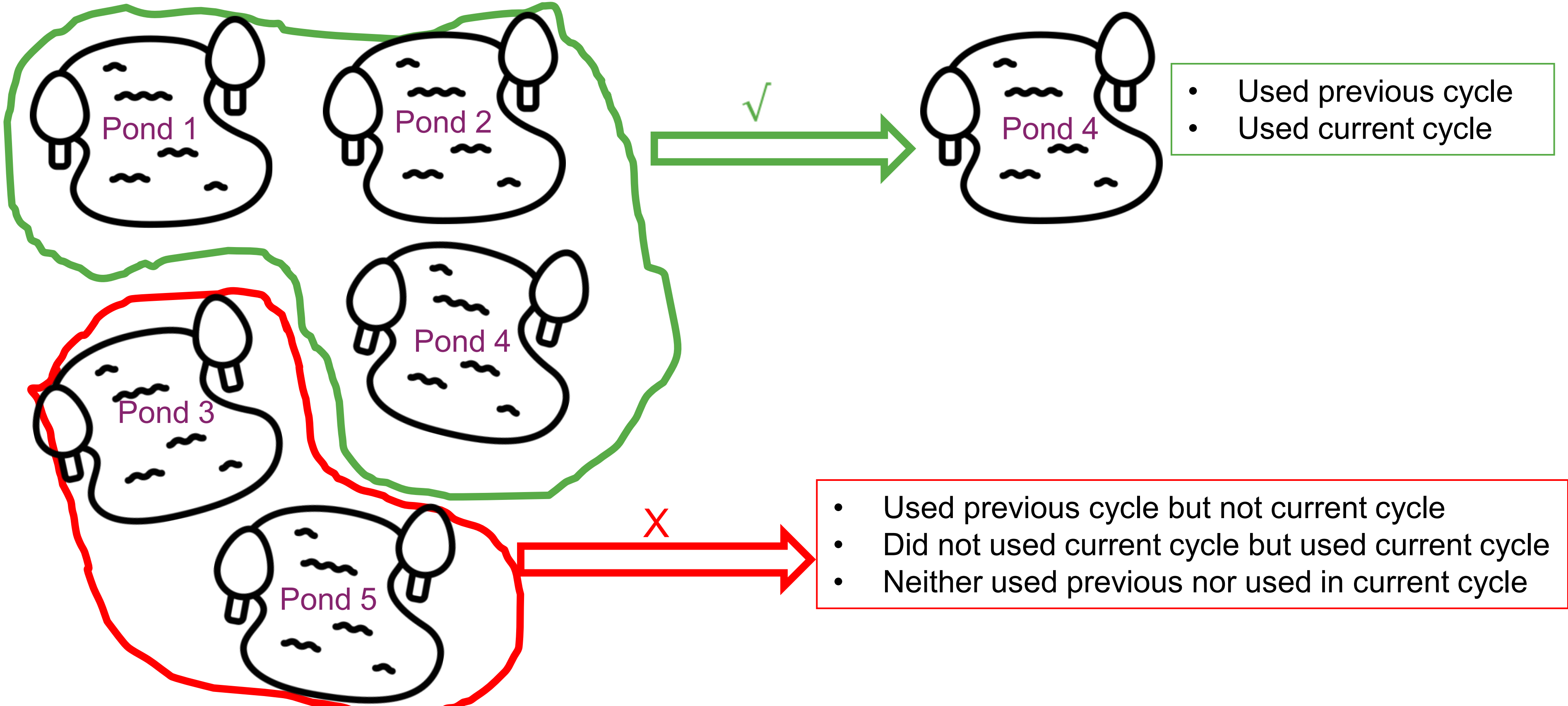




**Commercial tilapia farm population census**

- KIIs: Local fisheries officers & fish farmer cooperatives leaders
- FGDs: community farmers
- Confirmatory list: Field visit, phone contact, screening of initial list

# Methodology: Pond selection

From each recruited farm, a single unit of tilapia pond was randomly selected from eligible pond list



# Methodology: survey tools development

**Questionnaires: Digital tools for collecting responses:**

| Survey tools | Description |
|---|---|
| CS tool | **Farm-level information:** Socioeconomic/demographic information, AMR awareness and attitudes, farm layout and worker information, general farming practice and biosecurity.<br><br>Pond-level information from previous completed production cycle: Farming practices e.g., stocking, feeding, fertilization and harvesting, disease, mortality, response to mortality, prevention, treatments, production economics. |
| Owner information | Only used if owner was absent during cross-sectional (CS) survey |

**Enumerator training**

- ❖ 3 led-enumerator and 7 enumerators went through 2 days training to counduct the CS survey

- ❖ Conducted input shop survey in six upazilas and performed an extensive web search to catalog commonly used chemicals in aquaculture farms.

- ❖ Compiled the findings into a photobook, which was presented to farmers during the survey.


Photobook

# Results

## Demographics and farming system characteristics of commercial tilapia farms

- Predominantly male-operated commercial tilapia farming sector in Bangladesh, with middle-aged men typically managing the farms.
- Farms were characterized continuous polyculture systems, where multiple species of fish are raised alongside tilapia in overlapping production cycles.

| **Demographic characteristics** | **Responses (percentage)** |
|---|---|
| Position of the respondents | |
| Owner | 112 (96.6%) |
| Manager | 4 (3.4%) |
| Gender | |
| Female | 0 (0%) |
| Male | 116 (100.0%) |
| Training | |
| Yes | 35 (30.2%) |
| No | 81 (69.8%) |
| **Culture type** | |
| Polyculture | 106 (91.4%) |
| Monoculture | 3 (2.6%) |
| Both | 7 (6.0%) |
| **Stocking practice** | |
| All-in-all out | 32 (27.6%) |
| Continuous | 84 (72.4%) |
| **Production cycle (per year)** | |
| One production cycle | 14 (12.1%) |
| Two production cycles | 93 (80.2%) |
| Three production cycles | 9 (7.8%) |
| **Type of cultured fish** | |
| Tilapia | 2 (1.7%) |
| Tilapia and carp | 62 (53.5%) |
| Tilapia and catfish | 6 (5.2%) |
| Tilapia, carp and catfish | 46 (39.7%) |

# Results

❖ 52.6% farms reported using chemicals for disease treatment

| Compounds | Farms reported (n) | Farms reported (%) | Administration events (n) | Administration events (%) | Maximum time applied |
|---|---|---|---|---|---|
| Antibiotics | 18 | 15.5 | 21 | 8.4 | 2 |
| Antiparasitics | 18 | 15.5 | 19 | 7.6 | 2 |
| Disinfectants | 46 | 39.7 | 97 | 38.6 | 4 |
| Growth promoter | 4 | 3.4 | 5 | 2.0 | 2 |
| Oxygen enhancer | 30 | 25.9 | 35 | 13.9 | 2 |
| Probiotics | 5 | 4.3 | 5 | 2.0 | 1 |
| Gas reducers | 47 | 40.5 | 66 | 26.3 | 5 |
| Feed supplement | 3 | 2.6 | 3 | 1.2 | 1 |

A total of 251 instances of chemical administration reported, chemicals with antimicrobial properties (antibiotics, antiparasitics, and disinfectants) were used in more than half of the cases (54.6%).

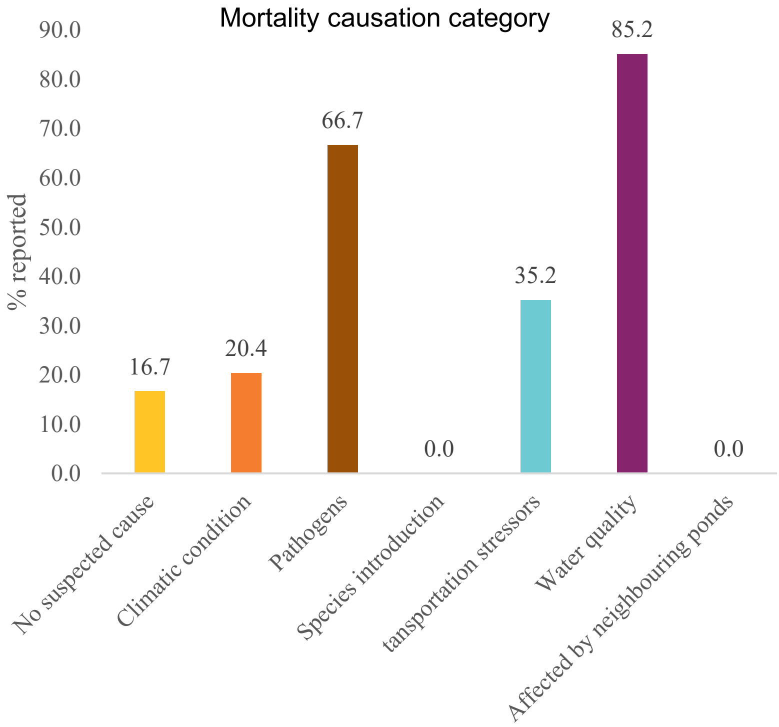
# Results

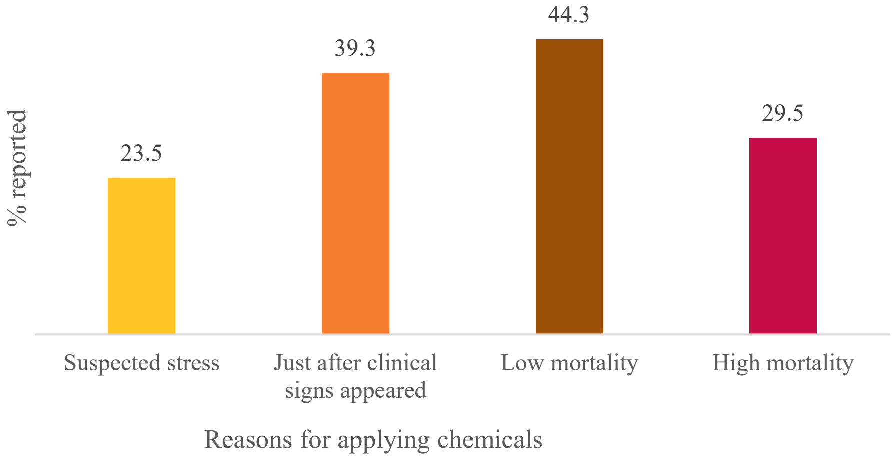
- Limited use of antibiotics
- Some classes are critically important antimicrobials (CIA) and highly important antimicrobials (HIA) for human medicine

| **Commercial name** | **Antibiotic[a]** | **Antibiotic class** | **Treatments N (%)** |
|---|---|---|---|
| **Cotrim-Vet® Suspension** | TMP, SMX | Diaminopyrimidine, Sulfonamide | 2 (9.5) |
| **Renamycin® (vet), Otetra-vet® 50** | OTC | Tetracycline | 5 (23.8) |
| **Ciptec 10%** | CIP | Fluoroquinolone | 1 (4.8) |
| **Renamox® 30% (Vet)** | AMX | Penicillin (Beta-lactam) | 3 (14.3) |
| **Erocot®, Erazine™ VET, Erisen-Vet®, Micronid® (vet)** | ERY, SFD, TMP | Macrolide, Sulfonamide, Diaminopyrimidine | 4 (19.0) |
| **ENROSEF, Enroflox® DS Vet** | ENR | Fluoroquinolone | 4 (19.0) |
| **Pansol-Vet** | CIP, ENR, COL | Fluoroquinolone, Polymyxin | 1 (4.8) |
| **ASCO-Cvita® (Antibiotic as feed additive)** | OLA | Quinoxaline | 1 (4.8) |

# Results

Nearly half of the studied ponds (46.6%, 54/116) reported fish mortality.

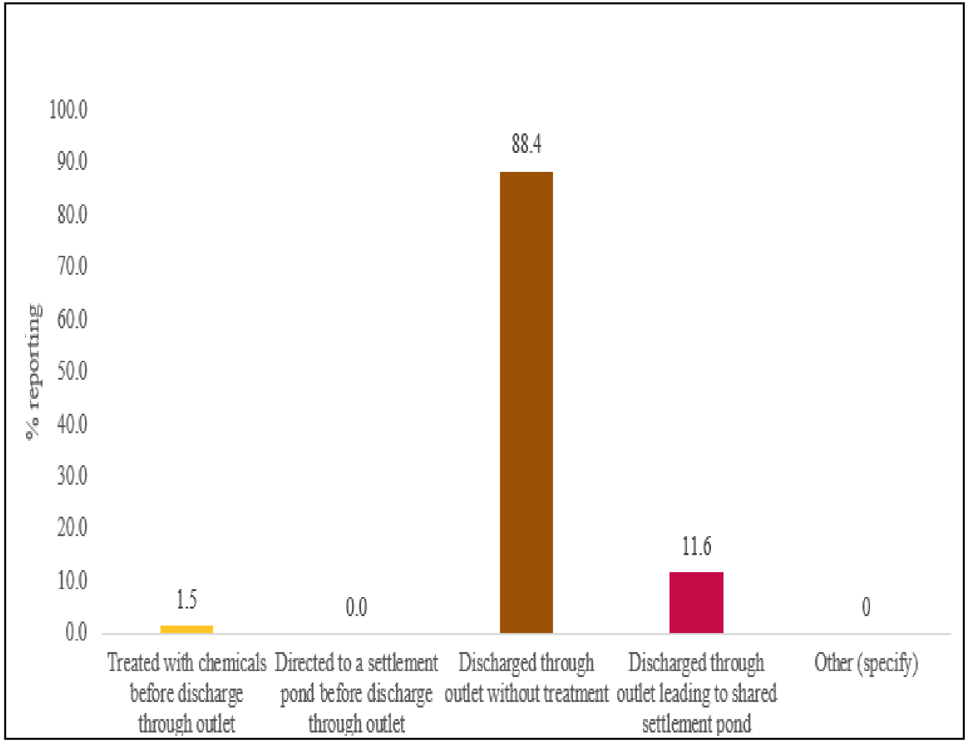


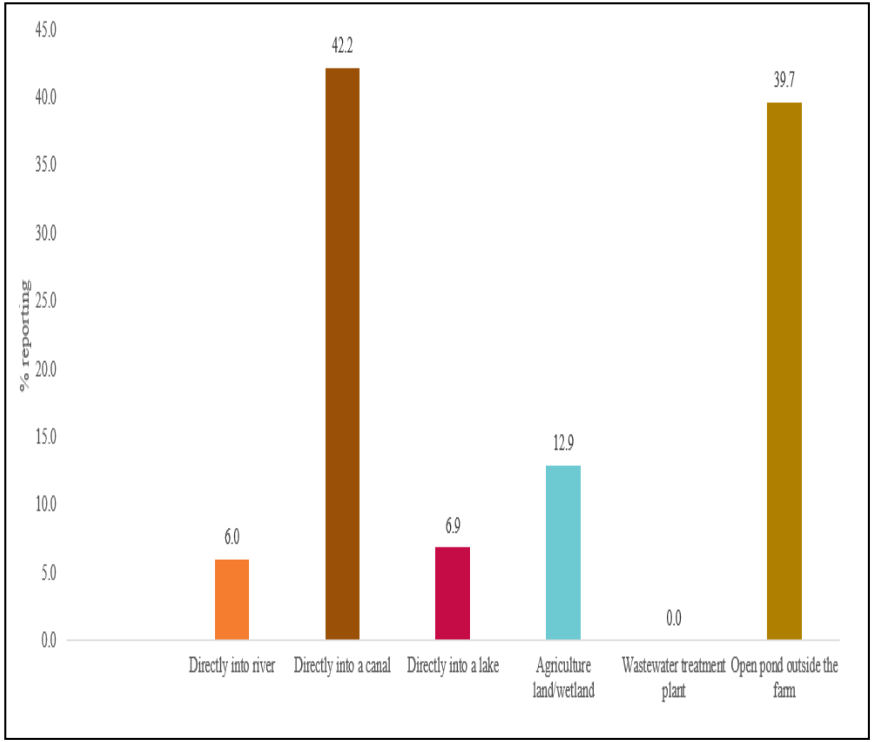




## Preventive measures taken to avoid disease occurrence

| Preventive measures | Frequency | % responses |
|---|---|---|
| Cleaning/ disinfecting | 85 | 73.28 |
| Veterinary drugs (antibiotics, antivirals, antiparasitics excluding vaccines) | 8 | 6.89 |
| Vaccines | 0 | 0 |
| Adequate feeding | 16 | 13.79 |
| Special diet (including supplements) | 0 | 0 |
| Avoid mixing with other fish | 1 | 0.89 |
| Others | 19 | 16.38 |

# Results


100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
% reporting
1.5
0.0
88.4
11.6
0
Treated with chemicals before discharge through outlet
Directed to a settlement pond before discharge through outlet
Discharged through outlet without treatment
Discharged through outlet leading to shared settlement pond
Other (specify)


45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
% reporting
6.0
42.2
6.9
12.9
0.0
39.7
Directly into river
Directly into a canal
Directly into a lake
Agriculture land/wetland
Wastewater treatment plant
Open pond outside the farm

# Results

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Likelihood of using any chemical inputs (95% CI, $p<0.05$). )

- 23.8 times where clinical signs of illness were present
- 5.3 times for poly culture system,

| | | 95% CI | | |
|---|---|---|---|---|
| | OR | Lower | Upper | Sig |
| **Pond size (ha)** | | | | |
| Small (<0.3) | Ref | | | |
| Medium (0.3-0.7) | .631 | .050 | 8.028 | .722 |
| Large (>0.7) | .354 | .028 | 4.549 | .425 |
| **Culture techniques** | | | | |
| Monoculture | Ref | | | |
| Polyculture | 5.277 | 1.061 | 26.250 | .042 |
| **Stocking density** | | | | |
| Extensive (<15000) | Ref | | | |
| Semi-intensive (15000-35000) | .550 | .082 | 3.692 | .538 |
| Intensive (>35000) | .877 | .283 | 2.723 | .821 |
| **Clinical signs** | Ref | | | |
| No | Ref | | | |
| Yes | 23.779 | 4.861 | 116.312 | .000 |
| **Mortality** | | | | |
| No | Ref | | | |
| Yes | .750 | .182 | 3.084 | .690 |
| **Culture days** | | | | |
| Normal culture period | Ref | | | |
| Extended culture period | 2.299 | .794 | 6.656 | .125 |

# Conclusion

- Addressing shortcomings in biosecurity measures, waste management, water quality, and disease management is crucial to reducing the indiscriminate use of chemicals in commercial tilapia farms, thereby safeguarding human, animal, and environmental health

# Thank You

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