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Farmer perception and usage patterns on chemicals in aqua-farms of Raipur, Chhattisgarh

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Abstract

Aquaculture is a vital economic sector in Chhattisgarh, with the state ranking sixth in India's inland fish production. However, the increasing reliance on aqua-drugs by fish farmers, coupled with inadequate awareness, raises concerns about food safety, environmental sustainability, and responsible aquaculture practices. This study evaluates farmers' perceptions, usage patterns, and challenges associated with aquaculture drugs and chemicals in Raipur district. Data were collected through field surveys, semi-structured questionnaires, and Focus Group Discussions (FGDs) involving 60 respondents, including fish farmers and hatchery owners. The findings reveal extensive use of chemicals such as Tag Lamina (56% farmers), Potash (64%), Lime (54%), and Bio-ox (66%) for disease control, water quality management, and oxygen enhancement. Commonly used chemicals include sodium chloride, formalin, potassium permanganate, and copper sulphate for health management, while zeolite, lime, and oxy-lime were preferred for pond preparation. However, farmers lack proper knowledge of dosage and active ingredients, leading to potential misuse. Despite challenges, 76% of farmers reported satisfaction with drug outcomes, though awareness of safe application remained low. Furthermore, key constraints faced by the farmers included high feed costs (43.33%), disease outbreaks (31%), inadequate infrastructure (69.33%), and lack of technical knowledge. The findings provide critical insights for policymakers, researchers, and extension services to improve sustainable aquaculture practices by bridging knowledge gaps on proper dosage and application methods for safer and more efficient fish farming, contributing to long-term sectoral growth.

Keywords: Aquaculture drugs, sustainable practices, fish health management, farmer constraints

1. Introduction

Aquaculture has emerged as crucial sector in India's food production system, with the country's total fish production reaching 17.52 million tonnes in 2023, contributing significantly to food security and livelihoods (DAHD, 2023) [1]. The state Chhattisgarh has emerged as a key player in inland fisheries, producing 5.91 lakh tonnes of fish in 2022, ranking 6th in fish production and fifth in fish seed production. Notably, Raipur district leads in fish production within the state, underscoring its importance in regional aquaculture (DoF, Chhattisgarh, 2023) [2]. The intensification of aquaculture has led to an increased reliance on chemical inputs**,** including disinfectants (e.g., potassium permanganate, formalin), antibiotics (e.g., oxytetracycline), and water conditioners (e.g., lime, zeolite) to enhance productivity and manage diseases (Ciji & Akhtar, 2021) [4]. While these chemicals play a vital role in maintaining fish health, their indiscriminate use raises concerns about antimicrobial resistance (AMR), environmental pollution, and food safety **(**FAO, 2022) [3]. Studies indicate that small-scale farmers often lack awareness of proper dosage and withdrawal periods, leading to potential residue accumulation in fish and ecosystem disruption (Rathore *et al*., 2022) [5]. In Chhattisgarh, six categories of aqua drugs and chemicals were found to be used by the fish farmers and hatchery owners which included those used for i) water quality management, ii) anti-parasitic drugs, iii) disinfectants or sanitizers, iv) water and feed probiotics, v) feed supplements and growth promoters and vi) antibiotics (Mishra *et al*., 2017) [6]. However, the lack of standardized guidelines and farmer awareness on chemical usage poses risks to sustainable aquaculture. The present study investigates the usage patterns, farmer perceptions, and challenges associated with aqua-drugs in Raipur.

2. Methodology

The study was undertaken in Raipur district of Chhattisgarh (Latitude: 21.2514° N, Longitude: 81.6296° E), a major hub of inland aquaculture in the state. As of 2022–23, the district reported an annual fish production of 51,941.80 metric tonnes, with approximately 96% derived from pond and tank-based systems, highlighting its significance in the region's aquaculture landscape. Two prominent aquaculture-intensive blocks *viz. Abhanpur* and *Arang* were purposively selected for the study due to their high concentration of fish farms and hatcheries. A purposive sampling technique was used to select 60 respondents, comprising 45 pond-based fish farmers and 15 hatchery owners, ensuring adequate representation of both production

and seed supply sectors. Primary data was collected using a combination of structured interviews with individual farmers using a pre-tested questionnaire, field observations to validate on-ground practices and input usage and Focus Group Discussions (FGDs) to gather qualitative insights on constraints, perceptions, and community practices. Secondary data was also obtained from various government reports, journals and technical reports. Furthermore, to assess farmers' perception towards the use of aquaculture drugs and chemicals, a structured questionnaire was administered using a five-point Likert-type scale that is Strongly Agree (SA);Agree (A);Undecided (U); Disagree (D);Strongly Disagree (SD).

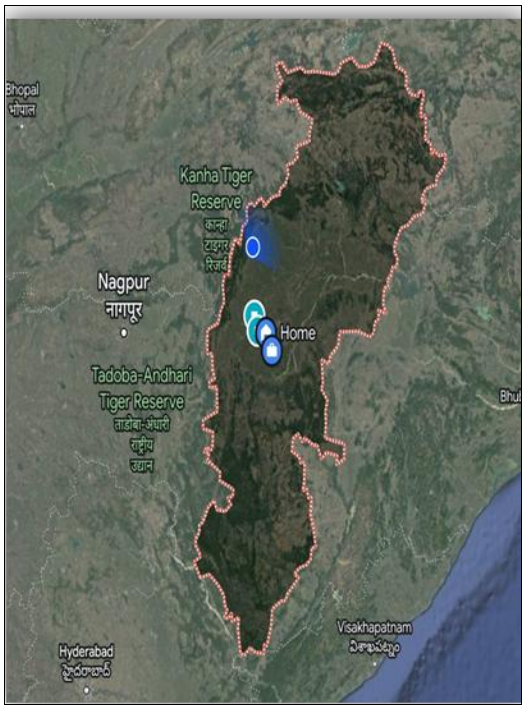

Fig 1: Chhattisgarh Map

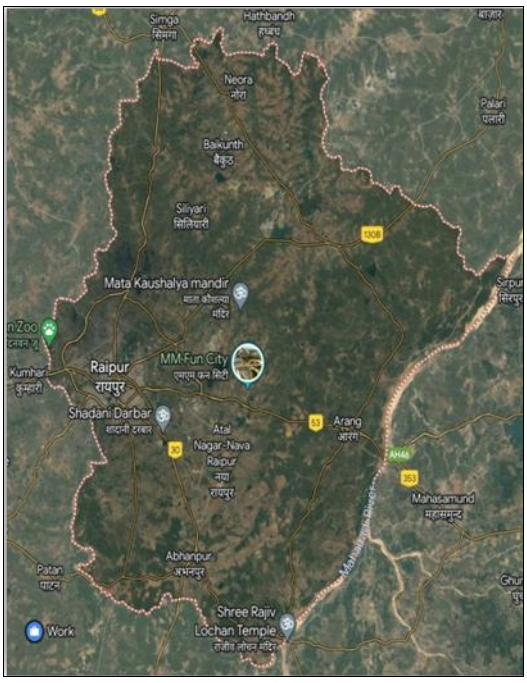

Fig 2: Raipur district

3. Results and Discussion

The study on availability and usage pattern of various aquaculture drugs and chemical in the study areas revealed that the respondents used it at different stages of aquaculture practices such as pond preparation, water quality management, oxygen enhancement and as disinfectants. The table 1 shows the drugs and chemicals used as herbicides in aquaculture ponds and hatchery.

Table no. 1: Herbicides used in aquaculture

S. No.	Trade name	Active ingredient	Dose per acre	Farmer's usage (%)
1.	Tag lamina	Copper sulphate pentahydrate	1-5 gallon	56
2.	Round up	Glyphosate	0.5-1.5 kg	42
3.	Pretilamax	Cao, $Ca(OH)_2$	100 kg	32
4.	Clinar	Cypermethrin- (High Cis)	30-35L	46
5.	Blue vitriol	Liquid copper sulphate	3-4 kg	36

The most used herbicide is Tag Lamina (56%), which is likely due to the effectiveness of copper sulphate in controlling algae and unwanted weeds in and around the ponds. Clinar (Cypermethrin) also showed high usage (46%) which is considered as an effective insecticide and control weed fishes. Pretilamax was the least used (32%) which may be possibly due to high dosage requirement or lack of awareness among the farmers.

Table 2: Disinfectants used in aquaculture

S. No.	Trade name	Active ingredient	Dose per acre	Farmer's usage (%)
1.	Potash	$KMNO_4$	0.5-1.5 kg	64
2.	Bleaching	Chlorine	60 ppm	36
3.	EDTA	Sodium thiosulphate	0.1 – 1 ppm	24
4.	Salt	NaCl	45.3kg	46
5.	Formalin	38% formaldehyde	15-25mg/l	50

Table 2 shows the lists of disinfectants used by the respondents of the study area. Study showed that that 64% of farmers used potash and was the most preferred disinfectant due to its strong oxidizing properties which effectively kill pathogens and oxidise organic matter. Formalin (50%) was widely used to control parasite and external infection. 46% of farmers used salt which is cost effective. Furthermore, only 24% of farmer used EDTA which may be due to inadequate awareness and non-availability of it locally.

Table 3: Chemicals used for Water quality management

S. No.	Trade name	Active ingredient	Dose per acre	Farmer's usage (%)
1.	Lime	CaO, $Ca(OH)_2$	100 kg	54
2.	Aqua lime	$CaCO_3$, $Ca(OH)_2$	100 kg	52
3.	Zeolite	SiO_2, Al_2O_3, Fe_2O_3, CaO, MgO, Na_2O	20 - 30 kg	38
4.	Hunter	Rotenone 9%	5-6 kg	18
5.	Zeofresh	SiO_2, Al_2O_3, Fe_2O_3,CaO, MgO, Na_2O, K_2O,TiO_2	24 kg	30

Table 3 shows the lists of Chemicals like Lime and Aqua lime were the most frequently used (54% and 52%,

respectively), Both are essential for maintaining pH, alkalinity and promoting microbial activity. Zeolite was moderately in used (38%) which is mainly for removal of ammonia from ponds. Rotenone was the least used (18%) and Zeofresh only used by 30% which may be due to its higher cost.

Table 4: Oxygen enhancers used in Aquaculture

S. No.	Trade name	Active ingredient	Dose per acre	Farmer's usage (%)
1.	Bio-ox	Sodium carbonate, Hydrogen Peroxide (H_2O_2)	500 gm	66
2.	Oxymax	Hydrogen Peroxide (H_2O_2)	250 – 500gm	24
3.	Oxylime	Sodium percarbonate	500gm	16
4.	Oxyflow	Sodium carbonate, H_2O_2	500 gm	30
5.	Oxymore	Sodium Carbonate Peroxyhydrate compound	-	44

Bio-ox had the highest usage (66%) and the farmers considered it as an efficient and widely available oxygen enhancer. Oxymore also showed good acceptance (44%) and used of oxylime is observed at the lowest.

Farmers perception towards used of drugs and chemical in aquaculture

Table 5 presents the perceptions of the farmers regarding the use of drugs and chemicals in aquaculture. It shows the farmers perception towards the use of drugs and chemical in the study area.

Table 5: Farmers Perception Towards used for drugs and chemical in Aquaculture

S.N.	Statements	Farmers' Perception (N=60)				
		SA	A	U	DA	SD
1	Are you satisfied by the outcome or result using drug and medicines?	28	19	13	-	-
2	Would you like to continue to use of drug & Medicine.	17	25	18	-	-
3	Are you aware about the product details and application Method?	20	25	15	-	-
4	Have you ever incurred loss or suffered as a result that drug & Medicines sold were not useful.	8	20	17	15	-
5	Do you think that DOF extension officers should help you about the use of drug and medicines?	4	20	4	15	17
6	The use of aquaculture products can greatly improve production.	22	13	25	-	-
7	Are the drug and medicines are cost effective.	12	10	22	10	6
8	Is it easy to apply drug and medicines by beginner?	5	8	12	21	14
9	Would you suggest other farmers to use drug and medicines?	-	37	23	-	-
10	Is required products are available in market.	14	28	18	-	-

**SD-Strongly Disagree; D-Disagree; U-undecided; A- Agree; SA-Strongly Agree

A majority of farmers (47 out of 60) are satisfied with the results of using drugs and chemical in aquaculture. The farmers generally perceive drugs and chemicals as effective and beneficial for aquaculture production with many willing to continue use and recommend others too. 45 farmers claim awareness of product details and application methods but 15 numbers are undecided, highlighting a need for better education or communication about the products. Twenty eight respondents reported losses from ineffective drugs, while 15 disagreed. The high number of undecided (17) suggests variability in experiences or lack of clear attribution of losses to drug use. Twenty four believe extension officers should assist with drug use but maximum responds (32) disagrees or strongly disagree. This polarised response may reflect mixed experiences with extension services or differing expectations. Nevertheless, the area of concerns is its cost-effectiveness and ease of application are significant barriers particularly for beginners. Strengthening extensions services, improving training and ensuring affordable user-friendly solutions are essential to enhance adoption and maximize the benefits of these inputs in aquaculture practices.

Constraints faced by the fish farmers

Table 6 shows the constraints faced by the respondents in aquaculture. The farmers have identified various operational and financial constraints and ranked them by perceived severity (First ranked being the most significant and tenth being the least significant among the listed constraints).

Table 6: Constraints faced by the respondents in aquaculture

S.N.	Constraints	Rank
1	Insufficient financial support from financial institution or inadequate government benefits including schemes etc.	I
2	Unavailability of infrastructure including fish transportation vehicle, lab for pond water testing, cold storage.	II
3	Theft and pilferage.	III
4	Unavailability of inputs mostly fish seed, lime, hormones etc. on time	IV
5	Inadequate information on scientific fish farming.	V
6	Dependency on unqualified person/quack because of unavailability of qualified extension person.	VI
7	Price of feed is expensive.	VII
8	Unavailability of market.	VIII
9	Occurrence of fish disease.	IX
10	Occurrence of natural calamities.	X

The study revealed that insufficient financial support from financial institution including governmental schemes, hindering investment in better practices, infrastructure and inputs. The second most pressing issue is the lack of essential physical infrastructure. This directly impacts the efficiency of operations, quality controls and post-harvest management, leading to potential losses and reduced market access. Security concerns rank high, highlighting the vulnerability of fish farms to theft. Timely access to crucial farming inputs is a major challenge. Without essential items like quality fish seed, lime for pond preparation, and hormones for breeding, farmers cannot maintain optimal production cycles or ensure healthy stock. Farmers lack sufficient knowledge about scientific and modern fish farming techniques. This suggests a need for better extension services, training, and dissemination of best practices to improve productivity and sustainability. farmers are forced to rely on untrained individuals for advice due to a scarcity of qualified extension personnel. he high cost of fish feed impacts the profitability of aquaculture, as feed constitutes a significant portion of operational expenses. This can force farmers to use lower-quality feed or reduce feeding, affecting fish growth and health. Access to suitable markets for selling their produce is a challenge, indicating potential issues with demand, distribution channels, or fair pricing, which can lead to gluts and reduce farmer income. Fish diseases are a concern, leading to mortality and economic losses. Natural disasters are identified as the least significant among the listed constraints. However, it can cause sudden and significant losses.

Conclusion

The study highlights the widespread use of aqua-drugs and chemicals in the study area with farmers relying on products like Tag Lamina, Potash, Lime and Bio-ox for disease control, water management and oxygen enhancement. While 76% of farmers reported satisfaction with these inputs, critical gaps in knowledge about proper dosage, application methods and potential risks persist. Key challenges include high feed costs, disease outbreaks, inadequate infrastructure and insufficient technical guidance with financial constraints and lack of extension support ranking as top concerns. Despite perceived benefits, issues like cost effectiveness, ease of use and occasional inefficacy of drugs underscore the need for targeted interventions. Strengthening extension services, providing affordable training and improving access to quality inputs are essential to promote sustainable practices. Addressing these challenges will enhance productivity, reduce environmental and health risks and ensure long term growth of the aquaculture sector of the study area. Policymakers and stakeholders must prioritize farmer education, infrastructure development and financial support to foster responsible and efficient aquaculture practices.

Conflict of Interest

The authors declare no conflict of interest.

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