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Analysis of constraints perceived by fish farmers in the Kumaun division of Uttarakhand

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Abstract

The present study identified and prioritized constraints faced by fish farmers in adopting scientific aquaculture practices in the Kumaun Division of Uttarakhand, India. Data were collected from 159 fish farmers across two districts (Udham Singh Nagar and Pithoragarh) using a multi-stage sampling design. The Garrett's ranking technique was employed to prioritize constraints. The analysis revealed ten major constraints, ranked by mean Garrett scores: high cost and poor quality of feed (69.38), poor knowledge of disease prevention (62.44), fish losses due to predation and illegal fishing (59.02), flooding (56.04), inadequate knowledge of scientific fish culture (48.33), inadequate credit facilities (45.89), unstable fish prices (41.93), poor road connectivity and high transportation costs (40.44), inadequate infrastructure for storage and preservation (39.67), and non-availability of fish seeds throughout the year (34.81). The findings underscore the need for multi-level interventions combining policy support, technical training, infrastructure development, and institutional strengthening to enhance the productivity and sustainability of aquaculture in the region.

Keywords: Aquaculture, constraints, fish farming, Garrett's ranking technique etc.

Introduction

The Kumaun Division of Uttarakhand is endowed with exceptional ecological conditions that support diverse aquaculture potential. The region possesses approximately 2,686 km of riverine networks supporting indigenous species such as mahseer and exotic varieties including trout and carps. Inland water resources comprise seven major reservoirs (20,587 hectares), thirty-one natural lakes (297 hectares), and pond areas (871 hectares). Institutional support infrastructure includes 14 fish farms and hatcheries, two state-level brood banks, and 149 fisheries cooperative societies facilitating input supply, extension services, and market linkages. The total fisheries resource area is estimated at 26,000 hectares. Fish production varies significantly across districts. Udham Singh Nagar contributes approximately 2,167 metric tonnes due to favorable agro-climatic conditions and greater adoption of aquaculture practices, while Garhwal's Haridwar district produces about 1,138 metric tonnes. Aquaculture in the region centers on Indian major carps (Catla, Rohu, Mrigal, Common Carp) and exotic species (Silver Carp, Grass Carp), with Rainbow Trout farming prevalent in colder, higher-altitude areas. Aquaculture offers substantial potential for rural development, including income diversification, employment generation, and nutritional security. Rising consumer awareness, increasing incomes, and changing dietary patterns have driven steady demand

growth for fish and fish products. However, Uttarakhand's fish production remains below consumption requirements, indicating a demand-supply gap. This mismatch reflects suboptimal productivity and underutilization of available resources.

Despite aquaculture's growing popularity as an income-generating enterprise, its expansion is constrained by interconnected socio-economic, technical, institutional, and infrastructural challenges. Fish farmers in the Kumaun Division face multiple barriers that limit the adoption of scientific farming practices and reduce overall enterprise profitability. Understanding these constraints from the farmer's perspective is critical for designing evidence-based policies and interventions. This study was undertaken to identify, analyze, and prioritize the constraints faced by fish farmers in the Kumaun Division, providing actionable insights for policymakers, researchers, and extension agencies to address key bottlenecks in aquaculture development.

Materials and Methods

The Kumaun Division of Uttarakhand was selected as the study universe. Two districts—Udham Singh Nagar and Pithoragarh—were purposively selected based on their high concentration of fish farmers. From each district, two blocks with the highest number of fish farmers were selected: Kashipur and Rudrapur (Udham Singh Nagar), and

Kanalichina and Munsyari (Pithoragarh). Sample size determination followed Cochran's formula at 7% error level, yielding a total of 159 fish farmers. Probability Proportionate to Size (PPS) sampling allocated farmers across blocks as follows: Kashipur (28), Rudrapur (23), Kanalichina (56), and Munsyari (52).

Data Collection: Primary data were collected through face-to-face interviews with selected fish farmers. Respondents were asked to identify and rank constraints they faced in fish farming operations. A structured questionnaire was administered to ensure consistency in data collection.

Garrett's Ranking Technique

The Garrett's ranking technique was used to prioritize constraints based on farmer perceptions. This methodology converts subjective rankings into quantitative scores enabling statistical comparison.

The procedure is as follows

1. Farmers ranked each constraint on an ordinal scale (1st, 2nd, 3rd, etc.)
2. Each rank was converted to a percentage position using the formula:

$$\text{Percent Position} = 100(R_{ij} - 0.5)/N_j$$

Where: R_{ij} = rank assigned to constraint i by respondent j

N_j = total number of constraints ranked by respondent j

3. Percentage positions were converted to Garrett scores using a standardized conversion table
4. Individual Garrett scores for each constraint were summed and divided by the total number of respondents to obtain the mean Garrett score
5. Constraints were ranked in descending order of mean scores, with higher scores indicating greater severity.

This approach translates ordinal rankings into interval-scale data suitable for parametric statistical analysis and comparison across constraints.

Results and Discussion

The Garrett's ranking analysis identified ten major constraints affecting fish farming in the Kumaun Division. Table 1 presents the Garrett score conversion table, while Table 2 summarizes the mean Garrett scores and priority rankings for each constraint. The constraints faced by fish farmers were analyzed using Garrett's Ranking Technique, which enabled prioritization based on the severity perceived by the respondents. The analysis revealed that the most critical constraint was the high cost and poor quality of feed, with the highest mean Garrett score of (69.38). This was followed by poor knowledge of disease prevention (62.44), indicating a significant gap in technical awareness among farmers. Fish losses due to birds, animals, and illegal fishing (59.02) emerged as another major constraint affecting productivity and profitability. Environmental challenges such as flooding (56.04) were also reported as significant barriers. Further, inadequate knowledge about scientific fish culture practices (48.33) and inadequate credit facilities (45.89) were identified as important institutional and knowledge-related constraints. Market-related issues such as unstable fish prices (41.93) and infrastructural limitations like poor road connectivity and high transportation costs (40.44) also hindered the growth of fish farming. Additionally, inadequate infrastructure for storage and preservation (39.67) was reported as a constraint affecting post-harvest management. The least ranked yet notable constraint was the non-availability of fish seed throughout the year (34.81), which still poses a challenge to continuous aquaculture operations.

Table 1: Garrett's Score Conversion Table

Rank	Percentage Position	Garrett Score
1	5	82
2	15	71
3	25	64
4	35	58
5	45	53
6	55	48
7	65	43
8	75	37
9	85	30
10	95	19

Table 2: Constraints Ranked by Mean Garrett Score

Constraint	Mean Garrett Score	Rank
High cost and poor quality of feed	69.38	I
Poor knowledge of disease prevention	62.44	II
Fish losses due to birds, animals, or illegal fishing	59.02	III
Flooding	56.04	IV
Inadequate knowledge about scientific fish culture	48.33	V
Inadequate credit facilities	45.89	VI
Unstable fish prices	41.93	VII
Poor road connectivity and high transport costs	40.44	VIII
Inadequate infrastructure for storage and preservation	39.67	IX
Non-availability of fish seeds throughout the year	34.81	X

Table 3: Distribution of respondents on basis of constraints faced by fish farmers (n = 159)

S. No.	Ranking	1	2	3	4	5	6	7	8	9	10	Total	Average score	Rank
	Garrett's Table Score(X)	82	70	63	57	52	47	42	37	30	18			
1	Inadequate knowledge about scientific fish culture	0	12	17	19	28	21	22	23	14	3	7686	48.33	5 th
2	High cost and poor quality of feed	47	53	39	10	3	4	1	1	0	1	11032	69.38	1 st
3	Fish losses due to birds, animals, or illegal fishing.	3854	3710	2457	570	156	188	42	37	0	18	9385	59.02	3 rd
4	Poor knowledge of disease prevention	44	18	26	15	13	9	4	7	7	16	9928	62.44	2 nd
5	Inadequate credit facility	3608	1260	1638	855	676	423	168	59	210	288	7297	45.89	6 th
6	Flooding	32	33	25	27	20	6	5	6	3	2	8911	56.04	4 th
7	Inadequate infrastructure for Storage and preservation	2624	2310	1575	1539	1040	282	210	222	90	36	6309	39.67	9 th
8	Unstable fish prices	4	3	15	22	22	28	15	18	19	13	6667	41.93	7 th
9	Non availability of fish seeds throughout the year	328	210	945	1254	1144	1316	630	666	570	234	5536	34.81	10 th
10	Poor road connectivity and high transport cost	24	20	17	23	22	10	20	11	7	5	6431	40.44	8 th
		1968	1400	1071	1311	1144	470	840	407	210	90			
		0	0	2	7	19	23	35	37	19	17			
		0	0	126	399	988	1081	1470	1369	570	306			
		2	3	1	18	17	30	29	18	24	17			
		164	210	63	1026	884	1410	1218	666	720	306			
		2	1	3	5	12	18	17	22	34	45			
		164	70	189	285	624	846	714	814	1020	810			
		4	16	14	13	3	10	11	16	32	40			
		328	1120	882	741	156	470	462	592	960	720			

Constraint-Wise Analysis

1. High Cost and Poor Quality of Feed

Mean Garrett Score: 69.38 (Rank I)

Feed represents the largest operational cost in aquaculture, typically accounting for 60-70% of production expenses. This constraint emerged as the most critical barrier, with the highest mean Garrett score. A substantial proportion of respondents reported that elevated feed costs significantly reduce production profitability and discourage farm expansion. Beyond cost, farmers also cited concerns regarding feed quality, including inconsistent nutrient composition, poor palatability, and presence of contaminants. Limited access to quality assurance mechanisms and certified feed suppliers further exacerbates this problem. The poor availability of locally-manufactured feed necessitates long-distance transportation, adding to costs and reducing product freshness. Inadequate knowledge among farmers about feed formulation, storage, and management practices contributes to wastage and inefficiency. Recommended interventions: (1) Establishment of cooperative-based or government-supported feed mills to reduce transportation costs and ensure freshness, (2) Implementation of quality control standards and certification mechanisms, (3) Farmer training programs on feed management, storage conditions, and feed efficiency monitoring, (4) Subsidy schemes for quality feed, and (5) Promotion of locally-sourced feed ingredients to reduce costs.

2. Poor Knowledge of Disease Prevention

Mean Garrett Score: 62.44 (Rank II)

Disease management represents a critical technical knowledge gap among fish farmers. The majority reported limited awareness of common fish diseases (bacterial infections, parasitic infestations, fungal diseases), early recognition signs, preventive measures, and appropriate treatment protocols. This knowledge deficit often results in delayed disease detection and reactive rather than proactive management, leading to high fish mortality rates, production

losses, and economic damage. Inadequate awareness of the relationship between pond management practices (water quality, stocking density, feed quality, hygiene) and disease occurrence further compounds the problem. Many farmers rely on informal advice networks or costly, ineffective treatments discovered through trial and error. Recommended interventions: (1) Strengthening extension services with adequate staffing and resources for field-level advisory services, (2) Regular training workshops on disease identification, prevention, and management, (3) Establishment of fish health clinics or mobile diagnostic units, (4) Promotion of best management practices through demonstration farms, and (5) Linkage development between farmers and aquatic animal health specialists for consultation and treatment support.

3. Fish Losses Due to Birds, Animals, and Illegal Fishing

Mean Garrett Score: 59.02 (Rank III)

Predation by aquatic birds (kingfishers, herons, cormorants) and terrestrial animals (jackals, wild boar, dogs) combined with illegal fishing/poaching causes substantial stock losses. These losses directly reduce productivity and profitability, with farmers reporting mortality rates ranging from 5-25% in unprotected ponds. The open design of most ponds, coupled with limited protective measures, facilitates such losses. Additionally, the social issue of illegal fishing in community ponds reflects weak enforcement of regulations and inadequate farmer vigilance systems.

Recommended interventions: (1) Installation of protective netting and screening devices at pond inlets/outlets, (2) Physical barriers such as fencing and bird-scaring mechanisms, (3) Community-based vigilance systems and shared security arrangements, and (4) Awareness campaigns about legal consequences of unauthorized fishing.

4. Flooding

Mean Garrett Score: 56.04 (Rank IV)

Flooding presents a significant environmental risk,

particularly for ponds in low-lying areas and those adjacent to rivers and streams. Flood events cause pond overflow, escape of cultured fish into surrounding water bodies, entry of wild and unwanted species, damage to embankments, and destruction of related infrastructure. These incidents result in complete or partial loss of stock and disrupt production cycles, sometimes requiring 1-2 years for recovery. The study region's topography and seasonal rainfall patterns create vulnerability to flooding, particularly during monsoon months (July-September).

Recommended interventions: (1) Construction of elevated pond embankments with adequate freeboard, (2) Installation of proper inlet and outlet screening systems, (3) Development of resilient pond designs, (4) Early warning systems for flood forecasting and farmer alerts, and (5) Crop insurance schemes offering protection against climate-related losses.

5. Inadequate Knowledge About Scientific Fish Culture **Mean Garrett Score: 48.33 (Rank V)**

A significant proportion of farmers lack comprehensive knowledge of scientific aquaculture practices, including optimal stocking densities, species-specific feed requirements, water quality parameters (dissolved oxygen, pH, temperature, ammonia), seasonal management practices, and species selection criteria. This knowledge gap results in suboptimal resource utilization, lower yields, and reduced enterprise profitability. Many farmers still employ traditional, low-input methods rather than adopting evidence-based practices that could substantially improve productivity. Limited access to training, extension literature, and demonstration facilities contributes to this constraint.

Recommended interventions: (1) Capacity-building programs through government fisheries departments and agricultural universities, (2) Strengthening of extension services and outreach mechanisms, (3) Establishment of demonstration farms showcasing best management practices, and (4) Development of simplified, vernacular training materials and videos.

6. Inadequate Credit Facilities

Mean Garrett Score: 45.89 (Rank VI)

Limited access to institutional credit at reasonable interest rates restricts farmers' ability to make necessary capital investments in quality inputs (seed, feed), pond construction/renovation, and equipment. Many farmers consequently depend on informal credit sources—money lenders, traders, which typically charge exploitative interest rates (20-40% annually), increasing financial burden and reducing enterprise viability. Banks' reluctance to lend for aquaculture stems from perceived high risk, limited collateral availability among small farmers, and insufficient knowledge of aquaculture economics among lending officers.

Recommended interventions: (1) Simplification of loan procedures and reduction of documentation requirements, (2) Awareness campaigns about fisheries-specific credit schemes, (3) Promotion of self-help groups and cooperative credit mechanisms, and (4) Government-backed credit

guarantee schemes to reduce lending risk.

7. Unstable Fish Prices

Mean Garrett Score: 41.93 (Rank VII)

Price fluctuations in fish markets create income uncertainty, discouraging production expansion. Seasonal gluts depress prices, while supply shortages spike prices unpredictably. This volatility makes production planning difficult and increases financial risk for farmers. The absence of organized marketing structures places farmers at disadvantage relative to middlemen and traders who control price information and market access. Perishability of fresh fish further constrains farmers' negotiating power.

Recommended interventions: (1) Development of organized fish markets with transparent pricing, (2) Establishment of price support mechanisms and procurement programs, (3) Strengthening of farmer producer organizations (FPOs) and cooperatives for collective marketing, and (4) Promotion of direct-to-consumer and digital marketing platforms.

8. Poor Road Connectivity and High Transportation Costs

Mean Garrett Score: 40.44 (Rank VIII)

Inadequate road infrastructure, particularly in hilly and remote areas, increases transportation costs and limits market access. Poor road conditions necessitate expensive transportation modes and longer travel times, reducing profit margins especially for perishable fish products. Some remote farms face effective market isolation, preventing competitive price realization.

Recommended interventions: (1) Investment in rural road infrastructure development, (2) Support for cold-chain transportation facilities enabling wider market access, (3) Promotion of cluster-based aquaculture reducing per-farmer logistics costs, and (4) Government transport subsidies for aquaculture products.

9. Inadequate Infrastructure for Storage and Preservation

Mean Garrett Score: 39.67 (Rank IX)

Lack of cold storage, ice production facilities, and preservation infrastructure compels farmers to sell perishable fish immediately at lower prices to minimize spoilage. This eliminates opportunities for price timing and reduces bargaining power against wholesale traders. Limited preservation options prevent value addition and restrict market reach to local areas. Post-harvest losses from spoilage remain substantial.

Recommended interventions: (1) Establishment of cooperative cold storage and ice plants, (2) Training in post-harvest handling, hygiene, and preservation techniques, (3) Promotion of fish processing and value-addition units, and (4) Support for development of cooperative-based storage networks.

10. Non-Availability of Fish Seed Throughout the Year **Mean Garrett Score: 34.81 (Rank X)**

Although ranked lowest, seed availability remains

operationally significant. Limited hatchery capacity and seasonal production patterns create availability gaps, disrupting stocking schedules and production cycles. Irregular seed supply forces farmers into suboptimal timing of stocking operations. Additionally, seed quality and genetic characteristics are inconsistent across suppliers, affecting final product quality and productivity.

Recommended interventions: (1) Expansion of hatchery infrastructure and capacity, (2) Promotion of private hatcheries and seed production enterprises, (3) Development of brood banks ensuring consistent genetic quality, (4) Strengthening of seed distribution networks for timely availability, and (5) Implementation of quality standards and certification for seed suppliers.

Conclusion

The systematic analysis of fish farmer constraints in the Kumaun Division reveals a complex, interconnected set of challenges spanning technical, economic, institutional, and infrastructural domains. Feed costs, disease management knowledge, predation, and flooding emerge as the most critical barriers, collectively reflecting problems in input availability/quality, technical capacity, and environmental management. Effective aquaculture development requires multi-level interventions addressing these constraints simultaneously. A coordinated approach involving capacity building, infrastructure investment, institutional strengthening, and policy support offers the best prospect for achieving sustainable productivity growth and improved farmer livelihoods. Extension agencies, government departments, research institutions, and farmer organizations must collaborate to implement evidence-based solutions tailored to local conditions. The findings provide a prioritized agenda for policymakers and development practitioners, enabling resource allocation toward high-impact interventions. Regular monitoring and adaptive management will be essential as constraints evolve with changing environmental and market conditions.

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