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Research Article

Adoption Status of Traditional and Commercial Fish Feeds among Fish Farmers in the Fish Super Zone of Rupandehi, Nepal

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Abstract

This study was conducted from February to July of 2023 in the Fish Superzone of Rupandehi, Nepal, using a semi-structured questionnaire administered to 135 randomly selected respondents. The objectives were to assess the feeding system, the willingness of fish farmers to adopt commercial fish feed, and the factors associated with feed type adoption. Results showed that 69.6% of respondents were using traditional feed, 25.9% both traditional and commercial feed, and 4.4% were using commercial feed exclusively. Among traditional feed users, 83.7% relied solely on mustard oilcake (MOC) and rice bran (RB), with significant variation in blending ratios. Additionally, 92.4% of respondents using traditional feed were unwilling to switch to commercial fish feed, primarily due to high cost (94.7% of responses) and adherence to traditional practices (88.3%). The pond water surface area and gender were found to be significantly associated with the type of feed adopted. This study suggests, providing women-specific training, optimizing nutrients in fish feed through training on blending of locally available inputs for traditional feed with effective pond management, and subsidy programs on feed additives (vitamins, minerals, and probiotics) can improve feeding system.

Keywords: fish feed, fisheries, aquaculture, carps, feed industry.

Introduction

The agriculture sector in Nepal dominated the economy, contributing 24.09% to GDP recorded in 2023/24 (NSO, 2024). While Fisheries alone contributed 1.56% to the agricultural GDP and approximately 0.38% to GDP in Nepal (NSO, 2024). The current total national fish production is 113,736 Metric tons (mt), of which 18.5% is contributed by capture fisheries while 81.5% is from aquaculture (MOALD, 2024). Fish farming is mostly done in the Terai parts of Nepal, with the high production in districts like Bara, Dhanusha, Rupandehi, Siraha, Saptari, and Morang (MOALD,2024). In Rupandehi, fish farming covers 1,487 ha of water surface area of the pond with a

total production of 8,545 mt and a yield of 5.75 mt per hectare (MOALD, 2024).

Feeding cost represents about 60% of the total cost of fish production (Baki and Yucel, 2017). A high-quality quality nutritionally balanced diet is required for fish to grow and to produce market-size fish in the shortest possible time (Gabriel, 2007). In Nepal, wheat bran, rice bran, mustard oil cake, kitchen leftovers, and maize are the main ingredients used in the formulation of traditional fish feed, while Berseem, Banana leaves, Napier, and Chari are mainly used for Grass carp (Bhandari *et al*., 2019). The traditional feed system uses locally available sources, which are more sustainable and are prepared at a low cost. Commercial feed has a well-blended nutrient content. Commercial fish feed adds ingredients like fish meal, soybean meal, corn gluten meal, rice bran, molasses, gelatin, and bone meal (Nyamwaka *et al*., 2020), and other ingredients like vitamins, minerals, and probiotics. Adding soybeans to traditional feed achieves higher growth rates, better feed conversion ratios, and greater profitability compared to using only rice bran and mustard oilseed crops (Subedi *et al*., 2019).

Rupandehi district has higher water surface area than Dhanusha and is close to Bara, however, fish yield and production are both found to be lower than Bara and Dhanusha districts (MOALD, 2024). Most farmers practice an inappropriate feeding system without proper protein supplementation (Subedi *et al*., 2019). Commercial feed adoptions remain low due to high costs, lack of awareness, limited access to quality feed (Khatri *et al*., 2021), and a lack of technical knowledge (Gurung *et al*., 2020). However, no study has assessed these problems in the Rupandehi district. With the increasing demand for fish and attaining a high growth rate well-nutrient composition commercial feed has become more prevalent. This research helps fill gaps in feeding practices for necessary improvement, with the objectives to assess the feeding practices and types of feed commonly used by fish farmers, identify the willingness of fish farmers to switch from traditional feed to commercial fish feed, and analyze the factors associated with feed type adoption.

Methodology

Study site

Rupandehi district, located in Lumbini Province of Nepal, borders Kapilvastu in the west, India in the south, Nawalparasi to the east, and Palpa in the north. Administratively, the district is divided into 16 local-level units. This study was conducted in five purposively selected municipalities with high fish farming activity: Lumbini Sanskritik Municipality, Mayadevi Rural Municipality, Siyari Rural Municipality, Suddhodhan Rural Municipality, and Gaidahawa Rural Municipality.

Sampling and sample size

Rupandehi district was selected purposively as many fish farmers were engaged in fish farming. A total of 204 farmers' groups/cooperatives/Agri Entrepreneurs and businessmen were registered and renewed in the Fish Super Zone, Rupandehi, in the fiscal year 2078/79(PMAMP, 2022). Among these, 201 were from the area presented below in Table 1, and the sample size was determined for each municipality by using the Taro Yamane (Yamane, 1973) formula with a 95% level of confidence. Five municipalities were selected purposively as a high number of respondents were registered from these areas in fiscal year 2078/79, and respondents were selected randomly from each municipality, resulting in a total of 135 (Table 1).

Source of information and collection techniques

Primary data were collected through a pre-tested semi-structured questionnaire administered to the respondents, including both closed-ended and open-ended questions. Before starting the actual respondent survey, the questionnaire was pre-tested with 10 non-sample farmers and reviewed by aquaculture experts for content validity and clarity. Secondary data were collected from PMAMP reports, the District annual report, and relevant research papers.

Table 1: Sample size of different municipalities in the Fish Super Zone, Rupandehi

Locations	**Population size**	**Sample size**
Siyari Rural Municipality	73	50
Suddhodhan Rural Municipality	38	25
Mayadevi Rural Municipality	22	15
Gaidahawa Rural Municipality	54	35
Lumbini Sanskritik Municipality	14	10
Total	201	135

Data analysis techniques

Collected data was inserted into MS Excel and analyzed using SPSS (Version 26) for statistical interpretation. This analysis includes descriptive statistics like mean, standard deviation, and percentage. A chi-square test was performed for the identification of the association of selected variables

with the type of feed adoption. Group comparisons utilized independent samples t-tests with Levene's test for equality of variances. Specifically, productivity (kg/kattha/year) was compared between farmers who adopted traditional feed only versus those using both traditional and commercial feed. Statistical significance was determined at $p < 0.05$, with exact p-values reported. Effect sizes (Cohen's d) complemented null hypothesis significance testing to evaluate practical importance.

Result and Discussion

Socio-Demographic Characteristics

Most respondents were male (78.5%), reflecting male dominance in fish farming (Neupane & Gharti, 2018). As shown in Table 2, the majority (63.7%) were aged between 26-50 years, indicating middle-aged engagement shows individuals of middle age are economically more active and primarily involved in the fish farming sector. Family size averaged 7.65, higher than the national average of 4.37 (NSO, 2023). Madhesi ethnicity (39.3%) was the most common, followed by Brahmin/Chettri (29.6%). Most respondents (68.9%) of the respondents attended secondary or higher education, which may facilitate a high rate in new technology adoption (Ruzzante *et al*., 2021). Agriculture was the primary occupation (84.4%), while a few farmers are also involved in trade business and service, and practice fish farming as a part-time. Diversification of income sources also helps in reducing the vulnerability of farmers to risks.

Fish Farming Practices and Production Characteristics

Summary of Fish Farming Practices and Farmer Profiles

The result from Table 3 shows that most respondents were farming on their own owned land as proprietors (87.4%). 48.9% of respondents were farming fish in less than 10 kattha of land, and this low area under fish farming may be due to most of the respondents (59.3%) were new to the fish farming business and starting from a small area to minimize financial risk while gaining experience before scaling up the operation. Ownership of nursery ponds was high, with 73.3% of respondents having a nursery pond. Having a nursery pond along with a production pond reduces cost as larger fingerlings cost more, and also, this helps in the timely availability of fish seeds. Around half of the respondents received training related to fish farming. In the study area, the Prime Minister Agriculture Modernization Project (PMAMP) is actively involved in providing training, but the reason may be that the selected respondents were new to fish farming, and problems with access to information on fish-related training. It is also found that among the training received, 42.96% was received from government organizations, mainly from PMAMP, the Fish Super Zone, Rupandehi.

Table 2: Socio-demographic characteristics of respondents

Characteristics	Categories	Frequency (%)
Gender Distribution	Male	106 (78.5)
	Female	29 (21.5)
Age Distribution (years)	≤ 25	14 (10.4)
	26-50	86(63.7)
	≥ 51	35 (25.9)
Family Size (number)	≤ 4	20 (14.8)
	5-6	44 (32.6)
	≥ 7	71 (52.6)
Ethnicity	Brahmin/Chhetri	40 (29.6)
	Madhesi	53 (39.3)
	Janajati	25 (18.5)
	Muslim	9 (6.7)
	Dalit	8 (5.9)
Religion	Muslim	9 (6.7)
	Hindu	126 (93.3)
Education Level	Illiterate	2 (1.5)
	Basic	40 (29.7)
	Secondary level	72 (53.3)
	university	21 (15.6)
Major Occupation	Agriculture	114 (84.4)
	Trade business	5 (3.7)
	Service	5 (3.7)
	Industry	11 (8.1)

Source: Field Survey, 2023

Fish species cultured and pond facilities

97.8% of the total respondents were farming only carp polyculture, while only 2.2% of respondents were farming species other than carp. Polyculture of carp includes Bighead carp, silver carp, Grass carp, Common carp, and local breeds Rohu, Naini, and Bhakur. These seven carp species are most cultured in the study area due to their suitability in the Terai climate.

91.9% of the respondents were found farming fish in earthen ponds, while 8.1% adopted both earthen and silpaulin used systems of fish farming. Where most adopted Silpaulin were government-subsidized (PMAMP) support programs.

Table 3: Summary of Fish Farming Practices and Farmer Profiles in the Study Site

Characteristics	Categories	Frequency (%)	Mean ± SD
Ownership of land under fish farming	Proprietorship (single owner of land)	118 (87.4)	
	Co-ownership	4 (3.0)	
	Leasehold	11 (8.1)	
	Proprietorship + leasehold	2 (1.5)	
Water surface area (kattha)	≤ 10	66 (48.9)	
	11-20	36 (26.7)	
	21-30	14 (10.4)	
	31-40	6 (4.4)	
	≥ 41	13 (9.6)	
Own a nursery pond	Yes	99 (73.3)	
	No	36 (26.7)	
No. of nursery ponds			1.03 ± 1.18
Water surface area of nursery pond (kattha)			2.56 ± 7.24
No. of production ponds			2.07 ± 1.47
Water surface area of the production pond (kattha)			16.99 ± 20.36
Fish farming experience (years)	≤ 5	80 (59.3)	
	6-10	25 (18.5)	
	11-15	10 (7.4)	
	16-20	14 (10.4)	
	≥ 21	6 (4.4)	
Training received from	Government organization	58 (42.96)	
	Mixed GO/INGO/NGO	4 (2.97)	
	No training received	73 (54.07)	
Number of training sessions attended	One time	34 (55)	
	Two times	19 (31)	
	Three or more times	9 (14)	

Note: 1 kattha = 333.33 m^2, SD = Standard Deviation

Source: Field Survey, 2023

Stocking density in carp polyculture

Fig. 1 shows 62.2%. respondents adopted fish farming while maintaining a stocking density of 301-350 fish seeds per kattha in production ponds. only 2.2% of respondents were stocking more than 400 fish seeds, 7.4% were less than 200, 14.8% were 251-300, and 13.3% adopted 351-400 fish seeds per kattha of earthen ponds.

Source of stocking fingerlings

Government fish training centers and private hatcheries are the major sources of hatchlings and fingerlings. Farmers with a nursery pond buy hatchlings, and farmers without a nursery pond buy fingerlings directly. It was found that 87.4% of the respondents buy fingerlings from private hatcheries, 3.0% buy from government hatcheries, and 9.6% buy from both of them.

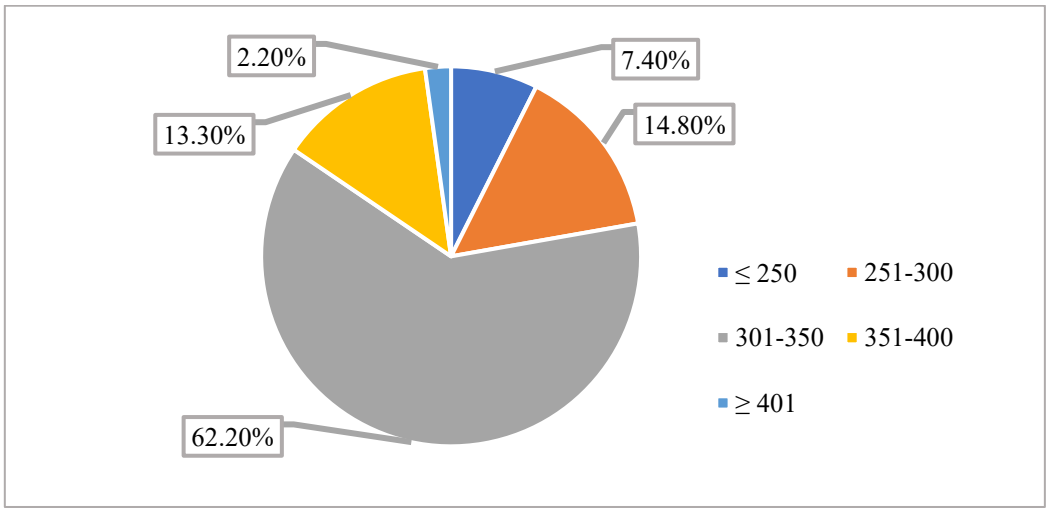


Fig. 1: Stocking density (fish seeds/kattha) in carp polyculture for production pond

Source: Field Survey, 2023

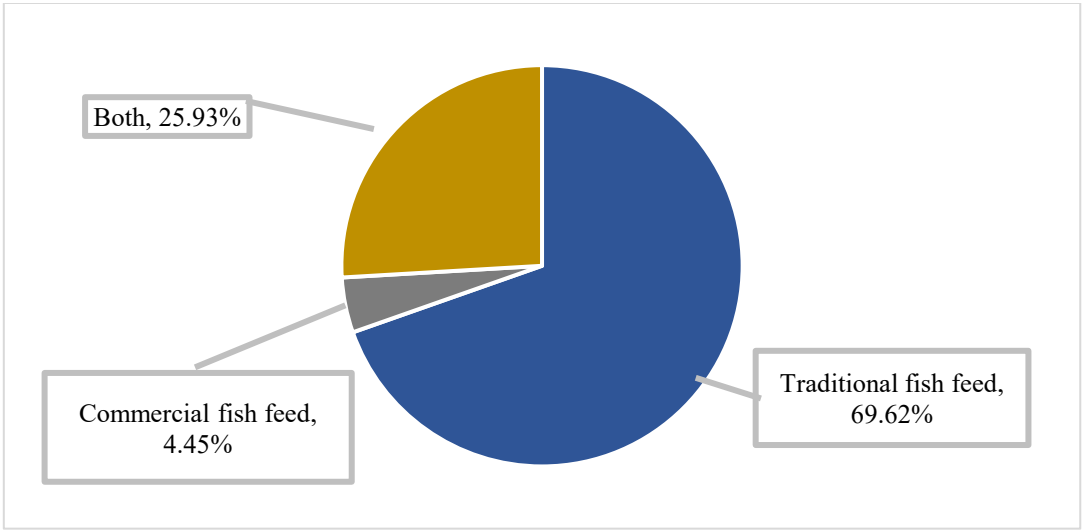


Fig. 2: Types of feed used for feeding fish

Source: Field Survey, 2023

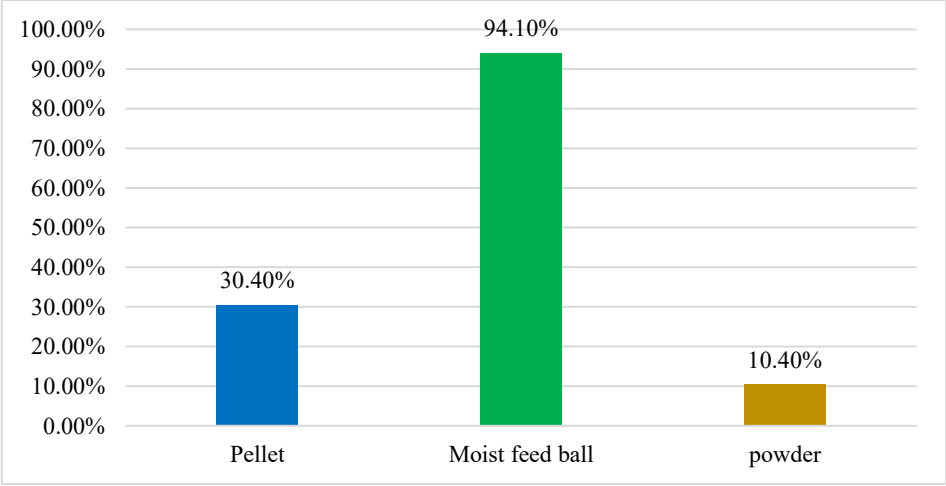


Fig. 3: Form of fish feed used by respondents

Source: Field Survey, 2023

Fish Feeding Practices

Types of feed used for feeding fish

Among the total respondents surveyed, 69.6% were feeding traditional feed to the fish, 25.9% were feeding both traditional and commercial feed to the fish, and only 4.4% were feeding commercial feed to the fish. This is in line with research by Gabriel *et al*. (2007), who found that small-scale farmers in developing nations frequently depend on locally accessible and affordable feed supplies. Traditional feeds use locally available inputs and reduce the cost of production.

Form of fish feed used by Respondents

Fig. 3 shows that most of the respondents feed in the form of moist feed balls (94.1%) to fish. Some respondents were fed in pellet form. Pellet and moist feed balls minimize feed wastage, while powder form spreads and settles under the pond and starts to decay, as hard to feed by fish on feed mixed with soil.

Ingredients for Traditional Feed

Fig. 4 shows that 83.7% of respondents used MOC + RB as a traditional feed, which is even higher than the 55% from the result of Subedi *et al*. (2019). MOC was used as the primary source of protein, which was used by all traditional feed-using respondents, and RB was used as the primary source of energy. sometimes respondents were using maize, wheat bran, and other legume and grain bran. 12.4% of total respondents were found feeding MOC + RB +VIT/MIN while 1.6% and 2.3% were feeding MOC+RB+SBM and MOC+RB+SBM+VIT/MIN respectively. In rice bran and mustard oil cake mixing, respondents were found to use different ratios. Fig. 5 shows that among 124 respondents using only mustard oilcake and rice bran (excluding soybean users), only 29% were fed in the ratio of 1:1 of mustard oilcake and rice bran, while 32.3% were fed with a ratio of 1:3, which lacks a major protein source and low-quality feed form. This inappropriate ingredient blending shows a lack of knowledge and requires training on optimal inclusion of nutrient-holding ingredients.

Reason for choice of feed

Fig. 6 shows 98.5% and 71.1% of the respondents selected readily available and low cost as the main reasons for the choice of feed. This result shows cost as the major factor in the choice of feed.

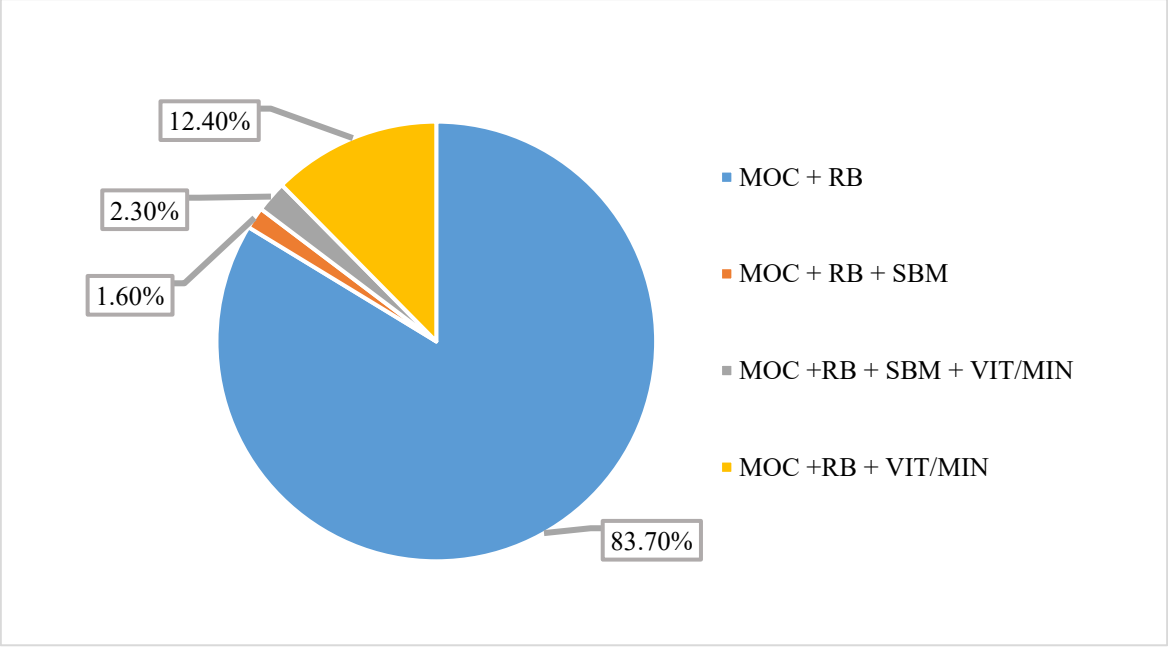


Fig. 4: Ingredients used for traditional feed

Note: MOC = mustard oil cake, RB = rice bran, SBM = soybean meal, MIN = mineral mix, VIT = vitamin mix

Source: Field Survey, 2023

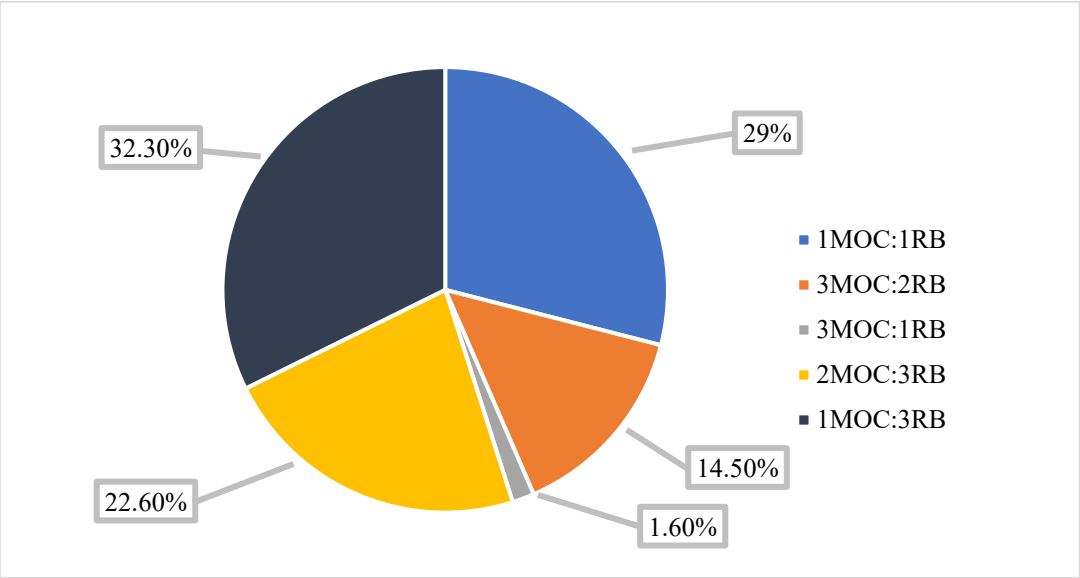


Fig. 5: Different ratios of ingredients (mustard oilcake: Rice bran) used in traditional feed

Note: MOC = mustard oil cake, RB = rice bran

Source: Field Survey, 2023

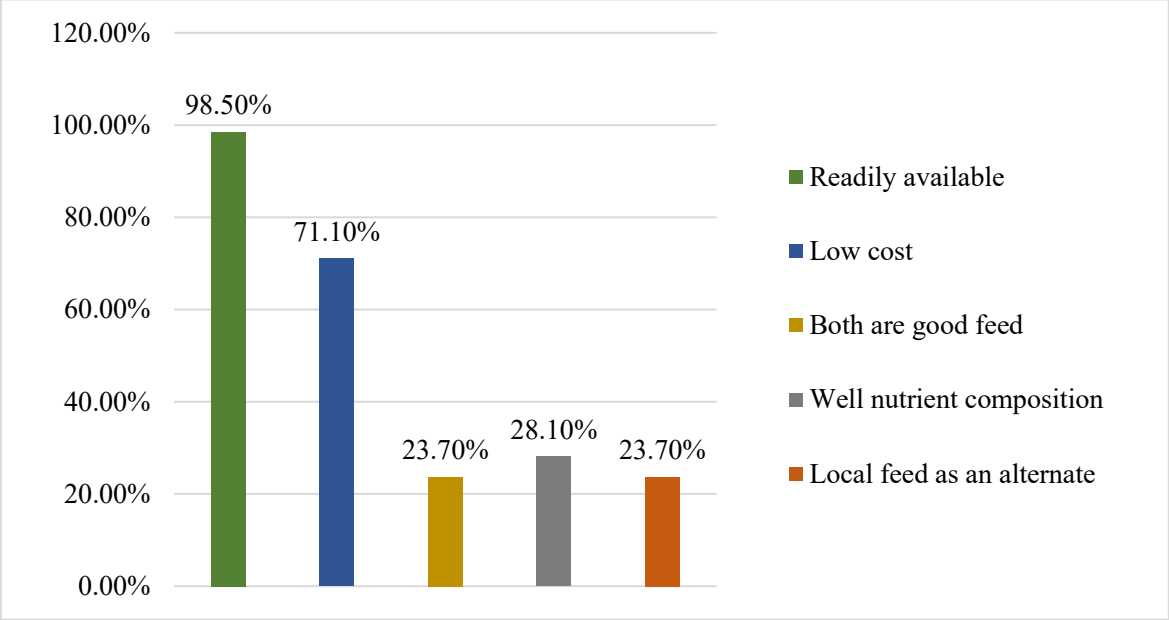


Fig. 6: Reason for choice of feed

Source: Field Survey, 2023

Willingness to switch to commercial feed

Among respondents using only traditional fish feed, only 7.6% of respondents were found to switch to commercial, and a high percentage of 92.4% were not willing to switch to commercial fish feed. Respondents were willing to change to commercial because of the good growth of fish on commercial, easily available, while traditional was found time-consuming in ingredient procurement and mixing.

Reason for not being willing to use commercial feed

Fig. 7 shows that the reason for not being willing toward commercial feed for respondents who only use traditional fish feed was due to high cost, which in total cases is 94.7% of total responses. This aligns with the findings of Subedi *et al*. (2019) and Neupane & Gharti (2018) that high fish feed cost is a major problem in fish farming in Nepal. The high input cost and low market price of fish lead to a problem with the adoption of quality commercial feed. For effective adoption, training on feed formulation using locally available ingredients and a subsidy program will be beneficial in improving feeding quality and better yield attainment. 88.3% selected Cultural/traditional practices as a reason for not being willing means they have been practicing for a long time, and were satisfied with the production from that feed.

Feed usage system in both types of feed users

Fig. 8 shows that among respondents using both traditional fish feed and commercial fish feed, 45.7% of respondents were found using traditional fish feed in the morning and commercial fish feed in the evening. 31.4% and 22.9% of both types of feed-using respondents were found using mixed application of both feed and fingerlings with commercial and later-stage fishes with traditional fish, respectively.

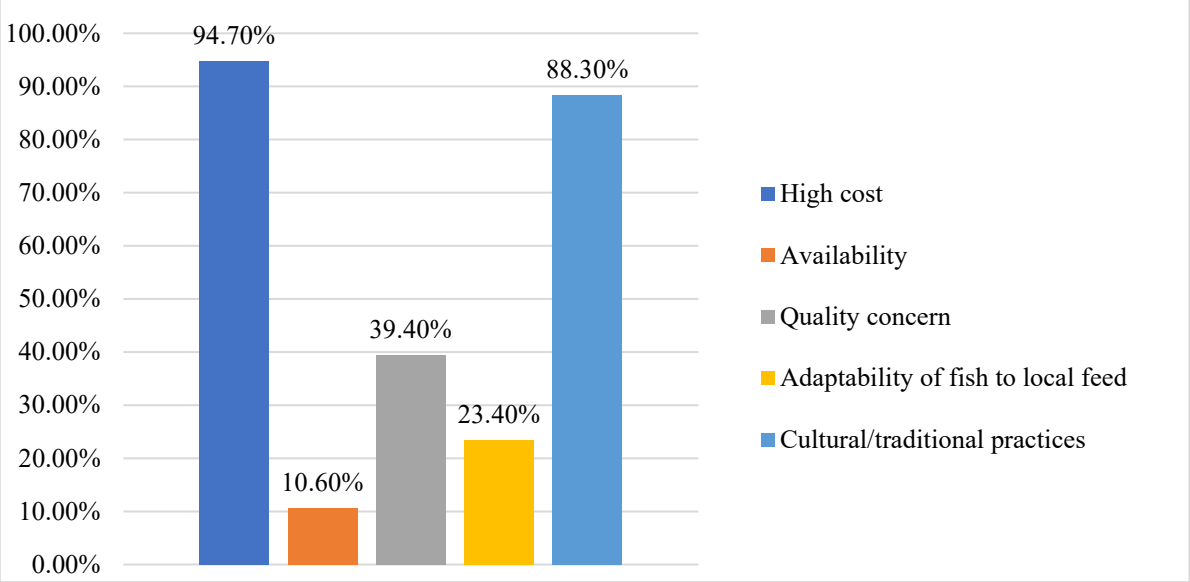
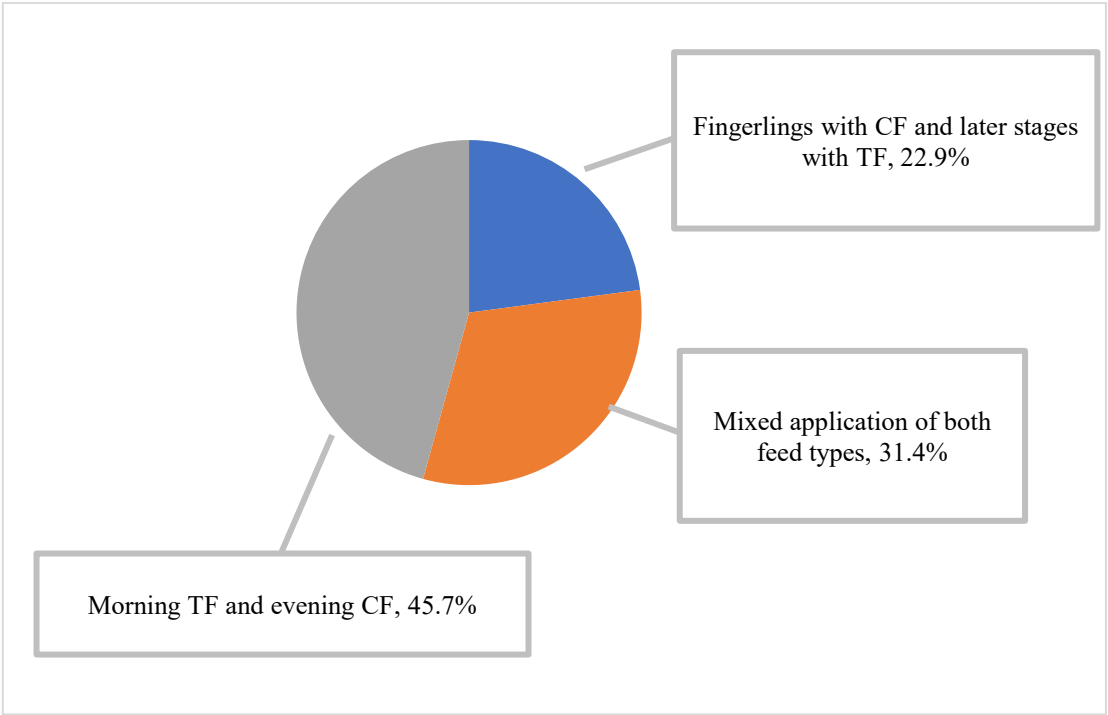


Fig. 7: Reason for not being willing to use commercial feed

Source: Field Survey, 2023



Note: TF= traditional feed, CF= commercial feed

Fig. 8: Feed usage system in both types of feed users

Source: Field Survey, 2023

Types of feeding devices used and feeding patterns

97.8% of total respondents were using hand feeding, while only 2.2% were using demand feeders to feed fish. This shows a lack of technology adoption, but there may be a reason this study found most were new fish farmers and small area holdings.

The majority of the respondents practiced spot feeding (91.1%) while 8.9% of respondents adopted broadcast feeding. Farmers believe spot feeding makes fish easy to identify of feeding location and minimize feed wastage.

Using feed additives

Feed additives include vitamins, minerals, and probiotics, which improve the digestibility and health of fish (Riaz *et al*., 2024). Among the total respondents, only 14.1% were found using feed additives (like Minerals, Vitamins, and Probiotics). This shows there is a lack of information for farmers on the benefits of feed additives.

Grass feeding practice

The survey result shows that 88.1% of the respondents were feeding grasses like Berseem, Napier, Sorghum, and Banana leaves, especially for Grass carp.

57.4% of the total respondents of 122 feeding grasses to the fish were found feeding on random days, 34.4% feeding by skipping a day per week, and 8.2% of the total respondents were feeding grasses to the Grass carp daily.

When excess grass remains uneaten in the pond starts to decay in a few days, which decreases the oxygen level in the pond. Among grass feeding respondents, 94.3% of respondents found removing excess grasses left uneaten in a pond before it starts decaying, and 5.7% of respondents left grasses in the pond to decay in the pond. This shows that most of the respondents are aware of the negative impact of the decay of grasses in the pond, which decreases the oxygen level.

Feeding frequency and method

The result of the study indicated that 42.2% of farmers prefer to feed their fish based on the body weight of the fish. 41.5% of respondents feed fish depending on the availability of feed, while the remaining 16.3% feed their fish based on satiation.

Among the respondents feeding fish based on body weight, 50.9% of respondents feed fish at 5% of fish body weight to fingerlings and 3% body weight to later stages, 42.1% feed at 3% body weight, while the remaining 7.0% feed at 5% body weight to all stage fish.

Most of the respondents were found feeding fish in the morning and once a day, with 72.6% of the total respondents and 27.4% of respondents feeding fish twice a day, both morning and evening. Body weight gain in common carp has a significant positive impact with increasing feeding frequency (Stankovic *et al*., 2010).

Fish Status Monitoring Frequency

Fish monitoring is done to know the health condition, growth performance, and feed consumption, which also helps to calculate the efficient amount of feed application in a pond on a weight basis feeding. Figure 9 shows that 60.7% of respondents were monitoring fish status once a month, 36.3% were random, and 3% were found monitoring weekly basis.

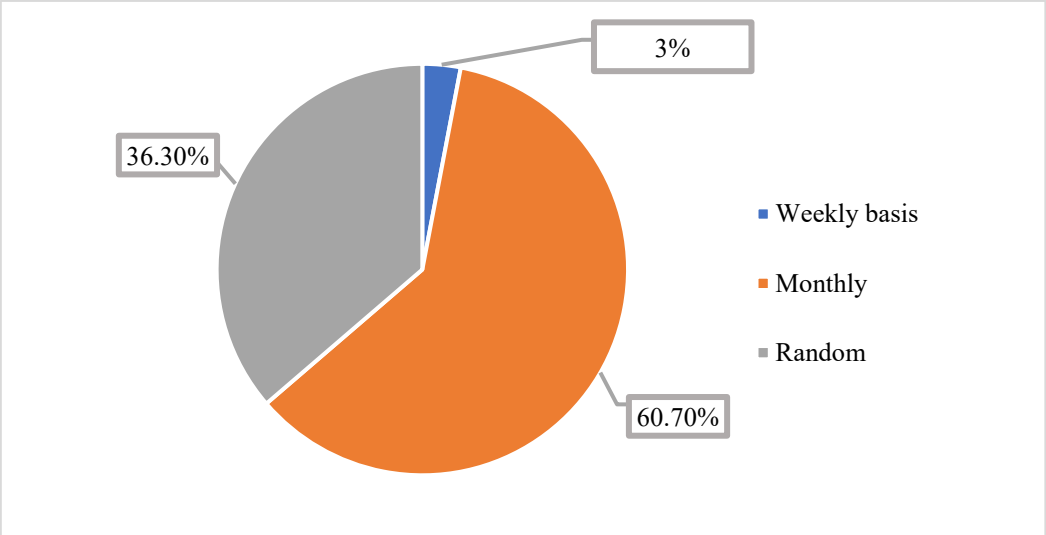


Figure 9: Fish status monitoring frequency

Source: Field Survey, 2023

Fish yield

Fig. 10 shows fish yield from respondents' ponds and found that the majority of the respondents (51.9%) found having fish yield between 151 to 200 kg/ kattha/year or 4500 to 6000 kg/ ha of water surface area or mean of 160.76 kg/kattha/year (4.8 Metric tons./ha/year) which found lower than national yield of 5.57 Mt/ha (MoALD, 2024).

Comparison of Productivity Between Feed Types

Table 4 shows that no significant difference in productivity was found between traditional feed users (M = 160.84, SD = 43.14) and users of both feed types (M = 160.59, SD = 40.08), *t*(133) = 0.032, *p* = 0.974. The research article by Zulfiqar *et al*. (2024) confirms that specific, well-formulated commercial feeds (e.g., those with better FCR and crude protein levels) can improve the growth and composition of fish. However, these studies are conducted under managed semi-intensive conditions. Our data reveals a significant gap: while quality feeds may work in experiments, their actual benefit for small farmers depends on two critical factors. First, farmers must be able to identify and access the right, high-quality formulas. Second, they need the management skills to support the feed's effectiveness. Lacking either factor makes the investment unprofitable. Without targeted training to help farmers select efficient feeds and maintain optimal pond conditions, simply supplementing with commercial feeds becomes an unprofitable expense, as our results show.

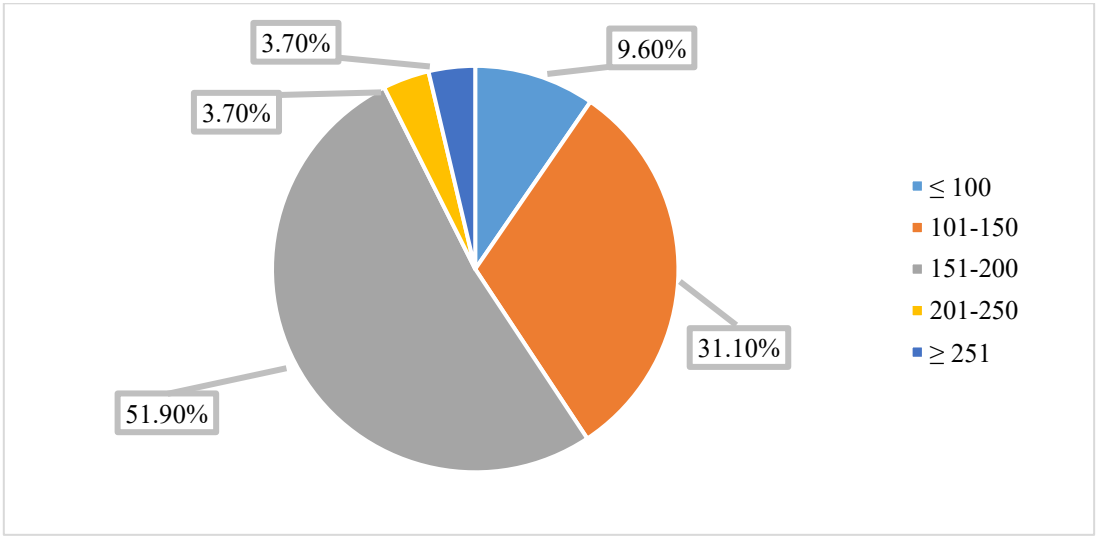


Fig. 10: Fish yield (Kg/Kattha)

Source: Field Survey, 2023

Table 4: Comparison of Productivity Between Feed Types

Feed Type	N	M	SD	M dif.	95% CI	t	df	p
Traditional only	94	160.84	43.14					
Both traditional & commercial feed	41	160.59	40.08	0.26	[-15.38, 15.89]	0.032	133	0.974

Note: Independent samples *t*-test; equal variances assumed (Levene's F = 0.163, *p*= 0.687). M = mean, SD = standard deviation, M dif. = mean difference, CI = confidence interval.

Association between selected variables with the type of feed adoption

Table 5 shows the association between various selected variables with the type of feed adopted, assessed using a Chi-square (χ^2) test. The result found a statistically significant association between the pond water surface area held by respondents and gender, with feed type adoption at a 10% level of significance, while other variables like age, education, training, and farming experience did not show a significant association. These findings align with findings by Brugere *et al*. (2021) found that education level, fish farming experience, and training received have no significant association with the type of fish feed used. In contrasts Amankwah & Quagrainie, (2019) found education level, experience, training, and fish farm size to be significant with household decisions to adoption of improved feed, where bigger farms are more favorable to improved feed adoption decisions. While in our study, farmers with small pond water surface area showed a high proportion using both types of feeds, as compared to the large pond area holding farmers. This could be due to the time-consuming process of procuring and formulating traditional fish feed by small ponds holding farmers. Additionally, most small-scale farmers were new to fish

farming activities, and a lack of knowledge on the optimum blending for the preparation of traditional feed. Sakib and Afrad (2014) found that education level, fish farming area, and age were significantly related to the adoption of modern aquaculture technologies. In our study, male shows more adoption of both types of feed. This aligns with the findings of Li *et al*. (2008), Males show a more rapid rate of new technology adoption than women. There need for women-specific training to enhance women in decision-making in feed adoption. Contrary to expectations, training did not show any significant influence on feed type adoption. This may be due to the high cost of commercial feed, which is the main reason for unwillingness to adopt commercial feed found in the survey findings. Our research findings indicate no significant difference in yield with different feed type adoption, suggesting that yield may be more influenced by feeding practices and pond management rather than feed type alone. Policy measures like credit facilities, a subsidy scheme, and a discount on bulk purchasing could help mitigate this high-cost-related barrier.

Table 5: Association between selected variables and with type of feed adoption

Variables	**Categories**	**Type of feed adopted**		**χ^2 Value**	**p-value**
		Both feed	**Traditional feed**		
Pond water surface area (Kattha)	≤ 10	22	44	4.742	0.093*
	11-20	6	30		
	≥ 21	13	20		
Age Group (Year)	≤ 25	5	9	1.483	0.476
	26-50	23	63		
	≥ 51	13	22		
Productivity (kg/Kattha)	≤ 150	16	39	0.072	0.789
	≥ 151	25	55		
Gender	Female	5	24	3.011	0.083*
	Male	36	70		
Training Received	No	18	44	0.097	0.755
	Yes	23	50		
Family Size (number)	≤ 4	7	13	3.035	0.219
	5-6	9	35		
	≥ 7	25	46		
Education Level	Basic	13	29	0.143	0.931
	Secondary	21	51		
	University	7	14		
Farming experience (year)	≤ 4	24	56	0.574	0.750
	5-10	9	16		
	≥ 11	8	22		

Note: * represents significance at the 10% level. Both feed includes the adoption of commercial + traditional feed or commercial feed only. Only six farmers were commercial feeding farmers, so for robust analysis merged with both types of feed adoption.

Source: Field Survey, 2023

Conclusions

Fishery in Nepal demonstrates a growing trend and also has significant potential for income generation and nutrient security. However, farmers of the Fish Super Zone, Rupandehi, face critical problems like feed cost and fish seed availability on time. Quality fish seed, feed, and fertilizer are crucial topics for optimizing fish yield. A key finding of this research is that traditional fish feed users often blend ingredients in an inappropriate proportion, negatively affecting water quality and fish growth. Additionally, it also found that high cost is the major barrier to using commercial fish feed. To increase fish yield, an improvement in the feeding system is crucial. Policymakers should prioritize implementing effective subsidy programs for feed additives, training on optimal use of locally available input in traditional feed for nutrient improvement, pond management, and women-specific training to enhance participation in feed adoption decisions and new technologies adoption.

Authors' Contributions

Govind Singh Yadav: Conceptualization, Data curation, Formal analysis, Methodology, Software, Validation, writing - original draft, Writing - reviewing and editing; Poonam Kumari Yadav: Methodology, Data curation, Writing - reviewing and editing; Aashish Upadhyaya: Methodology, Investigation, Software, Writing- reviewing, and editing.

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Author Contribution Statement

All authors have read and approved the final version of this manuscript.

Data Availability

Data used for this research will be made available on reasonable request from the corresponding author.

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