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RESEARCH ARTICLE

CURRENT SCENARIO OF FISH-HORTICULTURE BASED INTEGRATED FARMING SYSTEM IN THE NORTH-WEST OF BANGLADESH: MANAGEMENT SYSTEM AND CONSTRAINTS

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ABSTRACT

This research focuses on the current scenario of the Fish-Horticulture based integrated farming system (FHIFS) compared with conventional fish farming (CFF) in north west Bangladesh. Data were collected through face-to-face interviews from farmers of FHIFS and CFF. The findings reveal that fishes were cultured in polyculture systems and horticultural crops were planted in the embankment of pond. A total of 22 species of fish, 8 species of fruits and 6 species of vegetables were cultivated as integrated farming in the study area. In FHIFS the highest cultivated fish was Rui (82.76%) and the most cultivated crop was Banana (70.83%). The study also reveals that the annual hectare^{-1} net revenue from FHIFS was US$ 12,462.7, 2.5 times higher than CFF (US$ 4941.2). FHIFS had a higher benefit-cost ratio (BCR) of 1.70 as compared with 1.43 for CFF. The annual net revenue and BCR shows that the FHIFS is highly potential and profitable than CFF. The also findings indicate that 65.5% of the respondent experienced medium constraints. Based on the constraint facing index (CFI) the lack of proper distribution of government facilities was ranked first among all the constraints which was followed by insufficient extension services (Rank 2nd) and high cost of operation (Rank 3rd). FHIFS could be prioritized to ensure food security through proper distribution of support, minimizing operation and labor costs, and developing a community-based integrated fish farming.

KEYWORDS

Chapainawabganj, constraints, fish-horticulture, integrated farming

1. INTRODUCTION

Considering Bangladesh is a crowded country, only linear improvement is achievable by inserting farming aspects that need less area and time while offering constant money to the farmer. As a result, the integrated farming system becomes more relevant for making good use of agricultural resources in order to boost farm output, prevent environmental degradation, raise the standard of living for impoverished farmers, and maintain sustainability (Al Mamun et al., 2011). With rising food demand in Bangladesh, agriculture has been intensified by increased chemical use, resulting in soil fertility depletion. This is primarily due to the loss of organic matter in the soil which is caused by intensive land cropping year after year without effective soil management measures. To keep the soil productive, organic manure must be supplied. Farmers in Bangladesh are being advised to combine multiple farming operations in order to meet the new difficulties of a changing world, with the importance of soil fertility and its anticipated effects on crop output being recognized (Uddin and Takeya, 2006). In Bangladesh, ongoing land degradation is jeopardizing household food security. Including the production of vegetables, trees, cattle, and fish in the commercial farming system could be the answer to halting soil degradation and restoring productivity. The integrated farming system has several goals: to improve household food production, to sustain the natural resource base that contributes to food security and rural people's well-being, to contribute to revenue generation, and to be accepted by local communities (Al Mamun et al., 2011). Chapainawabganj is a plain region with rivers in north-western Bangladesh and it is well-known for its abundant open waterbody resources, which include multiple rivers and beels. The entire district is covered in fertile land and has adequate irrigation equipment; thus, the economy is mostly centred on agriculture; besides that, several rivers cross through this region, relying on fishing and other similar industries as well. At the moment, farmers are primarily focused on crop production, which is ambiguous in terms of income and employment and now it is critical to devise a viable strategy for boosting a farm's income throughout the year (Al Mamun et al., 2011). The agricultural economy benefits greatly from the integration of various agricultural enterprises, such as cropping, animal husbandry, fisheries, forestry, and so on, within the farming system. These businesses not only assist farmers to augment their income but also serve to increase family labour employment throughout the year (Jayanthi et al., 2000). The integrated agricultural system is used in a variety of ways in many different nations. However, a combination of agricultural and livestock companies is a prevalent feature of the integrated farming system whereas the combinations with aquaculture or trees are examples of other sorts of integrated farming. The grown fish and normal farming procedures are simple to integrate (Al Mamun et al.,. 2011). According to the study of in the Nilphamari District of Bangladesh 33% of farmer in that area practices FHIFS (Rahman et al., 2018). Integrated farming systems were created to meet basic needs such food security for subsistence family farms, water conservation, and pollution control (Ahmed et al., 2011; Nhan et al., 2007; Little and Edwards, 2003). These days, integrated aquaculture and integrated farming systems are used worldwide (Zajdband, 2011). Mymensingh, Jessore, and other Bangladeshi areas practice integrated aquaculture proficiently (Ahmed et al., 2008). Few areas in Chapainawabganj district practice integrated aquaculture, which is still developing. In this context, the objectives of this research were to describe the socio-demographic profile of the farmers involved in the FHIFS, to estimate the profitability differences between the FHIFS than CFF; to assess the extent of constraints faced by the farmers.

2. Research Methods

The study was conducted in Sadar Upazila in Chapainawabganj district, which is located in Bangladesh's northwestern region. Chapainawabganj is located between latitude $24^0$22' and latitude $24^0$57' and longitude $87^0$23' and $88^0$23'.

The study areas were selected from 7 villages (Shahibug, Jamtola, Hossaindong, Atahir, Polsha, Mia para and Dargapara) of Chapainawabgonj Sadar upazila; 3 villages (Kollanpur, Chaitonopur and Dhainagor) of Shibgonj upazila; 2 villages (Mollikpur and Kholai) of Nachol upazila; 7 villages (Neemtola, Kalon bill, Prantic para, Kashimpur, Katheya para, College gate, Katheya para) of Gomostapur. Total 29 farmers from 19 villages were selected and monitored by using random sampling method. A pre-structured questionnaire was used to collect data during the face-to-face interview. The entire process of data collection was conducted from February, 2022 to May, 2022. SPSS (Statistical Package for Social Science) was used to conduct the analysis. For data analysis and interpretation, statistical tests such as frequency counts, percentages, means, and standard deviations (SD) were used. To investigate the link between the variables in question, a 95% confidence level regression analysis was done.

The study's variables were eight selected socioeconomic characteristics of farmers. These were age, family size, education level, farm size, farm ownership, farmer experience, annual income (lakh), training status, constraints in fish-horticulture based integrated farming. Appropriate procedures, such as developing appropriate scales, were employed to operationalize the variables. Farmers' constraints in vegetable production are the dependent variable. Three categories were evaluated to measure constraints in fish-horticulture based integrated farming. The responses were gathered using a four-point scale of "high," "medium," "low," and "not at all." and weights were assigned to these responses as 3, 2, 1 and 0 respectively. That also used similar scale for measuring constraint score in their respective study (Khan et al., 2022; Molla, 2020). Each respondent's total constraint score was calculated by summing his constraints scores from all four areas. To measure constraints in fish-horticulture based integrated farming, the responses were obtained through a 4-point scale of “severe”,” moderate”,” low” and “not at all” and weights were assigned to these responses’ as 3,2,1 and 0 respectively. Overall constraints score for each respondent was computed by adding his

constraints scores in all five aspects. The possible range of the overall constraint score of the farmers could range from 0 to 51 and which being categorized as “Low” (0-17), “Medium” (18-30), “High” (31-51). 17 aspects of constraints were arranged by rank order by developing Constraint Facing Index (CFI) by using the following formula.

CFI = fh×3 + fm×2 + fl×1 + fn×0

Where,

CFI= Constraints Faced Index

fh = No. of respondents faced severe constraints

fm = No. of respondents faced moderate constraints

fl = No. of respondents faced low constraints

fn = No. of respondents faced no constraint

For total 29 farmers the Constraints Faced Index could range from 0-87. The Constraints Faced Index (CFI) for each constraint can range from 0 to 87, with 0 indicating the least number of constraints and 87 indicating the greatest number of constraints.

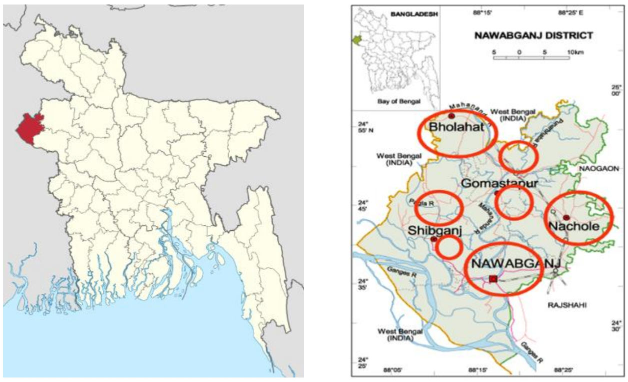


Figure 1: Map showing the location of the study area

3. Results and Discussion

3.1 Socio-demographic profile of fish farmers

Table 1: Demographic profile of framers of fish-horticulture based integrated farming system

Variable	Categories	Percentage	Mean	Standard Deviation
Age	Young (20-40 years)	48.3	43.41	9.88
	Middle (41-60 years)	44.8		
	Old (>60 years)	6.9		
Family size	Small (2-4 persons)	55.2	4.76	1.33
	Large (5-8 persons)	44.8		
Education level	Primary level (1-5)	17.2	7.59	4.75
	Secondary level (6-10)	34.5		
	Higher secondary level (11-12)	10.3		
	Graduate	20.7		
	Illiterate	17.2		
Farm size	Medium (0.21- 0.28 ha)	10.3	2.80	3.93
	Large (>0.29 ha)	89.7		
Farm ownership	Self	13.8	2.52	0.79
	Joint	13.8		
	Leased	55.2		
	Joint+ Leased	17.2		
Farmer experience	Low (1-4 years)	24.1	10.55	6.38
	Medium (5-9 years)	24.1		
	High (10-13 years)	51.7		
Annual income	Low income (1,760 - 4,700$)	27.6	11,669.41	16,240.18
	Medium income (4700-8,230$)	44.8		
	High income (>8,230 $)	27.6		
Training status	No training	48.3	1.48	0.51
	Trained	51.7		
Training Institution	GOs	17.24%		
	NGOs	13.79%		
	DoF	3.45%		
	BFRI	10.34%		

According to the data, young-aged farmers contributed a major proportion (48.3.8%) and most farmers had completed secondary education (34.5%) (Table 1). The proportion of large farm owners is the highest (89.76 %) and many of the farmers had land over leased and the proportion (55.2 %). The proportion of the farmers with medium annual income constituted the highest proportion (44.8 %) and most of them (51.7 %) fell in the trained category (Table 1). The reported similar socio-demographic features among the area's farmers. 17.24% of farmers got training from Govt (Khan et al., 2022). training institutes such as the Department of Youth Development, Department of Agricultural Extension, Bangladesh Krishi Bank;10.34% got from BFRI and 3.45% got from DoF. 13.79% of farmers got training from NGOs like BRAC bank and Grameen Bank (Table 1).

3.2 Cultivated Fish Species

Farmers used most of their land for fish farming and only dyke of the pond was used for planting fruits, vegetables and plantation trees. The highest cultivated fish species (82.76%) was found Rui (*Labeo rohita*). Other cultivated spices are Catla (*Labeo cattla*), Silver carp (*Hypophthalmichthys molitrix*), Japanese rui (*Marsupenaeus japonicus)* Mrigal carp (*Cirrhinus cirrhosis),* Bata (*Labeo bata),* Bighead carp (*Hypophthalmichthys nobilis*).

3.3 Pond Management

Most of the farmers (82.76%) constructed ponds before cultivating fish. Of these, 10.3% of the farmers had nursery ponds, 36.9% had grown-out ponds, and 51.8 % had both kinds (Table 2). The pond's average depth was between 4 and 6 feet. The current study area had several ponds built with the required specifications for fish farming. Most farmers raised fish by maintaining old ponds, while a small number used machinery to build ponds on barren land. The main shore was 7-8 feet wide and used for growing both horticulture crops as well as for fish feeding and observation. Before releasing fish, a few farmers dried their ponds well and removed aquatic weeds manually or chemically. Ponds were fertilized with urea and triple super phosphate (TSP) and cow dung. Farmers fertilized their ponds with both chemical and organic fertilizers. Most farmers (69%) combined the two forms of fertilizer for fertilizer application (Table 1). Farmers also cleaned the mud at the bottom of the pond. Before the monsoon season, some fish farmers encircled the pond with a net to keep the fish in the pond. To keep the fish in the pond, the fish farmer occasionally cut a portion of the pond's dyke to remove the extra water after encircled by a net.

The study shows 48.3% of farmers used farm-made feeds, 51.6% of farmers provided feed according to the weight of fish and the feeding frequency once a day (55.2%) (Table 2). The hand-feeding technique was more frequently utilized in case of feeding applications. Supplementary feeds were applied by the most of the farmers in large-scale fish farming, while in integrated aquaculture systems, farmers mainly used on-farm inputs such as rice bran, wheat bran and mustard oilcake.

Table 2: Pond Management System in the Study Area

Parameters	Categories	Percentage
Plot and ditch preparation	Yes	82.8
	No	17.2
Types of ponds	Nursery	10.3
	Grow-out	37.9
	Both	51.7
Pond depth	Low (2-4 ft)	3.4
	Medium (4.1-6 ft)	69.0
	Deep (>6)	27.6
Disease Treatment	Yes	89.7
	No	10.3
Fertilizer application	Organic	6.9
	Inorganic	24.1
	Both	69.0
Feed type	Artificial	17.2
	Farm-made	48.3
	Both	34.5
Feeding Rate	Body weight basis	51.7
	Stocking density basis	48.3
Feeding frequency	One time (Morning or Evening)	55.2
	Two times (Morning & Evening	44.8
Feeding method	Feed tray	17.2
	Hand feeding	79.3
	Demand feeder	3.4

3.4 Stocking and Harvesting of Fish

Table 3 shows a maximum stocking density of 5.89 kg/decimal and a minimum stocking density of 0.064kg/decimal. Stocking density varies on the size of the fry, fingerling and egg. Stocking density was divided into 3 categories as low, medium, and high. Studies had shown that most farmers (55.20%) maintained low stocking density which was below 3 kg/decimal.

Table 3: Stocking density and harvesting of fish

Categories (Kg/Decimal)	Stocking Density %	Categories (Times/Year)	Harvesting of fish %
Low (<3)	55.20	Low (<3)	34
Medium (3-5)	27.60	Medium (3-6)	59
High (>5)	17.20	High (>6)	7

Also, the study indicated that the maximum stocking time per year was 4 and the minimum was 1. This stocking and harvesting time depend upon the fish size like egg, fry, fingerling, small fish and medium fish and depend on the pond types like nursery pond and grow-out pond (Table 3). In the current research the maximum harvesting time was varies from 6-1 and the fast-growing fish species such as Tilapia, Japani rui, Grass carp, Bata, and Silver carp were harvested 4-6 times a year. Other fish like Rui, Catla, Chitla, Black carp, Mrigle etc were harvested 1-3 times per year. Here the time of harvesting was categorized into 3 groups where maximum fish harvesting was 3-6 time in a year, estimated as 59% (Table 3).

3.5 Cultivated of Horticultural Crops

Fruit trees were cultivated all year round, with mango, coconut, malta, litchi, dragon fruit, guava, citrus, and jujube being the most cultivated. Vegetable plants were cultivated two or three times a year, while fruit trees were commercially cultivated with good yields. Banana was the most cultivated plant species (70.83%). According to the study the fish pond embankment comprising 20–30% can be used for growing cucurbits and fruit (Gill et al., 2009).

Table 4: Cultivation of horticultural crops in the study area

Horticultural crops	Scientific name	(%)	Planting time (Month)	Harvesting (Month)	Yield (kg/plant)	Production (ton/ha)
Fruits						
Banana	*Musa paradisiaca*	70.83	May- Jun	Year around	32	37.5-62.5
Mango	*Mangifera indica*	50.00	Jun- Jul	May- Aug	5- 400	9-12
Papaya	*Carica papaya*	20.83	May to Jun	Year around	35-60	42-45
Jujube	*Ziziphus maurititana*	12.50	Before monsoon season	Mar-Apr	20-25	4.5-6
Litchi	*Litchi chinensis*	8.33	Before monsoon season	May- Jul	66-75	2.23
Guava	*Psidium guajava*	8.33	Jun- Jul	May –Jun	120-150	15-22
Dragon fruit	*Selenicerew undatus*	4.17	May to Jun	May- Oct	4-5	0.91
Coconut	*Cocos nucifera*	4.17	Year around	Year around	78	3.6
Malta	*Citrus sinensis*	4.17	Before rainy season	Sept- Oct	6.5-7	1.3-2
Vegetables						
Bitter gourd	*Momordica charantia*	8.33	Year around	Any time	2-2.5	18
Sponge gourd	*Luffa aegyptiaca*	8.33	Apr-May	Jul-Aug	5	6.5
Bottle gourd	*Lagenaria siceraria*	8.33	Jan-Feb	Apr- May	7-8	2.25-3
Lady's fingur	*Abelmoschus esculentus*	4.17	May-Jun	Aug- Sept	0.5	7.5
Brinjal	*Solanum melongena*	4.17	Aug-Oct	Mar- Jun	1.5	11.5
Chilli	*Capsicum frutescens*	4.17	Year around	Any time	0.30	19-20

3.6 Planting and Harvesting of Horticultural crops

Farmers in the study area used the broadcasting method for growing vegetables and the line sowing method for planting fruit trees. Fruit trees were planted before the monsoon, while vegetable plants were planted according to seasons. Low-canopy plants were planted along the bank of the pond, with mango plantations 8-15 feet apart and banana, papaya planted 4-5 feet apart in pits of 50 cm in diameter and 30 cm deep. Vegetable plants were grown in beds, with Lady's finger, Brinjal and Chills planted on beds.

Plot and ditch preparation includes dike repair, weed control, soil ploughing, and seedling planting. Over 82.8 % of farmers prepared pond dykes before releasing fish fingerlings. The dyke was constructed of soil with enough clay and thickness, and was thicker than a typical pond. Farmers used a roller machine or hand labor to compress the soil for the dyke, and bamboo pegs were used as an additional layer of protection. Most of the ponds had a favorable inner slope (1:2 ratio), but none had outer slope. Horticultural crops were planted on the dyke. Digging and combining soil with compost and manure was used to prepare the pit for planting horticultural crops. Banana plants were typically removed sick and dead leaves, while citrus seedlings were created via grafting. Mango plants received fertilizer and irrigation two to three times each year, and fungicides and insecticides were treated multiple times. Papaya plants were to be removed, keeping only one plant in each pit and maintaining a female: male plant ratio of 10: 1. Irrigation should be applied 6–10-day intervals in summer and 10-15 days in winter. Removal of side shoots, older and diseased leaf was provided support with bamboo and rope.

The most important details are that 70.83% of farmers planted banana as the plantation crops on the dyke, which was the highest among all horticultural crops due to its low-cost integration system and high return. Dragon fruit and coconut were the lowest (4.17%), while Bottle gourd and bitter gourd were the highest (8.33%) in the vegetable category.

Mango and litchi were harvested from May to July. The average yield of mango was 9-12 tons/ha and litchi were 2.23 tons/ha. Papaya, Dragon fruit, and Banana were harvested year around and the yield were 42-45, 0.91 and 37-62 tons/ha respectively. In the vegetable category Bottle gourd and bitter gourd were the highest.

3.7 Marketing Channel of Fish and Horticultural Crop

Most farmers favored selling their fish straight to the wholesaler (65.5%). The small farmers used other channels, such as farmer-fish agents-wholesaler (13.8%) and farmers-fish collectors- wholesaler (20.7%). 55.2% of farmers sale of their products was the producer- primary wholesaler- secondary wholesaler-retailer- consumer (distant market).

Table 5: Marketing Channel

Marketing Channel	Category	Percentage
Fish	Farmer → Agent→ Wholesaler	13.8
	Farmer → Collector→ Wholesaler	20.7
	Farmer → Wholesaler	65.5
Horticultural produce	Producers → Consumer (village sale)	6.9
	Producer-retailer → Consumer (local market)	20.7
	Producer→ Primary wholesaler→ Secondary Wholesaler → Retailer→ consumer (distant market)	55.2

4. Cost Return Analysis

In this study, the cost of production was gathered from 24 respondents. Then a simple economic analysis was performed to estimate the various costs of production and returns for each respondent. The average return on salmon among the farms studied was US $32,884.2. The average annual return from plants per hectare was determined to be US $5,231.2. In addition, the average cost of production for fish was US $ 9,972.8. The average annual production cost per hectare for horticultural plants was discovered to be US $ 755.8. Due to differences in land size, terrain, experience, administration, and, most importantly, the quality and market value of the harvested plant products, the production costs varied. The found similar result in the integrated farming system practiced in Noakhali region of Bangladesh (Ullah et al., 2020; Alam et al., 2009). In the case of

CFF, the average return of fish per year per hectare is US $ 17,882.4, the average cost of fish production per hectare is US $ 12,941.2, and the average net income is US $ 4,881.2. Most producers in the study area reported greater returns from fish than from plants.

Table 6: Cost-Return Analysis of FHIFS and CFF									
Cost of Production of FHIFS							Cost of production of CFF		
Average Cost of Production of Fish/Year/ Ha (USD)	Average Cost of Horticultural Plants/Year/Ha (USD)	Average Total Cost /Year/ Ha (USD)	Average Return of Fish/ Year/ Ha (USD)	Average Return of Horticultural Plants/Year/Ha (USD)	Average Total Return/ Year/Ha (USD)	Average Net Return (USD)	Average Cost of Production of Fish/Year/ Ha (USD)	Average Return of Fish/ Year/ Ha (USD)	Average Net Income (USD)
9,972.8	7,55.8	25,642.9	32,884.2	5,231.2	38,105.6	12,462.7	12,941.2	17,882.4	4,941.2

4.1 Comparison between FHFIS and CFF

From the above two BCR tables, it can be seen the difference in the cost-return ratio in two different cultivation systems. One was a fish-horticulture based farming system and another was single fish culture. Farmers who adopted fish-horticulture based integrated cultivation had gotten higher average returns than farmers who adopted single fish culture. According to the study of the integrated culture of fish and vegetables shows higher BCR compared to conventional farming (Sunny et al., 2019). According to Table (6), the highest BCR in the fish-horticulture integrated system was 2.37 and the lowest was 1.29.

On the other hand, the highest BCR in single fish culture was 1.56 and the lowest was 1.29 (Table 6). BCR of fish-horticulture based farming systems would have been much higher but most of the farmers have started integrated farming. Since the fruit-bearing capacity of the tree has not yet reached its maximum, the yield is getting lower. After 4-5 years the BCR ratio will be much higher than single fish culture.

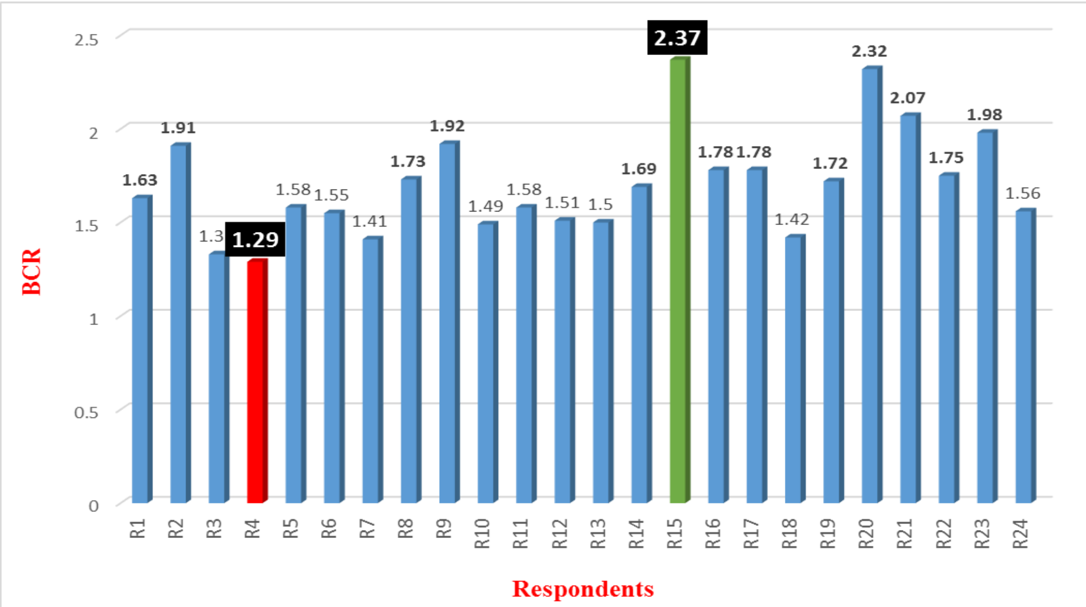


Figure 2: BCR of fish-horticulture based integrated farming system

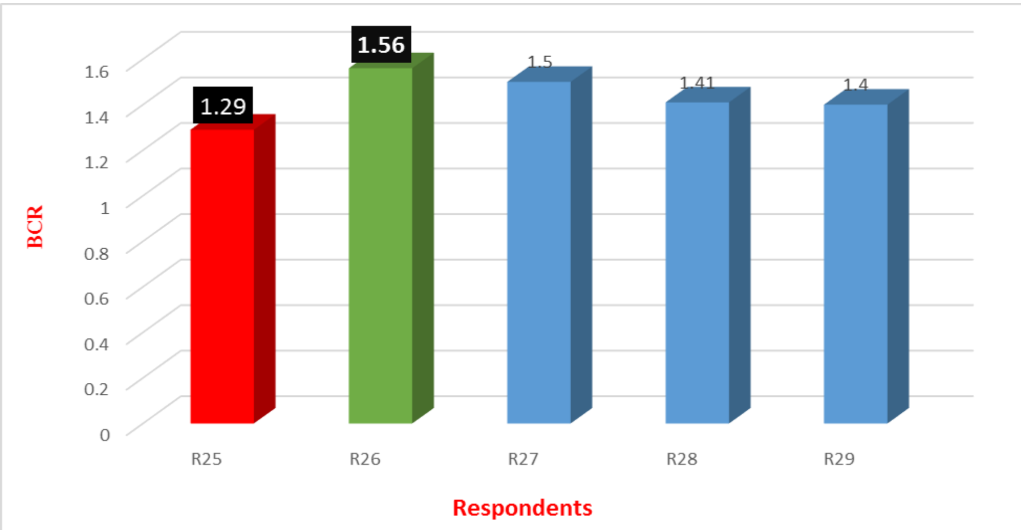
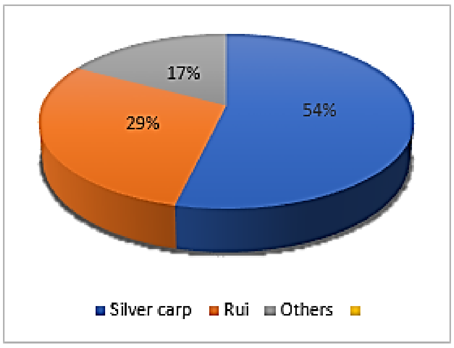


Figure 3: BCR of Conventional fish farming

4.2 Most Productive Fish and Horticultural Crop Species

According to the study Silver carp 53.7 % and Rui 29.3 % was more productive among other fish species. Due to low input cost and high return, Banana (50%) and papaya (38%) were more productive among other plant species (Figure 3)



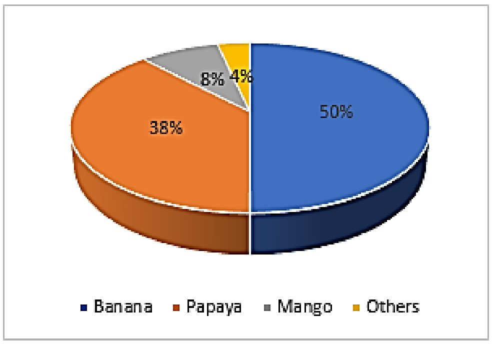


Figure 4: Most productive fish and horticultural found in the study area

4.3 Constraints Faced by the Farmers

In the study area, farmers faced various constraints related to integrated farming or fish farming. Based on constraints score, the respondents were categorized into three groups, low, medium and high as shown in Figure 4. Constraints faced by the farmers were scored off the farmers ranged from 16 to 36 against the possible score of 0 to 51. The figure revealed that 65.5% of the respondent had medium, 20.7% high and 13.8% low constraints in integrated fish-horticulture-based integrated farming and in single fish culture (Figure 4).

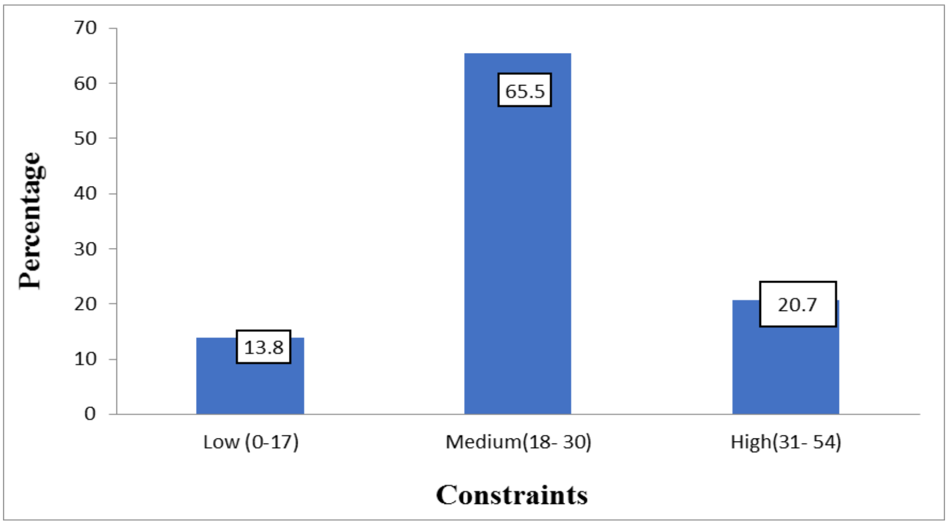


Figure 5: Distribution of the farmers according to their constraints

4.4 Rank Wise Distribution of Constraints

Table 8: Rank Wise Distribution of Constraints

Constraints	CFI score	Rank
Uneven distribution of government facilities	79	1st
Insufficient extension services	75	2nd
High cost of operation	68	3rd
High labour cost	68	4th
Inadequate scientific and technical knowledge	65	5th
Price fluctuation	57	6th
Exploitation by middleman	40	7th
Low water retention capacity of the soil	37	8th
Disease and pest management	37	9th
Insufficient transportation facilities	36	10th
Irregular supply of input	34	11th
Low levels of water during the summer	32	12th
Poor water quality	32	13th
Unavailability of quality fish seed	27	14th
Inadequate finance	25	15th
Poor growth of fish	24	16th
Insufficient land	18	17th

Integrated fish-horticultural crop cultivation also faces many different constraints. Farmers in the study areas also ran into several issues that worked as roadblocks to fish-horticultural crop integrated cultivation. The lack of distribution of government facilities was the key issue and ranked 1st. Small farmers did not get government support but large farmers got government support. Soil with a low water retention capacity, ponds cannot hold water throughout the year. As a result, fish cultivation in the pond could only be done for a maximum of 7-8 months, which was insufficient for a good harvest of larger species of fish. One of the key issues was the scarcity of high-quality fish seeds in adequate quantities. Other significant constraints and issues in integrated cultivation of fish-horticultural crops reported by farmers included high input prices and low output prices, a lack of capital, insufficient scientific and technical knowledge on the combination of different components of integrated farming systems, insufficient extension services, high lease value, poor loan facility, poor fish growth, low water levels during the summer, poaching, poor water quality, high labour cost, insufficient training etc. held back farmers from successful integrated farming.

5. Conclusion

The fish-horticulture-based integrated farming system is a low-cost technology that is more sustainable and eco-friendlier than other farming systems. It increases the yield of fish and vegetable production due to the presence of nutrients in the form of organic manure in pond water. It also minimizes feed and labour costs, allowing for the production of various products at low prices. Systematic guidelines, technical and financial support will ensure the enhancement of production of these integration systems. Integrated farming technology is a new way of intensifying and increasing the production of aquaculture in Chapainawabganj. To achieve maximum benefits, the following action should be implemented: need-based training and adequate supply of technologies from DoF, NGOs and other private organizations, cultivation of native fish, development of community-based integrated farming, cultivation of more expensive fish, government responsibility for marketing channel, supply of good quality fingerlings from hatcheries and nurseries, machinery lease system, enriching the security of the rural area, managing the pond and farm according to standard and responsible aquaculture, design training about how farmers develop horticulture crop production on the dyke, introduction of exotics high value crop, improved marketing channel, campaigns to raise awareness among farmers, design training about how farmers develop horticulture crop production on the dyke, and initiating farmer's club.

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