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PROBLEMS OF INTEGRATED FARMING SYSTEMS: A COMPARATIVE ANALYSIS OF PUNJAB STATE OF INDIA AND RANGPUR DIVISION OF BANGLADESH

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ABSTRACT

The present study was carried out in the Punjab State of India and the Rangpur Division of Bangladesh. This study aims to identify and analyze the problems faced by the farmers in practising Integrated Farming Systems (IFS). A survey method and focus group discussion were conducted for data collection from the farmers and expert members in both locations. The problems were analyzed by computing the Problem Facing Index (PFI) score by the farmers and the expert members. Lack of marketing products from various IFS components had the highest PFI (285 and 52) like from the farmers and expert members in Punjab., the same problem was ranked 3rd by the farmers and expert members in Bangladesh. Lack of coordinated extension services was ranked 1st both by the farmers (PFI, 295) and expert members (PFI, 54) in Bangladesh part which was rated 7th by the farmers (6th by the expert members) in Punjab. The problem is the lack of IFS model demonstrations ranked 2nd by the farmers (5th ranking by expert members) in Punjab, which had 4th ranking by the farmers and the expert members in the Bangladesh side. Besides, the high initial cost was rated 3rd by the farmers (2nd by the expert members) in Punjab study areas, which was ranked 2nd most important problems by the farmers and expert members from the Bangladesh part. Component-wise problems were also assessed and rated separately. It was suggested that developing location-specific IFS models through research activities, the establishment of agro-processing industries, coordinated extension services, proper marketing channels, and ensuring product price would support important initiatives for improving IFS.

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INTRODUCTION

Both India and Bangladesh are highly populated countries that face a significant challenge to meet the increasing food demand for their ever-growing populations. In both countries, a reduction of space for cultivating crops due to rapid urbanism and population increase. In India, for the years 2015-16, the mean land holdings were reduced to 1.08 hectares, 1.16 hectares, and 2.28 hectares, correspondingly during 2010-11 and 1970-71 (AIRAS, 2020). If this trend continues, India's average size will fall by 0.32 ha by 2030 (Sheikh *et al.*, 2021). A similar scenario is also happening in Bangladesh. Only 0.05 hectares are per capita arable land in the country. FAO (1993) estimates about 0.07

hectares of land per person for the year-round vegetarian diet. The year-round varied food, including meat, requires a minimum of 0.5 hectares for each person. Low per capita land in Bangladesh and India is thus one of the most significant difficulties in tackling food security. Both countries will face the problem of meeting food security shortly. Therefore, it is important to increase agricultural output per unit area through the integration of different agricultural and allied enterprises in the production system.

Modern agriculture is operational in two main dimensions viz., time and space. Income through cropping alone is insufficient for a massive percentage (70-80%) of the marginal farmers in India and Bangladesh (Sheheli, 2012). Therefore, it is important to increase agricultural production. It can be done by increasing yield production and economic productivity per unit area per unit time under the Integrated Farming System (IFS) concept. IFS involves the integration of two or more enterprises with the best use of available resources to satisfy the maximum needs of the owner. IFS leads to increased productivity per unit area, efficient recycling of farm wastes, better utilization of resources, generating employment, reducing risks, and ensuring sustainability (Biswas and Singh, 2003). Activities such as dairying, poultry, fish culture, sericulture, biogas production, edible mushroom cultivation, agro-forestry, agri-horticulture etc., assume critical importance in supplementing farm income. It fits well with farm-level infrastructure and ensures fuller utilization of by-products (Pushpa, 2010). Ponnusamy and Devi (2017) described the inter-dependent nature of an Integrated Farming System as the main input to another component by using one component's primary and secondary products. It produces the two components as units with each other. IFS may thus play a key role in tripling farmers' incomes. The IFS' primary objective involves further maximizing the yield, ensuring constant and stable incomes at higher levels, improving the productivity of components, and achieving agroecological balance. IFS also contributes to the efficiency of using natural resources through early nutrient recycling and reducing the negative environmental effects of the system of agriculture. An evaluation of agricultural systems seeks to determine the extent of the profit from each component of the agricultural system and increase the utilization capacity of the local resources (Singh *et al.*, 2011).

Punjab is a state in the northern-western part of India, and its' economy has been primarily agriculture-based. Punjab has abundant water sources and fertile soils; most of the places of the state lie in a fertile alluvial plain with many rivers and an extensive irrigation canal system (Anonymous, 2018). Punjab makes up about 17 percent of India's wheat production, around 12 percent of its rice production, and about ten percent of its milk production, known as India's breadbasket (Jayan, 2018; Government of India, 2020). Similarly, Rangpur is the northernmost division of Bangladesh. It plays a significant role in agricultural production for the whole country as it is primarily plain land with fertile soil characteristics and favourable environmental conditions. This region has the highest cropping intensity (230%), comparing the national cropping intensity is 216 percent (Agricultural Diary, 2021).

Integrated farming with crops, fisheries, and livestock can give potential improvements in yield maximization and economic advantages along with sustainable implications for food security, a balanced diet, and adequate nutrition (Uddin *et al.*, 2016). It ensures increased protection from disease-pest attacks, reduces uncertainty and enterprise failure risk, and significantly increases income generation opportunities. It contributes to extending the harvesting period and solving the seasonal food shortage problems, generation household employment, thus bringing stability to household food access. IFS thus ensures the food security problems as well as the nutritional requirements. Apart from optimum resource utilization, farmers can introduce waste materials recycling and family labour involvement in IFS (Sasikala *et al.*, 2015). Besides the many advantages, farmers are facing several obstacles to adopting IFS. Farmers stated that skilled workers in IFS were difficult to locate or train. Previous research also identified problems like low access to financing to pay an integrated system's expenses and hazards (Garrett *et al.*, 2020). Furthermore, the farmers in both countries face several problems in keeping multiple enterprises in their farming activities, and they are not reasonably aware of how to deal with them. The present study was sketched with the objectives to identify and analyze the problems faced by the farmers in practising integrated farming systems in both locations so that it could create an experience sharing ground among the farmers of Punjab, India, and the Rangpur Division of Bangladesh.

METHODOLOGY

The present study was conducted in purposely selected two districts of Punjab State, India, and two districts of the Rangpur division from Bangladesh from January 2020 to February 2021. In the Punjab part, Patiala and Amritsar districts were selected because Punjab Agricultural University had ongoing IFS projects in those districts, and a sufficient number of respondents were available for data collection. Two Blocks from each district (Patiala: Nabha and Rajpura; Amritsar: Majitha and Verka) were selected for the study purposively. The researcher visited the Krishi Vigyan Kendra (KVK) in each district (Patiala and Amritsar) and collected a list of farmers practising integrated farming. From the list, 30 farmers from each block (25%) were personally interviewed through a semi-structured questionnaire, which constituted 120 respondents in the Punjab part. Similarly, Rangpur and Kurigram districts were purposively selected as those districts had Integrated Farm Management Components (IMFC) projects at Upazilla (Sub-districts) level. Two Uapazilas from each district were selected (Rangpur: Gangachara and Pirganj; Kurigram: Bhurungamari and Nageswari) and a list of IFS farmers was collected from the office of Upazilla Agriculture Office, Department of Agricultural Extension (DAE) in Bangladesh side and 30 farmers from each Upazilla (30%) were approached personally. A total of 240 farmers was the sample size of the study. Problems were identified and assessed with the following categories; i) overall problems involved in IFS, ii) component-wise (crop production, dairy, fisheries, goat, poultry, mushroom, bee-keeping, and horticulture) problems analysis.

In addition, problems were also rated by 20 expert members (scientists, extension experts, academicians, market specialists) from each side (Punjab and Rangpur division) and finally ranked based on the PFI scores.

Research instruments and data collection

A research instrument (interview schedule) was prepared as per the study's objectives to collect the data from the respondents. The interview schedule was pre-tested with 15 farmers from Punjab and 15 farmers from Bangladesh in non-sample areas. The research instrument was modified to remove existing discrepancies and make it more understandable by the respondents based on the information gathered. Expert consultation was also made with academicians, extensionists and scientific personnel for the finalization of the interview schedule. The data were collected personally by the researchers by visiting the study area (both Punjab and Bangladesh) and face to face interviews with the respondents. Besides personal interviews, two focus group discussions (FGDs) were conducted together with farmers and experts' members. Each FGD consists of 10 IFS farmers and 10 expert members from research and extension departments to identify the problems regarding integrated farming systems. In this current study, 1 (one) FGD was conducted in the Bangladesh part and 1 (one) FGD in the Punjab part.

Data Analysis

Data analysis Microsoft excels and SPSS-26 were used to analyze the data. Simple descriptive analysis was used to find out the frequency, percentage (%) and average values of different demographic characteristics of the farmers in the study areas.

Problem facing index

Problem analysis was done by computing a score of the Problem Facing Index (PFI). The score was computed in the category of overall problems existing and particular component-based problems in integrated farming systems on a 4-point rating scale (3, 2, 1, and 0 for high, medium, low, and not at all, respectively) for selected items. The problem statements under each component were selected through the item analysis process. For example, the overall constraints score was computed for each problem by adding scores from all respondents. The possible range of problems facing index for each problem could be 0 to 360, where 0 indicated no problem facing and 360 indicated the highest problem facing. Then, based on the PFI score, problems were ranked. The component-wise problems were also computed similarly and ranked thereafter. A problem facing index (PFI) was computed by using the following formula (Uddin et al., 2015; Pervez et al. 2015):

$$PFI = (Ch \times 3) + (Cm \times 3) + (Cl \times 2) + (Cn \times 0)$$

Where;

Ch= Number of responses indicating severity high;
Cm= Number of responses indicating severity medium;
Cl= Number of responses indicating severity low and
Cn= Number of responses indicating severity, not at all.

RESULTS AND DISCUSSION

Demographic characteristics of respondents

The farmers' demographic characteristics in this study are shown in Tables 1 and 2. Most of the farmers in both India and Bangladesh are middle-aged category. Among 120 participants in India, 48.33% had completed education up to the secondary level. Similarly, in Bangladesh, among the same participants, 46.67% had competed for a similar qualification. Most of the family size in Punjab was small (45%), whereas in Rangpur, middle-sized families are more common (76%). The nuclear family are common in both countries.

Social participation was 55% in Punjab and 66.67% in Rangpur. Extension contacts and mass media exposures are higher in India than in Bangladesh. In Punjab, farmers received more training than the farmers of Rangpur. The number of farmers who attained medium to the high category of training is 87, in comparison with Bangladesh, it is only 56. Farming experiences are more or less same in both countries. 82.5% of farmers received credit from different sources in Bangladesh whereas, the data is 80% for India.

Table 1. Demographic characteristics of the farmers.

Parameters	Categories	India (n=120)		Bangladesh (n=120)		Overall
		f	%	f	%	(n=240)
Age	up to 30 years)	34	28.33	40	33.33	74 (30.83)
	31-50 years	63	52.50	58	48.33	121 (50.42)
	above 50 years	23	19.17	22	18.33	45 (18.75)
Education	Illiterate	04	03.33	13	10.83	17 (7.08)
	Primary	30	25.00	23	19.17	53 (22.08)
	Secondary	58	48.33	56	46.67	114 (47.50)
	Graduate	17	15.17	25	20.83	42 (17.50)
	Post graduate	11	09.17	03	02.50	14 (5.83)
Family type	Nuclear	78	65.00	88	73.33	166 (69.17)
	Joint	42	35.00	32	26.67	74 (30.83)
Family size	Small (up to 4)	55	45.83	39	32.50	94 (39.17)
	Medium (5-8)	43	35.83	76	63.33	119 (49.58)
	Large (> 8)	22	18.33	05	05.17	27 (11.25)

Table 2. Other demographic characteristics of the farmers.

Social participation	Low (0-1)	17	15.17	23	19.17	40 (16.67)
	Medium (2-3)	66	55.00	80	66.67	146 (60.83)
	High (above 3)	37	30.83	17	15.17	54 (22.50)
Extension contacts	Low (0-9)	11	09.17	27	22.50	38 (15.83)
	Medium (10-18)	73	60.83	68	56.67	141 (58.75)
	High (19-28)	36	30.00	25	20.83	61 (25.42)
Mass media exposure	Low (0-6)	14	11.67	48	40.00	62 (25.83)
	Medium(7-12)	76	63.34	59	49.17	135 (56.25)
	High (>12)	30	25.00	13	10.83	43 (17.92)
Training experience	No training (0 days)	--	--	09	07.50	09 (3.75)
	Low training (up to 10 days)	33	27.50	55	45.83	88 (36.67)
	Medium training (11-30days)	60	50.00	38	31.67	98 (40.83)
	High training (above 30 days)	27	22.50	18	15.00	45 (18.75)
Farming experience	5-10 years	28	23.33	38	31.67	66 (27.50)
	11-15 years	35	29.17	34	28.33	69 (28.75)
	16-20 years	27	22.50	28	23.33	55 (22.92)
	Above 20 years	30	25.00	20	16.67	50 (20.83)
Credit received	Yes	96	80.00	102	85.00	198 (82.50)
	No	24	20.00	18	15.00	42 (17.50)

Overall problems related to IFS

The respondents' overall problems related to integrated farming systems were assessed, and the details are presented in Table 3. The farmers and expert members reported a total of fourteen fixed problems with varying degrees of severity. The most important problem said to have been faced by the farmers was lack of marketing of products from various components having the highest PFI (285) and also ranked 1st by the expert members in Punjab part that was ranked 3rd most serious problem by the farmers as well as the expert members from Bangladesh part. The problem is the lack of IFS model demonstrations ranked 2nd by the farmers (5th ranking by expert members) in the Punjab study location, which had 4th ranking by the farmers and the expert members on the Bangladesh side.

Besides, the high initial costs were rated 3rd by the farmers (2nd by the expert members) in Punjab study areas, which was ranked 2nd most important problem by the farmers and expert members from the Bangladesh part. But in the case of Bangladesh, the lack of coordinated extension services was ranked 1st both by the farmers and expert members which were rated 7th by the farmers (6th by the expert members) in the Punjab study areas. Pushpa (2010) found a maximum of 86.19 percent of respondents lacked coordinated extension services, followed by the lack of demonstration of integrated farming systems in Salem district of India. A study conducted by Uddin *et al.* (2016) had similar findings from Bangladesh part.

Table 3. Overall IFS problems along with problem facing index and rank order in both study areas.

No.	Problems	Punjab				Bangladesh			
		Farmers (n=120)		Experts (n=20)		Farmers (n=120)		Experts (n=20)	
		PFI	Rank	PFI	Rank	PFI	Rank	PFI	Rank
1.	Lack of marketing of products from different components	285	I	52	I	282	III	47	III
2.	High initial costs	279	III	50	II	288	II	48	II
3.	Shortage of labor and its high cost during peak season	215	VII	42	VII	208	IX	33	IX
4	Lack of infrastructure facilities	233	VI	47	IV	226	VIII	34	VIII
5	Non-availability of improved varieties of seed /breeds	180	XIII	36	X	175	XIV	25	XIV
6	Electricity supply problem for irrigation and farm purpose	185	XIV	27	XIV	230	VII	38	VII
7	Lack of inputs availability	190	XI	34	XI	175	XIII	26	XIII
8	Lack of skilled family labour	196	X	31	XII	174	XII	28	XII
9	Lack of co-ordinated extension servies	208	VII	44	VI	295	I	54	I
10	Lack of IFS models demonstration	282	II	46	V	274	IV	44	IV
11	Incidence of natural calamities	181	XII	28	XIII	206	X	31	X
12	Credit unavailability	208	IX	41	VIII	182	XI	30	XI
13	Lack of storing and processing facilities	264	IV	49	III	256	V	41	V
14	Lack of proper suggestions and guidelines	250	V	40	IX	250	VI	40	VI

Source: Field Survey, 2020-21; PFI: Problem Facing Index

Problems of crop production faced by farmers in integrated farming systems

Crop production is the main component of integrated farming systems. It involves a variety of activities, including choosing and implementing recommended technologies. The detailed problems faced by the farmers in crop production are presented in Table 4. A total of 11 problems were assessed by the IFS farmers and the expert members as well. The computed PFI of the 11 problems ranged from 187 to 296 in Punjab and 197 to 297 in Bangladesh part, respectively. The majority of the farmers mentioned that uncertain market prices were the most serious problem (PFI, 296) in Punjab survey areas (2nd ranking by the expert members) as well as in Bangladesh (PFI, 297) study location (3rd ranking by the expert members). Lack of input availability (PFI, 280) and lack of crop diversification (PFI, 270) was ranked as the second (10th

by expert members) and third (1st in experts' ranking) most important problems among the farmers in the study areas of Punjab.

Lack of mechanization and small & fragmented landholdings were remarkable problems assessed by the farmers of Bangladesh part having PFI 290 and 282, respectively and rank order of 2nd and 3rd. The expert members from Bangladesh ranked small & fragmented landholdings as the most severe problem followed by lack of mechanization.

Table 4. Problems related to crop production along with problem facing index and rank order.

No.	Problems	Punjab				Bangladesh			
		Farmers (n=120)		Experts (n=20)		Farmers (n=120)		Experts (n=20)	
		PFI	Rank	PFI	Rank	PFI	Rank	PFI	Rank
1.	Lack of inputs availability	280	II	31	X	228	VIII	37	VII
2.	Uncertain market price	296	I	49	II	297	I	50	III
3.	Lack of labor and its high cost	187	XI	34	IX	215	X	35	VIII
4	Non-availability of high yielding varieties	201	X	29	XI	197	XI	33	IX
5	Lack of crop insurances	232	VI	45	IV	252	VI	45	V
6	Inadequate storing facilities	222	VIII	44	V	265	V	46	IV
7	Soil fertility depletion	253	V	48	III	242	VII	31	X
8	Small and fragmented landholdings	211	IX	38	VIII	282	III	55	I
9	Poor extension services	227	VII	42	VI	272	IV	40	VI
10	Lack of mechanization	259	IV	39	VII	290	II	52	II
11	Lack of crop diversification	270	III	53	I	226	IX	30	XI

Source: Field Survey, 2020-21; PFI: Problem Facing Index

Problems related to the dairy component under integrated farming systems

Dairy production is one of the potential components of integrated farming systems. Farmers are facing various problems in dairy production. The detailed problems faced by the farmers of dairy products are presented in Table 5. A total of 12 problems were assessed by the IFS farmers (48) and the expert members (20) as well. The computed PFI of the 12 problems ranged from 66 to 123 in Punjab and 57 to 115 in Bangladesh part, respectively with the possible range of 0 to 144. High cost of concentrates (PFI, 123) ranked 1st by the farmers of Punjab location (3rd experts' ranking) and by the farmers as well as expert members from the Bangladesh part (PFI, 115). The farmers of the Punjab and Bangladesh study areas ranked fodder crisis as the second most severe problem which had 4th and 3rd rank order by the expert members from Punjab and Bangladesh survey areas, respectively. Quddus (2013) and Patidar (2012) also mentioned the fodder crisis in Bangladesh and India, respectively. Irregular and uncertain market prices are rated 3rd most serious problem by the farmers of the Punjab side (1st expert ranking) as well as Bangladesh farmers (2nd in expert ranking).

Problems of fisheries component involved under integrated farming systems

Fisheries are another important component of integrated farming systems. There are several problems associated with fisheries enterprise. The detailed problems faced by the farmers in fisheries production are described in Table 6. A total of 10 problems were assessed by the IFS farmers (40) and the expert members (20) as well. The computed PFI of the 10 problems ranged from 51 to 96 in Punjab and 60 to 98 in Bangladesh part, respectively with the possible range of 0 to 120. The highest PFI (96) was found for the problem of insufficient fingerlings stocks by the farmers of Punjab location (7th in expert ranking) which had the second-highest PFI (94) among the farmers of Bangladesh part (4th in expert ranking). Rahman (2012) identified a similar problem in Bangladesh. The high cost of feed was ranked 2nd by the Punjab farmers (3rd in expert ranking) that were rated 3rd major problem by the farmers and expert members from the Bangladesh study area. Kalra et al. (2013) reported the high feed price in India in previous research and Khairul Islam *et al.* (2020) identified previously the same problem in Bangladesh. Farmers and expert members from Bangladesh ranked the presence of middleman business in fish markets as 1st while 5th and 8th by farmers and expert members, respectively in Punjab.

Table 5. Problems related to the dairy component under IFS along with problem facing index and rank order.

No.	Problems	Punjab				Bangladesh			
		Farmers (n=48)		Experts (n=20)		Farmers (n=48)		Experts (n=20)	
		PFI	Rank	PFI	Rank	PFI	Rank	PFI	Rank
1.	Fodder crisis	117	II	46	IV	106	II	49	III
2.	Lack of adequate veterinary services	105	IV	33	X	97	IV	40	VI
3.	Frequent outbreaks of infectious diseases	94	VII	45	V	72	IX	36	VII
4.	High mortality rate	72	X	27	XII	66	X	30	X
5.	Irregular and uncertain market prices	114	III	54	I	100	III	52	II
6.	Lack of technologies and insurance	96	VI	53	II	85	VII	35	VIII
7.	High marketing and transportation costs	102	V	43	VI	75	VIII	33	IX
8.	High cost of concentrates	123	I	48	III	115	I	53	I
9.	Limited artificial insemination facilities	66	XII	31	XI	93	V	42	V
10.	Problems with mineral mix application	83	VIII	39	VII	90	VI	46	IV
11.	Dewarming problem	80	IX	34	IX	59	XI	28	XI
12.	Irregular conception	71	XI	36	VIII	57	XII	26	XII

Source: Field Survey, 2020-21; PFI: Problem Facing Index

Table 6. Problems related to fisheries component under IFS along with problem facing index and rank order.

No.	Problems	Punjab				Bangladesh			
		Farmers (n=40)		Experts (n=20)		Farmers (n=40)		Experts (n=20)	
		PFI	Rank	PFI	Rank	PFI	Rank	PFI	Rank
1.	Lack of sufficient extension activities such as fairs, demonstration	64	VIII	30	X	71	VII	38	VI
2.	Lack of suitable policies governmental policies for the fishery sector	62	IX	40	VI	61	VIII	41	V
3.	High cost of fish feed	90	II	47	III	89	III	48	III
4.	Lack of value addition	68	VII	50	II	62	IX	35	VII
5.	Lack of financial assistance	80	IV	52	I	85	IV	51	II
6.	Lack of contact farming	72	VI	44	IV	76	V	33	VIII
7.	Middleman business in fish markets	78	V	35	VIII	98	I	55	I
8.	Lack of scientific knowledge and skills on fish farm management	86	III	34	IX	75	VI	30	IX
9.	Insufficient fingerlings stocks	96	I	37	VII	94	II	45	IV
10.	Shortage of water supply	51	X	41	V	60	X	28	X

Source: Field Survey, 2020-21; PFI: Problem Facing Index.

Problems of goatary component under integrated farming systems

Goatary is also an important component of integrated farming systems contributing to income generation through milk and meat production. The detailed problems faced by the farmers in goatary component are described in Table 7. A total of 7 (seven) problems were assessed by the IFS farmers (24) and the expert members (20). The computed PFI of the 7 problems ranged from 32 to 55 in Punjab and 35 to 58 in Bangladesh part, respectively with the possible range of 0 to 72.

Table 7. Problems of goatary component under IFS along with problem facing index and rank order.

No.	Problems	Punjab				Bangladesh			
		Farmers (n=24)		Experts (n=20)		Farmers (n=24)		Experts (n=20)	
		PFI	Rank	PFI	Rank	PFI	Rank	PFI	Rank
1.	Lack of genetic potential breeds	46	III	46	III	52	II	51	II
2.	Lack of scientific feeding practices	40	IV	50	II	42	IV	47	III
3.	Limited commercial markets	52	II	45	IV	37	VI	43	IV
4.	High incidence of diseases like PPR, Haemoncosis	55	I	55	I	58	I	53	I
5.	Poor attention from the research and extension side	31	VII	38	VI	44	III	41	VI
6.	Care and management problems	32	VI	35	VII	35	VII	39	VII
7.	Lack of farmers training	38	V	40	V	39	V	44	V

Source: Field Survey, 2020-21; PFI: Problem Facing Index

The highest PFI 55 and 58 was found for the problem of the high incidence of diseases among the farmers of both study areas which had 1st rank order also by the expert membres from both locations. Limited commercial markets ranked 2nd (4th in expert ranking) by the farmers in Punjab part which was ranked 6th by the farmers in Bangladesh side (4th in expert ranking). Lack of genetic potential breeds ranked 2nd severe problem in Bangladesh both by the farmers and expert members, that was rated 3rd serious problem by the farmers and expert members in Punjab survey areas. Poor attention from research and extension was also another significant problem in Bangladesh part.

Problems related to poultry farming under integrated farming systems

The details problems analysis is recorded in Table 8 involved in poultry farming under IFS. A total of 10 problems were assessed by the IFS farmers (18) and the expert members (20) as well. The computed PFI of the 10 problems ranged from 18 to 46 in Punjab and 18 to 41 in Bangladesh part, respectively with the possible range of 0 to 54. The high rate and inferior quality of poultry feed (PFI, 46) ranked 1st by the farmers of Punjab location (3rd experts' ranking) and by the farmers as well as expert members from the Bangladesh part (PFI, 115). Chatterjee & Rajkumar (2015) identified similar problem in India. Lack of credit facilities had the second-highest PFI (44) among the farmers of Punjab (4th expert rank order) and was rated 3rd most severe problem by farmers and expert members from Bangladesh. High establishment costs ranked 1st by the expert members of the Punjab study area, which was rated 2nd severe problem in Bangladesh.

Problems of mushroom and bee-keeping enterprises under integrated farming systems

Table 9 represented detailed problems analysis records related to mushroom and bee-keeping under IFS. A total of 6 (six) problems were assessed by the IFS farmers (16) and the expert members (20) as well. The computed PFI of the problems ranged from 30 to 42 in Punjab and 26 to 45 in Bangladesh part, respectively with the possible range of 0 to 48. Lack of storing facilities (PFI, 42) ranked 1st by the farmers and expert members of Punjab location, which was rated 3rd most serious problem by the farmers from the Bangladesh part (2nd in expert ranking). Lack of training had the second-highest PFI 39 among the farmers and rated 3rd most severe problem by the expert members of both the

locations. Limited wholesale markets ranked 1st severe problem by the farmers and expert members from Bangladesh part that was rated 3rd most important problem by the Punjab farmers (2nd in expert ranking).

Table 8. Problems related to poultry component under IFS along with problem facing index and rank order.

No.	Problems	Punjab				Bangladesh			
		Farmers (n=18)		Experts (n=20)		Farmers (n=18)		Experts (n=20)	
		PFI	Rank	PFI	Rank	PFI	Rank	PFI	Rank
1.	High rate and inferior quality of poultry feed	46	I	50	III	41	I	52	I
2.	Lack of credit facilities	44	II	48	IV	33	III	47	III
3.	High establishment costs	25	VII	56	I	30	IV	50	II
4.	Lack of technical assistance	24	IX	47	V	26	VI	28	X
5.	High incidence of diseases and high mortality rate	24	VIII	45	VI	38	II	34	VIII
6.	Selling of eggs and meat	41	III	40	VIII	28	V	35	VII
7.	Deficiency of improved breeds	37	IV	42	VII	24	VII	46	IV
8.	Insufficient expert services	35	V	36	IX	19	IX	38	VI
9.	High medication and vaccination costs	26	VI	53	II	21	VIII	41	V
10.	Backyard poultry	18	X	33	X	18	X	31	IX

Source: Field Survey, 2020-21; PFI: Problem Facing Index

Table 9. Problems of mushroom and bee-keeping enterprises under IFS along with problem facing index and rank order.

No.	Problems	Punjab				Bangladesh			
		Farmers (n=16)		Experts (n=20)		Farmers (n=16)		Experts (n=20)	
		PFI	Rank	PFI	Rank	PFI	Rank	PFI	Rank
1.	Lack of training	39	II	46	III	39	II	47	III
2.	Lack of storing facilities	42	I	54	I	37	III	53	II
3.	Limited wholesale markets	37	III	52	II	45	I	56	I
4.	Limited advertisement	30	VI	37	VI	26	VI	40	V
5.	Capital crisis	34	IV	41	IV	34	IV	43	IV
6.	Lack of technical knowledge and skills	33	V	40	V	28	V	38	VI

Source: Field Survey, 2020-21; PFI: Problem Facing Index

Problems with horticulture faced by farmers in integrated farming systems

Table 10 represents detailed problems analysis records related to horticulture under IFS. A total of 6 (six) problems were assessed by the IFS farmers (30) and the expert members (20) in both locations. The computed PFI of the problems ranged from 52 to 78 in Punjab and 51 to 80 in Bangladesh part, respectively, with the possible range of 0 to 90. High start-up costs (PFI, 78) ranked 1st by the farmers (2nd in expert ranking) of Punjab location, which was rated the most serious problem (1st rank order) by the farmers and expert members from the Bangladesh part. Poor marketing infrastructure had the second-highest PFI 73 and 68 among the farmers of Punjab and Bangladesh locations, respectively (4th & 3rd in expert ranking). The lack of agro-processing industries rated 3rd and 2nd most severe problem by the farmers of Punjab and Bangladesh study areas, respectively (1st & 3rd in expert ranking). Quddus (2009) and Kachru (2010) identified the lack of agro-industry in Bangladesh and India, respectively. Lack of skilled labour, storing facilities, and high disease-pest attacks were also identified as significant horticulture problems.

Table 10. Problems of horticulture component under IFS along with problem facing index and rank order.

No.	Problems	Punjab				Bangladesh			
		Farmers (n=30)		Experts (n=20)		Farmers (n=30)		Experts (n=20)	
		PFI	Rank	PFI	Rank	PFI	Rank	PFI	Rank
1.	High start-up costs	78	I	51	II	80	I	52	I
2.	Lack of skilled labour	52	VI	46	III	51	V	36	VI
3.	High incidence of diseases and insect-pest attacks	55	V	35	VI	55	VI	38	V
4.	Lack of storing facilities	61	IV	40	V	61	III	43	IV
5.	Poor marketing infrastructure	73	II	42	IV	68	II	47	III
6.	Lack of agro-processing industries	68	III	55	I	59	IV	48	II

Source: Field Survey, 2020-21; PFI: Problem Facing Index

CONCLUSION AND RECOMMENDATIONS

According to the findings, a significant percentage of farmers ranked lack of marketing, lack of IFS model demonstrations, and high initial costs as some of the most critical problems the farmers face in Punjab. Most of the expert members from Punjab rated lack of crop diversification, lack of financial assistance, irregular and uncertain market prices, high establishment costs, lack of storing/agro-processing industries as severe problems in practising integrated farming systems. In contrast, lack of coordinated extension services, high initial costs, lack of marketing, lack of farm mechanizations, small and fragmented landholdings, lack of processing industries, credit unavailability, lack of cooperative systems are the significant constraints of IFS identified by the farmers and expert members in Bangladesh location.

Crop diversification, IFS model demonstration, financial support, increasing export facilities are highly recommended in the Punjab part. Farm mechanization, synchronized cultivation (due to small landholding), providing technical knowledge, coordinated extension services are crucial needs in Bangladesh side. Providing farmers training on IFS activities, strengthening proper marketing channels and cooperative systems, simplifying credit facilities and establishing agro-processing industries are thoroughly recommended for both the countries. The present study was conducted purposively in selected two districts (two blocks/sub-districts from each district) in Punjab and Bangladesh part as well. Therefore, more similar studies could be undertaken in other districts for better understanding and clarification of findings. Due to time and resources constraints, the study comprised only 120 farmers and 20 expert members from each side, being a small sample size. Further similar studies could be conducted with a large sample size.

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