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PRESENT STATUS OF INTEGRATED FARMING SYSTEM IN PATIALA

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ABSTRACT

The Integrated Farming System (IFS) is a holistic approach that combines various agricultural components like crop cultivation, livestock farming, aquaculture, and horticulture to enhance productivity, sustainability, and income. In Patiala District, IFS adoption is gaining traction, with farmers integrating diverse practices to improve farm efficiency, environmental sustainability, and economic viability. Accordingly, a study was conducted in Patiala district of Punjab state to check the status of Integrated Farming System under the All India Coordinated Research Project on Integrated Farming System. The findings of the study indicated that Among IFS adopters, all engage in crop cultivation, with 33.33 per cent integrating dairy farming and smaller percentages adopting combinations like fisheries (1.67%), mushroom (8.33%), goat farming (16.67%), poultry (8.33%), horticulture (8.33%), and vermicomposting (5.00%). Diversified systems like poultry-fisheries and mushroom-beekeeping are also practiced (8.33% each). Non-adopters focus solely on crop cultivation, with only 20% integrating dairy farming. among IFS adopters, 90% practice the Paddy-Wheat system, with 55% using Green manure–Paddy-Wheat and smaller proportions adopting systems like Green manure–Basmati-Wheat (16.67%), Moong-Basmati/Paddy-Vegetables (6.67%), and diversified combinations. Non-adopters primarily focus on Paddy-Wheat (95%), with limited adoption of alternatives like Green manure–Paddy-Wheat (5%) and Berseem-Bajra (25%). Crop preferences shows Paddy and Wheat as dominant crops for both IFS adopters and non-adopters. Adopters diversify with crops like Maize, Bajra, Pulses, vegetables, and fruits, while non-adopters focus more on traditional crops with limited diversification. There is a significant difference at the 5% level ($p < 0.05$), highlighting greater adoption or presence of specific crops, systems, or animals among IFS adopters, while non-significant values suggest minimal or no difference between the groups.

Keywords: *integrated farming system, productivity, status, diversification*

INTRODUCTION

India, covering just 2.4 percent of the world's land area, is home to over 17 percent of the global population. Despite its relatively small landmass, agriculture remains the backbone of the rural economy, with small and marginal farmers constituting 82 percent of the farming community but controlling only 44 percent of the total operational land (GOI, 2018). In 2021-22, about 55 percent of India's workforce was employed in agriculture and related sectors, contributing 18.8 percent to the nation's Gross Value Added (GVA) (Anonymous, 2022).

The specific components of Integrated Farming Systems (IFS) can vary considerably depending on factors such as agro-climatic zones, land characteristics, farmers' socioeconomic conditions, and prevailing market trends (Paramesh *et al.,* 2022). Despite this variability, IFS holds considerable promise for improving both global food supply and farmers' livelihoods (Saikanth *et al.,* 2023).

This highlights the pressing need to adopt innovative farming approaches like IFS to enhance employment opportunities, boost agricultural yields, and stabilize incomes in rural communities (Vinaya and Chauhan, 2018). IFS contributes to these goals through crop diversification, improved soil health, and strengthened resilience to climate variability (Mishra *et al.,* 2022). Unlike conventional monocropping—which often depletes biodiversity, degrades soil, and weakens ecosystems—IFS supports sustainable agriculture (Panklang *et al.,* 2022). By combining practices such as crop production, livestock rearing, agroforestry, and aquaculture, IFS ensures better use of resources and adapts well to challenging environments like waterlogged areas (Uddin *et al.,* 2016).

Farmers adopting IFS not only tackle economic and ecological challenges but also gain access to essential

by-products like fuel, manure, and fodder, thereby raising overall productivity (Islam *et al.,* 2015). IFS stands out as a comprehensive, modern solution that strengthens farm sustainability, improves food security, increases income stability, and boosts adaptability (Paramesh *et al.,* 2022).

By coordinating diverse activities—such as crops, trees, animals, and fish—on the same piece of land, IFS integrates time and space efficiently. This leads to higher productivity, minimized environmental footprint, and effective resource recycling (Kumar *et al.,* 2018). Remarkably, IFS can increase output significantly—up to tenfold in some cases—while supporting domestic needs and export demands for resources like bioenergy, fertilizers, and animal feed (Maji and Ghosh, 2021). In essence, integrated farming serves as a cornerstone for advancing sustainable agriculture, boosting rural livelihoods, and promoting ecological responsibility.

The country's agricultural landscape is undergoing a transformation, especially in Punjab, as it strives for sustainability, profitability, and environmental conservation. One of the most promising solutions emerging is Integrated Farming Systems (IFS), which addresses key challenges like declining soil fertility, reduced farm incomes, and environmental degradation. (Nababan F E and Regina D, 2021)

In Patiala district, known for its dominance of conventional monocropping systems Remarkably, 100per cent of its cultivated area is irrigated, predominantly by tubewells, though submersible pumps are increasingly used due to groundwater depletion. Paddy and wheat dominate cropping, with Patiala achieving the second-highest wheat yield in Punjab. Problems of groundwater depletion, reduced biodiversity, and economic instability for smallholder farmers are becoming increasingly evident (Singh *et al.,* 2020). The adoption of IFS offers a potential solution by diversifying farming activities and improving income streams. However, despite its proven benefits, the uptake of IFS in the region remains limited. Therefore, understanding its current status, the patterns of adoption, and the barriers to its expansion current study aims to explore the extent of IFS adoption in Patiala district, examining the common practices, cropping pattern their economic impact, and their contribution to environmental sustainability.

OBJECTIVE

To study the status of integrated farming system in Patiala district of Punjab under All India Co-ordinated Research Project

METHODOLOGY

The study was conducted in the Patiala district of Punjab, India, chosen due to ongoing Integrated Farming System (IFS) projects by School of Organic Farming, Punjab Agricultural University (PAU), Ludhiana and a sufficient number of respondents were available for data collection. The All India Coordinated Research Project on IFS is operational in this district. The research focused on three adopted villages—Mardanpur, Kamalpur, and Gadapur of Block Ghanaur, along with a randomly selected non-adopted village, Kabulpur, from the same block. A total of 400 farmers participated in the study, including 300 beneficiaries of the IFS project and 100 randomly selected respondents from the non-adopted village. Data were collected through personal interviews using a semi-structured questionnaire. Additionally, five progressive farmers from the adopted villages were purposively selected for detailed case studies. Researchers conducted face-to-face interviews during visits to the study area to ensure comprehensive data collection.

RESULTS AND DISCUSSION

Table 1 highlights the demographic and socio-economic characteristics of adopters and non-adopters of Integrated Farming Systems (IFS) reveal key differences and similarities. Age, an important factor influencing farming practices. Most adopters (48.33%) and non-adopters (58.00%) fell within the 36–49 age group. The younger group (22–35 years) accounted for 24.33 per cent of adopters and 24.00 per cent of non-adopters, while the older group (50–63 years) included 27.34 per cent of adopters and 18.00 per cent of non-adopters.

Educational attainment showed notable differences. Among adopters, 42% had completed secondary education, followed by 26.34 per cent with higher secondary education. Approximately 13.33 per cent had primary education, 10 per cent were graduates, and 3.33 per cent postgraduates, with only 5 per cent being illiterate. In contrast, non-adopters also showed the highest proportion (52%) in secondary education but had a higher percentage (26%) with primary education. The higher secondary group accounted for 11%, while graduates and postgraduates were 4 per cent and 3 per cent respectively. Khalid *et al* (2017) IFS farmers had completed primary or secondary education, aligning with the study's findings.

Family size and structure were also analyzed. Among adopters, 45% belonged to small families (3–4 members), 32.67 per cent to medium-sized families (5–6 members), and 22.33 per cent to large families (7–8 members). Non-adopters showed similar trends, with 46 per cent in small families, 37 per cent in medium-sized families, and 17 per cent in large families. Data are in line with Nageswaran *et al* (2009) most IFS farmers had marginal landholdings (less than 2.5 acres), supporting the data on small-scale farmers adopting IFS.

Table 1: Distribution of respondents according to their socio-personal characteristics (n=400)

Sr. No.	Parameters	Categories	IFS adopter (n=300)		Non adopters (n=100)	
			f	%	f	%
1	Age	(22-35 years)	73	24.33	24	24.00
		(36-49 years)	145	48.33	58	58.00
		(50-63years)	82	27.34	18	18.00
2	Education	Illiterate	15	05.00	04	04.00
		Primary	40	13.33	26	26.00
		Secondary	126	42.00	52	52.00
		Higher secondary	79	26.34	11	11.00
		Graduate	30	10.00	04	04.00
		Post graduate	10	03.33	03	03.00
3	Family size	Small (3-4)	135	45.00	46	46.00
		Medium (5-6)	98	32.67	37	37.00
		Large (7-8)	67	22.33	17	17.00
4	Land holding	Marginal (up to 1.0 hac)	168	56.00	28	28.00
		Small (1.0-2.0 hac)	85	28.34	36	36.00
		Semi-medium (2.0-4.0 hac)	43	14.33	12	12.00
		Medium (4.0-10.0 hac)	03	01.00	17	17.00
		Large (> 10 hac)	01	0.33	07	07.00
5	Annual income	Low (₹ 1-4 lakh)	113	37.67	54	54.00
		Medium (₹5-8 lakh)	127	42.33	29	29.00
		High (Above ₹ 8 lakh)	60	20.00	17	17.00
6	Daily time use in agricultural activities	2-4 hrs. /day	38	12.67	03	03.00
		4-6 hrs. /day	31	10.33	10	10.00
		6-8 hrs. /day	49	16.33	35	35.00
		> 8 hrs. /day	182	60.67	52	52.00
7	Family labour force	Low (2-3)	135	45.00	56	56.00
		Medium (4-5)	89	29.67	32	32.00
		High (5-6)	76	25.33	12	12.00

Farm size distribution varied significantly. Among adopters, the majority (56%) operated marginal farms, followed by 28.34 per cent with small farms, 14.33 per cent with semi-medium farms, and only 1% and 0.33% with medium and large farms, respectively. Non-adopters, however, had a higher proportion (36%) in the small farm category, with 28 per cent in marginal farms. Medium-sized farms were more prevalent among non-adopters (17%), followed by 12 per cent in semi-medium farms and 7 per cent in large farms.

Income levels reflected a clear disparity. Most adopters (42.33%) belonged to the medium-income group (₹ 5–8 lakh annually), followed by 37.67 per cent in the low-income category (₹ 1–4 lakh) and 20 per cent in the high-income bracket (above ₹ 8 lakh). For non-adopters, 54 per cent fell into the low-income category, 29 per cent into medium-income, and 17 per cent into high-income groups.

Adopters showed greater time commitment to farming, with 60.67 per cent spending over 8 hours daily, compared to 52 per cent of non-adopters. Similarly, adopters had a higher proportion (45%) with low family labor (2–3 members), while non-adopters had 56 per cent in the same category. Medium and high family labor force proportions were relatively lower in both groups. The results are in line with the studies of Sudhanand et al. (2024); Madhuprasad et al. (2024); Prajapati et al. (2022).

Models of Integrated farming systems adopted by respondents

The table 2 presents the components of Integrated Farming Systems (IFS) adopted by both IFS adopters and non-adopters. For IFS adopters, all individuals (100%) are engaged in crop cultivation. Among them, 33.33 per cent (100 individuals) have integrated Dairy farming with Crop cultivation, while smaller percentages are involved in other combinations such as Crop cultivation + Fisheries (1.67%), Crop cultivation + mushroom (8.33%), Crop cultivation + Goat farming (16.67%), and Crop cultivation + Poultry (8.33%). Additionally, Crop cultivation + Horticultural crops

Table 2: Components of integrated farming systems adopted by respondents (n=400)

Sr. No.	Components	IFS Adopter (n=300)		Non adopter (n=100)		z-value
		f	%	f	%	
1	**Agriculture (crops) + Dairy**	100	33.33	20	20.00	2.51*
2	**Agriculture (crops) + Fishries**	05	1.67	-	-	1.29
3	**Agriculture (crops) + Mushroom**	25	8.33	-	-	2.99*
4	**Agriculture (crops) + Goatry**	50	16.67	-	-	4.36*
5	**Agriculture (crops) + Poultry**	25	8.33	-	-	2.98*
6	**Agriculture(crops) + Horticultural crop (Fruit)**	25	8.33	-	-	2.98*
7	**Agriculture(crops) + vermicomposting**	15	5.00	-	-	2.27*
8	**Agriculture (crops) + Poultry + Fishries**	25	8.33	-	-	2.98*

*Significant at 0.05 level

(fruits) is practiced by 8.33 per cent. Among them, 5.00 per cent have integrated vermicomposting with Crop cultivation. There are 8.33 per cent of respondents are engaged in more diversified systems such as Crop cultivation + Poultry + Fisheries and Crop cultivation + Mushroom + Beekeeping (8.33%). On the other hand, non-adopters primarily focus on crop cultivation, with 100 per cent of them practicing it. The adoption of other components is relatively low, with 20.00 per cent integrating Dairy farming with crop cultivation, and no other combinations such as Fisheries, Mushroom farming, or Agroforestry were observed among non-adopters. A z-value indicates a significant difference at the 5% level, showing higher adoption of specific IFS components like Dairy, Mushroom, and Goatry among adopters, while non-significant values reflect minimal group differences. Singh (2017) highlighted those farmers in Punjab, awarded by PAU, practiced various IFS models, including crop + dairy, crop + floriculture, crop + fruits, crop + poultry, crops + vegetables, and crops + beekeeping.

Cropping inventory

Table 3: Cropping system under integrated farming systems adopted by respondents (n=400)

Sr. No.	Cropping system	IFS adopter (n=300)		Non adopter (n=100)		z-value
		f**	%	f**	%	
1	**Paddy-Wheat**	270	90.00	95	95.00	1.53
2	**Green manure – Paddy-Wheat**	165	55.00	05	05.00	8.75*
3	**Green manure – Basmati-Wheat**	50	16.67	30	30.00	2.88*
4	**Moong-Basmati/Paddy-Vegetables**	20	06.67	10	10.00	1.06
5	**Maize (F)-Bajra(F)-Maize(cobs+F)-Raya/Gobhi sarson**	50	16.67	-	-	4.36*
6	**Summer Moong-Basmati/Paddy-Gram**	20	10.00	-	-	2.64*
7	**Berseem-Bajra/ Napier Bajra**	30	03.33	25	25.00	3.77
8	**Turmeric-radish/radish-Cucurbits**	10	01.67	-	-	1.89
8	**Crops+ Horticultural crop (Fruit)**	05	06.67	-	-	1.29

*Significant at 0.05 level **Multiple response

Data presented in table 3 that among IFS adopters, the most common cropping system is Paddy-Wheat, practiced by 90.00 per cent (270 individuals). A notable number of adopters also use Green manure – Paddy-Wheat, with 55.00 per cent (165 individuals) adopting this practice. Other cropping systems in use by adopters include Green manure – Basmati-Wheat (16.67%), Moong-Basmati/Paddy-Vegetables (6.67%), and Maize (F)-Bajra(F)-Maize(cobs+F)-Raya/Gobhi sarson (16.67%). A smaller portion of adopters engage in diversified cropping combinations such as Moong-Basmati/Paddy-Gram (10.00%) and Berseem-Bajra/Napier Bajra (3.33%). More specialized cropping systems like Turmeric-Radish/Radish-Cucurbits (1.67%) and Crops + Horticultural crops (Fruit) (6.67%) are also practiced by some adopters.

For non-adopters, the primary cropping system is Paddy-Wheat, practiced by 95.00 per cent. The adoption of other cropping systems is limited, with 5.00 per cent practicing Green manure – Paddy-Wheat, and 30.00 per

cent engaging in Green manure – Basmati-Wheat. A few non-adopters also practice Moong-Basmati/Paddy-Gram (10.00%) and Berseem-Bajra/Napier Bajra (25.00%), but no non-adopters engage in more diverse or specialized systems like those seen among adopters. In summary, while both adopters and non-adopters commonly practice the Paddy-Wheat system. A z value indicates a significant difference at the 5% level, showing higher adoption of systems like Green manure–Paddy–Wheat and Maize–Bajra among IFS adopters, while others like Paddy–Wheat show no significant difference.

Table 4: Season wise major crops grown by respondents (n=400)

Sr. No.	Seasonal crops		IFS adopter (n=300)		Non adopter (n=100)		z-value
			f **	%	f **	%	
1	**Kharif season**						
	Paddy		287	95.67	100	100.00	2.11*
	Basmati		70	23.33	30	30.00	1.33
	Pulses		20	06.67	10	10.00	1.96
	Maize		38	12.67	-	-	3.74*
	Fodder Maize		42	14.00	-	-	3.95*
	Bajra/ Napier bajra		75	25.00	25	25.00	0.00
	Vegetables	Turmeric	07	02.33	-	-	1.54
		Cucurbits	10	03.33	-	-	1.84
	Fruits		05	01.67	-	-	1.29
2	**Rabi season**						
	Wheat		280	93.33	100	100.00	2.64*
	Maize		35	11.67	-	-	3.57*
	Berseem		40	13.33	27	27.00	3.16*
	Pulses		20	06.67	-	-	2.64*
	Vegetables (Radish)		20	06.67	10	10.00	1.09
	Oilseeds		32	10.67	25	25.00	3.55*
	Fruits		05	1.67	-	-	1.29

*Significant at 0.05 level**Multiple response

Data presented in Table 4 also revealed the percentage of Kharif season**,** Paddy is the most commonly grown crop among both groups, with 95.67 per cent of IFS adopters and 100.00 per cent of non-adopters cultivating it. Basmati is grown by 23.33 per cent (70 adopters) and 30.00 per cent (30 non-adopters). Other crops like Pulses are cultivated by 6.67 per cent (20 adopters) and 10.00 per cent (10 non-adopters). Maize and Fodder Maize are grown by 12.67 per cent (38 adopters) and 14.00 per cent (42 adopters), but are absent among non-adopters. Bajra/Napier Bajra is grown by 25.00 per cent (75 adopters) and 25.00 per cent (25 non-adopters). Some adopters also grow vegetable**s**, such as Turmeric (2.33%) and Cucurbits (3.33%), as well as fruits (1.67%).

In the Rabi season**,** Wheat is the dominant crop, grown by 93.33 per cent (280 adopters) and 100.00 per cent (100 non-adopters). Other crops include Maize (11.67% adopters), Berseem (13.33% adopters, 27% non-adopters), Pulses (6.67% adopters), Vegetables like Radish (6.67% adopters, 10% non-adopters), and Oilseeds (10.67% adopters, 25% non-adopters). Fruits are grown by 1.67 per cent (5 adopters) in the Rabi season, but not by any non-adopters. A z-value indicates a significant difference at the 5% level, showing that crops like Kharif Paddy, Maize, Fodder Maize, and Rabi Wheat, Maize, Berseem, Pulses, and Oilseeds are significantly more adopted by IFS adopters, while others like Basmati and Bajra show no significant difference.

The Cropping pattern deals with the crops grown by sampled households in an agricultural year. The major cropping patterns followed by the sampled farmers is shown in Table 5. The Table depicted that the sample includes IFS adopters with a gross cropped area of 1159.5 ha (average per farm area 3.87 ha) and 100 non-adopters with a gross cropped area of 310.6 ha (average per farm area 3.11 ha**).** For IFS adopters, Wheat is the most prominent crop, covering 435.2 ha (37.53%) with an average of 1.45 ha per farm. Paddy/Rice follows, occupying 322.4 ha (27.81%) with an average of 1.07 ha per farm. Basmati accounts for 11.26 per cent (130.6 ha), while Vegetables constitute 7.11 per cent (82.4 ha). Other significant crops include Maize (5.23%, 60.6 ha), Fodder (4.86%, 56.4 ha), Pulses (3.04%, 35.2 ha), and Oilseeds (1.40%, 16.2 ha). Additionally, Fruits make up 1.59 per cent (18.4 ha), and miscellaneous crops account for 0.18 per cent (2.1 ha). For non-adopters, Wheat is also the dominant

Table 5: Distribution of crops according to their area under major crops grown by respondents (n=400)

Sr. No	Crops	IFS adopter (n=300)		Share (%)	Non adopters(n=100)		Share (%)	z-value
		Total area (ha)	Per farm area (ha)		Total area (ha)	Per farm area (ha)		
1.	**Wheat**	435.2	1.45	37.53	140.0	1.40	45.07	1.15
2	**Paddy/Rice**	322.4	1.07	27.81	93.4	0.93	30.07	0.46
3	**Basmati**	130.6	0.44	11.26	33.2	0.33	10.69	0.23
4	**Vegetables**	82.4	0.27	7.11	16.4	0.16	5.28	0.59
5	**Maize**	60.6	0.20	5.23	0.00	0.00	0.00	2.26*
6	**Fodder**	56.4	0.19	4.86	12.6	0.13	4.06	0.34
8	**Pulses**	35.2	0.12	3.04	2.6	0.03	0.84	1.01
9	**Oilseed**	16.2	0.05	1.40	8.4	0.08	2.70	3.13*
13	**Fruits**	18.4	0.06	1.59	0.2	0.00	0.06	1.42
14	**Other crops**	2.1	0.01	0.18	3.8	0.04	1.22	1.00
Gross cropped area (ha)		**1159.5**	**3.87**	**100.00**	**310.6**	**3.11**	**100.00**	

*Significant at 0.05 level

crop, covering 140.0 ha (45.07%) with an average of 1.40 ha per farm. Paddy/Rice occupies 93.4 ha (30.07%), with an average of 0.93 ha per farm. Basmati represents 10.69 per cent (33.2 ha), while Vegetables cover 5.28 per cent (16.4 ha). Other crops include Fodder (4.06%, 12.6 ha), Oilseeds (2.70%, 8.4 ha), and Pulses (0.84%, 2.6 ha). Non-adopters allocate minimal land to Fruits (0.06%, 0.2 ha) and other crops (1.22%, 3.8 ha). A z-value indicates, maize (z = 2.26) and oilseed (z = 3.13) have significantly different cropped areas between the groups, reflecting distinct cultivation patterns. In contrast, crops like wheat, paddy, basmati, and vegetables show no significant differences, indicating similar area allocation. The z-test thus identifies crops with meaningful variations in cultivation between adopters and non-adopters.

Livestock inventory: average size of dairy, poultry, goatry of the sample farms

Table 6: Average size of dairy, poultry, goatry of the sample farms in both locations (n=400)

Sr. No.	Types of animals	IFS adopter		Non adopters		z-value
		Average number of animals	Share (%)	Average number of animals	Share (%)	
1	**Dairy**					
	Cows	04	40.00	03	50.00	1.42
	Buffaloes	06	60.00	03	50.00	1.42
2	**Poultry birds**	21	100	-	-	14.14*
3	**Goats**	07	100	-	-	14.14*

*Significant at 0.05 level

Table 6 represents the average size of livestock components per farm. There were two types of dairy farming in the dairy component in adopters viz. average Cows 4.00 and 5.00 Buffaloes per farms having 40 per cent and 60 per cent share respectively. In non-adopters, 3.00 average number of Cows and Buffaloes per farms having 50-50 per cent share respectively under Dairy farming. The average number of poultry birds in adopter was 21 per sample farm. The adopter's farmers had an average of 7.00 goats per sample farm whereas, non-adopters do not rear poultry birds and goats. A z-value indicate that poultry birds and goats have z-values of 14.14, indicating they are significantly more prevalent among IFS adopters. In contrast, dairy animals like cows and buffaloes show no significant difference, suggesting similar numbers between both groups.

Fisheries, mushroom, vermicomposting and bee-keeping inventory

Data regarding fisheries, mushrooms, and bee-keeping are furnished in Table 7. Fisheries account for an average of 0.50 acres, representing 12.50 per cent of the enterprises undertaken by IFS adopters. Mushroom cultivation is a significant enterprise, with an average of 400 square feet dedicated to it, making up 100 per cent of the mushroom-related activities among adopters. Vermicomposting is a significant enterprise, with an average of 4 bags dedicated to it, making up 100 per cent of the vermicomposting-related activities among adopters. Similarly, Bee-keeping is also a key activity, with 15 boxes on average per farm, contributing to 100 per cent of the bee-keeping operations within the IFS adopter group.

Table 7 : Average size of fisheries, mushroom and bee-keeping of the sample farms

Sr. No.	Types of enterprise (average size)	IFS adopter	
		Average	Share (%)
1	**Fisheries (Acre)**	0.50	12.50
2	**Mushroom (S. ft)**	400	100
3	**Vermicomposting (Bags)**	04	100
4	**Bee-keeping (Boxes)**	15	100

CONCLUSION

This comprehensive data provides a detailed comparison between adopters and non-adopters of Integrated Farming Systems (IFS) in Patiala district, highlighting significant insights into socio-economic characteristics, cropping patterns, and adoption models. Adopters diversify their farming systems significantly more than non-adopters, integrating livestock, fisheries, mushroom farming, and horticulture alongside traditional crop cultivation. Adoption of green manures and integrated practices by adopters highlights the potential for ecological balance and sustainability. The inclusion of livestock, fisheries, and vermicomposting among adopters' points to improved resource use efficiency. The limited adoption of IFS among non-adopters underscores the need for greater awareness, capacity-building programs, and policy support to promote its wider implementation. By addressing the barriers to adoption, IFS can play a pivotal role in ensuring the long-term resilience and profitability of agriculture in Punjab and beyond.

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CONFLICT OF INTEREST

All authors declare that they have no conflict of interest.

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