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Adoption Patterns of Integrated Farming System Components: A Study of Central India (Chhattisgarh and Madhya Pradesh)

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Abstract: ***Context**: Integrated Farming Systems (IFS) play a vital role in enhancing agricultural sustainability, income diversification, and livelihood resilience among small and marginal farmers in Central India. Despite their potential, the actual field-level adoption of recommended IFS components remains low across Chhattisgarh and Madhya Pradesh. **Objectives**: The study aimed to assess the extent of adoption of recommended IFS components under irrigated and rainfed farming situations in both states and to compare differences in adoption patterns across farmer categories. **Methodology**: A multistage random sampling technique was used to select 320 farmers from four districts. Adoption levels were measured as the percentage of recommended components followed by farmers. Descriptive statistics were used to summarize adoption patterns, and a Chi-square test was employed to determine state-wise differences in the number of components adopted. **Results and Discussion:** Adoption of IFS components was generally low, with mean adoption levels of 18.14 per cent (irrigated) and 18.57 per cent (rainfed) in Chhattisgarh, and 20.29 per cent (irrigated) and 18.98 per cent (rainfed) in Madhya Pradesh. Most farmers in both states practiced fewer than 4 components. The Chi-square test ($\chi^2 = 5.83$; $p = 0.054$) indicated no statistically significant difference between states in the number of IFS components adopted, though a slight tendency toward higher diversification in Madhya Pradesh was observed. **Significance**: The findings highlight substantial gaps in the field-level adoption of IFS models, underscoring the need for stronger extension efforts, improved market access, and enterprise-specific support. Enhancing these areas can promote wider adoption of IFS and contribute to more sustainable and diversified farming systems in Central India.*

Keywords: Integrated farming systems, adoption levels, small farmers, livelihood resilience, Central India

1. Introduction

Agriculture in India is predominantly smallholder-based, characterized by fragmented landholdings, erratic rainfall, unstable market prices, declining soil fertility, and limited access to institutional support. In this context, the Integrated Farming System (IFS) has emerged as a sustainable approach to improving farm productivity, profitability, and livelihood resilience. IFS encourages the integration of multiple enterprises such as crops, livestock, poultry, horticulture, fisheries, and vermicomposting to maximize resource-use efficiency and ensure year-round income and employment generation (Rai et al., 2018; Behera et al., 2012).

Central India, particularly the states of Chhattisgarh and Madhya Pradesh, represents an agrarian landscape dominated by rainfed farming, small and marginal farmer populations, and socio-economic vulnerability. Despite the region's potential for diversified farming, the adoption of IFS components varies widely. Prior research (Singh et al., 2017; Kumar et al., 2021) has shown that adoption levels are influenced by awareness, labour availability, risk perception, market access, and technological exposure. However, comparative assessments of IFS adoption across adjoining states with similar agro-ecological settings remain limited.

To fill this gap, the present study evaluates the extent of adoption of recommended IFS components in four districts: Rajnandgaon and Kawardha (Chhattisgarh), and Balaghat and Mandla (Madhya Pradesh). These districts represent typical mixed farming systems of Central India. The study gains further relevance due to the increased policy emphasis on integrated and climate-resilient agriculture under national programs such as RKVY, ATMA, NFSM, and KVKs.

Evidence suggests that IFS can enhance farm income by 30–50 per cent and generate 20–40 per cent more employment compared to traditional farming systems (Mandal et al., 2015; Channabasavanna et al., 2020). Recent studies in Central India have also highlighted the role of diversified IFS in employment generation (Rawat et al., 2025). However, actual field-level adoption remains relatively low due to socio-economic and infrastructural constraints.

The findings of the present investigation confirm this trend. Adoption of recommended IFS components averaged 18.14 per cent (irrigated) and 18.57 per cent (rainfed) in Chhattisgarh and 20.29 per cent (irrigated) and 18.98 per cent (rainfed) in Madhya Pradesh. Most farmers in both states adopted fewer than four components, indicating limited enterprise diversification.

Given this context, the study aims to quantify and compare adoption levels in Chhattisgarh and Madhya Pradesh and identify gaps to guide policymakers, planners, and extension systems.

Objective
To study the extent of adoption of Integrated Farming System (IFS) components practiced by farmers in Chhattisgarh and Madhya Pradesh.

2. Materials and Methods

Location of the Study Area
The study was conducted in Central India, covering two adjoining states—Chhattisgarh and Madhya Pradesh—selected purposively due to similarities in agro-ecological and socio-economic conditions. From Chhattisgarh, Rajnandgaon and Kawardha districts were selected, whereas Balaghat and Mandla districts were chosen from Madhya Pradesh. These districts fall under the agro-climatic zones of the Chhattisgarh plain and adjoining hill regions, characterized by mixed farming systems, tribal population, and dependence on rainfed agriculture.

Sampling Procedure

A multistage random sampling technique was adopted:
Selection of Districts
Four districts (two from each state) were selected purposively based on geographical contiguity and similar agro-ecological settings.

Selection of Blocks
Two blocks from each district were randomly selected, resulting in a total of eight blocks.

Selection of Villages
From each block, four villages were randomly selected, a total of 32 villages (16 from each state).

Selection of Respondents
From each village, 10 farmers practicing IFS were chosen randomly. Thus, the final sample comprised 320 respondents (160 from each state).

Measurement of the Extent of Adoption
Adoption was operationalized following Rogers' (1995) innovation-decision process. The extent of adoption was measured based on the percentage of recommended IFS components adopted by farmers under irrigated and rainfed conditions. Farmers were categorized as:

- Low adoption: Up to 4 components
- Medium adoption: 4 to 5 components
- High adoption: More than 5 components

Data Collection Method
Data were collected through personal interviews using a pre-tested structured interview schedule. Respondents were informed about the purpose of the study, rapport was established, and confidentiality was ensured to obtain accurate responses.

Statistical Analysis
To evaluate the stated hypothesis regarding differences in the adoption of Integrated Farming System (IFS) components between Chhattisgarh and Madhya Pradesh, appropriate statistical procedures were employed. Descriptive statistics (frequency and percentage) were used to summarize adoption levels across components and landholding categories. Since the distribution of respondents across the categories of number of components adopted (<4, 4–5, and >5 components) was categorical, a Chi-square test of independence (χ^2) was applied to determine whether adoption patterns differed significantly between the two states. The test was performed at 5% level of significance.

Hypothesis
H_0: *There is no significant difference between the extent of adoption of IFS practices among farmers of Chhattisgarh and Madhya Pradesh.*

3. Results

1.1 Extent of adoption of integrated farming system (IFSs) practices by the farmers.

The extent of adoption of Integrated Farming System (IFS) practices among farmers in Chhattisgarh and Madhya Pradesh was assessed based on the percentage of adoption of recommended components for each farmer category under irrigated and rainfed conditions. The recommended IFS models varied according to landholding size and farming situations. Adoption levels were computed by summarizing the percentage use of each component, and the findings are presented in Table 1.

In Chhattisgarh, under irrigated conditions, marginal farmers recorded the highest adoption for cereals/pulses/oilseeds + pulses (on bund) at 81.20 per cent, followed by vegetables (7.10%), cattle rearing (2.23%), poultry (1.90%), and goat farming (1.42%). Under rainfed conditions, the adoption of cereals/pulses/oilseeds + pulses (on bund) was 72.60%, with vegetables (4.50%), poultry (2.64%), cattle rearing (1.95%), and goat farming (1.76%) being the other major components adopted.

Among small farmers, adoption of cereals/pulses/oilseeds + pulses (on bund) under irrigated conditions was 80.50 per cent, followed by vegetables (21.50%), poultry (1.89%), cattle rearing (1.51%), and goat farming (0.98%). Under rainfed conditions, cereals/pulses/oilseeds + pulses (on bund) accounted for 75.46 per cent, followed by vegetables (10.46%), poultry (1.90%), cattle rearing (1.65%), and goat farming (1.26%).

Table 1: Adoption of integrated farming systems (IFSs) practices in Chhattisgarh and Madhya Pradesh states, (N = 320)

Sl. No.	Categories/ Landholding Size	Components	CG (n = 160)				MP (n = 160)			
			Irrigated situation (n= 104)		Rainfed situation (n= 56)		Irrigated situation (n= 130)		Rainfed situation (n= 30)	
			R	A	R	A	R	A	R	A
1	Marginal farmer (< 1.00 ha)	Cereals/Pulse/Oilseed + Pulse (on bund)	100	81.2	100	72.6	100	86.83	100	79.7
		Cattle rearing	2	2.23	2	1.95	2	2.78	1.9	2.3
		Vegetable	100	7.1	100	4.5	100	10	100	8
		Poultry	20	1.9	30	2.64	20	1.7	20	1.9
		Goatry	20	1.42	20	1.76	20	1.75	20	2.43
		Vermicompost	2	-	2	-	2	-	2	-
2	Small farmer (1.00 to 2.00 ha)	Cereals/Pulse/Oilseed + Pulse (on bund)	100	80.5	100	75.46	100	80.54	100	72.2
		Cattle rearing	2	1.51	2	1.65	2	1.53	2	1.98
		Vegetable	100	21.5	100	10.46	100	27.54	100	10.23
		Poultry	20	1.89	30	1.9	20	1.23	30	1.57
		Goatry	15	0.98	15	1.26	15	1.08	15	1.86
		Fishery/duck	20	-	20	-	20	-	20	-
		Vermicompost	4	-	4	-	4	0.37	4	0.18
3	Medium farmer (2.01 to 4.00 ha)	Cereals/Pulse/Oilseed + Pulse (on bund)	100	82.69	100	85.95	100	83.5	100	81.25
		Cattle rearing	2	3.15	2	2.85	2	3.37	2	3.17
		Vegetable	100	20.25	100	2.5	100	60	100	35
		Poultry	20	1.18	30	0.56	20	0.15	30	0.4
		Goatry	15	0.72	10	0.18	15	2.46	10	0.82
		Fishery/duck	20	0.07	20	-	20	0.1	20	-
		Vermicompost	6	0.11	6	-	6	0.21	6	-
4	Big farmer (> 4.00 ha)	Cereals/Pulse/Oilseed + Pulse (on bund)	100	-	100	60	100	-	100	-
		Cattle rearing	30	-	30	3	30	-	30	-
		Vegetable	100	-	100	-	100	-	100	-
		Poultry	40	-	40	5	40	-	40	-
		Goatry	30	-	30	-	30	-	30	-
		Fishery/Duck	30	-	20	-	20	-	20	-
		Vermicompost	8	-	8	-	8	-	8	-
Average			-	18.14	-	18.57	-	20.29	-	18.98

*R= Recommended, A= Adoption

For medium farmers, irrigated conditions showed adoption of cereals/pulses/oilseeds + pulses (on bund) at 82.69 per cent, vegetables (20.25%), cattle rearing (3.15%), poultry (1.18%), goat farming (0.72%), vermicomposting (0.11%), and fishery/duck (0.07%). In rainfed conditions, cereals/pulses/oilseeds/oilseeds + pulses (on bund) were adopted at 85.95%, followed by cattle rearing (2.85%), vegetables (2.50%), poultry (0.56%), and goat farming (0.18%). No large farmers were recorded under irrigated farming conditions, while in rainfed conditions, cereals/pulses/oilseeds + pulses (on bund) accounted for 60.00 per cent, followed by poultry (5.00%) and cattle rearing (3.00%).

In Madhya Pradesh, under irrigated conditions, marginal farmers reported an adoption level of 86.83 per cent for cereals/pulses/oilseeds + pulses (on bund), followed by vegetables (10.00%), cattle rearing (2.78%), goat farming (1.75%), and poultry (1.70%). Under rainfed conditions, the same component was adopted at 79.70%, along with vegetables (8.00%), goat farming (2.43%), cattle rearing (2.30%), and poultry (1.90%).

Among small farmers, adoption of cereals/pulses/oilseeds + pulses (on bund) under irrigated conditions was 80.54 per cent, followed by vegetables (27.54%), cattle rearing (1.53%), poultry (1.23%), goat farming (1.08%), and vermicomposting (0.37%). Under rainfed conditions, cereals/pulses/oilseeds + pulses (on bund) were adopted at 72.20 per cent, with vegetables (10.23%), cattle rearing (1.98%), goat farming (1.86%), and poultry (1.57%).

For medium farmers, irrigated conditions showed adoption of cereals/pulses/oilseeds + pulses (on bund) at 83.50 per cent, vegetables (60.00%), cattle rearing (3.37%), goat farming (2.46%), vermicomposting (0.21%), poultry (0.15%), and fishery/duck (0.10%). Under rainfed conditions, the adoption of cereals/pulses/oilseeds + pulses (on bund) was 81.25%, followed by vegetables (35.00%), cattle rearing (3.17%), goat farming (0.82%), and poultry (0.40%). No large farmers were reported under either farming situation.

The average adoption of recommended IFS components in Chhattisgarh was 18.14 per cent under irrigated conditions and 18.57 per cent under rainfed conditions. In Madhya Pradesh, the average adoption was slightly higher at 20.29 per cent under irrigated and 18.98 per cent under rainfed conditions. These findings indicate that the adoption of IFS components in Chhattisgarh is marginally lower compared to Madhya Pradesh. Possible reasons include limited awareness, labour shortages during peak seasons, market fluctuations for perishable commodities such as vegetables, and the high

initial investment required for enterprises like dairy, poultry, and goat farming.

Overall, the average adoption of IFS models across most farming situations in both states remained below 20 per cent, indicating substantial scope for improvement. Strengthening extension services, value chain linkages, and enterprise-specific support mechanisms could enhance adoption and contribute to more sustainable and diversified farming systems.

1.2 Distribution of respondents according to their involvement in no. of components of integrated farming system models

The data about the participation in different components of integrated farming systems are grouped into the three categories as presented in Table 2.

The finding indicated that in the case of Chhattisgarh, most (89.38%) of the farmers were associated with < 4 components of integrated farming system, followed by 18.75 per cent of them engaged in 4 to 5 components, and only 1.25 per cent of farmers were involved in >5 components of integrated farming system.

Table 2: Distribution of respondents according to their association in no. of components of integrated farming system models, (N =320)

S. No.	Categories	CG (n = 160)		MP (n = 160)		Difference (%)
		F	%	F	%	
1	Less than 4 components	143	89.38	128	80	10.49
2	4 to 5 components	15	9.38	30	18.75	-99.89
3	More than 5 components	2	1.25	2	1.25	0
Average adoption of components		2.72		2.98		-
Chi-square test (χ^2)		5.83				

F - Frequency, % - Percentage, df = 2, p = 0.054

Similarly, in the case of Madhya Pradesh, most (80.00%) of the farmers were engaged in < 4 components of integrated farming system, followed by 18.75 per cent of them practicing 4 to 5 components, and 1.25 per cent were involved in > 5 components of integrated farming system. The average participation in different components of integrated farming system models in Chhattisgarh and Madhya Pradesh was 2.72 and 2.98 components, respectively.

A comparison of percentage differences shows that participation in fewer than 4 components was higher in Chhattisgarh than Madhya Pradesh, with a positive difference of 10.49 per cent. Conversely, the difference for the category of 4 to 5 components was negative (–99.89%), indicating a higher proportion of farmers in Madhya Pradesh adopting a broader combination of IFS components. No difference was observed in the category of farmers adopting > 5 components, as both states had equal participation (1.25% each).

Chi-Square Test for Association

A Chi-square test of independence was carried out to determine whether the distribution of respondents across the three adoption categories of IFS components < 4 components, 4 to 5 components, and >5 components differed significantly between Chhattisgarh and Madhya Pradesh. The test indicates that the difference in the number of IFS components adopted by farmers between the two states was not statistically significant at the 5% level, although the p-value approached marginal significance. This suggests a slight tendency toward greater diversification among farmers in Madhya Pradesh compared to Chhattisgarh, but the difference was not strong enough to be considered statistically meaningful at the conventional threshold.

4. Discussion

The study revealed that the overall adoption of recommended Integrated Farming System (IFS) components was low in both Chhattisgarh and Madhya Pradesh, with average adoption levels remaining below 21 per cent across all farming situations. This highlights a substantial gap between recommended practices and actual field-level implementation. Although Madhya Pradesh recorded slightly higher adoption (20.29% irrigated; 18.98% rainfed) than Chhattisgarh (18.14% irrigated; 18.57% rainfed), the Chi-square test (χ^2 = 5.83; p = 0.054) confirmed that this difference in the number of components adopted was not statistically significant. Thus, adoption behaviour in both states appears broadly similar despite minor numerical differences.

Several factors may explain the marginally higher adoption levels in Madhya Pradesh. These include relatively better awareness of diversified enterprises, stronger market linkages, greater participation in vegetable cultivation among small and medium farmers, and improved access to extension services. Across both states, however, farmers predominantly adopted traditional cereal–pulse–oilseed cropping systems with pulses on bunds, indicating continued reliance on familiar and low-risk practices. Diversified enterprises such as dairy, poultry, goatry, fisheries, and vermicomposting remained consistently under-adopted, largely due to high initial investments, labour constraints, market uncertainties, perceived risks, and infrastructural limitations.

The distribution of farmers according to the number of components adopted further reinforces the limited diversification within IFS models. A majority of respondents (89.38% in Chhattisgarh and 80.00% in Madhya Pradesh) were engaged in fewer than four components, while only 1.25 per cent in each state adopted more than five components.

Although earlier studies (Rawat et al., 2025) showed that higher integration of enterprises contributes significantly to employment generation and livelihood improvement, the present findings indicate that such diversification is yet to be realized at scale in the region.

The present results are consistent with past research in Central India. Sharma and Yadav (2019) reported that socio-economic limitations, including labour scarcity and financial constraints, restrict farmers from adopting integrated models. Patel et al. (2020) also highlighted that inadequate institutional support and limited exposure to diversified enterprises hinder the adoption of IFS-based approaches. Similarly, Singh et al. (2017) emphasized that market instability and lack of technical knowledge often discourage smallholders from adopting additional enterprises beyond cropping.

Taken together, the evidence indicates that while the potential benefits of IFS are widely acknowledged, adoption remains significantly constrained by structural, economic, and institutional barriers. Therefore, strengthening extension systems, improving value-chain linkages, reducing initial investment burdens, and enhancing enterprise-specific technical support are essential to promoting diversified and sustainable IFS adoption in Central India.

5. Conclusion

The study concludes that the overall adoption of Integrated Farming System components among farmers in Chhattisgarh and Madhya Pradesh is low, with most farmers practicing fewer than four components. Although Madhya Pradesh exhibited marginally higher adoption levels, the Chi-square analysis confirmed that the difference in adoption categories between the two states was not statistically significant. This indicates that similar structural and socio-economic challenges influence adoption behaviour across the region.

The findings highlight substantial scope for strengthening IFS-based interventions. Enhancing extension services, improving market access, reducing initial investment barriers, and promoting enterprise-specific training can help improve diversification and adoption. Strengthened institutional support has the potential to improve livelihood security, increase income stability, and promote sustainable agricultural development for small and marginal farmers in Central India.

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