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## Comparative efficiency of integrated farming systems in enhancing employment generation in central India

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### Abstract

This study evaluates the efficiency of Integrated Farming Systems (IFS) in enhancing employment opportunities in Central India, focusing on the districts of Rajnandgaon and Kawardha in Chhattisgarh, and Balaghat and Mandla in Madhya Pradesh. IFSs integrate various components such as crop production, animal husbandry, horticulture, aquaculture, and agroforestry, offering a sustainable agricultural model aimed at improving productivity and ensuring economic stability for smallholder farmers. The primary objective was to compare the efficiency of IFSs in generating employment across the selected districts. Using a multistage random sampling design, the study selected two blocks from each district and randomly chose sixteen villages in each state, resulting in a total sample size of 320 respondents (160 from each state). The research employed surveys, interviews, and focus group discussions to assess the impact of various IFS activities on employment generation. The findings revealed significant differences between the states, with crop production, cattle rearing, and vegetable cultivation being the main employment drivers in Chhattisgarh, while crop production, cattle rearing, and poultry farming were dominant in Madhya Pradesh. Madhya Pradesh demonstrated higher average employment generation, indicating more effective utilization of IFSs for livelihood enhancement. These results highlight the potential of IFSs to increase smallholder farmers' income, promote employment, and foster sustainable agricultural practices, offering valuable insights for policymakers and agricultural planners in the region.

**Keywords:** Integrated farming system, employment generation, Chhattisgarh and Madhya Pradesh

### Introduction

Integrated Farming Systems (IFSs) offer a holistic approach to sustainable agriculture by enhancing productivity and generating employment opportunities among farming communities (Sharma *et al.*, 2015) <sup>[17]</sup>. IFS integrates activities such as crop production, animal husbandry, horticulture, aquaculture, and agroforestry, aiming to maximize resource utilization while minimizing waste (Ravi, 2018) <sup>[10]</sup>. This approach is particularly relevant in developing regions, where smallholder farmers rely heavily on agriculture for their livelihoods (Singh & Rathi, 2020) <sup>[18]</sup>.

In Central India, the states of Chhattisgarh and Madhya Pradesh play a crucial role in the agricultural sector. Both states exhibit diverse agro-climatic conditions, making them ideal for implementing and studying IFS (Singh *et al.*, 2017) <sup>[19]</sup>. Chhattisgarh, characterized by fertile soils and a significant tribal population, and Madhya Pradesh, known for its expansive agricultural base and varied topography, provide a unique setting to evaluate the impact of IFS on rural economies (Rathore *et al.*, 2019) <sup>[11]</sup>. The integration of diverse farming activities in these regions has demonstrated significant potential for improving employment opportunities and enhancing farmers' socio-economic conditions (Jain & Meena, 2021) <sup>[6]</sup>.

This study focuses on a comparative analysis of employment generation from different IFS components in Chhattisgarh and Madhya Pradesh. By examining specific districts—Rajnandgaon and Kawardha in Chhattisgarh, and Balaghat and Mandla in Madhya Pradesh—the research aims to assess the socio-economic benefits of IFS and identify best practices for wider application (Sharma & Joshi, 2018) <sup>[16]</sup>. The findings will contribute to a deeper understanding of how IFS can be tailored to local agro-ecological conditions to promote sustainable

agricultural practices.

The primary objective of this study is to analyse and compare employment opportunities generated from various IFS components, including crop production, cattle rearing, vegetable cultivation, poultry, goat rearing, fishery, and vermicomposting, in the selected districts. Additionally, the study evaluates different IFS models to determine their effectiveness in improving farmers' livelihoods (Kumar *et al.*, 2020) [7]. By identifying the strengths and limitations of these models, the research aims to provide actionable insights for scaling IFS practices for broader impact.

This research seeks to inform policymakers, agricultural planners, and development practitioners about the potential of IFS to improve farmers' economic well-being in Chhattisgarh and Madhya Pradesh. Ultimately, the study contributes to advancing sustainable agricultural practices and fostering rural development in Central India (Sharma *et al.*, 2017) [17].

**Objective**

To analyse employment generation from Integrated Farming Systems (IFS) in Chhattisgarh and Madhya Pradesh.

**Research Methodology**

- **Locale:** The study was conducted in Chhattisgarh (Rajnandgaon and Kawardha) and Madhya Pradesh (Balaghat and Mandla), purposively selected for their diverse agro-climatic zones and prevalence of IFS.
- **Design:** A comparative descriptive design was used to compare the impact of IFS on employment across the two states.
- **Sampling:** A multistage random sampling design was employed. From each state, two districts, two blocks per district, and four villages per block were selected, resulting in 32 villages and 320 respondents.
- **Data Collection:** Field surveys were conducted from 2022 to 2024 using quantitative methods (structured questionnaires) and qualitative methods (interviews, focus groups, and farm observations).

**Measurement Techniques:** The study used a Likert Scale for measuring attitudes toward IFS, a Semantic Differential Scale for evaluating IFS components, and an Employment Index to assess hours worked in farming activities. A scoring system evaluated integration levels across farming activities. To conduct a detailed analysis, Cohen's d Formula was calculated:

**Cohen's d Formula**

$$\frac{\bar{X}_1 - \bar{X}_2}{SD \text{ pooled}}$$

Where

- $\bar{X}_1, \bar{X}_2$ : Mean values for Chhattisgarh and Madhya Pradesh
- $SD \text{ pooled} = \sqrt{\frac{(n_1 - 1)SD_1^2 + (n_2 - 1)SD_2^2}{n_1 + n_2 - 2}}$
- $n_1, n_2$ : Sample size for Chhattisgarh and Madhya Pradesh

Interpretation of Cohen's d

1.  $d < 0.2$ : Small effect
2.  $0.2 \leq d < 0.5$ : Medium effect
3.  $d \geq 0.5$ : Large effect

**Results**

**1. Comparison of employment generation from different components of IFS in Chhattisgarh and Madhya Pradesh states**

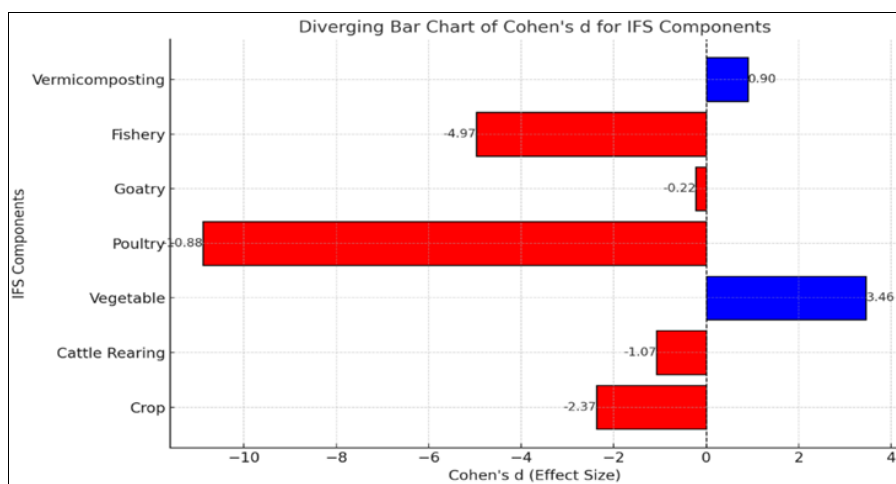
The table No. 1 provides a comparative analysis of employment generation from various components of Integrated Farming Systems (IFS) in Chhattisgarh (CG) and Madhya Pradesh (MP). The data reveal significant differences in employment generation across different components.

**Table 1:** Comparative analysis of employment generation components in IFS: Chhattisgarh and Madhya Pradesh state

Component	Mean		Pooled SD	Cohen's d	Interpretation
	CG	MP			
Crop	140.98	165.93	10.51	-2.37	LE
Cattle Rearing	117.26	130.67	12.51	-1.07	LE
Vegetable	113.35	83.85	8.51	3.46	VLE
Poultry	27.26	87.36	5.52	-10.88	ELE
Goatry	61.94	63.63	7.52	-0.22	SE
Fishery	105.60	152.88	9.51	-4.97	VLE
Vermicomposting	30.50	24.64	6.52	0.90	LE

\* SE= Small effect LE= Large effect, VLE= Very large effect, ELE= Extremely large effect

For crop production, Madhya Pradesh outperforms Chhattisgarh, with a mean of 165.93 man-days compared to 140.98 in Chhattisgarh, reflected by a large effect size ( $d=-2.37d$ ). Similarly, cattle rearing generates more employment in Madhya Pradesh, with a mean of 130.67 man-days compared to 117.26 in Chhattisgarh, also showing a large effect size ( $d=-1.07d$ ).



**Fig 1:** Comparative analysis of employment generation components in IFS

In contrast, vegetable farming contributes significantly more to employment in Chhattisgarh, with a mean of 113.35 man-days compared to 83.85 in Madhya Pradesh. The very large positive effect size ( $d=3.46d$ ) highlights Chhattisgarh's dominance in this component. On the other hand, poultry farming shows a stark disparity, with Madhya Pradesh generating 87.36 man-days compared to just 27.26 in Chhattisgarh, as indicated by an extremely large negative effect size ( $d=-10.88d$ ).

Employment generation from goatry is nearly equal in both states, with mean values of 61.94 in Chhattisgarh and 63.63 in Madhya Pradesh. The small effect size ( $d=-0.22d$ ) suggests minimal practical differences. Fishery, however, shows a significant advantage for Madhya Pradesh, with 152.88 man-days compared to 105.60 in Chhattisgarh, reflected by a very large negative effect size ( $d=-4.97d$ ). Lastly, vermicomposting generates more employment in Chhattisgarh, with a mean of 30.50 man-days compared to 24.64 in Madhya Pradesh, supported by a large positive effect size ( $d=0.90d$ ).

Overall, the analysis highlights that Madhya Pradesh excels in crop production, cattle rearing, poultry, and fishery, whereas Chhattisgarh shows strengths in vegetable farming and vermicomposting. The employment potential of goatry remains similar across both states, indicating limited variation in this component. These insights provide a nuanced understanding of the state-specific strengths and areas for improvement in IFS-based employment generation.

## 2. Average annual employment generation from different IFS models

**Table 2:** Average annual employment generation from different IFS models in Chhattisgarh and Madhya Pradesh States

Sl. No.	IFS models	Man days/year		Difference (%)
		CG	MP	
FS-I	C + CR	320.49	344.15	-7.38
FS-II	C + G	215.29	427.50	-98.57
FS-III	C + CR + P	252.03	312.77	-24.10
FS-IV	C + CR + G	240.55	285.54	-18.71
FS-V	C + CR + G + P	332.00	246.20	25.84
FS-VI	C + V + CR	388.24	377.30	2.82
FS-VII	C + V + CR + P	378.20	360.00	4.81
FS-VIII	C + V + CR + G	438.50	399.43	8.91
FS-IX	C + CR + F	462.40	590.00	-27.60
FS-X	C + CR + VC	397.00	483.50	-21.79
FS-XI	Others IFS models	198.03	308.11	-55.59
Average		329.34	375.86	-

\*C = Crop Production, CR = Cattel rearing, G = Goatry, P = Poultry, F = Fishery, VC = Vermicomposting

The comparative analysis of employment generation from different Integrated Farming System (IFS) models across Chhattisgarh and Madhya Pradesh revealed significant variations in outcomes. On average, IFS models in Madhya Pradesh generated 375.86 man days per year, surpassing the 329.34 man days per year generated in Chhattisgarh. This indicates that the IFS models in Madhya Pradesh were generally more effective in creating employment opportunities.

For instance, the FS-I model (Crop + Cattle Rearing) in Madhya Pradesh generated 344.15 man days per year compared to 320.49 in Chhattisgarh, with a difference of -7.38%. Similarly, the FS-II model (Crop + Goatry) displayed the most substantial disparity, with Madhya Pradesh generating 427.50 man days per year against 215.29 in Chhattisgarh, resulting in a difference of -98.57% (Singh & Sharma, 2022) [15]. Other models, such as FS-III (Crop + Cattle Rearing + Poultry) and FS-IV (Crop + Cattle

Rearing + Goatry), also generated more employment in Madhya Pradesh, with differences of -24.10% and -18.71%, respectively. However, certain IFS models performed better in Chhattisgarh. The FS-V model (Crop + Cattle Rearing + Goatry + Poultry) generated 332.00 man days per year compared to 246.20 in Madhya Pradesh, with a positive difference of 25.84%. This highlights the potential of diversified systems integrating poultry and goatry to optimize employment in Chhattisgarh (Agricultural Census, 2022) [1]. Additionally, the FS-VIII model (Crop + Vegetable + Cattle Rearing + Goatry) in Chhattisgarh produced 438.50 man days per year compared to 399.43 in Madhya Pradesh, showing a positive difference of 8.91%.

Several models involving fisheries and vermicomposting exhibited significant advantages in Madhya Pradesh. The FS-IX model (Crop + Cattle Rearing + Fishery) generated 590.00 man days per year in Madhya Pradesh, compared to 462.40 in Chhattisgarh, with a difference of -27.60%. Likewise, FS-X (Crop + Cattle Rearing + Vermicomposting) generated 483.50 man days per year in Madhya Pradesh, compared to 397.00 in Chhattisgarh (-21.79%). The higher employment generation in these models highlights Madhya Pradesh's better implementation of fishery and vermicomposting practices (Government of India, 2023) [4].

In conclusion, Madhya Pradesh outperformed Chhattisgarh in most IFS models, particularly those integrating crop production with fisheries, goatry, and vermicomposting. Nevertheless, Chhattisgarh showed notable strength in models emphasizing poultry and vegetable production. Policymakers in Chhattisgarh should consider adopting best practices from Madhya Pradesh to enhance employment generation. Improved integration of fishery and vermicomposting systems could be pivotal in achieving this goal.

## Discussion

The comparative analysis of employment generation from Integrated Farming Systems (IFS) in Chhattisgarh and Madhya Pradesh reveals significant state-specific strengths and areas for improvement. The analysis of employment generation from various components of IFS highlighted marked disparities between the two states. Madhya Pradesh demonstrates a clear advantage in crop production, generating 165.93 man-days compared to 140.98 in Chhattisgarh, with a large effect size (Cohen's  $d = -2.37$ ). This could be attributed to better agricultural practices, larger landholdings, or higher crop diversity in Madhya Pradesh. Similarly, cattle rearing in Madhya Pradesh produces 130.67 man-days, significantly higher than 117.26 in Chhattisgarh (Cohen's  $d = -1.07$ ). Enhanced livestock management and integration into farming systems in Madhya Pradesh may contribute to this disparity. Contrastingly, vegetable farming in Chhattisgarh generates 113.35 man-days, significantly surpassing the 83.85 man-days in Madhya Pradesh (Cohen's  $d = 3.46$ ). The dominance of Chhattisgarh in this component likely reflects a regional emphasis on horticulture and small-scale vegetable production, which are labour-intensive. Madhya Pradesh outperforms Chhattisgarh in poultry farming, generating 87.36 man-days compared to 27.26, with an extremely large effect size (Cohen's  $d = -10.88$ ). The stark difference may be due to larger poultry operations and better market integration in Madhya Pradesh. Employment generation from goatry is nearly equal across both states (61.94 in Chhattisgarh vs. 63.63 in Madhya Pradesh), with a small effect size (Cohen's  $d = -0.22$ ), indicating minimal variation. Madhya Pradesh's fishery sector significantly outperforms Chhattisgarh, generating 152.88 man-days compared to 105.60, with a very

large effect size (Cohen's  $d = -4.97$ ). This may be due to better aquaculture practices or larger water body utilization in Madhya Pradesh. Chhattisgarh excels in vermicomposting, with 30.50 man-days compared to 24.64 in Madhya Pradesh (Cohen's  $d = 0.90$ ), potentially reflecting higher awareness or adoption of organic farming practices in Chhattisgarh.

The analysis of average annual employment generation from IFS models further underscores the variations. Madhya Pradesh exhibits higher employment generation across most IFS models, with an average of 375.86 man-days/year compared to 329.34 in Chhattisgarh. Models such as FS-I (Crop + Cattle Rearing), FS-II (Crop + Goatry), and FS-IX (Crop + Cattle Rearing + Fishery) showcase Madhya Pradesh's advantages, with differences of -7.38%, -98.57%, and -27.60%, respectively. These findings highlight the effectiveness of Madhya Pradesh's integration of diverse components, particularly fishery and goatry, into farming systems. Chhattisgarh demonstrates notable advantages in certain models, such as FS-V (Crop + Cattle Rearing + Goatry + Poultry), FS-VI (Crop + Vegetable + Cattle Rearing), FS-VII (Crop + Vegetable + Cattle Rearing + Poultry), and FS-VIII (Crop + Vegetable + Cattle Rearing + Goatry). Differences of 25.84%, 2.82%, 4.81%, and 8.91%, respectively, suggest that Chhattisgarh's strengths lie in labour-intensive practices and diversified horticulture-based systems. Despite Chhattisgarh's success in specific models, the average annual employment generation across all models is higher in Madhya Pradesh. This indicates that Madhya Pradesh's IFS models are more uniformly optimized for employment generation.

Both states should capitalize on their respective strengths. Madhya Pradesh should continue to enhance its performance in crop production, cattle rearing, poultry, and fishery, while Chhattisgarh can focus on vegetable farming, vermicomposting, and diversified horticulture-based models. Efforts should be made to bridge gaps in underperforming components. For instance, Chhattisgarh could invest in improving fishery practices and poultry farming, while Madhya Pradesh could explore ways to boost vegetable farming and vermicomposting. Policymakers should design state-specific interventions that align with the unique strengths and challenges of each region. For instance, promoting aquaculture in Madhya Pradesh and expanding horticulture schemes in Chhattisgarh could enhance employment generation. Training programs tailored to the needs of farmers in both states can improve efficiency and employment potential. Emphasizing sustainable and integrated practices will ensure long-term benefits. Improved infrastructure, market access, and financial support for IFS components can further enhance their employment potential in both states.

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The comparative analysis underscores the potential of IFS to generate significant rural employment while highlighting

regional disparities in performance. By building on strengths, addressing weaknesses, and implementing targeted interventions, both Chhattisgarh and Madhya Pradesh can maximize the employment and economic benefits of Integrated Farming Systems.

### Conclusion

The study highlights the critical role of Integrated Farming Systems (IFS) in generating rural employment and the significant variations in their performance across Chhattisgarh and Madhya Pradesh. Madhya Pradesh emerges as a leader in employment generation through components like crop production, cattle rearing, poultry, and fishery, demonstrating the state's robust agricultural and allied sector integration. Conversely, Chhattisgarh excels in vegetable farming and vermicomposting, showcasing its strengths in horticulture and organic practices. The comparative analysis of IFS models reveals that Madhya Pradesh's systems are generally more effective in creating employment, with an average of 375.86 man-days/year compared to 329.34 in Chhattisgarh. However, Chhattisgarh's higher employment generation in specific models like FS-V (Crop + Cattle Rearing + Goatry + Poultry) and FS-VIII (Crop + Vegetable + Cattle Rearing + Goatry) underscores the potential for region-specific approaches to optimize IFS contributions.

The findings emphasize the need for targeted interventions to address regional disparities and maximize employment potential. Policymakers and stakeholders should focus on enhancing infrastructure, training, and market linkages tailored to the unique characteristics of each state. Promoting sustainable practices, diversifying IFS components, and fostering knowledge exchange between states can further enhance the effectiveness of IFS. By leveraging these strategies, both Chhattisgarh and Madhya Pradesh can harness the full potential of Integrated Farming Systems to drive rural development and improve livelihoods.

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