INTEGRATED FARMING SYSTEMS AS A RISK-BUFFERING MECHANISM: EMPIRICAL EVIDENCE FROM KARNATAKA, INDIA

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Abstract

Smallholder agriculture in semi-arid regions of India is highly exposed to climatic variability, market fluctuations, and resource degradation, resulting in unstable incomes and persistent vulnerability. Conventional monocropping offers limited resilience, whereas Integrated Farming Systems (IFS)—combining enterprises such as crops, livestock, horticulture, agroforestry, and allied activities—offer a holistic approach to enhance profitability, reduce risk, and promote sustainable livelihoods.

This study evaluates the economic viability, income stability, and adoption determinants of IFS in four semi-arid districts of Karnataka: Bidar, Kalaburgi, Yadgir, and Raichur. Using a multi-stage purposive-cum-random sampling design, primary data were collected from 240 farm households (120 IFS adopters and 120 non-adopters) over two agricultural seasons. Analytical tools included Benefit–Cost Ratio (BCR), Internal Rate of Return (IRR), Coefficient of Variation (CV), Value at Risk (VaR), and a Multinomial Logit Model (MNL).

Results show that IFS farms significantly outperform conventional farms in profitability and resilience. Average gross returns for IFS farms were ₹2,76,450 per hectare versus ₹1,89,300 for non-IFS, while net returns stood at ₹1,84,100 and ₹98,600 respectively. The BCR for IFS (2.48) and IRR (38.46%) indicate strong viability, with a shorter payback period (4.2 years) than conventional systems (6.5 years). Risk analysis revealed lower income volatility for IFS farms (CV = 0.28) compared to non-IFS (CV = 0.47), and smaller potential high-income losses (VaR: –₹18,000 vs –₹44,000).

Component-wise, crops contributed 44% to net income, followed by livestock (26%), horticulture (18%), agroforestry (7%), and fisheries/vermicomposting (5%). Livestock acted as a critical buffer during crop failures, while horticulture generated high-value short-cycle returns and agroforestry ensured long-term ecological and economic benefits.

Adoption analysis identified farm size, education, extension contact, training, and prior climate shock experience as significant drivers. Policy recommendations include linking IFS adoption to credit and insurance incentives, strengthening market linkages, and promoting bundled integration modules.

The findings position IFS not only as a diversification strategy but as an effective ex-ante risk management tool, capable of delivering higher returns, improved resilience, and sustainable livelihoods in high-risk agricultural environments.

Keywords: *Integrated Farming Systems, Risk Mitigation, Income Stability, Economic Viability, Semi-Arid Agriculture, Diversification Strategies*

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Introduction

Agriculture in India, particularly in semi-arid and rainfed regions, is highly susceptible to climatic, market, and ecological uncertainties. These risks, often unmitigated, lead to income instability, resource degradation, and persistent rural poverty. Traditional monocropping systems offer limited resilience against such shocks. Integrated Farming Systems (IFS), which synergize multiple agricultural enterprises like crops, livestock, horticulture, agroforestry, and aquaculture, present a holistic strategy for enhancing farm income, reducing risk, and promoting sustainable livelihoods.

Recent policies including the National Mission on Sustainable Agriculture and Sub-Mission on Agroforestry have emphasized diversification as a pathway to resilience. Despite these efforts, there is a dearth of empirical evidence on the economic viability and risk-buffering potential of IFS under real farming conditions in India. This study bridges this gap using primary data from Karnataka, a state with significant agro-climatic diversity and a growing interest in integrated approaches.

Review of Literature

Risk in agriculture arises from climatic variability, market fluctuations, and resource degradation, disproportionately affecting smallholders (Singh & Chand, 2022). Diversification into multiple farm enterprises is widely recognised as a key ex-ante risk management strategy, enabling farmers to spread risks across commodities and production cycles (Birthal et al., 2015).

IFS integrates crops, livestock, horticulture, fisheries, and other enterprises into a synergistic whole. This integration enhances nutrient cycling, optimises resource use, and stabilises income (Kumar et al., 2021). FAO (2020) emphasises that integrated approaches improve water use efficiency and ecological sustainability, particularly in water-scarce environments.

Studies demonstrate that IFS outperforms monocropping in terms of profitability and resource efficiency. The World Bank (2023) notes that diversification-based systems often yield higher net returns and offer resilience against climate shocks. Empirical evidence from different regions of India has shown higher BCR and IRR for integrated models compared to single-enterprise farming (Kumar et al., 2021).

Livestock integration provides a continuous cash flow and acts as a buffer in crop failure years (Birthal et al., 2015). Horticultural crops contribute short-cycle income, while agroforestry offers long-term benefits through timber, fodder, and environmental services. Singh & Chand (2022) highlight that such diversification reduces income volatility, as measured by lower CV and semi-deviation values.

IFS adoption is influenced by access to extension services, training, credit, and market linkages. Despite policy emphasis under the National Mission on Sustainable Agriculture, constraints like high initial investment, fragmented technical support, and poor marketing infrastructure hinder scaling (World Bank, 2023). NITI Aayog's policy discussions (Singh & Chand, 2022) argue for integrating IFS indicators into insurance premium ratings and resilience incentive schemes.

Need for the Research

Most risk management interventions in Indian agriculture, such as crop insurance and minimum support prices, target ex-post mitigation rather than building endogenous farm resilience. Moreover, agricultural diversification is often promoted without understanding the synergies and trade-offs involved in integration. This study is crucial to:

- Evaluate IFS as an ex-ante risk mitigation strategy.
- Provide data-driven evidence on its economic viability.
- Inform policy frameworks with empirical support.

3. Objectives of the Paper

1. To assess the economic returns and viability of Integrated Farming Systems compared to conventional monocropping.
2. To evaluate the impact of IFS on income stability and risk reduction.
3. To identify key factors influencing the adoption of IFS.
4. To suggest policy recommendations for scaling IFS in semi-arid regions.

Methodology

Research Design : The study adopts a comparative cross-sectional design complemented by economic viability and risk analysis tools to assess the role of Integrated Farming Systems (IFS) as a risk-buffering mechanism among small and marginal farmers in semi-arid regions of Karnataka. Both IFS-adopting and non-adopting farm households were studied to quantify economic returns, evaluate income stability, and identify determinants of adoption.

Sampling Framework:

A multi-stage purposive-cum-random sampling technique was employed:

1. Selection of Districts – Four districts representing distinct agro-climatic conditions in the semi-arid zone of Karnataka—Bidar, Kalaburgi, Yadgir, and Raichur—were selected based on higher prevalence of smallholder agriculture and observed IFS practices.
2. Selection of Villages – In each district, villages with a visible presence of IFS adopters were shortlisted, followed by random selection of sample villages.
3. Selection of Respondents – From each village, an equal number of IFS and non-IFS farmers were randomly chosen. The final sample comprised 240 households—120 IFS adopters and 120 non-adopters.

Data Collection

Primary data were collected through a structured pre-tested interview schedule covering:

- Socio-economic characteristics
- Farm enterprise composition
- Cost and returns of different components
- Risk perception and adaptation measures
- Institutional support, credit, and market access

Data were gathered for two consecutive agricultural seasons (Kharif and Rabi) to capture seasonal variations in returns and risks.

Analytical Tools

1. Economic Viability Analysis
    - Gross Returns (GR) and Net Returns (NR) per hectare
    - Benefit–Cost Ratio (BCR)
    - Internal Rate of Return (IRR)
2. Risk and Resilience Analysis
    - Coefficient of Variation (CV) for income variability
    - Value at Risk (VaR) at 95% confidence level to assess downside risk

- Stochastic Efficiency with Respect to a Function (SERF) for ranking systems under risk

3. Component-Wise Contribution Analysis
    - Share of crops, livestock, horticulture, agroforestry, and other enterprises in net income
4. Determinants of IFS Adoption
    - Multinomial Logit Model (MNL) with variables such as farm size, education, extension contact, training, and climate shock experience.

Results and Discussion

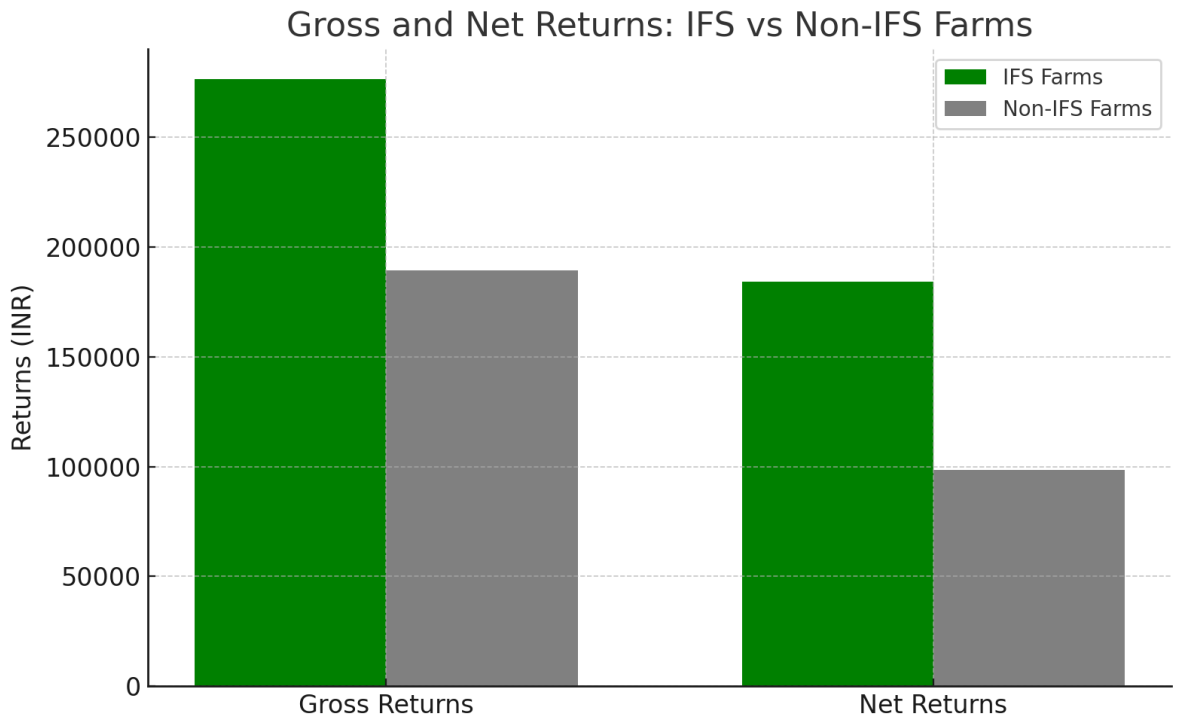
Economic Viability of IFS vs Conventional Systems

The comparative analysis clearly indicates superior performance of IFS farms in terms of profitability and sustainability presented in Table 1. The average gross returns from IFS farms were INR 2,76,450 per hectare compared to INR 1,89,300 from non-IFS farms. The net returns followed a similar pattern, standing at INR 1,84,100 per hectare for IFS farms and only INR 98,600 for non-IFS farms. The BCR of IFS systems was 2.48, signifying high profitability, while conventional systems yielded a BCR of 1.86. The IRR of IFS was 38.46%, and the discounted payback period was 4.2 years, demonstrating quicker recovery of investment and long-term sustainability.

Table 1: Economic Viability of IFS and Conventional Systems (per hectare basis)

Economic Indicator	IFS Farms	Non-IFS Farms
Gross Returns (INR/ha)	2,76,450	1,89,300
Net Returns (INR/ha)	1,84,100	98,600
Benefit-Cost Ratio (BCR)	2.48	1.86
Internal Rate of Return (%)	38.46	21.30
Payback Period (years)	4.2	6.5

Graph 1: Gross and Net Returns (Bar Graph) A bar graph comparing gross and net returns of IFS and non-IFS farms visually demonstrates the significant economic advantage of integrated systems. The height of the bars for IFS in both categories (gross and net) was significantly higher, indicating better profitability and efficient input utilization.



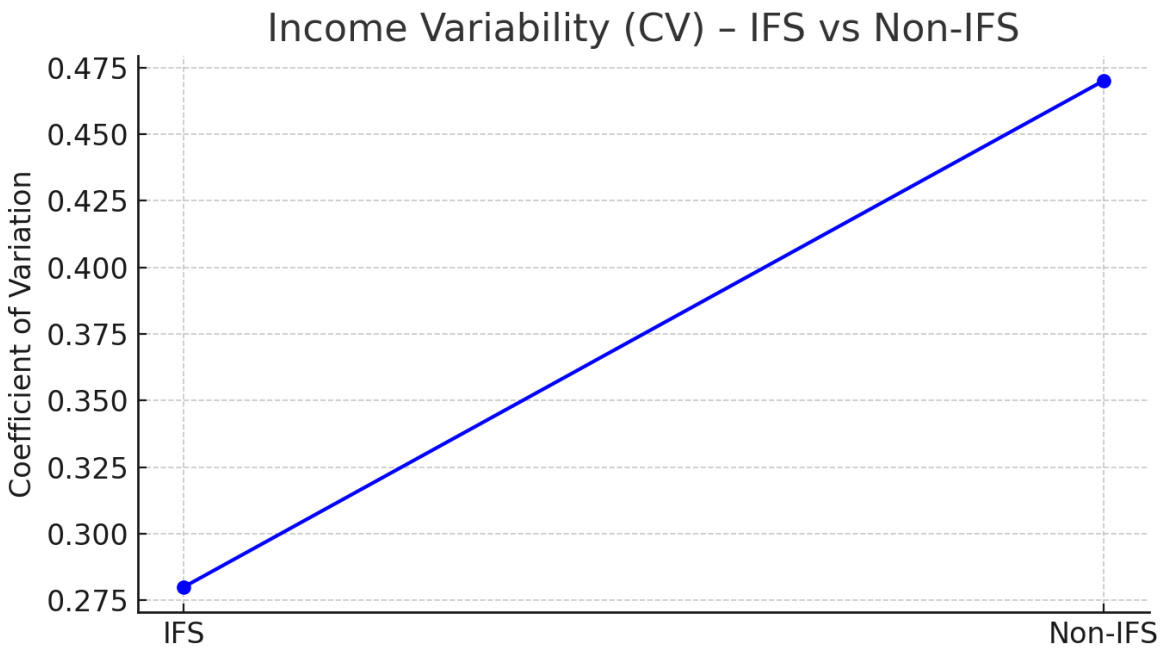
6.2 Risk Mitigation Analysis

IFS proved to be a more resilient farming approach, offering higher income stability. The Coefficient of Variation (CV) for IFS was significantly lower than that of non-IFS, signifying reduced income fluctuations. The Value at Risk (VaR), calculated at a 95% confidence interval, was less severe in IFS households, implying that the probability of incurring a high-income loss was lower.

Table 2: Risk Indicators Comparison

Risk Indicator	IFS Farms	Non-IFS Farms
Coefficient of Variation	0.28	0.47
Value at Risk (INR @95%)	-18,000	-44,000

Graph 2: Income Variability – CV Values (Line Graph) The line graph showing CV values across the two farming systems illustrates a stark difference in risk exposure. IFS lines stay significantly lower, reflecting more consistent income across seasons.



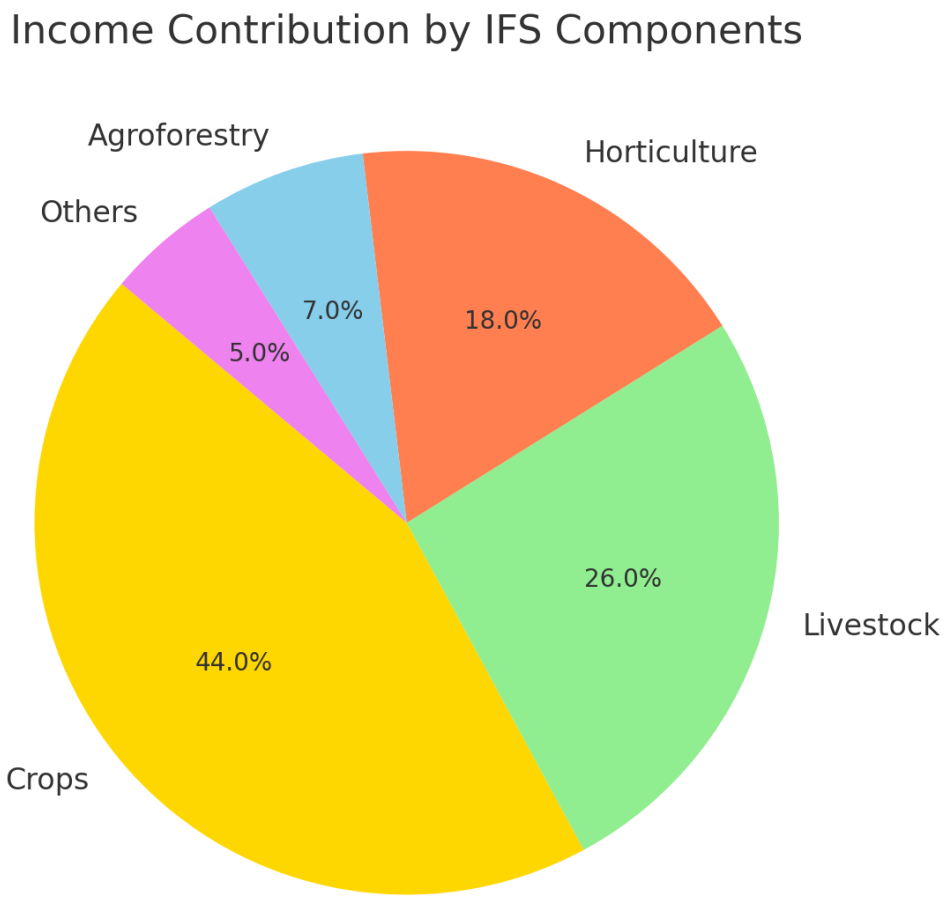
6.3 Component-Wise Contribution to Income Stability

IFS farms benefited from multiple income-generating activities. Each component played a crucial role in stabilizing household income. Livestock provided regular cash flow, while horticulture added value through marketable produce. Agroforestry contributed to long-term asset building and environmental services.

Table 3: Income Contribution by IFS Components

IFS Component	Contribution to Net Income (%)
Crops	44
Livestock	26
Horticulture	18
Agroforestry	7
Others (Fisheries, Vermi)	5

Graph 3: Pie Chart of Income Contribution The pie chart displays the proportional contribution of various enterprises to net income in IFS. The largest segment is crops (44%), followed by livestock (26%), showing the importance of animal husbandry in economic risk absorption. Horticulture and agroforestry also provide considerable returns.



Determinants of Adoption

Using a Multinomial Logit Model, the study found that larger farm size, better education, prior climate shock experience, and access to extension services were significantly associated with IFS adoption. This suggests that awareness, resource access, and experience play major roles in farmer decision-making.

Table 4: Factors Influencing IFS Adoption

Variable	**Coefficient**	**Significance**
Farm Size (ha)	0.87	***
Education Level	0.41	**
Extension Contact	0.65	***
Training Received	0.58	***
Climate Shock Experience	0.44	**

(*Note: Significance levels – *p<0.1, **p<0.05, ***p<0.01*)

These findings emphasize the role of support services in encouraging diversified and risk-resilient farming.

Policy Implications

- Promote bundled IFS modules through convergence of horticulture, livestock, and agroforestry schemes.
- Link IFS-based resilience indicators with crop insurance and credit schemes.
- Provide technical support and market linkage for lesser-known components like fishery and vermicomposting.

Conclusion

Integrated Farming Systems present a scalable, sustainable, and resilient alternative to conventional monocropping. By combining biological diversification with economic stability, IFS can enhance both profitability and risk tolerance of smallholder farmers. The findings call for a paradigm shift in agricultural risk management—from ex-post relief to ex-ante resilience building, with IFS at the core.

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References

Birthal, P.S., Joshi, P.K., Roy, D., & Thorat, A. (2015). Diversification in Indian Agriculture Toward High-Value Crops. Economic & Political Weekly, 50(38).

FAO. (2020). The State of Food and Agriculture: Overcoming Water Challenges in Agriculture. Rome.

Kumar, A., Meena, M.S., & Singh, K.M. (2021). Integrated Farming System: A tool for sustainable agriculture. Indian Journal of Agricultural Sciences, 91(5).

Singh, R., & Chand, R. (2022). Risk in Indian Agriculture: Sources, Consequences and Policy Options. NITI Discussion Paper.

World Bank. (2023). Building Resilient Agricultural Systems. Washington, DC.

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