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Inderjeet Kaur
University Institute of Agricultural
Sciences, Chandigarh University,
Punjab, India

Amit Raj
University Institute of Agricultural
Sciences, Chandigarh University,
Mohali, Punjab, India

Dr. Gurshaminder Singh
University Institute of Agricultural
Sciences, Chandigarh University,
Mohali, Punjab, India

Dr. Navjot Gill
University Institute of Agricultural
Sciences, Chandigarh University,
Mohali, Punjab, India

Corresponding Author:
Dr. Gurshaminder Singh
University Institute of Agricultural
Sciences, Chandigarh University,
Mohali, Punjab, India

Enhancing farm productivity through livestock-based integrated farming systems in Punjab

Inderjeet Kaur, Amit Raj, Gurshaminder Singh and Navjot Gill

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Abstract

This study evaluates the role of livestock-based Integrated Farming Systems (IFS) in enhancing farm productivity, income, and sustainability in Punjab. The analysis, based on primary data collected from farmers across multiple villages during the RAWA programme, highlights the comparative advantages of integrated systems over crop-only farming. The results indicate that IFS improves crop productivity by 8–12% through better nutrient recycling and use of farmyard manure. Livestock contributes significantly (35–40%) to total farm income, providing regular cash flow and enhancing economic stability. Integrated farms also recorded higher net returns and employment generation, along with improved benefit–cost ratios. However, the adoption of scientific practices such as balanced fertilizer application, soil testing, and advanced organic nutrient management remains limited. Socio-economic and technical constraints, including high initial investment, limited awareness, and inadequate veterinary services, continue to hinder widespread adoption. Overall, the study concludes that livestock-based IFS is a viable and sustainable approach for improving farm productivity, profitability, and resilience in Punjab, provided adequate institutional and extension support is ensured.

Keywords: Integrated farming system, livestock, farm productivity, income, sustainability, Punjab

1. Introduction

Ensuring food security for a rapidly expanding global population, projected to reach 9.1 billion by 2050 and exceed 10 billion by the end of the century, remains a significant challenge for existing agricultural systems. In India, agriculture forms the backbone of the economy, and nearly 85% of farmers are small and marginal, possessing only 44% of the total cultivated land. Landholdings have average dimensions declined from 2.28 ha in 1970–71 to 1.08 ha ^[1]. This reduces their ability to boost output using traditional techniques ^[2]. Though effective, the rice-wheat cropping system, which has historically dominated Punjab's agriculture, has sparked major worries about diminishing soil health, groundwater depletion, and diminished sustainability over time. Recent research on continuous monocropping in the state has revealed soil deterioration and organic matter loss, stressing the critical necessity of varied and environmentally friendly agriculture approaches.

The Integrated Farming System (IFS) integrates animal and crop farming systems whereby the animals consume agricultural by-products and their power may be used for farm operations and they produce manure used as fertiliser and fuel. The principle of Integrated Farming Systems emphasizes that “there is no waste,” as materials considered waste can be effectively utilized as inputs for other farm enterprises ^[3]. Due to the fact that 80% of farm households belong to small and impoverished farmers, average farm size is decreasing in India together with financial restrictions on growing investment in agriculture.

This involves adopting scientific agronomic practices as well as technologies that have the potential to boost productivity of traditional farming methods. Agronomics practices such as the excessive use of inorganic fertilizers and pesticides all throughout the twentieth century boosted output greatly, but negatively: environmental deterioration plus increased agricultural operating expenses raised questions concerning the viability and sustainability of the economy ^[4]. The Integrated Farming System (IFS) has become a promising way to deal with these difficulties in the last few years. Holistic farming approach called IFS combines several businesses inside one

farm including crops, livestock, fisheries, agroforestry, and chicken. These elements are linked, with the output of one becoming the input for the next, therefore encouraging effective resource use and lowering trash ^[5]. Livestock-based IFS not only provides regular income but also contributes to soil fertility through organic manure and helps in efficient utilization of crop residues. Therefore, the adoption of IFS can enhance farm productivity, ensure income stability, and promote sustainable agriculture in Punjab.

Concept of integrated farming system in Punjab

The concept of Integrated Farming System (IFS) in Punjab has gained importance as a sustainable alternative to the conventional rice-wheat cropping system. Punjab agriculture, which was once highly productive due to the Green Revolution, is now facing challenges such as declining soil fertility, groundwater depletion, and rising input costs. In this context, IFS provides a holistic and resource-efficient approach to improve farm productivity and sustainability. IFS encourages variety in Punjab, where farmers mostly rely on monocropping, by adding new businesses including dairy farming, beekeeping, and fishery. This diversification offers several sources of income

all year long while lowering hazards connected to market volatility and crop failure. In Punjab, the idea of Integrated Farming System (IFS) originated as a sustainable and varied substitute for the conventional rice-wheat cropping system. Punjab agriculture is now experiencing major difficulties such as deteriorating soil, dwindling groundwater supplies, and declining production. These problems draw attention to the necessity of a more resource-efficient and balanced farming method ^[6].

2. Materials and Methods

The study was conducted in selected villages of Punjab during the RAWF programme. A total of 64 farmers were selected across 10 villages using random sampling.

Primary data were collected through structured interviews and field observations. Secondary data were obtained from published reports and research studies.

The study focused on livestock-based IFS models such as crop + dairy and crop + dairy + poultry systems. Data on cropping pattern, livestock, milk production, income, and resource use were analysed using averages and percentages

Table 1: Village-wise Livestock-Based IFS Data

1.	Bajheri	6	Rice-Wheat+Fodder	Crop + dairy	4-6	12-18	52-55	2,00,000
2.	Deh kalan	5	Rice-Wheat	Crop + Dairy	3-4	10-14	50-52	1,50,000
3.	Mehmoodpur	7	Rice-Wheat+Fodder	Crop+Dairy+Poultry	5-7	15-20	50-55	2,40,000
4.	Madlan	6	Rice-Wheat	Crop+Dairy	3-5	11-15	51-53	1,70,000
5.	Karimpur	8	Mixed Cropping	Crop +Dairy + Poultry	5-8	16-22	55-57	2,60,000
6.	Kalaundi	6	Rice-wheat+Fodder	Crop +Dairy	4-6	12-16	53-55	2,10,000
7.	Dugri	8	Diversified crops	Crop + Dairy + Poultry	6-9	18-25	56-59	2,80,000
8.	Kotli	6	Rice-Wheat	Crop + Dairy	3-4	10-13	50-52	1,60,000
9.	Dholan majra	6	Crop+Fodder	Crop + livestock	4-5	11-15	52-54	1,90,000
10.	Dumna	6	Mixed Farming	Crop + Dairy +Poultry	4-7	14-18	53-55	2,20,000

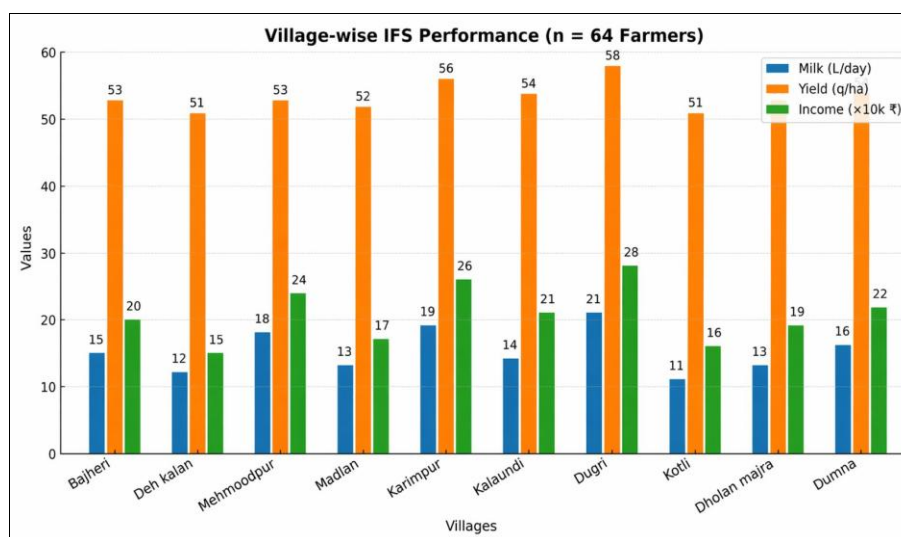


Fig 1: Village-wise IFS performance (Milk, Yield and Income)

3. Results and Discussion

The results highlight the advantages of livestock-based Integrated Farming Systems (IFS) over crop-only farming.

- IFS recorded slightly higher crop yield (54–58 q/ha) compared to crop-only systems (50–52 q/ha), mainly due to better nutrient management through farmyard manure and recycling of crop residues. Milk production (12–20 L/day per farm) was observed only in IFS, providing a regular and stable source of income.

- Economic analysis showed that net income under IFS (₹2.0–2.8 lakh/year) was more than double that of crop-only farming (₹80,000–1,00,000/year). Employment generation was also higher in IFS (260–300 man-days) compared to crop-only systems (170–190 man-days), ensuring year-round work opportunities.
- The Benefit–Cost ratio was higher in IFS (2.0–2.4), indicating better economic efficiency. Overall, livestock-based IFS proved to be more productive, profitable, and

sustainable for farmers.

Table 2: Comparison of Crop-only and Livestock-Based IFS

Particulars	Crop- only system	IFS system
Crop yield (q/ha)	50-52	54-58
Milk production	----	12-20 L/day (per farm)
Gross income(₹/year)	2,00,000-2,40,000	3,80,000-4,50,000
Net income(₹/year)	80,000-1,00,000	2,00,000-2,80,000
Employment(man-days)	170-190	260-300
B:C Ratio	1.6-1.8	2.0-2.4

3.1 Extent of Crop–Livestock Integration

The study conducted on 64 farmers across 10 villages of Punjab revealed that all farmers followed the wheat–paddy cropping system, which continues to dominate the state’s agriculture. This trend is widely reported in Punjab due to assured procurement and irrigation facilities. However, the level of crop–livestock integration varied among farmers. Based on your dataset and supported by recent studies, the distribution can be presented as:

Table 3: Extent of Integration

Farming system type	Farmers	Percentage
Crop-only	10	15.6
Crop + Dairy (IFS)	42	65.6
Crop + Dairy +Poultry	12	18.8
Total	64	100

The results show that about 84% farmers adopted IFS, with crop + dairy being the dominant system.

3.2 Contribution of Livestock to Farm Income

Livestock plays a crucial role in enhancing farm income and livelihood security among farmers in Punjab. Livestock emerged as an important supplementary as well as regular source of income. Milk production was the primary contributor, with average production ranging between 12–20 litres per day per farm, while progressive farmers reported production as high as 120–150 litres per day due to better breeds and management practices. This indicates the high potential of dairy farming in the region.

Table 4: Contribution of Livestock to Farm Income

Source of income	Average Contribution (%)
Crops	58-62
Livestock	35-40
others	2-5

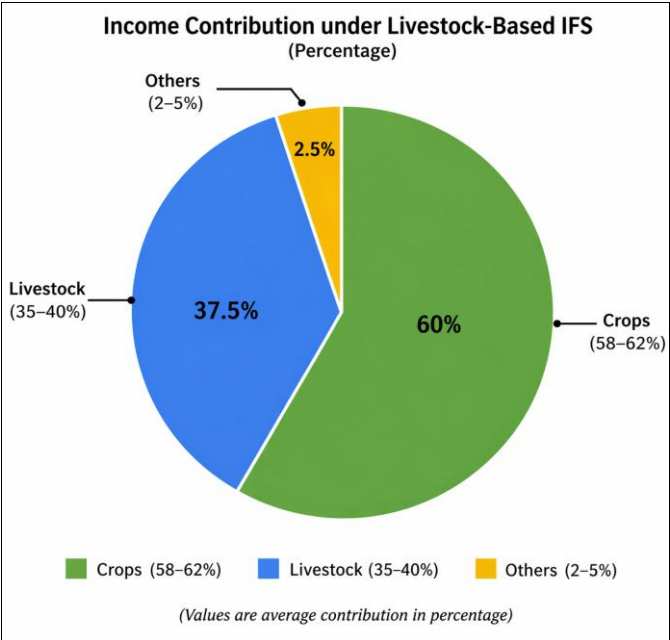
Table 5: Adoption of nutrient management practices among farmers

Nutrient Management practice	Number of farmers	Percentage (%)
Chemical fertilizers (Urea, DAP)	58	90.6
Farmyard manure (FYM)	44	68.8
Composting	18	28.1
Vermicomposting	10	15.6
Biogas slurry application	6	9.4
Balanced fertilizer application	20	31.3
Soil testing	14	21.9

3.4 Impact on Crop Productivity

The finding indicate that livestock-based Integrated Farming Systems (IFS) positively influence crop productivity. Farms practicing integration recorded 8–12% higher yields compared to non-integrated farms, mainly due to improved soil fertility through the application of farmyard manure (FYM), efficient nutrient recycling, and better soil structure. Crops like wheat and

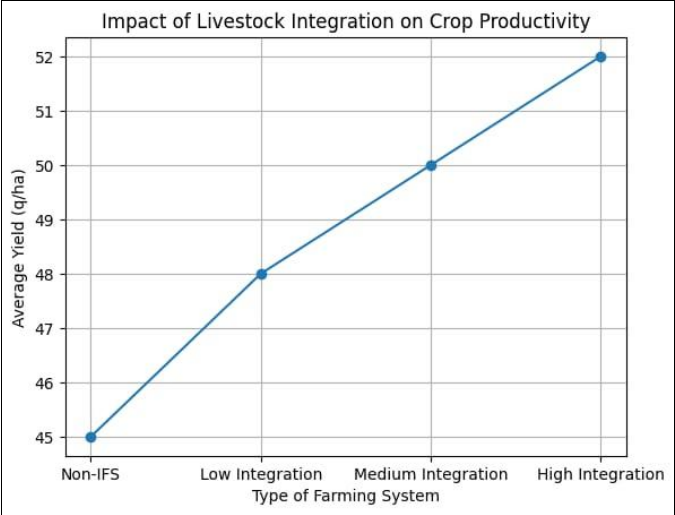
Livestock contributed significantly through milk production (12–20 L/day per farm), ensuring regular income and financial stability.



3.3 Nutrient Management Practices

The results revealed that nutrient management practices are largely dominated by the use of chemical fertilizers, with 90.6% of farmers relying on inputs such as urea and DAP. Although these inputs enhance short-term productivity, their excessive use may negatively impact soil health. A significant proportion (68.8%) of farmers utilized farmyard manure (FYM), indicating partial adoption of organic nutrient recycling due to livestock integration. However, advanced organic practices such as composting (28.1%), vermicomposting (15.6%), and use of biogas slurry (9.4%) were adopted by relatively few farmers, highlighting underutilization of available resources. Scientific nutrient management practices were also limited, with only 31.3% practicing balanced fertilizer application and 21.9% conducting soil testing. Overall, the findings suggest that while livestock integration supports some level of nutrient recycling, the adoption of comprehensive integrated nutrient management practices remains inadequate, requiring improved awareness and extension support.

paddy showed noticeable yield improvements under integrated systems. The benefits were more significant among farmers adopting balanced fertilizer use along with FYM. However, the extent of productivity gains varied depending on the level of integration and adoption of scientific practices, with highly integrated farms achieving better results than those with limited integration.



3.5 Economic Comparison

Livestock-based Integrated Farming Systems (IFS) demonstrate clear economic advantages over non-integrated farming in terms of profitability and income stability. Integrated farms earned 25–35% higher net returns, mainly due to diversified income sources, particularly dairy farming. Livestock contributed 35–40% of total farm income, providing a regular and reliable cash flow. Input costs were relatively lower in integrated systems due to the use of farmyard manure (FYM) and efficient recycling of farm resources. In contrast, non-integrated farms relied solely on seasonal crop income, making them more vulnerable to market and climatic risks. Despite benefits, constraints such as initial investment, feed costs, and limited access to veterinary services were observed. Overall, integrated farming systems proved to be more economically viable and sustainable.

Table 6: Economic comparison

Parameters	Non-Integrated farms	Integrated farms
Average annual Income (₹)	1,20,000	1,60,000
Net returns (₹)	80,000	1,10,000
Livestock contribution (%)	---	35-40
Input cost (₹)	Higher	Lower
Income stability	Low	High

3.6 Socio-Economic and Technical Constraints in IFS Adoption

Although integrated farming systems (IFS) based on livestock have clear advantages, their uptake is limited by a mix of technical and socioeconomic factors. Effective adoption of integrated methods is limited by farmers' lack of technical expertise and poor knowledge. High initial costs for cattle, housing, and supporting infrastructure additionally deter adoption, especially among small and marginal farmers. Significant obstacles also come from financial restrictions including restricted institutional credit access and growing feed expenses. Furthermore, impeding adequate livestock management and lowering system efficiency are inadequate veterinary services and extension assistance. Technical gaps including low adoption of scientific feeding, breeding, and nutrient management techniques additionally limit the potential benefits of IFS. Enhancing the adoption and sustainability of integrated farming systems requires targeted training, increased access to credit and veterinary services, and stronger extension systems, all aimed at tackling these limits.

4. Conclusion

Livestock-based Integrated Farming Systems (IFS) emerge as a sustainable and economically viable alternative to conventional crop-only farming in Punjab. The integration of livestock with crops enhances resource-use efficiency, improves soil fertility through organic nutrient recycling, and contributes to higher crop productivity. In addition, the system provides diversified income sources, with livestock playing a significant role in ensuring regular cash flow, income stability, and risk reduction for farmers. The study also indicates that integrated systems generate higher employment opportunities and better benefit–cost ratios, making them particularly suitable for small and marginal farmers. However, the full potential of IFS remains underutilized due to limited adoption of scientific practices, lack of awareness, and constraints related to initial investment, credit access, and veterinary services. To enhance the effectiveness of IFS, there is a need to strengthen extension services, promote farmer training, and improve access to institutional support. Encouraging the adoption of advanced nutrient and livestock management practices can further improve productivity and sustainability. Overall, livestock-based IFS has strong potential to enhance agricultural sustainability, profitability, and rural livelihoods in Punjab.

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