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Designing a profitable and sustainable integrated farming system model for small and medium farmers in the Vidarbha region of Maharashtra

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Abstract
Integrated farming system (IFS), consist of the components like cropping systems, horticulture, fishery, poultry and goat rearing, livestock's rearing was undertaken at IFSR unit Akola Maharashtra, India during 2022-23 and 2023-24 to study profitability and employment generation of IFS over conventional Cotton-based system in Vidarbha region of Maharashtra. Fishery component achieved highest returns. Employment generation and maximum returns were observed in case of IFS over conventional agriculture. The relative contribution of different components to the total returns was 28.20% from fish, 22.82% from crops, 18.18% from Dairy + Vermicompost, and 16.57% from goat. IFS has generated highest employment of 568 Man days ha^{-1} $year^{-1}$ against conventional system generated only 97 Man days ha^{-1} $year^{-1}$.

Keywords: Cropping system, aquaculture, profitability, employment generation, kitchen garden

Introduction
Agriculture in the Vidarbha region of Maharashtra is largely dominated by the Cotton based cropping system. Out of a total cultivable area of 15 lakh hectares, Cotton alone covers more than 2 lakh hectares. Most farmers in this region are small and medium holders who have already utilized nearly 80% of the yield potential of Cotton, leaving limited scope for further productivity improvement. As a result, the natural resources have become overexploited and fatigued. There is a clear need for diversification, as the income of farmers relying solely on the traditional Cotton-based system is declining due to shrinking profit margins. Hence, there is an urgent requirement to develop a profitable Integrated Farming System (IFS) model that can perform on par with or better than the existing cotton-based system.

Materials and Methods
The present investigation was conducted during 2022-2024 at the AICRP on Integrated Farming System Research, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. The site is located in a subtropical region at 22°42′ N latitude, 77°02′ E longitude, and at an elevation of 307.42 m above mean sea level (MSL).

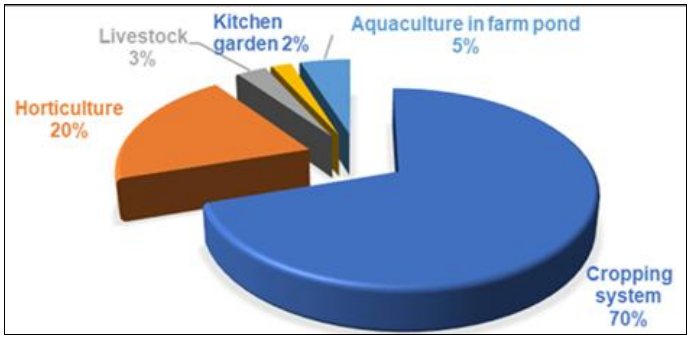

Fig 1: The percentage distribution of the area among different components

The Integrated Farming System (IFS) model was developed on a 1-hectare area, comprising crops, horticultural crops, livestock (cow, goat, and poultry), kitchen garden, aquaculture (farm pond), and vermicomposting components. Out of the total area, 0.70 ha was allotted to field crops, 0.03 ha to livestock, 0.02 ha to the kitchen garden, and 0.05 ha to aquaculture. The percentage distribution of the area among different components is shown in Figure 1. The experimental treatments were as follows T_1: Crop components, T_2: Crop components + Dairy + Vermicompost, T_3: Crop components + Goat, T_4: Crop components + Poultry, T_5: Crop components + Kitchen Garden, T_6: Crop components + Horticulture, T_7: Crop components + Fishery and T_8: Crop components + Dairy + Vermicompost + Goat + Poultry + Kitchen Garden + Horticulture + Fishery. Each treatment represented a different combination of enterprises to evaluate the performance and integration efficiency of the IFS model.

Poultry droppings were collected and released into the fish pond, serving as a natural food source for fish. After one year, the fish were harvested using a drag net. Data were collected on the economics and employment generation, each component as well as for the entire IFS model, following standard procedures.

a) Economic Analysis

Production costs and gross returns were calculated using market prices for inputs and outputs. In India, salaries are determined by the government's minimum wage, which no worker can be paid below.

Net Returns = Gross Returns−Cost of Cultivation

$$\text{BC Ratio} = \frac{\text{Gross Returns}}{\text{Cost of Cultivation}}$$

b) Employment Generation (Man-days ha^{-1} year^{-1})

Labor needs for various activities were measured in man-days per hectare per year. One man-day was defined as a person working 8 hours in a day. Man-days were computed separately for each component as well as for all treatment combinations, and then compared.

Results and Discussion

Table 1: Profitability and employment generation of different components under integrated farming system (pooled data of 2 years)

Treatments	Area (ha)	Cost of Cultivation (Rs)	Net returns (Rs)	Employment generation	BC ratio
Integrated farming system					
Cropping system	0.70	97744	111048	115	2.14
Dairy+ Vermicompost	0.01	106864	88451	84	1.83
Goat	0.01	120246	80611	223	1.67
Poultry	0.01	20566	25928	12	2.26
Kitchen garden	0.02	2235	4879	5	3.18
Horticulture	0.20	15536	38484	15	3.48
Fish	0.05	72082	137218	57	2.90
Total	1.00	435273	486619	468	2.11
Conventional cropping system					
Cotton	1.00	53448	41086	91	1.77
Total	1.00	53448	41086	91	1.77

a) Economic analysis

Within the IFS model (0.70 ha under crops), the maximum net return of ₹ 1,37,218 was obtained from the fish component, followed by 1,11,048 from crop component. The relative contribution of different components to the total returns was 28.20% from fish, 22.82% from crops, 18.18% from Dairy + Vermicompost, and 16.57% from goat.

The total net return from all components of the IFS was ₹4,86,619, showing an increase of 10.84 times over the conventional Cotton based system. These economic results align with studies by Singh (2012) [5], Surve (2014) [6], Sharma (2017) [4] and Vinodakumar *et al.,* (2017) [7]. Similar findings were reported by Bahera and Mahapatra (1998) [1], who observed higher profitability through IFS.

The benefit-cost ratio (BC ratio) of the IFS (2.11) was found to be higher than that of the conventional system (1.77). Among the different components, the horticulture enterprise recorded the highest BC ratio (3.48), followed by Kitchen Garden (3.18), mainly due to their lower production costs. The Fish component also showed a favourable BC ratio of 2.90, whereas goat registered the lowest ratio (1.67) because of its initial establishment cost.

b) Employment Generation (Man-days ha^{-1} year^{-1})

In case of employment generation IFS recorded highest employment generation of 468 Man days ha^{-1} year^{-1} followed by goat (223), cropping system (114), Dairy +Vermicompost (84), Fish (57), Horticulture (15), Poultry (12) and Kitchen Garden (5) and conventional system generated only 91 Man days ha^{-1} year^{-1} employment.

Including animals in the farming system demanded more man-days than conventional practices, leading to higher overall employment generation. Comparable findings were reported by Singh *et al*. (2012) [5] Kharche *et al*. (2022) [2] and Kumar *et al*. (2012) [3].

Conclusion

In conclusion, the Integrated Farming System (IFS) that combined with cropping systems poultry, fish, and goat enterprises proved to be highly profitable and employment generating. This model is particularly suitable for small and marginal farmers located in the Vidarbha region of Maharashtra, under irrigated conditions. Hence, it serves as an efficient and sustainable alternative to the conventional cotton-based system.

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