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Economic evaluation of integrated farming system in eastern Vidarbha zone

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Abstract

This study explores the "Economic Evaluation of the Integrated Farming System in the Eastern Vidarbha Zone." Primary data was gathered from 90 farmers, with 45 farmers selected from each district, namely Nagpur and Bhandara. The four integrated farming systems were observed viz. Crop integrated farming system (IFS I), Crop + Vegetable integrated farming system (IFS II), Crop + Fruit crop integrated farming system (IFS III), and Crop + Livestock integrated farming system (IFS IV). The highest per hectare total cost was recorded in the Crop + Fruit crop system (Rs. 772,825.53), while the Crop + Livestock system followed at Rs. 678,409.75. The Crop + Fruit crop system also yielded the highest gross returns (Rs. 1,069,078.34), followed closely by the Crop + Livestock system (Rs. 1,042,461.70). However, the highest net returns were observed in the Crop + Livestock system (Rs. 363,421.95), with a B:C ratio of 1.54, indicating superior profitability compared to other systems. Additionally, the sustainability value index (SVI) revealed that the Crop + Livestock system is the most sustainable (0.72). Therefore, it is concluded that the Crop + Livestock integrated farming system is both more profitable and sustainable in the Eastern Vidarbha Zone. There is significant potential to increase farm income in the Eastern Vidarbha zone by promoting integrated farming systems that combine livestock enterprises with agronomical crops, particularly in areas with paddy-based cultivation.

Keywords: Integrated farming system, gross returns, net returns, sustainability value index (SVI), paddy-based cultivation

Introduction

India's economy is predominantly driven by agriculture, with small and marginal farmers at its core. These farmers make up 86.2% of the total farming community but control only 47.3% of the operational land, as reported in the 10th Agricultural Census (2015-16). Over the decades, the average size of land holdings has significantly decreased, from 2.28 hectares in 1970-71 to just 1.08 hectares in 2015-16. This decline, particularly pronounced in states like Bihar and Kerala, is attributed to population pressures on limited arable land.

Since the Green Revolution, Indian farmers have largely shifted towards single enterprise-based agricultural systems, which has led to deteriorating soil health, increased risk of crop failure, and declining productivity. As population growth, urbanization, and income levels rise, the demand for animal-based food products is also increasing, further intensifying the competition between crop cultivation and livestock production. This situation highlights the urgent need for a systems-based approach that can meet the growing food demand without disrupting ecological balance.

The integrated farming system (IFS) presents a promising solution for addressing these challenges, particularly for small and marginal farmers with limited resources. It offers a sustainable way to enhance productivity, reduce dependence on chemical fertilizers, and ensure ecological soundness. Additionally, it promotes efficient resource management and supports income stability and nutritional security for farmers. Recognizing its potential, the Government of India, through the Ministry of Agriculture and Farmers' Welfare, has emphasized the importance of IFS in its goal to double farmers' incomes by 2022. However, the successful implementation of IFS requires a more scientific and systematic approach to understanding the

interactions between different agricultural components for improved food security.

The Integrated Farming System (IFS) offers significant potential in terms of both productivity and profitability. By intensifying crop and allied enterprises, IFS allows farmers to increase economic yield per unit of area and time. In terms of profitability, IFS promotes the efficient use of resources, where waste from one component can be repurposed for another. For instance, dairy animal dung can be used to produce compost for crop production, reducing reliance on chemical fertilizers and lowering cultivation costs. This approach manages waste effectively and enhances farm sustainability and economic efficiency.

Objectives

1. To identify the existing integrated farming system in Eastern Vidarbha Zone
2. To estimate the cost and returns of the Integrated Farming System
3. To estimate the sustainability value index of an integrated farming system

Methodology

The present investigation was carried out to evaluate the integrated farming system in Eastern Vidarbha Zone. The present study was undertaken in the Nagpur and Bhandara districts of the Eastern Vidarbha region, which were purposely selected due to their predominant paddy-based cultivation practices. The selection of tahsil depends upon the potential area under an integrated farming system. In Nagpur district, one tahsil, Bhiwapur, was selected, and in Bhandara district, three tahsils, Tumsar, Lakhani, and Sakoli, were selected for study. A total of 90 farmers were selected from the two districts, with 45 farmers from each district. In the Nagpur district, 45 farmers were selected from two villages in the Bhiwapur tehsil. In the Bhandara district, 10 farmers were selected from one village in the Tumsar tehsil, 20 farmers from one village in the Lakhani tehsil, and 15 farmers from one village in the Sakoli tehsil.

To accomplish the objectives of the study, the standard cost concepts were used, and cost cost-benefit analysis was carried out from the selected integrated farming systems to arrive at a meaningful conclusion.

Cost Concept

For the calculation of the cost of cultivation of crops of the integrated farming system, the standard cost concept was used according to various integrated farming systems. Similarly different types of cost like variable cost, fixed cost, and total cost ect, for calculation of livestock rearing and economics has been interpreted accordingly.

Sustainability Value Index

The sustainability of a farming system was evaluated using the Sustainability Value Index (SVI). This index is determined by calculating the ratio of the absolute difference between the Average Net Income (ANI) and the 1.96 times standard deviation of ANI, relative to the maximum net income over the entire period. The formula used to calculate the SVI can be

given as:

$$SVI = [ANI - (1.96 * SD)] / [MNI].$$

Where,

SVI = Sustainability value index

ANI = Average Net Income

MNI = Maximum net income

SD = Standard deviation

The value of SVI calculated by this formula lies between 0 to 1. A value of SVI near to zero indicates that the integrated farming system is not sustainable while a value of SVI near to one suggests that the integrated farming system is sustainable (Kiresur *et al.*, 2010) [3].

Results and Discussion

Identification of farming systems in selected districts

The integrated farming system in study area was identified and presented in Table 1.

Table 1: Identification of Integrated Farming System

Sr. No.	Integrated Farming System	No. of Farmers
1	Crop (IFS I)	26
2	Crop +vegetable (IFS II)	30
3	Crop + fruit crop (IFS III)	7
4	Crop + Livestock (IFS IV)	27
	Total Farmers	90

From Table 1 it was revealed that 26 farmers from the crop integrated farming system, 30 farmers from the crop + vegetable integrated farming system, 7 farmers from the crop + fruit crop integrated farming system, and 27 farmers from the crop + livestock integrated farming system were taken for the study.

Economics of the integrated farming system

The economics of selected farming systems were worked out by using standard cost concepts and the results obtained were presented in tables mention below from Table 2 to 7.

Economics of Crop integrated farming systems (IFS I)

The costs and returns of different enterprises under the Crop integrated farming system in the study area and the share of cost and returns of each enterprise in the whole farming system were presented in Table 2.1. It is observed from the table that the gross returns of the Crop integrated farming system as a whole was Rs. 542504.81, the net returns Rs. 128378.11, and the benefit-cost ratio was 1.31. It is also revealed from the table that from different crop enterprises the highest net returns was observed from the paddy crop i.e. Rs. 93841.51, followed by cotton and gram crop i.e. Rs. 48996.67 and Rs. 19274.10 respectively. In this integrated farming system, the gross returns was highest in the cotton crop Rs. 164513.93, followed by paddy and gram crop i.e. Rs. 114349.67 and Rs. 113493.75 respectively. The B: C ratio indicates the profitability of the crop. The highest B:C ratio was observed in cotton i.e. 1.42 followed by soybean and wheat i.e. 1.38 and 1.34 respectively.

Table 2: Economics of Crop integrated farming system (IFS I) (Rs/ha)

Particular	Total cost	Gross returns	Net returns	B:C Ratio
Paddy	93901.97 (22.67)	114349.67 (21.08)	93841.51 (73.10)	1.21
Soyabean	58501.21 (14.13)	81192.94 (14.97)	22691.73 (17.68)	1.38
Cotton	11517.25 (2.78)	164513.93 (30.32)	48996.67 (38.17)	1.42
Gram	94219.64 (22.75)	113493.75 (20.92)	19274.10 (15.01)	1.2
Wheat	51356.60 (12.40)	68954.50 (12.71)	17597.90 (13.71)	1.34
Overall	414126.70 (100.00)	542504.81 (100.00)	128378.11 (100.00)	1.31

Economics of Crop + Vegetable integrated farming system (IFS II)

The costs and returns of different enterprises under the Crop + Vegetable integrated farming system in the study area and the share of cost and returns of each enterprise in the whole farming system were presented in Table 3. It is revealed from the table that gross returns and net returns from the Crop + Vegetable integrated farming system as a whole is Rs. 789107.30 and Rs. 228591.77 respectively, and the B: C ratio is 1.41. It is observed in the table that gross returns are highest in tomato i.e. Rs. 302128.75, followed by paddy and gram crops i.e. Rs. 114349.67, and Rs. 113493.75 respectively. Net returns highest in tomato i.e. Rs. 132564.82 followed by cotton and soybean crops i.e. Rs. 49182.12, and Rs. 22582.11 respectively. In this integrated farming system benefit-cost ratio is highest in tomato i.e. 1.78, followed by cotton and soybean enterprises i.e. 1.42 and 1.38 respectively.

Table 3: Economics of Crop + Vegetable Integrated Farming System (IFS II) (Rs/ha)

Particular	Total cost	Gross returns	Net returns	B:C Ratio
Paddy	93805.60 (16.74)	114349.67 (14.49)	20544.11 (8.99)	1.21
Soybean	58610.80 (10.46)	81192.94 (10.29)	22582.11 (9.88)	1.38
Cotton	115332.00 (20.58)	164513.93 (20.85)	49182.12 (21.52)	1.42
Gram	94398.70 (16.84)	113493.75 (14.38)	19095.02 (8.35)	1.20
Wheat	51275.20 (9.15)	68953.05 (8.74)	17677.80 (7.73)	1.34
Chilli	92231.20 (16.45)	108989.12 (13.81)	16757.89 (7.33)	1.18
Tomato	169563.92 (30.25)	302128.75 (38.29)	132564.82 (57.99)	1.78
Overall	560515.53 (100.00)	789107.30 (100.00)	228591.77 (100.00)	1.41

Economics of Crop + Fruit Crop integrated farming system (IFS III)

The costs and returns of different enterprises under the Crop + Fruit crop farming system in the study area and the share of cost and returns of each enterprise in the whole farming system were presented in Table 4. It is revealed from the table that gross returns and net returns from the Crop + Fruit crop integrated farming system as a whole is Rs. 1069078.34, and Rs.

296252.79 respectively, and the B: C ratio is 1.38. It is observed from the table that gross returns are highest in orange i.e. Rs. 526575.00, followed by cotton and paddy crops i.e. Rs. 164513.93 and Rs. 114349.67 respectively. Net returns highest in orange i.e. Rs. 182203.40 followed by cotton and soybean crops i.e. Rs. 49170.12, and Rs. 20779.42 respectively. In this integrated farming system benefit-cost ratio is highest in orange i.e. 1.52, followed by cotton and soybean enterprise i.e. 1.42 and 1.34 respectively.

Table 4: Economics of Crop + Fruit crop integrated farming system (IFS III) (Rs/ha)

Particular	Total cost	Gross returns	Net returns	B:C Ratio
Paddy	94374.58 (12.37)	114349.67 (10.69)	19975.09 (6.51)	1.21
Soyabean	60413.53 (7.92)	81192.94 (7.59)	20779.42 (6.77)	1.34
Cotton	115343.80 (15.12)	164513.93 (15.38)	49170.12 (16.03)	1.42
Gram	106931.67 (13.83)	113493.75 (10.61)	6562.07 (2.21)	1.06
Wheat	51390.36 (6.64)	68953.05 (6.44)	17562.68 (5.92)	1.34
Orange	344371.6 (45.16)	526575 (49.25)	182203.4 (59.40)	1.52
Overall	762390.23 (100.00)	1069078.34 (100.00)	306688.10 (100.00)	1.38

Economics of Crop + Livestock integrated farming system (IFS IV)

The costs and returns of different enterprises under the Crop + Livestock integrated farming system in the study area and the share of cost and returns of each enterprise in the whole farming system were presented in Table 5. It is revealed from the table that in Crop + Livestock integrated farming system as whole gross returns i.e. Rs. 1042461.68, net returns i.e. Rs. 364051.90, and B: C ratio is 1.54. It is also observed from the table that among different enterprises, the highest net returns were observed from livestock enterprises Rs. 134709.80 followed by summer paddy and cotton enterprises i.e. Rs. 99645.12, Rs. 49214.73 respectively. Among the different enterprises highest gross returns observed from livestock enterprise was Rs. 310614.00 followed by summer paddy and paddy enterprises i.e. Rs. 189344.35, and Rs. 114349.67 respectively. The benefit-cost ratio was highest in summer paddy enterprise i.e. 2.11, followed by livestock and cotton crop i.e. 1.76 and 1.42 respectively.

Table 5: Economics of Crop + Livestock integrated farming system (IFS IV) (Rs/ha)

Particular	Total cost	Gross returns	Net returns	B:C Ratio
Paddy	93803.54 (13.82)	114349.67 (10.96)	20546.13 (5.64)	1.21
Soybean	58398.10 (8.60)	81192.94 (7.78)	22794.84 (6.26)	1.39
Cotton	115299.20 (16.99)	164513.93 (15.78)	49214.73 (13.51)	1.42
Gram	93974.29 (13.85)	113493.74 (10.88)	19519.45 (5.36)	1.2
Wheat	51331.21 (7.56)	68953.05 (6.61)	17621.83 (4.84)	1.34
Summer Paddy	89699.20 (13.22)	189344.35 (18.16)	99645.12 (27.37)	2.11
Livestock	175904.19 (25.92)	310614.00 (29.79)	134709.80 (37.00)	1.76
Overall	678409.73 (100.00)	1042461.68 (100.00)	364051.90 (100.00)	1.54

Cost and returns of integrated farming systems

A study on the economics of farming systems helps to understand the profitability and selection of appropriate farming systems on the farm. The data on cost and returns on various farming systems are presented in Table 6.

Table 6: Cost and returns of various integrated farming systems (Rs/ha)

Sr. No.	Particulars	Integrated Farming systems			
		IFS I	IFS II	IFS III	IFS IV
1	Value of Main Produce	534204.32	780808.26	1060779.32	718304.79
2	Value of By-Product	8300.50	8299.04	8299.03	13542.91
3	Gross Returns	542504.81	789107.30	1069078.35	1042461.70
4	Cost of Cultivation at				
	Cost A	289580.89	375448.73	549452.66	505308.91
	Cost B	380582.20	507469.03	728811.03	473541.06
	Cost C	414126.70	560515.53	772825.53	678409.75
5	Net Returns at				
	Cost A	252923.93	413658.57	519625.69	537152.78
	Cost B	161922.61	281638.27	340267.31	568920.64
	Cost C	128378.11	789107.30	296252.81	364051.95
6	Benefit-Cost ratio at				
	Cost A	1.87	2.10	1.94	2.06
	Cost B	1.43	1.55	1.46	2.20
	Cost C	1.31	1.41	1.38	1.54

Comparative economics of selected integrated farming system

The six farming systems identified as major farming systems across the study area, irrespective of the district are compared

It is revealed from the table that, in the Crop integrated farming system average gross returns worked out to Rs. 542504.81. The net returns obtained at various costs were Rs. 252923.93 at cost A, Rs. 161922.61 at cost B, and Rs. 128378.11 at cost C. In the Crop + Vegetable integrated farming system average gross returns worked out to Rs. 789107.30. The net returns obtained at various costs were Rs. 413658.57 at cost A, Rs. 281638.27 at cost B, and Rs. 789107.30 at cost C. The average gross returns in the Crop + Fruit crop farming system were Rs.1069078.35. The net returns obtained at various costs were Rs. 519625.69 at cost A, Rs. 340267.31 at cost B, and Rs. 296252.81 at cost C. In the Crop + Livestock farming system average gross returns worked out to Rs. 1042461.70. The net returns obtained at various costs were Rs. 537152.79 at cost A, Rs. 568920.64 at cost B, and Rs. 363421.95 at cost C.

The highest net returns at cost C was recorded in the Crop + Vegetable integrated farming system i.e. Rs. 789107.30 followed by the Crop + Livestock integrated farming system i.e. Rs. 363421.95. Among the integrated farming systems, the B:C ratio was observed highest at cost C i.e. 1.54 in the Crop + Livestock integrated farming system followed by Crop + Vegetable integrated farming system, and Crop + Fruit integrated farming system i.e. 1.41 and 1.38 respectively. Hence Crop + Vegetable + Livestock integrated farming system was more profitable than the other five integrated farming systems.

for their returns generating capacity, costs involved, net returns, and benefit-cost ratio. The outcomes of the analysis are presented in Table 7.

Table 7: Comparative economics of selected integrated farming systems as a whole (Rs./ha)

Particulars	Total Cost	Gross Returns	Net Returns	B:C Ratio
IFS I (Crop)	414126.70 (17.07)	542504.81 (15.76)	128378.11 (12.64)	1.31
IFS II (C+V)	560515.53 (23.11)	789107.30 (22.92)	228591.77 (22.50)	1.41
IFS III (C+F)	772825.53 (31.86)	1069078.34 (31.05)	295622.82 (29.10)	1.38
IFS IV (C+L)	678409.75 (27.97)	1042461.70 (30.28)	363421.95 (35.77)	1.54
Total	2425877.51 (100.00)	3443152.15 (100.00)	1016014.65 (100.00)	1.42

Table 7 reveals that the per hectare total cost was the highest in the Crop + Fruit integrated farming system i.e. Rs. 772825.53 followed by Crop + Livestock i.e. Rs. 678409.75 and Crop + Vegetable crop i.e. Rs. 560515.53. Among the systems, the highest per hectare gross returns was observed in the Crop + Fruit integrated farming system i.e. 1069078.34 followed by Crop + Livestock and Crop + Vegetable integrated farming system i.e. Rs. 1042461.70, and 789107.30. The net returns was highest in Crop + Livestock i.e. Rs. 363421.95, followed by Crop + Fruit i.e. Rs. 295622.82, and Crop + Vegetable i.e. Rs. 228591.77. Also, the B:C ratio was the highest in Crop + Livestock integrated farming system i.e. 1.54 followed by Crop + Vegetable integrated farming system i.e. 1.41, and the Crop + Fruit integrated farming system i.e. 1.38. It is calculated based on income on the hectare of agricultural land of each farming system and the number of animal units that exist in respective integrated farming systems. It is seen from the table that among the selected integrated farming systems the farmer practicing the Crop + Livestock integrated farming system has fetched the highest returns. It is suggested that to improve the economic condition of selected farmers, they should establish livestock unit as subsidiary occupation in addition to crops. Similar results were observed by Nalinashree *et al.* (2024) [5].

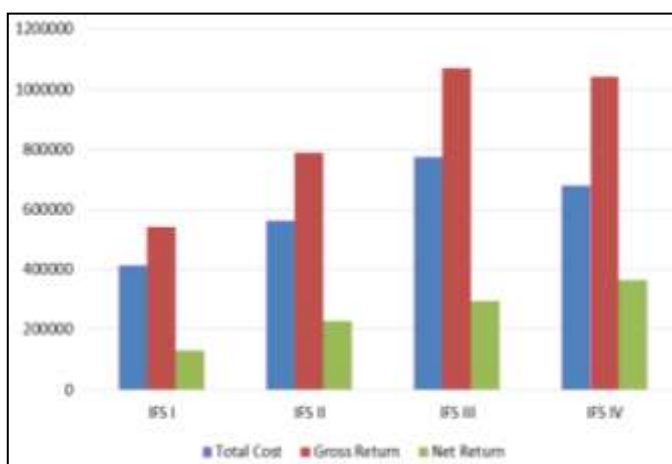


Fig 1: Cost and returns of different Integrated Farming Systems

Sustainability Value Index of different integrated farming systems

In an integrated farming system, various components are integrated therefore the assessment for income obtained from the different IFS plays a significant role. The maximum sustained income is desired. The sustainable value index is given in Table 2.7.

Table 8: Sustainability Value Index of different integrated farming systems

Particulars	ANI	MNI	SVI
IFS I	128378.11	136754.23	0.21
IFS II	228591.77	229512.34	0.56
IFS III	295622.82	358987.67	0.54
IFS IV	363421.95	363472.21	0.72
SD	100219.85		

The sustainability value index varied for different integrated farming systems. The sustainability value index (0.72) was higher in IFS IV: Crop + Livestock. It was followed by IFS II: Crop + Vegetable (0.56). The lowest sustainability value index (0.21) among the four IFS in the study with IFS I: Crop followed

by IFS III: Crop + Fruit (0.54). The trend for income sustainability was IFS IV > IFS II > IFS III > IFS I. The income sustainability in the crop integrated farming system was lower primarily due to fluctuating market prices during crop seasons, which resulted in reduced net returns. However, incorporating livestock into the system significantly stabilizes income sustainability. Despite the higher initial investment required for the livestock component, it offers the advantage of providing a steady, year-round income for the farm. Similar results were observed by Phuge *et al.* (2020) [6].

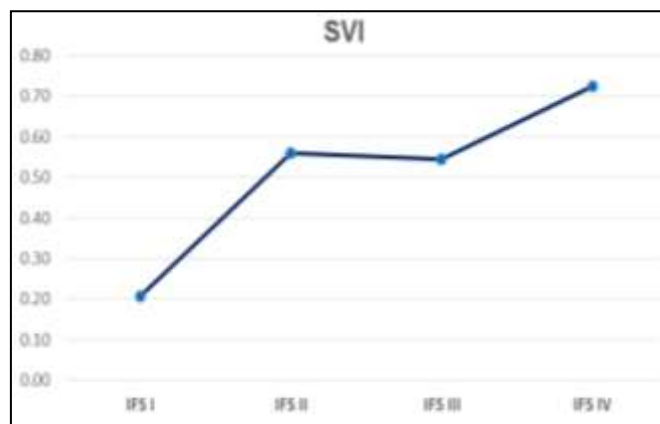


Fig 2: Sustainability Value Index of various Integrated Farming System

Conclusions

Based on the results obtained from the study, the following conclusions are drawn.

1. The four integrated farming systems were selected from the study area viz. Crop integrated farming system (IFS I), Crop + Vegetable integrated farming system (IFS II), Crop + Fruit crop integrated farming system (IFS III), and Crop + Livestock integrated farming system (IFS IV).
2. The per hectare total cost was highest in the Crop + Fruit crop integrated farming system (IFS I) i.e. Rs. 772825.53 followed by the Crop + Livestock integrated farming system (IFS IV) i.e. Rs. 678409.75.
3. Among the systems, the highest per hectare gross returns was observed in the Crop + Fruit crop integrated farming system (IFS III) i.e. Rs. 1069078.34 followed by the Crop + Livestock integrated farming system (IFS IV) i.e. Rs. 1042461.70.
4. The net returns was highest in Crop + Livestock integrated farming system (IFS IV) i.e. Rs. 363421.95 followed by Crop + Fruit crop integrated farming system (IFS III) i.e. Rs. 295622.82.
5. The B:C ratio of the Crop + Livestock integrated farming system is highest i.e. 1.54 followed by the Crop + Vegetable integrated farming system i.e. 1.41. Hence, the Crop + Livestock integrated farming system is more profitable than other integrated farming systems.
6. From the sustainability value index of integrated farming systems, it is observed that the most sustainable integrated farming system is the Crop + Livestock integrated farming system (IFS IV) i.e. 0.72 among all other integrated farming systems. Hence it is concluded that the Crop + Livestock integrated farming system is more profitable and sustainable in the Eastern Vidarbha Zone.

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