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Impact of Integrated Farming Systems on Agricultural Income in Bhadrak District, Odisha

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ABSTRACT: A study was conducted in core blocks (Chandbali, Dhamnagar and Dhusuri) of Bhadrak district of Odisha to evaluate the impact of integrated farming systems (IFS) on agricultural income. The objective of this study was to identify the most practiced IFS, evaluate the effectiveness of IFS and the problems and prospects of IFS farmers of Bhadrak district of Odisha. The primary data was collected by interacting with 110 farmers randomly using a well structured and pretested interview schedule. The percentage method was used for the farmers practicing various farming system. Economic viability was assessed through a comparative analysis of income generation where analytical tools such as benefit cost ratio, relative economic efficiency and marginal benefit cost ratio was used. Through this study, the challenges faced by farmers in adopting and implementing IFS was identified and ranked with the help of Garrett's Ranking Technique. Out of the 6 identified IFS combinations, Crop - Dairy (FS-I) was highly practiced with 30 per cent of respondents involved and the least practiced was Crop - Dairy - Fishery - Mushroom - Horticulture (FS-VI) with 2.73 per cent of respondents involved and was more profitable than other farming systems having BCR of 3.60 and relative economic efficiency of 198.33 per cent. The Farming System- VI (Crop - Dairy - Fishery - Mushroom - Horticulture) in one acre of land is significantly more profitable with marginal benefit cost ratio of 11.59 compared to Non-IFS farmers. Issues faced by the farmers such as "High cost of inputs to take up different farm enterprises", and "Scarcity and high cost of labour" was ranked I and II respectively. Ultimately, this research aims to enhance agricultural income, improve livelihoods, and foster sustainable rural development in Bhadrak district of Odisha and will contribute to policy and institutional support mechanisms required to promote and scale up IFS practices.

Keywords: IFS, Benefit cost ratio (BCR), Relative economic efficiency (REE), Marginal benefit cost ratio (MBCR).

INTRODUCTION

India is one of the developing economies with the greatest growth rates in the world, yet it still lags behind in providing better nutrition and a means of survival for small and marginal farmers. Despite the fact that 70% of the workforce is employed in agriculture and related industries, there are now widespread issues with resource management, employment generation, and food security. The condition of nutritional and livelihood issues must be addressed through the implementation of a sustainable agriculture system. The integrated farming system (IFS) is a sustainable agricultural method that integrates several farming operations into a unified system, fostering resource efficiency, diversity, and synergy between different components. In order to maximize productivity, increase environmental sustainability, and boost livelihoods, it involves the integration of crops, livestock, poultry, fisheries, and other agricultural operations. Traditional agricultural practices sometimes concentrate on a single crop or kind of animals, which reduces production and increases exposure to dangers. IFS, in contrast, takes a comprehensive and diverse strategy, relying on the interdependence of many parts to build a more robust and effective agricultural system. Maximizing resource use through integrating nutrient cycles, improving land use, and reducing waste is the fundamental tenet of IFS. For instance, agricultural wastes may be used as livestock feed while animal manure can be used as organic fertilizer for crop cultivation. IFS may be extremely helpful for India's small and marginal farmers in improving their economic status and way of life (Devendra and Thomas 2002; Singh *et al.*, 2006). Farmers may make money from a variety of sources, opening up chances for income diversification. As a result, the income

volatility of agricultural households is decreased, and general economic stability is improved. Additionally, IFS helps to increase food security by supplying a variety of agricultural goods all year long. In the coastal areas of Odisha, a state in eastern India, the adoption of Integrated Farming Systems (IFS) has attracted a lot of interest. Odisha's coastal regions have particular agricultural difficulties due to salty soil, a lack of water, and the growing effects of climate change leading to frequent natural disasters like cyclone, flood etc. The implementation of IFS has emerged as a sustainable and all-encompassing strategy to improve agricultural production and resilience in the coastal regions in response to these issues.

The future of studying Integrated Farming Systems is dynamic and wide-ranging, encompassing sustainability, resilience, technology integration, policy support, and more. IFS can address malnutrition and improve food security. As urbanization increases, there is potential for IFS to be adapted to urban and peri-urban contexts. Future studies can explore how IFS practices can be integrated into urban farming systems to increase local food production. Integrated farming can provide multiple income streams, reducing the dependency on a single crop or activity and can contribute to maintain biodiversity on farms. Integrated farming may lead to diverse products that require different market channels. Research can explore the development of value chains that accommodate IFS produce and connect farmers to broader markets.

The goal of integrated farming systems is to combine several aspects of agriculture, such as crop production, livestock care, fisheries, and agro forestry, into a seamless and mutually beneficial whole. IFS encourage resource conservation, maximize land use, and boost the general productivity and profitability of agricultural systems by integrating these many farming approaches. Farmers' reliance on a particular crop or activity is lessened through IFS, which also provides a varied revenue source for them. IFS is vital in helping the coastal districts of Odisha deal with issues that are unique to the area. Farmers may efficiently utilize water bodies and maximize the potential of the coastal ecology by integrating aquaculture and pisciculture methods into their agricultural system. Additionally, by integrating animal husbandry with crop development, it is possible to manage organic waste effectively, produce organic manure, and efficiently cycle nutrients, decreasing the need for chemical pesticides and fertilizers. For sustainable agriculture, the eradication of poverty, and improved lives for rural people, the application of IFS in the coastal regions of Odisha offers considerable potential.

The objectives of this study will be:

1. To explore the IFS that predominates in the Bhadrak area of Odisha.
2. To compare IFS's efficiency to that of traditional farming.
3. To pinpoint the issues and advantages IFS farmers have over traditional farms.

MATERIALS AND METHODS

To study the predominant IFS practiced in Puri district of Odisha, out of 7 coastal districts Bhadrak district was selected from which 3 blocks were selected randomly namely Chandbali, Dhamnagar and Dhusuri. The primary data was collected from 110 farmers practicing integrated farming system by survey method using a well-structured and pretested questionnaire. To minimize the errors, the quantitative data were collected in local units but later on they were converted into standard units. The major focus was on the type of Integrated farming systems adopted by different categories of farmers comprising marginal, small and medium type on their income.

Analytical framework and analytical tools

Ratio Measures. The ratio measures were used to analyze profitability of different farm enterprises adopted in different farming systems and the profitability of farm business as a whole. The measures were used to compare profitability, efficiency and superiority of enterprises and farming systems and helped in decision making process.

Benefit-Cost Ratio (BCR)

$$\text{BCR} = \frac{\text{Gross Income}}{\text{Total Variable Cost (TVC)}}$$

Relative Economic Efficiency

Farrell (1957) distinguished three types of efficiency, namely, technical efficiency, price or allocative efficiency, and economic efficiency (which is a combination of the first two). Economic efficiency is distinct from the other two efficiencies, even though it is the product of technical and allocative efficiencies. Relative economic efficiency, which is a comparative measure of economic gains, can be calculated by:

$$\text{REE} = \frac{\text{Net Income in IFS - Net Income in Single enterprise}}{\text{Net Income in Single enterprise}} \times 100$$

Marginal Benefit Cost Ratio (MBCR)

$$\text{MBCR} = \frac{\text{G.I of System A} - \text{G.I of System B}}{\text{Variable Cost of System A} - \text{Variable Cost of System B}}$$

Garrett's Ranking Technique. The Garrett's ranking technique (Garrett and Woodworth, 1969) was used for examination of constraints. It is important to note here that these constraints were focused on the response of all the sample farmers. The respondents were asked to rank the problems in adoption of Integrated Farming System in the study area. In the Garrett's ranking technique, these ranks were converted into percent position by using the formula:

$$\text{Percent position} = \frac{100(R_{ij} - 0.5)}{N_j}$$

Where,

R_{ij} = Ranking given to the i^{th} attribute by the j^{th} individual

N_j = Number of attributes ranked by the j^{th} individual.

By referring to the Garrett's table, the percentage positions estimated were converted into scores. Thus, for each factor, the scores of the various respondents

were added and the mean values were estimated. The mean values, thus, obtained for each of the attributes were arranged in descending order. The attributes with the highest mean value were considered as the most important one and the others followed in that order.

RESULTS AND DISCUSSIONS

A. Farming Systems and number of respondents in the sample farms

Out of 110 respondents 27.27 per cent of farmers were engaged in Non IFS (single crop) based farming. Out of the six farming systems 30 per cent practiced FS-II (Crop-Dairy) followed by 14.55 per cent practiced FS-III (Crop - Dairy - Horticulture) and 10.91 per cent farmers practiced FS-IV (Crop - Dairy - Poultry). The percentage of marginal farms was more in C, FS-I (Crop – Dairy) and FS-II (Crop – Poultry) was 21.54, 33.85 and 18.46 respectively. The respective figures for small farmers were 36.36, 24.24 and 18.19 in case of C, FS-I and FS-V. The percentage of large farms in C, FS-I and FS-III was 33.33, 25.00, and 16.67 respectively. In case of marginal farmers the number of farmers adopting different farming systems was 65 followed by 33 in case of small farmers and the lowest was 12 in case of large famers. The results are in line with the findings of Swain (2013) identified 4 IFS models in the Puri district of Odisha, Sahoo (2018) identified 6 IFS from 3 districts of Odisha respectively.

Table 1: Farming Systems and number of respondents in the sample farms.

Sr. No.	Type of Farming Systems	Code	Number of Respondents			Total Respondents	Percentage to total
			Marginal (<1 Ha)	Small (1-2 Ha)	Large (>2 Ha)		
1.	Crop	C	14(21.54)	12(36.36)	4(33.33)	30	27.27
2.	Crop - Dairy	FS-I	22(33.85)	8(24.24)	3(25.00)	33	30.00
3.	Crop - Poultry	FS-II	5(7.69)	0(0.00)	0(0.00)	5	4.55
4.	Crop - Dairy - Horticulture	FS-III	9(13.85)	5(15.15)	2(16.67)	16	14.55
5.	Crop - Dairy - Poultry	FS-IV	12(18.46)	0(0.00)	0(0.00)	12	10.91
6.	Dairy - Fishery	FS-V	3(4.62)	6(18.18)	2(16.67)	11	10.00
7.	Crop - Dairy - Fishery - Mushroom - Horticulture	FS-VI	0(0.00)	2(6.06)	1(8.33)	3	2.73
	Grand Total		**65(100.00)**	**33(100.00)**	**12(100.00)**	**110(100.00)**	**100**

(Figures in the parentheses indicate percentage)

The data showed in Table 2 indicates that the Farming System- IV (Crop - Dairy - Poultry) with less cost of cultivation of 16.13 per cent produces 80.33 per cent of income over Non-IFS systems. Farming system - VI (Crop - Dairy - Fishery - Mushroom – Horticulture) with having increased cost of cultivation of 19.54 per cent over non-IFS system produced 68.29 per cent gross income followed by FS-V (Dairy – Fishery) with percentage change of 24.15 per cent cost of cultivation with 38.36 per cent income over non-IFS system. The results are in line with the findings of Mukherjee (2015) where he reported that, in the mid-hill regions of West Bengal, India, farming systems involving crop + poultry + dairy + piggery enterprises had a positive advantage in terms of economic returns. They had high gross income (Rs. 101482/ha), net returns (Rs. 24935/ha), and sustainability (88.5%) in comparison with the crop-alone component (gross income Rs. 57589/ha, net returns Rs. 14002/ha and sustainability index 44.8%).

Table 2: Farming Systems and number of respondents in the sample farms.

Farming System Pairs	Total Cost (in Rs)		% change in IFS over Non-IFS	Gross Income (in Rs)		% change in IFS over Non-IFS
	IFS	Non- IFS		IFS	Non- IFS	
Crop - Dairy	95824	56404	69.89	242990	115252	110.83
Crop - Poultry	485450	56404	760.67	708225	115252	514.50
Crop - Dairy - Horticulture	71363	56404	26.52	213590	115252	85.32
Crop - Dairy - Poultry	65502	56404	16.13	207833	115252	80.33
Dairy - Fishery	70028	56404	24.15	159464	115252	38.36
Crop - Dairy - Fishery - Mushroom - Horticulture	67428	56404	19.54	193952	115252	68.29

B. Profit structure of different IFS per year per acre over Non IFS

The data showed that the Farming System- VI (Crop - Dairy - Fishery - Mushroom - Horticulture) in one acre of land is more profitable with BCR 3.60 and relative economic efficiency of 198.33 followed by Crop - Dairy - Poultry with BCR 3.17 and Crop - Dairy - Horticulture with BCR 2.99 of REE 141.68. The results are in line with the findings of Panwar (2014) where he integrated crop sequences with animal components that improved the system profitability in totality even on small farms of 0.50 ha. Singh *et al*. (2012) comprised the components like crop, dairy, fishery, horticulture and apiary where he recorded higher productivity,

profitability and employment generation. The study also revealed that farm enterprise II (Crop - Poultry) was the least profitable enterprise out of 6 farming systems with a BC ratio of 1.46 and REE of 278.56.

C. Marginal Benefit Cost Ratio (MBCR) of different IFS vs. Non-IFS

The data showed that the Farming System- VI (Crop - Dairy - Fishery - Mushroom - Horticulture) in one acre of land is significantly more profitable with MBCR 11.59 followed by Crop - Dairy - Poultry (FS-IV) with MBCR 10.18 and FS-III with MBCR of 6.57 over Non IFS farmers. The results with least return were FS-II with MBCR of 1.38. The findings are in line with Swain (2013).

D. Constraints faced by the IFS adopted farmers

The findings relating to constraints faced by the IFS adopted farmers have been summarized in Table 5. The majority of the respondents reported "High cost of inputs to take up different farm enterprises" with an average score of 70.03, ranked I. "Scarcity and high cost of labour" was ranked II and "Management of subsidiary enterprises like dairy, sheep and goat units" was ranked III. As per the data collected, "Lack of marketing facilities" and "Lack of access to information and extension services" and "Exploitation by middlemen at local level" are ranked IX, VIII and VII respectively are the least as per the respondents. The low ranks possess very less impact on the respondents.

The above findings are in the findings below are in line with the findings of Sanketh *et al.* (2019) where the major constraints faced by the farm innovators were lack of technical guidance, Lack of financial support, and Less documentation work. Ramya *et al.* (2021) study revealed the major such as Lack of remunerative prices for farm produce, long working hours, High cost of inputs to take up different farm enterprises. According to Pandey *et al.* (2019), the financial constraints such as lack of required finance and high cost of inputs emerged as major limitations in adopting crop-livestock integrated system in Madhya Pradesh.

Table 3: Profit structure of different IFS per year per acre over Non IFS.

Sr. No.	Type of Farming Systems	Variable Cost	Gross Income	Net Returns	BCR	REE
1.	Crop - Dairy	95824	242990	147166	2.54	150.08
2.	Crop - Poultry	485450	208225	222775	1.46	278.56
3.	Crop - Dairy - Horticulture	71363	213590	142227	2.99	141.68
4.	Crop - Dairy - Poultry	65502	207833	142331	3.17	141.86
5.	Dairy - Fishery	70028	159464	89436	2.28	51.98
6.	Crop - Dairy - Fishery - Mushroom - Horticulture	67428	242990	175562	3.60	198.33

Table 4: Marginal Benefit Cost Ratio (MBCR) of different IFS vs. Non-IFS.

Farming Systems	G.I. of System A	G.I. of System B	G.I. (B-A)	V.C. of System A	V.C. of System B	V.C. (B-A)	MBCR
Non- IFS (A) Vs. FS-I (B)	115252	242990	127738	56404	95824	39420	3.24
Non- IFS (A) Vs. FS-II (B)	115252	708225	592973	56404	485450	429046	1.38
Non- IFS (A) Vs. FS-III (B)	115252	213590	98338	56404	71363	14959	6.57
Non- IFS (A) Vs. FS-IV (B)	115252	207833	92581	56404	65502	9098	10.18
Non- IFS (A) Vs. FS-V (B)	115252	159464	44212	56404	70028	13624	3.25
Non- IFS (A) Vs. FS-VI (B)	115252	242990	127738	56404	67428	11024	11.59

Table 5: Constraints faced by the IFS adopted farmers (n=110).

Sr. No.	Constraints	Total	Average score	Garrett Rank
1.	Scarcity and high cost of labour	2100	67.74	II
2.	Management of subsidiary enterprises like dairy, sheep and goat units	1964	63.35	III
3.	Lack of marketing facilities	957	30.87	IX
4.	Lack of remunerative prices for farm produce	1282	41.35	VI
5.	High cost of inputs to take up different farm enterprises	2171	70.03	I
6.	Lack of remunerative prices for farm produce	1684	54.32	IV
7.	Lack of access to information and extension services	993	32.03	VIII
8.	Impact of natural calamities every year	1613	52.03	V
9.	Exploitation by middlemen at local level	1222	39.42	VII

CONCLUSIONS

The purpose of this study was to analyze the most practiced Integrated Farming Systems in Bhadrak district of Odisha. Efforts were made to systematically collate the data and analyze the share of each component in different farming systems. Preliminary findings indicate that IFS implementation in the coastal district of Odisha has demonstrated major economic outcomes from various farming systems. Out of numerous farming systems practiced only six (FS-I, FS-II, FS-III, FS-IV, FS-V and FS-VI) were selected which were more sustainable and economically viable farming systems, capable of addressing the challenges posed by climate change, resource limitations, and market dynamics in Odisha conditions. The study suggests that the adoption of IFS (FS-IV, FS-III and FS-VI) can have a significant increase in farm income and can promote resilience in the face of disasters and climate change. Major constraints faced by IFS respondents over non IFS farmers were "High cost of inputs to take up different farm enterprises", "Scarcity and high cost of labour" and "Management of subsidiary enterprises like dairy, sheep and goat units". Therefore, there is a need for policymakers to promote IFS and provide the necessary support to farmers to adopt this sustainable and resilient agricultural approach.

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Conflict of Interest. None.

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