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Economic evaluation of different integrated farming system modules under irrigated and dryland situations

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ABSTRACT

Integrated Farming System (IFS) is considered a sustainable and economically viable approach for enhancing farm productivity, profitability and livelihood security through the integration of different agricultural enterprises. However, the economic performance and suitability of IFS modules may vary with different modules considerably depending on resource availability and farming conditions, particularly under irrigated and dryland situations. The present study, entitled, Economic Evaluation of Different Integrated Farming System Modules under Irrigated and Dryland Situations, aims to analyse and compare the economic performance of different IFS modules practised by farmers under different conditions in north-eastern transition zone of *Karnataka*. The study will focus on identifying the major IFS modules, assessing enterprise-wise costs and returns and evaluating their overall economic viability. Key economic indicators, including total cost of production, total returns and benefit-cost ratio, the contribution of individual enterprises to total farm income, will be considered for the analysis. A total of four anticipated Integrated Farming System (IFS) modules were analysed under irrigated and dryland conditions. Under irrigated conditions, the Crop + Horticulture + Livestock + Forestry module recorded the highest benefit-cost (B:C) ratio, followed by Crop + Livestock + Forestry, Crop + Horticulture + Forestry, and Crop + Horticulture + Livestock modules. Under dryland conditions, the Crop + Livestock + Forestry module recorded the highest benefit-cost (B:C) ratio, followed by the Crop + Livestock and Crop + Horticulture + Forestry modules. A total of five Integrated Farming System (IFS) modules were analysed under irrigated and dryland conditions. Under irrigated conditions, the crop + dairy + sheep/goat module recorded the highest benefit-cost (B:C) ratio, followed by crop + dairy + forestry and crop + dairy + poultry modules. Under dryland conditions, the Crop + sheep/goat module recorded the highest benefit-cost (B:C) ratio, followed by the crop + dairy and crop + forestry modules. The comparative analysis was shown variations in the economic returns of different IFS modules under irrigated and dryland conditions. The findings of the study may help identify economically viable, resource-efficient and location-specific IFS modules suitable for different farming situations. The study is expected to provide valuable insights for farmers, extension professionals, researchers, and policymakers in promoting suitable enterprise combinations for enhancing farm income, generating employment, reducing production risks and ensuring sustainable agricultural development.

Keywords: IFS, Dryland, Irrigated, Modules, B:C ratio, Economic, Income

Introduction

Agriculture continues to play an important role in the livelihood and economic development of rural communities in India. However, the agricultural sector is increasingly facing challenges such as declining farm profitability, fragmentation of landholdings, degradation of natural resources, climate variability, rising input costs and uncertainty in agricultural markets. These challenges are particularly significant for small and marginal farmers, who often depend on a single crop or enterprise for their livelihood. Therefore, there is a need to adopt sustainable and economically viable farming approaches that can ensure regular income, efficient utilization of available resources and improved livelihood security. The Integrated Farming Systems (IFS) are considered a promising approach to address these challenges. IFS involves the combination of different agricultural enterprises such as crops, livestock, dairy, poultry, fisheries, horticulture, agroforestry and other farm-based activities within a single farming system. The major principle of IFS is the efficient utilization and recycling of resources and by-products among different enterprises. For example, crop residues can be used as livestock feed, while livestock waste can be recycled as organic manure for crop production. Such integration helps in reducing production costs, minimizing waste, improving soil fertility, enhancing resource-use efficiency and generating multiple sources of income for farm households. The selection and economic performance of IFS modules largely depend on the availability of natural resources, particularly water. Irrigated and dryland farming systems differ considerably in terms of resource availability, cropping patterns, enterprise combinations, productivity and income-generating opportunities. Irrigated areas generally provide greater scope for crop diversification and the integration of enterprises such

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as dairy, horticulture, forestry and intensive cropping systems. In contrast, dryland areas are characterized by limited and uncertain rainfall, moisture stress and greater production risks. Therefore, dryland farmers require farming systems that are resilient, resource-efficient and capable of providing stable income under adverse climatic conditions. Enterprises such as drought-tolerant crops, small ruminants, poultry, agroforestry and other low-water-requiring components may be more suitable for dryland farming situations. The economic viability of an Integrated Farming System depends on the appropriate combination of enterprises and their interaction with one another. A successful IFS module should enhance farm productivity and also provide higher net returns, improved benefit–cost ratios, regular employment opportunities and greater income stability. Different IFS modules may perform differently under different conditions because of variations in resource availability and production environments. Hence, a systematic comparison of the economics of various IFS modules is essential to identify the most profitable, sustainable and location-specific farming systems.

Comparative economic analysis provides valuable information regarding the costs and returns associated with different farming enterprises and their combinations. Parameters such as total costs, total returns and benefit–cost ratio can be used to evaluate the cost of production and returns obtained from each IFS modules. Such an analysis can help farmers, researchers and policymakers identify suitable enterprise combinations for irrigated and dryland regions.

In this context, the existing study on “Economic Evaluation of Different Integrated Farming System Modules under Irrigated and Dryland Situations” is undertaken to assess and compare the economic performance of different IFS modules under varying resource situations. The findings of the study may contribute to the development of economically viable, sustainable and location-specific integrated farming strategies for improving farm income and livelihood security among farmers.

Materials and Methods

The investigation was carried out in the North-Eastern Transition Zone of *Karnataka*, an area characterized by the presence of diverse farming systems and both irrigated and dryland agricultural conditions. The study area was purposively selected considering the prevalence of different combinations of crop and allied enterprises and the availability of farmers practising diversified farming systems. The North-Eastern Transition Zone includes five taluks of Bidar district, namely Bidar, Humnabad, Bhalki, Basavakalyan and Aurad, and two taluks of Kalaburagi district, namely Chincholi and Aland. Among these seven taluks, Basavakalyan, Aland and Chincholi were identified as the dryland areas for the present investigation. Villages representing the selected farming situations were subsequently identified for the collection of primary information. A multistage sampling approach was employed to identify the respondents. Initially, 59 farmers practising the Crop + Livestock + Forestry (C+L+F) farming system were identified from the lists available under the RKVY and SCP/TSP projects, along with records maintained by the Krishi Vigyan Kendra (KVK) and Raitha Samparka Kendras (RSKs). In addition, information and suggestions were obtained from 90 farmers practising diversified IFS involving the major components of the farming system under dryland conditions.

Primary information was obtained using a pre-tested structured interview schedule through personal interviews with the selected respondents. An ex-post facto research design was adopted because the respondents had already established and were practising the different enterprises constituting their respective farming systems. Hence, the researcher did not manipulate or introduce any treatment but documented and analysed the existing farming practices and their economic characteristics.

Identification and classification of IFS modules

The existing enterprise combinations followed by the selected farmers were examined and grouped into distinct Integrated Farming System (IFS) modules according to the major enterprises included in each combination. The modules were classified separately for irrigated and dryland conditions. Based on the existing farming practices followed by the farmers, different combinations of enterprises were identified and classified into IFS modules. Under irrigated condition Crop + Dairy, Crop + Dairy + Sheep/Goat, Crop + Dairy + Poultry, Crop + Dairy + Horticulture and Crop + Dairy + Forestry were selected and under dryland condition Crop + Dairy, Crop + Sheep/Goat, Crop + Horticulture, Crop + Forestry. These enterprise combinations were subsequently used for analysing the cost, returns and economic efficiency of different IFS modules under irrigated and dryland farming situations.

Result and Discussion

The variation in the economic performance of individual IFS components can be attributed to differences in their production costs and income-generating potential. When these enterprises are combined into different IFS modules, the higher cost associated with some components is partly compensated by the greater returns generated by other components. Consequently, the variation in returns per rupee of investment among the different modules was relatively small. Overall, all the IFS modules evaluated in the study area generated returns greater than the investment, indicating their economic viability, although differences existed among the modules.

The cost and returns associated with the proposed Integrated Farming System (IFS) modules under irrigated and dryland conditions are presented in [Tables 1](#) and [Table 2](#). Under irrigated conditions, the crop + livestock + forestry (C+L+F) module recorded the highest return per rupee invested, with a value of 2.32. This was followed by the crop + horticulture + forestry (C+H+F) and crop + horticulture + livestock + forestry (C+H+L+F) modules, both of which recorded a return of 2.31 per rupee invested. The crop + horticulture + livestock (C+H+L) module registered a comparatively lower return of 2.22 per rupee invested. Under dryland conditions, the C+L+F module again recorded the highest return per rupee of investment (2.11), followed by the crop + livestock (C+L) module (2.00) and the C+H+L module (1.99). The crop + forestry (C+F) module recorded a return of 1.78 per rupee invested. The relatively higher returns observed in the integrated modules may be attributed to the complementary nature of different farm enterprises and the efficient utilisation of available farm resources. Integration of crops, horticulture, livestock and forestry provides opportunities for recycling farm by-products, reducing dependence on external inputs and generating income from multiple enterprises. Such diversification can also reduce the economic risk associated with dependence on a single farm enterprise, particularly under variable production and market conditions.

The economics of the major IFS sub-components, namely field crops, horticulture, dairy, sheep/goat, poultry and forestry, were analysed separately under irrigated and dryland conditions. The results are presented in [Tables 3](#) and [Table 4](#). Under irrigated conditions, the crop + dairy + sheep/goat (C+D+S/G) combination recorded the highest return per rupee invested (2.49), followed by the crop + dairy + forestry (C+D+F) module (2.47). The C+D+P and C+D modules each recorded a return of 2.42 per rupee invested, while the C+D+H module registered a return of 2.39.

Under dryland conditions, the crop + sheep/goat (C+S/G) module recorded the highest return per rupee of investment (2.19). This was followed by the crop + dairy (C+D) module, with a return of 1.76, and the crop + forestry (C+F) module, which recorded 1.59. The crop + horticulture (C+H) and crop + poultry (C+P) modules registered an identical return of 1.44 per rupee invested.

Table 1. Comparative economics assessment (anticipated) of integrated farming systems modules under irrigated condition (Rs/ha/annum)

Modules	Crop (2.12 ac)		Horticulture (0.28 ac)		*Livestock		**Forestry		Total Cost	Total Return	Returns/ rupee of investment
	Cost	Return	Cost	Return	Cost	Return	Cost	Return			
C+H+L	36170	74881	25164	56416	62359	143917	----	----	123693	275214	2.22
C+H+L+F	36170	74881	25164	56416	62359	143917	3226	17609	126919	292823	2.31
C+L+F	36170	74881	----	----	62359	143917	3226	17609	101755	236407	2.32
C+H+F	36170	74881	25164	56416	----	----	3226	17609	64560	148906	2.31

Note: C= crop, H=horticulture, L= livestock , F=forestry ---- = not practicing

Unit = * Livestock :- Poultry – up to 50 Birds/ unit, Sheep/goat – up to 10/ unit, Dairy = more than 1 cow/buffalo

** Forestry (no. of trees on bunds) :- Teak – 10, Neem – 6, Bamboos – 50

Table 2. Comparative economics assessment (anticipated) of integrated farming systems modules under dryland condition (Rs/ha/annum)

Modules (units)	Crop (2.30 ac)		Horticulture (0.10 ac)		*Livestock		**Forestry		Total Cost	Total Return	Returns/ rupee of investment
	Cost	Return	Cost	Return	Cost	Return	Cost	Return			
C+L	34292	49219	----	----	62359	143917	----	----	96651	193136	2.00
C+L+F	34292	49219	----	----	62359	143917	3226	17609	99877	210745	2.11
C+F	34292	49219	----	----	----	----	3226	17609	37518	66828	1.78
C+H+L	34292	49219	1100	1800	62359	143917	----	----	97751	194936	1.99

Note – C= crop, H=horticulture, L= livestock , F=forestry, ---- = not practicing

Unit = * Livestock :- Poultry – up to 50 Birds/ unit, Sheep/goat – up to 10/ unit, Dairy = more than 1 cow/buffalo

** Forestry (no. of trees on bunds) :- Teak – up to 10/Subabul – up to 25/Neem – up to 6/Bamboos – up to 50

Table 3. Economics assessment of different IFS modules under irrigated conditions (Rs/ha/annum)

Modules (unit)	No. of farm-ers	Crop (2.30 ac)		Dairy		**Sheep/Goat		*Poultry		Horticulture (0.10 ac)		***Forestry		Total Cost	Total Return	Returns/ rupee of investment
		Cost	Return	Cost	Return	Cost	Return	Cost	Return	Cost	Return	Cost	Return			
C+D	90	36170	74881	168490	420200	----	----	----	----	----	----	----	----	204660	495081	2.42
C+D+S/G	26	36170	74881	168490	420200	40650	115000	----	----	----	----	----	----	245310	610081	2.49
C+D+P	38	36170	74881	168490	420200	----	----	776	1280	----	----	----	----	205436	496361	2.42
C+D+H	88	36170	74881	168490	420200	----	----	----	----	88073	204212	----	----	292733	699293	2.39
C+D+F	78	36170	74881	168490	420200	----	----	----	----	----	----	3226	17609	207886	512690	2.47

Note – C= Crop, H=horticulture, L= livestock, D= Dairy, S/G+ Sheep/goat, P=Poultry, F=forestry, ---- = not practicing

*Poultry – 8 Birds/ unit, **Sheep/goat – 3/ unit, Dairy = 2 cow and 2 buffalo, ***Forestry (no. of trees on bunds) :- Teak – 10/ Neem –6/Bamboos – 25

(Rs/ha/annum)

Table 4. Economic assessment of different IFS modules under dryland condition

Modules (unit)	No. of farm-ers	Crop (2.30 ac)		*Dairy		**Sheep/Goat		***Poultry		Horticulture (0.10 ac)		****Forestry (Anticipated)		Total Cost	Total Return	Returns/ rupee of investment
		Cost	Return	Cost	Return	Cost	Return	Cost	Return	Cost	Return	Cost	Return			
C+D	9	34292	49219	27740	60000	----	----	----	----	----	----	----	----	62032	109219	1.76
C+S/G	79	34292	49219	----	----	40650	115000	--	--	--	--	--	--	74942	164219	2.19
C+P	36	34292	49219	----	----	----	----	388	640	----	----	----	----	34680	49859	1.44
C+H	9	34292	49219	----	----	----	----	----	----	1100	1800	----	----	35392	51019	1.44
C+F	66	34292	49219	----	----	----	----	----	----	----	----	775	1550	7800	35842	1.59

Note – C= crop, H=horticulture, L= livestock , D= Dairy, S/G+ Sheep/goat, P=Poultry, F=forestry, -- = not practicing

*Dairy = 1 cow/buffalo, **Sheep/goat – 3/ unit, ***Poultry – 8 Birds/ unit, ****Forestry (no. of trees on bunds) :- Teak – 5 trees/Neem – 3 trees.

(n = 180)

Table 5. Distribution of Farmers Based on Livestock Holdings across Irrigated and Dryland IFS

Condition	Category	Livestock possession (1)		Livestock possession (2 to 3)		Livestock possession (4 and above)	
		f	%	f	%	f	%
Dryland condition	Bullock	----	----	61	67.78	3	3.33
	Buffalo	5	5.55	----	----	----	----
	Cow	4	4.44	----	----	----	----
	Sheep/Goat	----	----	24	26.66	55	61.11
	Poultry	----	----	6	6.66	30	33.33
Irrigated condition	Bullock	----	----	40	44.44	11	12.22
	Buffalo	9	10.00	42	46.67	14	15.56
	Cow	14	15.56	23	25.56	15	16.67
	Sheep/Goat	3	3.33	15	16.67	21	23.33
	Poultry	----	----	10	11.11	28	31.11

Note: f=Frequency, %=Per cent, --= no possession

Table 6. Anticipated Cost and Returns of Livestock Components under Integrated Farming Systems

Livestock inventory	Cost of Production (Rs.)	Gross return (Rs.)	Net return (Rs.)	Returns/ rupee of investment
Local buffalo/cow	27740	60000	32260	2.16
Cross breed cow	46350	124400	78050	2.68
Buffalo breed	47200	117900	70700	2.50
Sheep/ Goat unit	135500	383333.3	247833.3	2.83
Poultry / unit	4850	8000	3150	1.65

Note: Poultry -50 birds/ unit, Sheep/goat -10/ unit, Dairy = 1 cow/buffalo

The relatively higher economic performance of the C+D+S/G module under irrigated conditions and the C+S/G module under dryland conditions suggests that sheep/goat enterprise contributed substantially to the profitability of the respective farming systems. Sheep and goats can provide regular income opportunities and can be integrated with crop production by utilising available farm resources. Their relatively lower space and feed requirements compared with some other livestock enterprises may also support their inclusion in diversified farming systems. In addition, demand for sheep and goat meat provides an important market opportunity for farm households. Therefore, the inclusion of sheep/goat enterprise may enhance the economic viability of IFS modules, particularly where suitable feed resources and labour are available.

Livestock possession pattern

The livestock possession pattern of farmers under the study is presented in Table 5. Among the farmers, 67.78 per cent possessed two to three bullocks, whereas 3.33 per cent possessed four or more bullocks. About 5.55 per cent of the respondents owned one buffalo, while 4.44 per cent possessed one cow. Sheep and goat ownership was relatively more common, with 61.11 per cent of farmers maintaining four or more animals, followed by 26.66 per cent possessing two to three animals. With regard to poultry, 33.33 per cent of farmers maintained four or more birds, whereas 6.66 per cent possessed two to three birds.

The corresponding livestock ownership pattern observed among another group/condition of farmers showed that 44.44 per cent possessed two to three bullocks, followed by 12.22 per cent who maintained more than three. Buffalo ownership was relatively higher, with 46.67 per cent of farmers possessing two to three buffaloes, while 15.56 per cent maintained four or more and 10.00 per cent possessed one buffalo.

Regarding cows, 25.56 per cent of farmers maintained two to three cows, followed by 16.67 per cent possessing four or more cows and 15.56 per cent owning one cow. In the case of sheep and goats, 23.33 per cent of farmers possessed four or more animals, while 16.67 per cent maintained two to three animals and only 3.33 per cent possessed

one animal. Poultry ownership showed that 31.11 per cent of farmers maintained four or more birds, whereas 11.11 per cent possessed two to three birds.

The number of livestock maintained by farm households appeared to be influenced by the availability of fodder, family labour and the overall resource base of the farming system. Dairy animals, poultry and sheep/goats were maintained not only for household requirements but also as sources of supplementary farm income. Farmers commonly utilised crop residues and other farm by-products as livestock feed, thereby improving resource-use efficiency within the farming system. Similarly, livestock dung and other organic wastes can be recycled as farmyard manure and composting material. Cow dung and urine may also be utilised in the preparation of farm-based inputs such as jeevamrutha and panchagavya.

Livestock therefore represents an important component of livelihood diversification among rural farm households. Bullocks continue to have utility in several farm operations, including ploughing, land levelling, furrow formation, sowing, weeding and transportation of compost and other farm materials. Thus, livestock contributes to the farming system through both direct income generation and the provision of farm services and organic resources.

Economics of individual livestock enterprises

The annual cost and return analysis of individual livestock enterprises is presented in Table 6. Among the enterprises evaluated, the sheep/goat enterprise recorded an annual production cost of ₹1,35,500 and a return of 2.68 per rupee invested. The crossbred cow enterprise also recorded a return of 2.68 per rupee, with an annual cost of ₹46,350. The corresponding return for the buffalo enterprise was 2.50 per rupee invested, against an annual cost of ₹47,200.

The local buffalo/cow enterprise recorded an annual cost of ₹27,740 and generated 2.16 per rupee invested. Poultry recorded the lowest annual cost among the enterprises considered (₹4,850) and generated a return of 1.65 per rupee invested. The results indicate that livestock enterprises differed considerably in both their annual cost requirements and economic returns. The variation may be related to differ

ences in input requirements, maintenance costs, productivity, market prices and the scale of operation of each enterprise.

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