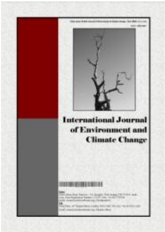

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Economic Analysis of Integrated Farming Systems in Mahbubnagar District of Southern Telangana Zone

P. Archana [a]*, Md. Ali Baba [a], K. Suhasini [a] and D. Srinivasa Chary [a]

[a] Department of Agricultural Economics, Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyd-500030, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Aim: Farmers followed integrated farming but not on a commercial scale with heightened practices. However, local level characterization of different farming systems were analyzed on how adoption of farming systems and which remunerative components can improve their income levels, in turn their livelihood sustainability particularly, small and marginal farmers.

Methodology: Mahbubnagar, a rainfed district of the state was chosen to understand the characterization of farming systems under resource poor conditions. Multistage sampling technique was used. Herfindahl index was calculated for selection of mandals. Two mandals, four villages from each mandal and 15 farmers @ each village, total 120 farmers were selected.

Results: Four major farming systems Crop, Crop -Cattle, Crop - Cattle - Goat, Crop - Cattle – Sheep labelled as (FS-I, FS-II, FS-III and FS-IV) were identified in the study area. FS-IV (1.81) was the most remunerative farming system. Even across different farmer sizes, it was found best with the highest Benefit-Cost ratio(B-C) ratios. The highest adoption percent was for FS-II (36.67%) followed by -I, III, IV (20.83 %), (19.2 %), (9.17%) respectively.

Of the integrated farming systems, the highest remunerative component was Cattle for FS-II. (Cattle >Goat> Crop) is the declining order of the remunerative components for FS-III. (Sheep >Crop > Cattle) is the order for FS-IV. Across different size-classes of farmers (marginal, small and semi-medium), in all FS-I was found least remunerative. They showed consistent declining order of

**Corresponding author: E-mail: archanapalamur27@gmail.com;*

remunerative systems (FS-IV >-II > -III >-I) for marginal farmers, small farmers (FS-II > -III >-I) and semi-medium farmers (FS-IV >-II > -III >-I)

Conclusion: IFS reaped higher returns than only crop farming system. Livestock components added more weightage on income yielded in each farming system. Across all farmers' classes, it is concluded that integration of different components enterprises increased the returns. Marginal and small farmers have better B-C ratios than semi-medium farmers in all farming systems.

Keywords: Integrated Farming Systems (IFS); remunerative components; remunerative farming system; marginal; small; semi medium farmers.

1. INTRODUCTION

Farmers in India, followed subsistence farming in the past with mere cultivation of plants and domestication of animals. It was later shifted to traditional farming where they used traditional seeds, farm practices with low mechanised tools, machines and more human labour and remained without any technological changes [1]. It produced low surplus and was sufficient enough to carry out minimal trade for the contemporary situations.

However, the traditional farming and non-uniformity of resource endowments led agriculture flourish only in certain productive areas. So, country couldn't cope up the drought and oversized population during 1965 - 1966 and caused the dearth of food. This led to the goal of self- sufficiency in food grain production [2]. Green revolution ushered this and whole focus was on high yielding varieties to increase farm productivity and to reach self-sufficiency. This led to the commercialisation of agriculture.

Meanwhile, there was change from traditional sustainable methods to monocropping and unsustainable practices [3]; it caused a collapse of agricultural systems in many regions [4] .The focus of farmers shifted towards monocropping and are still reluctant towards diversified farming and integrating practices for the problems of price volatility, increased climatic aberrations, market disruptions and low-size farm holdings etc., Though IFS, is an age-old practice still farmers did not heighten the integration practices.

Integrated Farming Systems (IFS) is a multidisciplinary whole farm approach [5] effective in addressing problems of small and marginal farmers by increasing income and employment by integrating various farm enterprises. It aims to improve the feasibility of small sized farming operations through integrated farming approach as compared with monoculture approaches [6]. IFS promoted with synergic blending of enterprises decreases cultivation cost and provides resilience for predicted climate change scenario [7].

There is potential for farmers to have a regular flow of income lifting them above the poverty line. There is convergence towards development of suitable location specific farm technology to raise and sustain the total farm productivity in terms of food, feed, fodder and fuel to meet the felt needs of the farming community. IFS is a powerful tool [8], to enhance profitability, improve productivity and sustainability and is less risky when a well-designed [9] system is adopted. No single farm enterprise, such as a typical mono-cropping system, is likely to be able to sustain the small-holder farmer. Integrated farming systems (IFS) are less risky if managed efficiently [10].

Understanding this, National Mission for Sustainable Agriculture (NMSA) has formulated for enhancing agricultural productivity especially in rainfed areas focusing on integrated farming, water use efficiency, soil health management and synergizing resource conservation. Rainfed Area Development (RAD) component of (NMSA), will introduce appropriate farming systems by integrating multiple components of agriculture such as crops, horticulture, livestock, fishery, forestry with agro based income generating activities and value addition [11]. Besides, (NMSA) also provides 50% of input cost with permissible assistance of maximum 2 ha/ beneficiary for crop and livestock based farming systems [12].

Emphasising single component in rural areas, particularly, whose livelihood is threatened cannot lead to overall improvement of a household. So, keeping in view the overall need of the area,

available technological options, market accessibility both for input and produce etc., interventions in IFS mode (crop-livestock-aquaculture) were planned and demonstrated under National Agricultural Innovation Project (NAIP), supported by The World Bank and implemented by the Indian Council of Agricultural Research (2006-14), to enhance income of the rural people living in selected disadvantaged regions through technology led innovation systems [**13**].

The Government of India in its annual budget of 2016-17 also set a policy target of doubling farmer's income by 2022. The seven income enhancing sources were, increase in productivity of crops, increase in production of livestock, improvement in efficiency of input use that would save cost, increase in cropping intensity at farmers' field, diversification towards high value commodities, better remunerative price realized by farmers, and shifting way surplus labour (unproductive) from agriculture to nom-farm activities [14]. However, the above five strategies could be achieved to a certain extent by integrated farming approaches.

In this context, the study examines the major farming systems of the area, the remunerative components that make each Farming system viable. It also analyses remunerative farming systems for different farm classes.

2. MATERIALS AND METHODS

2.1 Methodology

In Telangana state, Mahbubnagar district being one of the largest districts in terms of area (2737.96 .00 sq.km) has a large number of small and marginal farmers with the low per capita availability of land. The share of land holdings of small and marginal farmers to the total land holdings is more than three-fold (76.57per cent) compared to other landholdings size categories of farmers.

Besides this, the district receives 749mm of average annual rainfall with the highest drought frequency, the lowest share of irrigated area (19per cent), lower productivity of major crops and low per-capita income (15380). All these factors make many of them resort to emigration to earn their living. In spite of all these, the district is endowed with rich livestock resources characterized by dairy animals, extensive sheep flock, etc. Thus, the potential to increase production and income in rainfed areas can be harnessed with Integrated Farming Systems (IFS) i.e., integrating both crop and livestock of the district.

The present study was undertaken to understand how farmers adopt different farming systems in the rainfed, drought-prone and poor resource endowment conditions. The map of the Mahbubnagar district is shown in Fig. 1. In the district, Hanwada and Gandeed mandals were chosen for economic analysis. Herfindahl index was calculated and mandals were selected based

on the values obtained. When the value of HI declines, crop diversification takes place and when value of HI increases, crop concentration takes place. Hanwada was selected as less diversified mandal which shows the value of 0.40 and Gandeed was selected as more diversified mandal which shows the value of 0.35.

Four villages from each mandal and @15 farmers from each village were selected randomly. The data was collected by personal interview with the aid of pre-tested schedules, from 120 farmers.

The data collected was analysed by working out simple averages, percentages and simple budgeting techniques.

2.2 Tabular Analysis

Tabular analysis involving descriptive statistics like mean, frequency, percentages and simple budgeting techniques were employed to analyze the data and to ascertain the cropping pattern, livestock possession, costs and returns of the farmers and farming systems.

2.3 Index Analysis

Index analysis was used to select the mandals of the district based on intensity of crop diversification to understand the characterization of cropping systems. The crop diversification was measured using Herfindahl Index (HI) which is given by formula … (1)

$$\text{HI} = \sum_1^n P_i^2 \quad (1)$$

where, Pi is the proportion of area under the ith crop. And Pi= Ai / $\sum_1^n A_i$

And Ai is the actual area

under ith crop, and $\sum_1^n A_i$ is the summation of area under all 'i' crops and i = 1,2, 3…., n.

When the value of HI declines, crop diversification takes place and when value of HI increases, crop concentration takes place.

Returns: The returns from all the enterprises were estimated at the actual price received by the farmer.

Gross returns: The total value of the main product and by-product was calculated as gross returns.

Net returns: Net returns were obtained by subtracting the total costs from gross returns.

Returns per rupee spent/ Benefit-Cost ratio: It is the returns realised per rupee spent on the enterprise.

It was calculated as gross returns to the total costs incurred. Returns per rupee spent = gross returns/ total cost.

3. RESULTS AND DISCUSSION

3.1 Different Farming Systems Adopted by Farmers in the Region

The farmers of the study area practiced different farming systems. Based on the criteria of integration of different farm enterprises into the system, they were identified and characterized into ten different farming systems. The different farming systems adopted by farmers in the region are given in the Table 1.

Among the ten identified farming systems of the area, four of them were majorly adopted and they comprise of Crop, Crop -Cattle, Crop - Cattle - Goat, Crop - Cattle – Sheep labelled as FS-I, FS-II, FS-III and FS-IV. FS-II was highest adopted farming system by (36.67%) followed by FS-I (20.83%), FS-III (19.2%) and FS-IV (9.17%).

The details of cropping pattern of farmers in different farming system Table 2. reveal the major crops as paddy, jowar, red gram, groundnut and maize. Other crops grown were, castor, cotton, fodder, onion, millets and vegetables.

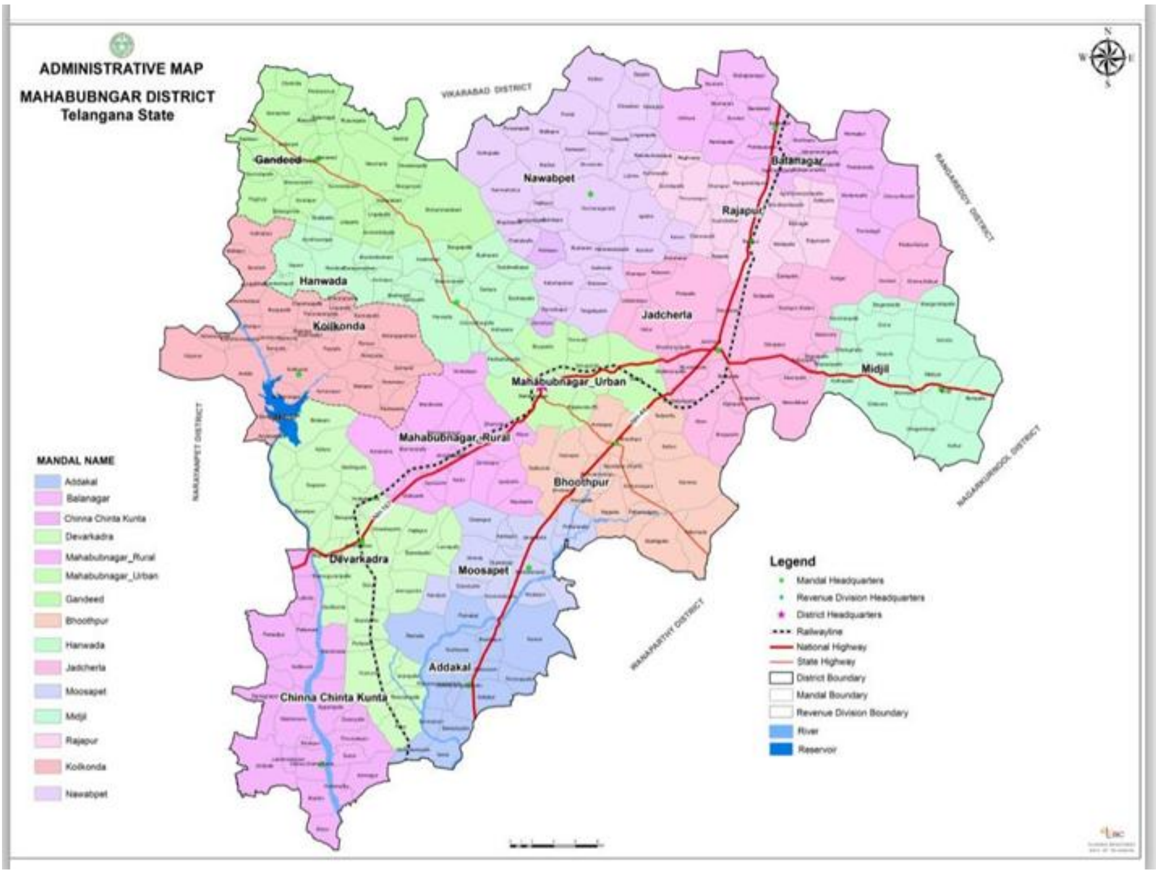

Fig. 1. Map of Mahabubnagar district

Table 1. Different farming systems adopted by sample farmers of study area

Farming systems	Crop	Crop-Cattle	Crop-Poultry	Crop-Goat	Crop-Sheep	Crop- Cattle-Goat	Crop- Cattle-Sheep	Crop- Cattle-Poultry	Crop- Cattle-Goat- Poultry	Crop- Cattle-Goat- Sheep	Total
No. of famers adopted	25	44	4	2	4	23	11	3	2	2	120
Percent of adoption	20.8	36.7	3.3	1.7	3.3	19.2	9.2	2.5	1.7	1.7	100

Table 2. The cropping pattern of farmers in different farming systems

S. No	Crops	FS-I		FS-II		FS-III		FS-IV	
		Avg. area (in ac.)	percent	Avg. area (in ac.)	percent	Avg. area (in ac.)	percent	Avg. area (in ac.)	percent
1	Paddy	2.02	32.84	2.54	36.24	1.61	32.97	0.92	14.48
2	Red gram	1.28	20.79	1.17	16.65	1.31	26.73	0.84	13.16
3	Jowar	1.15	18.68	0.83	11.82	1.33	27.18	1.75	27.64
4	Ragi	0.12	1.81	0.08	1.09	0.07	1.34	0.09	1.32
5	Maize	0.59	9.34	1.03	14.62	-	-	0.25	2.64
6	Groundnut	0.17	2.72	0.62	8.87	0.75	2.68	2.25	23.69
7	Cotton	0.36	5.73	0.17	2.34	0.75	2.68	-	-
8	Castor	0.33	5.13	0.31	4.36	-	-	1.25	13.16
9	Vegetables	0.04	0.61	0.20	2.80	-	-	-	-
10	Fodder	-	-	0.08	1.09	0.88	3.12	-	2.64
11	Millets	-	-	0.03	0.16	0.08	1.34	-	-
12	Onion	0.15	2.41	-	-	0.57	2.01	0.13	1.32

Table 3. The average size of the Cattle, Goat, Sheep of the major integrated farming systems.

S. No	Major Farming Systems	CROP	CATTLE	GOAT	SHEEP
		in ac.	Avg. size (in no.)	Avg. size (in no.)	Avg. size (in no.)
1	Crop (FS-I)	4.35	-	-	-
2	Crop -Cattle (FS-II)	5.91	4.84	-	-
3	Crop-Cattle-Goat (FS-III)	4.60	5.43	25.56	-
4	Crop-Cattle-Sheep (FS-IV)	5.96	3.66	-	88.33

Table 4. Component wise total costs and returns of identified major farming systems

Component	Average Area (ac)/ No	Total costs (Rs.)	Gross returns (Rs.)	Net returns (Rs.)	Benefit- cost ratio
			FS-I		
Crop	4.35	144784	32193	88161	1.60
			FS-II		
Crop	5.91	293687	521130	227538	1.78
Cattle	4.84	115329	228778	113449	**2.00**
Total	-	363975	650542	276903	1.77
			FS-III		
Crop	4.60	103101	163389	60288	1.56
Cattle	5.43	102836	208243	105407	**1.94**
Goat	25.56	49449	84078	34630	1.60
Total		243856	395710	199036	1.75
			FS-IV		
Crop	5.96	124260	192275	68015	1.56
Cattle	3.66	117497	177117	59620	1.53
Sheep	88.33	89583	229250	139667	2.41
Total		291990	544622	224906	1.81

Table 5. Economics of marginal, small and semi-medium farmers adopting major Farming Systems

Farming systems	No. of farmers	Avg. Area (in ac)	Cattle (No's)	Goat (No's)	Sheep (No's)	Total Costs (Rs)	Gross Returns (Rs)	Net Returns (Rs)	Benefit Cost Ratio
Marginal farmers									
FS-I	6	2.00	-	-	-	79312	123950	49369	1.60
FS-II	7	2.00	4.00	-	-	152102	281405	128763	1.81
FS-III	5	2.00	5.00	11	-	150354	264635	114281	1.75
FS-IV	4	2.00	2.00	-	80	157329	317000	159671	**2.01**
Small farmers									
FS-I	10	3.42	-	-	-	101304	165229	64635	1.62
FS-II	13	3.73	4.23	-	-	194080	373235	179156	**1.94**
FS-III	11	3.75	6.80	25	-	268945	496532	227587	1.65
FS-IV	-	-	-	-	-	-	-	-	-
Semi-medium farmers									
FS-I	11	5.96	-	-	-	216026	344605	127932	1.58
FS-II	12	6.63	5.00	-	-	260648	443742	183094	1.69
FS-III	7	6.33	3.66	30	-	310960	513796	203446	1.65
FS-IV	7	6	7.00	-	93.33	373950	683903	309953	**1.80**

Livestock possession of different farming systems was detailed in Table 3. Of all non-crop farm enterprises, cattle was the most integrated one in the systems.

3.2 Component wise Total Costs and Returns of Major Farming Systems

In FS-I, the total per farm costs, gross returns, net returns, B-C ratio were ₹144784, ₹32193, ₹88162, 1.60 respectively with average acreage of 4.35 acres.

In FS-II, the total farm costs, gross returns, net returns, B-C ratio of the entire farming system were ₹ 363975, ₹ 650542, ₹ 276903, 1.77 respectively. The component wise analysis indicates higher net returns for crop component, but B-C ratio was highest for Cattle because the proportionate total costs of crop is higher than cattle. The reason of lower costs incurred for cattle could be from the feed that is obtained from crop component.

In FS-III, the total per farm costs, gross returns, net returns, B-C ratio of the entire farming system were ₹243856, ₹395710, ₹199036, 1.75 respectively. Among all the components of FS-III, B-C ratio was observed to be highest for Cattle (1.94) followed by Goat (1.60) and Crop (1.56). This farming system has efficient cattle management on commercial scale than goats. The Crop and cattle systems acts as a complementing enterprises and goat subsystem as supplementary enterprise.

In FS-IV, the total per farm costs, gross returns, net returns, B-C ratio of the entire farming system were ₹291990, ₹544622, ₹224906, 1.81 respectively. Among all the components of FS-IV, B-C ratio was observed to be highest for sheep (2.41) followed by crop (1.56) and cattle (1.53). These farmers were more inclined to commercial sheep rearing, later crop and then cattle, which is reflected from the returns obtained from each component.

The Component wise total costs and returns of identified major farming systems are given in Table 4.Diagrammatic representation of three farming systems were given in Fig. 2,3 &4.

Analysis of the majorly adopted farming system reveals FS-IV as more remunerative with highest total benefit-cost ratio of 1.81. FS-II, FS-III and FS-I follows in order with 1.77, 1.75 and 1.60 as returns per rupee spent respectively. This implies IFS reaps higher returns than only crop farming systems. Sivamuruga et al. reported that integration of cropping along with other enterprises gave higher economic returns than the cultivation of crops alone [15].

Of the integrated farming systems, the highest remunerative component was Cattle for FS-II. (Cattle >Goat> Crop) is the declining order of the remunerative components for FS-III. (Sheep >Crop > Cattle) is the order for FS-IV. It implies livestock components added more weight to the income yielded by each farming systems. These results are in accordance with Jahan et al. [16]. Sachinkumar et al. [17] and Shankar et al. [18]. They revealed animal components recorded higher net income than crop and cropping sequences.The contribution to the farm income by the crop decreases with the increase in integration, which indicates farmers diverted their focus towards non-crop enterprises on integration.

It was observed that the B-C ratios did not vary much among integrated farming systems indicating that as net returns increased, simultaneously costs also increased with the integration of other enterprises Manjunatha et al. [19].

3.3 Economic Analysis of Farming Systems for Different Size Group Farmers

For marginal farmers, the returns per rupee spent was highest for FS-IV (2.01) followed by FS-II (1.81), FS-III (1.75) and FS-I (1.60).

For small farmers, declining order of remunerative systems was (FS-II > -III >-I) with the B- C ratios 1.94, 1.65 and 1.62 respectively. For semi-medium farmers, FS-IV (1.80) yielded better income followed FS-II (1.69), FS-III (1.65) and FS-I (1.58).

Across different size-classes of farmers (marginal, small and semi-medium), in all FS-I was found least remunerative. Despite the sizes of farmers' classes, it is concluded integration of the enterprises, increased the returns of each farming system.

It can be concluded that in all the four major identified farming systems, the B-C ratios were observed to be higher for marginal and small farmers than semi -medium farmers. Sen et al. from their study reveals that marginal farms had considerably higher per hectare farm income than small and medium farmers [20]. The small and marginal farmers being less resourceful, must have to use them efficiently and that is reflected in the better B-C ratios obtained for them than semi-medium farmers.

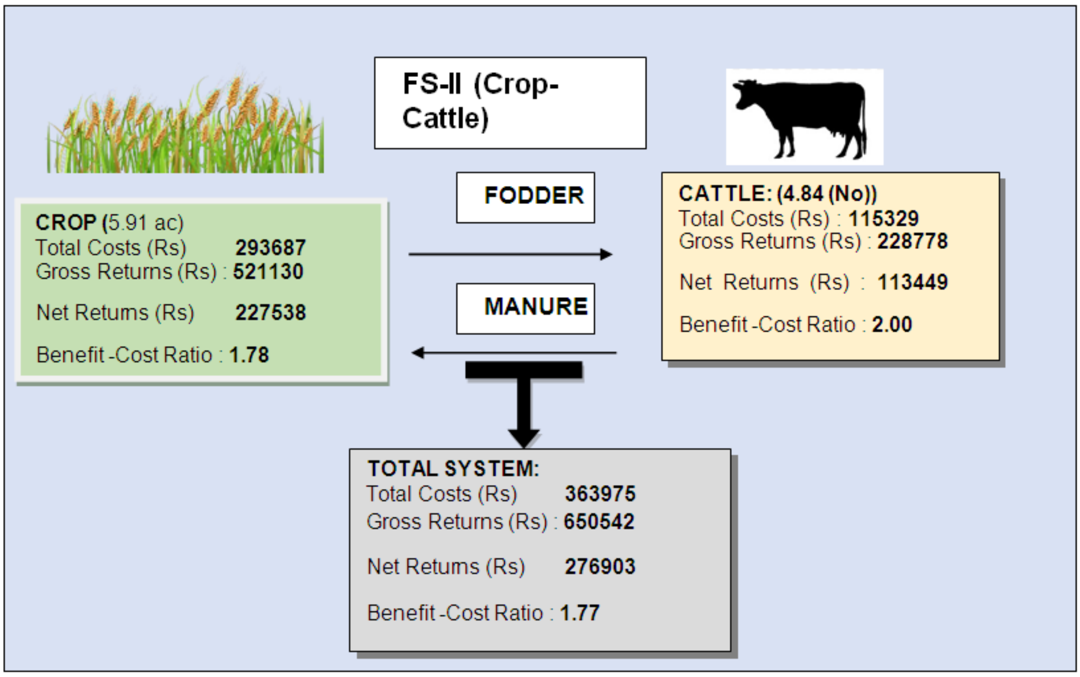

Fig. 2. Income generation of farmers through FS-II (Crop-Cattle)

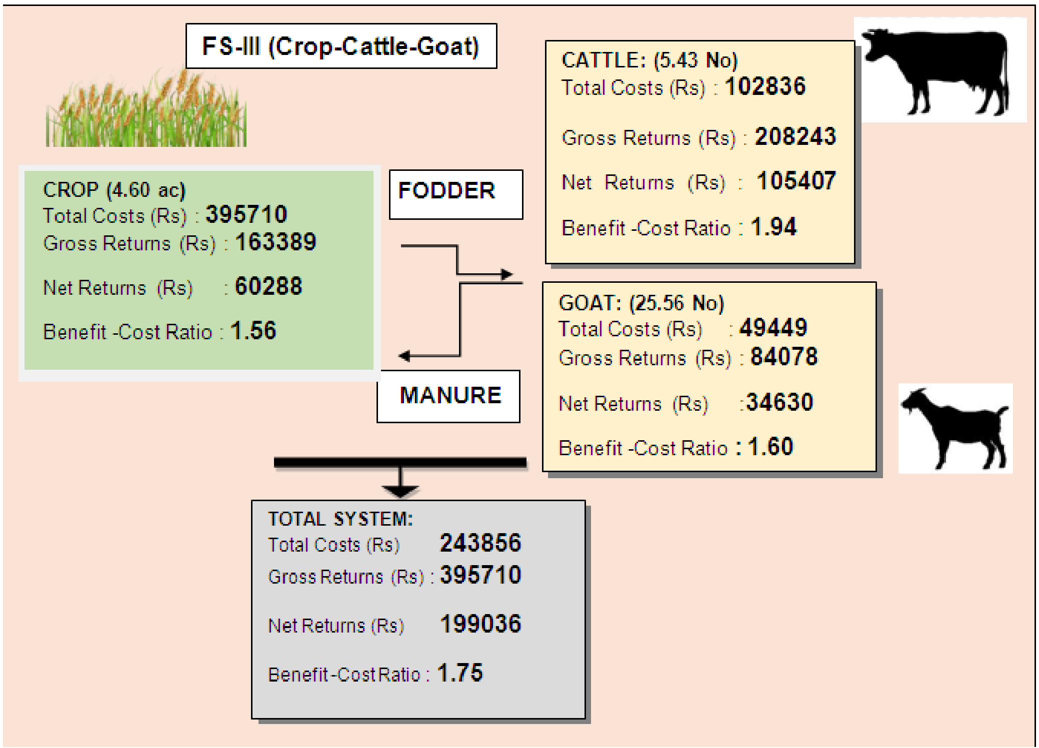

Fig. 3. Income generation of farmers through FS-III (Crop-Cattle-Goat)

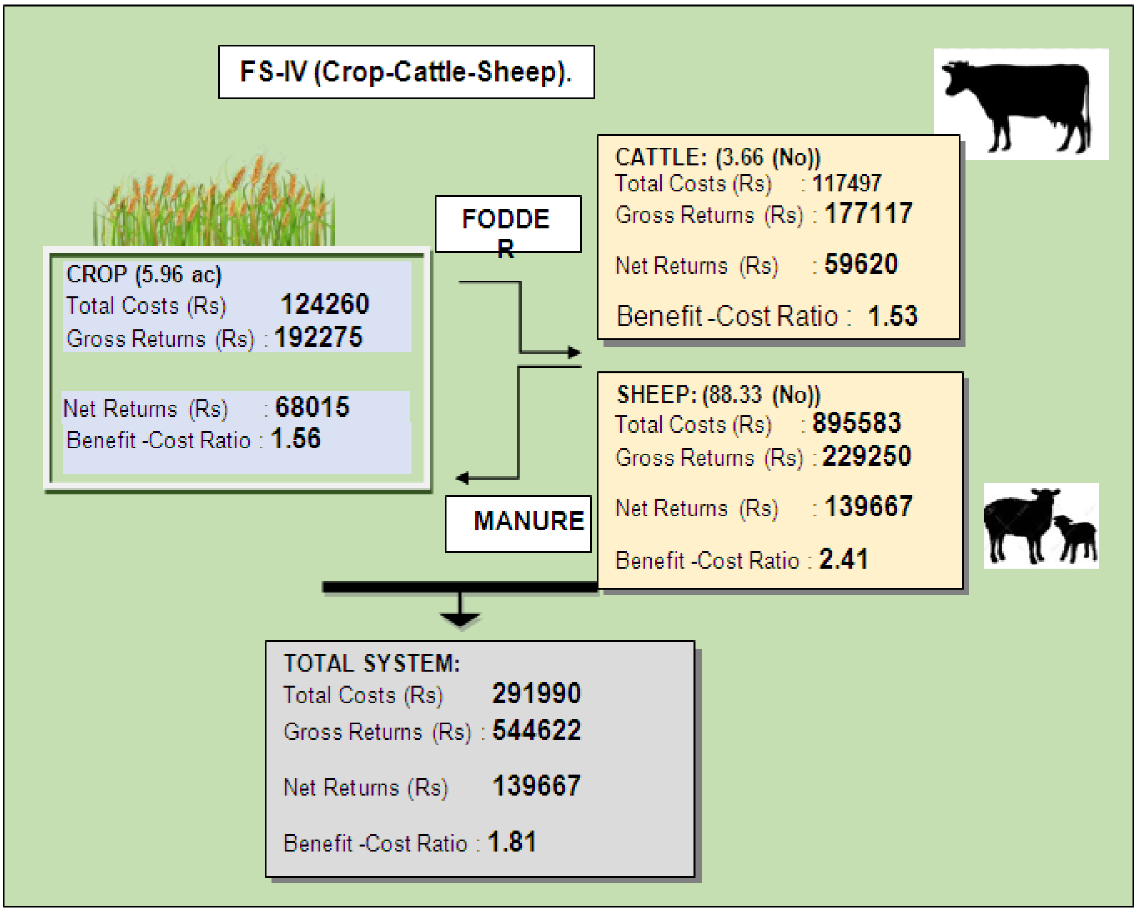

Fig. 4. Income generation of farmers through FS-IV (Crop-Cattle-Sheep)

4. CONCLUSIONS AND POLICY IMPLICATIONS

1. IFS reaps higher returns than only crop farming systems. However, among four farming systems though FS-IV was more remunerative, the highly adopted by them was one with moderate integration FS-II (crop-cattle). The farmers did not show up higher integration practices and adopted moderate systems.

2. The livestock components added more weight to the income yielded by each farming systems. The contribution to the farm income by the crop decreases with the increase in integration, because farmers diverted their focus towards non-crop enterprises with integration.

3. It was observed that the B-C ratios did not vary much among integrated farming systems indicating that as net returns increased, simultaneously costs also increased with the integration of other enterprises.

4. Despite the sizes of farmers' classes, it is concluded integration of the enterprises, increased the returns of each farming system.

5. In all farming systems, B-C ratios were observed to be higher for marginal and small farmers than semi -medium farmers. The small and marginal farmers being less resourceful, had used them efficiently and that is reflected in the better B-C ratios obtained for them than semi- medium farmers.

4.1 Policy Implications

From the findings of the study the following implications are drawn:

- Develop and promote identified location specific farming systems through well designed optimum farm plans.

- Field level demonstrations to be conducted on the remunerative and innovative enterprises.
- Proper trainings to be conducted for farmers to realize the benefits of Integrated Farming Systems.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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