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Research Paper

Integrated farming system for livelihood security of small farmers of North- East Karnataka

■ **S. N. VINODAKUMAR, B. K. DESAI, A.S. CHANNABASAVANNA, SATYANARAYANA RAO, M. G. PATIL AND S.S. PATIL**

See end of the paper for authors' affiliations

Correspondence to :
S. N. VINODAKUMAR
Department of Agronomy, University of Agricultural Sciences, RAICHUR (KARNATAKA) INDIA

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ABSTRACT : Investigations were carried out in Main Agricultural Research Station (MARS), Raichur district of Karnataka during 2012-14 to find out a sustainable mixed farming model which is economically viable by integrating the different components like crops, livestock, poultry, rabbits and fish on a 2.5 acre land holding. Seven integrated farming system models were developed to find out the best package on the land holding of 2.5 acre suitable for the North- East Karnataka region. Among various IFS models, F_7 model registered highest net returns (Rs. 1,89,069 ha/year) and least observed in conventional cotton alone (F_1) system (Rs. 74,592 ha/year). The similar trend was observed in return per day, diversity index and employment generation (Rs. 518/day, 2.92 and 206 mandays/ha/year).

KEY WORDS : Cost, Diversity index, Employment, Integrated farming systems (IFS) modules, Returns

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INTRODUCTION :

Karnataka is a state of diverse cultures, languages and faiths. The social and economic scenario in the state is marked by a lot of regional disparities. The state has 30 districts and 176 Taluks. Agriculture is the backbone of the people in Karnataka and is characterized by wide crop diversification. The state has 66 per cent of rural population and 56 per cent of the workers have been classified under the cultivators and agricultural labourers. The state has ten diversified agro-climatic zones including plains, plateau and hills. Types of natural vegetation, crops and resources available were varies to a great extent. Similarly, size and population of livestock inhabited in the different agro-climatic zones also varies largely (Anonymous, 2015).

The concept of the "humans - land - livestock" ecosystem is gaining momentum as a means to maximize food production and to elevate economic status of the farmers by multifarious farm activities particularly by incorporating livestock enterprises. For human need, the livestock provide food, fibre, skin, traction, fertilizer and fuel. Livestock also constitute a "living bank" providing flexible financial reserves in times of emergency and serve as "insurance" against crop failure for survival.

Farmers keep cows, buffaloes, sheep and goats and small numbers of poultry in the backyard to meet their domestic needs. Therefore, livestock became an integral part of farming system as such. Other agricultural components like horticulture, plantation, vegetables,

sericulture, agro-forestry etc. are also prevalent in the homesteads. These units are operated either alone or in combination depending upon the size of the farm holdings and other available resources.

In this system, animals are raised on agricultural waste. The animal power is used for agricultural operation and the dung is used as manure and fuel (Behera and France, 2016). It may be possible to reach the some level of yield with proportionately less input in the integrated farming and the yield would be inherently more sustainable because the waste of one enterprise becomes the input of another leaving almost no waste to pollute the environment or to degrade the resource base. To put this concept into practice efficiently, it is necessary to study linkage and complementarities of different enterprises that will help to develop integrated farming system in which the waste of one enterprise is more efficiently used as input to another within the system.

This study was conducted in the North-East Karnataka Plains having average rainfall of 1024mm. Location selected for experimentation was Raichur district (16.21°N and 77.35°E). The staple food consumed mainly rice (*Oryza sativa* L.), sorghum (*Sorghum bicolor*), which are produced during the monsoon. Cotton (*Gossypium hirsutum* L.) is an important fibre crop of the locality and raichur district called as bowl of cotton. Besides crop farming which is mainly for 4-6 months in a year, farmers livelihood supported by livestock farming (Anonymous, 2016). The traditional farming followed by the farmers and the income generated through such farming is hardly sufficient to meet their livelihood. However, using the existing resources the farming system can be made viable, sustainable and income generating with great opportunities of employment potential. Various IFS models with varied enterprise combinations were formulated to analyze complimentarity and sustainability suitable to prevalent farming system.

MATERIALS AND METHODS :

The present study was conducted (2012-14) in one hectare plot at Main Agricultural Research Station (MARS), Raichur district of Karnataka under tube well

Table A : Details of the experimental treatments

Treatments		Livestock components	Crops on bunds
F_1	Cotton alone	Nil	Nil
F_2	Maize - Bengal gram	Nil	Nil
F_3	Cotton + Cowpea (F) 1:1 Maize + Cowpea (F) 1:1 - Bengal gram	Goat (2)	Drum stick, curry leaf and Stylo
F_4	Cotton + Cowpea (F) 1:1 Maize + Cowpea (F) 1:1 - Bengal gram	Goat (2) + Poultry birds	Drum stick, Curry leaf and Guinea grass (Samruddhi)
F_5	Cotton + Cowpea (F) 1:1 Maize + Cowpea (F) 1:1 - Bengal gram Pillipesara (*Phaseolus trilobus*)	Goat (2) + Cow (1)	Agati and Hybrid napier grass (CO-4)
F_6	Cotton + Chilli (1:1) Pillipesara (*Phaseolus trilobus*)	Goat (2) + Rabbit (4)	Agati and Hybrid napier grass (DHN-6)
F_7	Cotton + Onion 1:2 Maize + Cowpea (F) 1:1 - Bengal gram	Goat (2) + Cow (1) + Poultry birds + Fishery	Fish pond bund- Banana Plot bund- Agati, Drum stick and curry leaf

F: Fodder crop

Animal components

1.	Goat (Jamanpari and Shirohi)	:	5 male (Stall fed system)
2.	Cow (HF)	:	1 each for F_5 and F_7
3.	Poultry birds (Giriraj Broiler)	:	25 Giriraj poultry birds each for F_4 (Brooder system) and F_7 (Battery system on fish pond)
4.	Rabbit (New Zealand White)	:	3 female + 1 male
5.	Fish (Common carp)	:	225 for F_7

Verities and hybrids used: Bt cotton (Jaadoo), Maize (Hiro-555), Chilli (G-4), Onion (Nasik Red), Fodder cowpea [Swad (DFC-1)], Pillipesara (Local), Bengal gram (A1), Drum stick (Dhanraj), Curry leaf (Suvasini), Banana (G-9), Stylo (Local), Guinea grass (Samruddhi), Hybrid napier grass (CO-4 and DHN-6) and Agati (Local).

irrigation source. The experiment was laid out on moderately drained deep black soil. The soil of the experiment site was deep black with pH 8.1. The N, P and K content of the soil was 243, 34 and 292 kg/ha, respectively. Farming system modules were formulated based on the primary data of existing farming systems of raichur district. The treatments consisted of six various farming system models of IFS compared with conventional system of cotton alone (Table A). Livestock components chosen by looking to the integration potentiality of the system. Poultry *var*., giriraj was reared in cage constructed on the fish pit (F_7) or reared separately (F_4) as brooder system. The poultry birds were fed with starter feed upto 20 days and later farm wastes (broken grains) were used as the source of feed. The droppings were allowed to drop directly into the fish pit in models (F_7) where the cage was constructed on the fish pit, while when poultry was reared separately (F_4) the droppings were collected once in 15 to 30 days and added to respective treatments. Fish (common carp) was reared in farm pond (F_7). After the harvest of fish, the fish pit silt was recycled to respective plots. Goat and dairy animals reared in stall fed system and dung/ refuge was collected and composted separately. The compost was recycled in the respective treatments. In F_7 system on regular basis certain, quantity of dung/ droppings added to the fish pond to supplement the dietary needs of fishes. Rabbits were reared in cages (F_6 system), droppings recycled in the respective treatments. Since, the study includes diversified enterprises like fish, poultry, goat, rabbit, milch animals and various crops, the yield was converted into diversity index as suggested by Singh *et al*. (2010). The data was calculated for its economics based on the rates prevailing during the year and presented in Table 1. Labour requirement for various activities in crop and live stock production were recorded and given in man days per hectare (Jayanthi, 1995). The labour use efficiency (LUE) was calculated by taking the ratio of total production in cotton kapas equivalent yield to the total man days per hectare.

RESULTS AND DATA ANALYSIS :

The results of this two year study (2012-14) indicated that, integration of various enterprises on a 2.5 acre size of land holding was theoretically viable. Further, better utilization of land, water and input and output resources were observed in the mixed farming model with cows, goats, poulry birds, rabbit, fisheries and horticultural crops as compared to cotton cropping alone.

Economic returns:

Irrespective of the integrated farming system

Table 1 : Economics of various farming systems (Rs. ha^{-1}) (pooled data of two years 2012-14)

Treatments		F_1	F_2	F_3	F_4	F_5	F_6	F_7
Crop	Production cost (Rs.)	27479	18372	29931	28501	23644	23499	29197
	Gross income (Rs.)	102071	59756	119199	115807	106905	122761	130441
Goat	Production cost (Rs.)	-	-	6135	5873	5571	6334	7576
	Gross income (Rs.)	-	-	35978	33941	28506	21852	23371
Poultry	Production cost (Rs.)	-	-	-	3952	-	-	12919
birds	Gross income (Rs.)	-	-	-	28180	-	-	30130
Cow	Production cost (Rs.)	-	-	-	-	7512	-	8504
	Gross income (Rs.)	-	-	-	-	48414	-	50102
Rabbit	Production cost (Rs.)	-	-	-	-	-	3202	-
	Gross income (Rs.)	-	-	-	-	-	50465	-
Fishery	Production cost (Rs.)	-	-	-	-	-	-	1505
	Gross income (Rs.)	-	-	-	-	-	-	14726
Total cost (Rs.)		27479	18372	36066	38325	36727	33034	59700
Total gross income (Rs.)		102071	59756	155177	177928	183825	195078	248769
Net return (Rs.)		74592	41384	119111	139603	147098	162043	189069
B: C		2.71	2.25	3.30	3.64	4.01	4.91	3.17
Return per day (Rs.)		204	113	326	382	403	444	518

Not statistically analysed

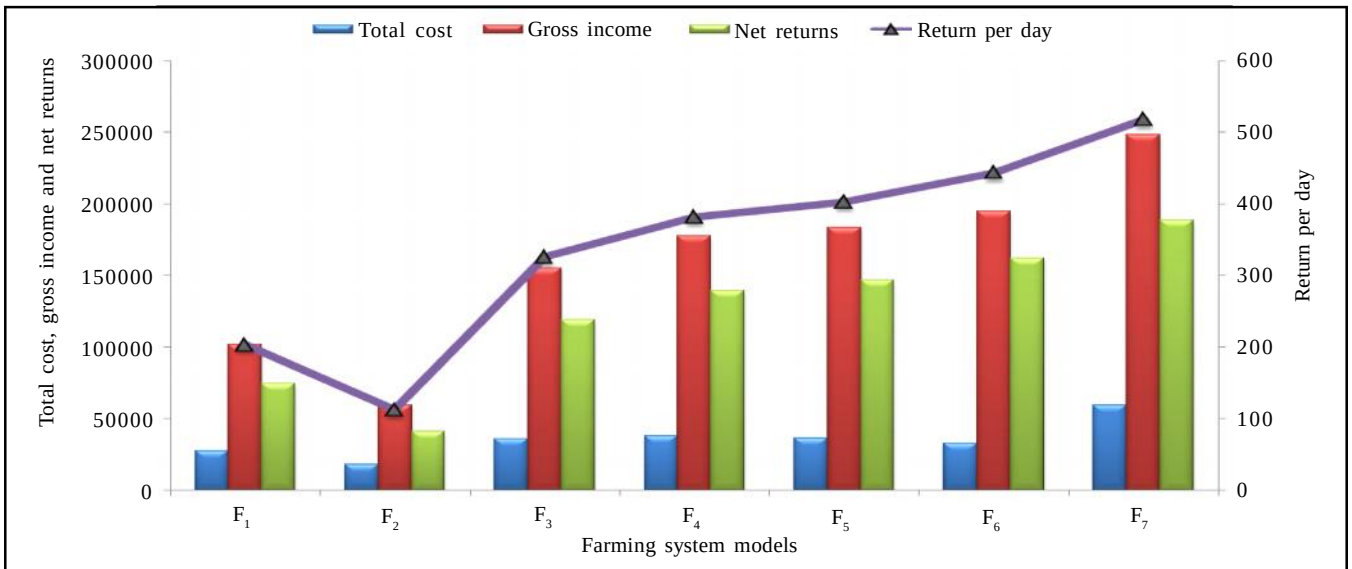

Fig. 1 : Economics of various farming systems (Rs. ha^{-1}) (pooled data of two years 2012-14)

models, F_7 system recorded the highest net returns of Rs. 1,89,069/ha/year over conventional cotton alone (F_1) system (Rs. 74,592/ha/year). The increase was to the tune of 253 per cent over the conventional systems (F_1). This may be attributed to the added income from the livestock components. Similar trend was observed with return per day (Table 1 and Fig. 1). Where, F_7 earned (Rs. 518/day) and which is closely followed by F_6 system (Rs. 444/day). Similar results were reported by Dey *et al*. (2007); Nhan *et al*. (2007) and Khondker and Diemuth (2011). The net returns in 2012-13 were less compared to 2013-14 due to higher initial cost of cultivation, indicating the profitability of IFS in long run.

The data on benefit cost ratio also revealed that, F_6 system (crop + goat + rabbit component), gives Rs. 4.91 for every rupee invested. This is due to, the integration of rabbit component and higher market price of chilli and low cost of production involved which provides more returns to the system (Subhadra *et al*., 2009).

Table 2 : Diversity index (DI) and employment generation (man days/ ha/year) of various farming systems (pooled data 2012-14)

Treatments	Income through components (Rs.)						
	F_1	F_2	F_3	F_4	F_5	F_6	F_7
Crop	102071	59756	119199	115807	106905	122761	130441
Goat	-	-	35978	33941	28506	21852	23371
Poultry birds	-	-	-	28180	-	-	30130
Cow	-	-	-	-	48414	-	50102
Rabbit	-	-	-	-	-	50465	-
Fishery	-	-	-	-	-	-	14726
Total income	102071	59756	155177	177928	183825	195078	247739
Diversity index	-	-	1.55	2.06	2.32	2.10	2.92
Employment generation (man days/ha/year)							
Crop	79	116	95	95	100	89	110
Goat	-	-	25	25	25	25	25
Poultry birds	-	-	-	15	-	-	15
Cow	-	-	-	-	51	-	51
Rabbit	-	-	-	-	-	21	-
Fishery	-	-	-	-	-	-	5
Total	79	116	120	134	176	135	206
Additional employment	-	37	41	55	97	56	127

Not statistically analysed

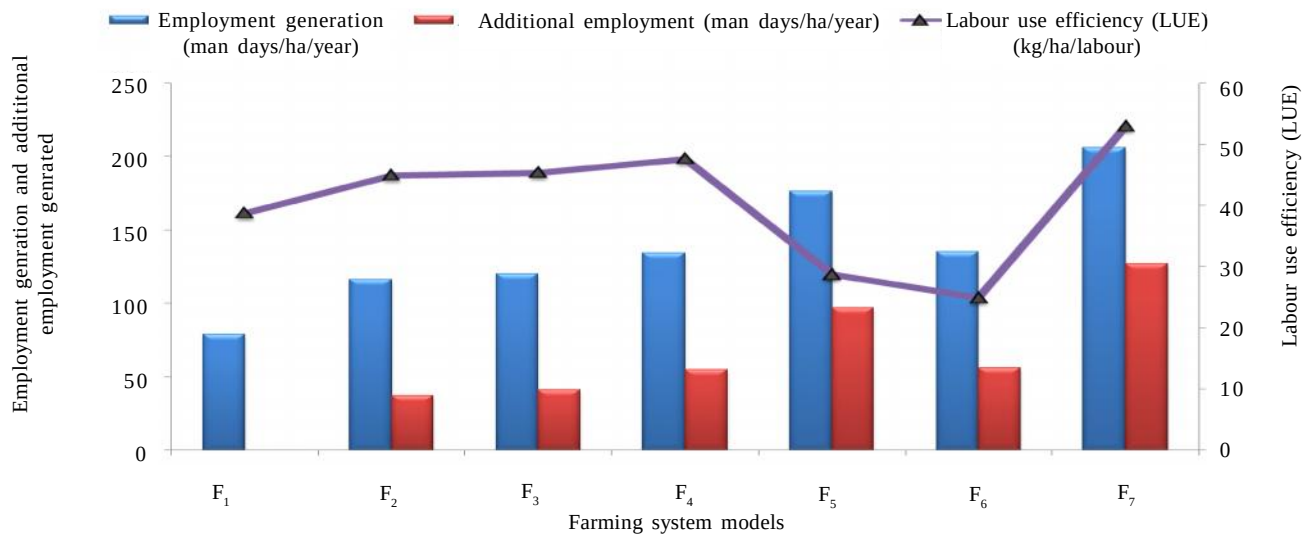

Fig. 2 : Diversity index (DI) and employment generation (man days/ha/year) of various farming systems (pooled data 2012-14)

Diversity index:

Maximum integration of different components in farming model will gives higher value of diversity index (Table 2 and Fig. 2). Among the various farming system models, the diversity index was higher in F_7 system (2.92). It was closely followed by F_5 with a diversity index of 2.32. Least values of diversity index recoded in F_3 (1.55). The integration of more components at the same time, in the same place, favoured for obtaining more income in a unit, space and time, which in turn helps for obtaining more diversity and place a way for more diversification in the farm, compared to practicing a single enterprise. Similar findings obtained by Devendra and Thomas (2002); Joshi *et al*. (2006) and Byrne *et al*. (2010).

Employment generation:

The present investigation (pooled data of 2012-13 and 2013-14) revealed that, integration of livestock components required higher man days (116, 120, 134, 176, 135 and 206 man days in F_2, F_3, F_4, F_5, F_6 and F_7, respectively) over conventional system (79 man days in F_1 system). A highest additional employment of 38.34 per cent was generated in F_7 system (Table 2 and Fig. 2). Labour use efficiency (LUE) was followed similar trend (52.92 kg/ha/labour) over conventional F_1 system (38.74 kg/ha/labour) and it closely followed by F_2 system (44.92 kg/ha/labour). Similar results with IFS were earlier reported by Moll (2005); Ramrao *et al*. (2006); Shabanali Fami (2006) and Ram and Singh (2008) also obtained similar findings.

Conclusion:

The integrated farming system with cow + goats along with other subsidiaries like poultry and fish is the most beneficial system which can augment the income of small and marginal farmers to improve their socio-economic status.

More emphasis is still required to generate a generalized model suited to various farm size holdings in different agro climatic conditions.

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Authors' affiliations:

B. K. DESAI, A. S. CHANNABASAVANNA AND SATYANARAYANA RAO, Department of Agronomy, University of Agricultural Sciences, RAICHUR (KARNATAKA) INDIA

M.G. PATIL, Department of Horticulture, University of Agricultural Sciences, RAICHUR (KARNATAKA) INDIA

S. S. PATIL, Department of Agricultural Economics, University of Agricultural Sciences, RAICHUR (KARNATAKA) INDIA

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