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DEVELOPMENT OF AN INTEGRATED FARMING SYSTEM MODEL FOR LIVELIHOOD SECURITY OF SMALL FARMERS IN TUNGABHADRA PROJECT AREA OF KARNATAKA

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ABSTRACT
An Integrated Farming System model of 1 ha was established at Agricultural Research Station, Siruguppa, Karnataka, under AICRP on Integrated Farming System for livelihood security of small farmers in Tungabhadra Project area during the year 2010-11. The model was designed in Vertisol with clayey in texture having more than 100 cm depth. The soil was low in available nitrogen (280 kg ha^{-1}), medium in organic carbon content (0.67 %) and available P (10.8) and rich in K (364 kg ha^{-1}) status. To meet out the basic components required for IFS model and small family (Six members) needs, the land was allocated under different components mainly on agriculture components including crop (Cereals and pulses components in 0.74 ha), horticultural in 0.18 ha (Sapota, curryleaf, papaya, vegetables and floriculture) and fodder component in area of 0.02 ha. The remaining land of 0.06 ha was allotted for agriculture allied activities such as live stock unit including 2 cows, one buffalo and goatary (14 nos.), Fish pond, Vermicomposting unit (4), compost unit (1) and Azolla unit (1). The boundary plantation with teak and glyricidia was established to protect the unit and to generate the biomass for further utilization. The internal bunds were also planted with pigeon pea, fig, fodder and banana to meet out nutritional security of a small family. The experiment was carried out from 2010-11 to 2015-16 and results revels that higher system equivalent yield (SEY) in terms of rice equivalent yield of 29.05 t/ha was recorded during 2014-15 as compared to initial year of 2011-12 (10.75 kg/ha) and it was increased with the years except during 2015-16. Among the different components, livestock unit contributed more towards SEY than the others. The higher grass returns (Rs. 375484/ha), net returns (Rs.208779/ha) and B:C ratio (2.25) was recorded during 2015-16 compared to other years and were relatively increases with year's. The IFS model generate employment throughout the year, however, the higher average employment generated (man days/year) was recorded in dairy component (225.5) followed by crop component (155.25) and lowest being in horticulture system (66.75).

KEY WORDS: Integrated Farming System, Gross returns, net returns, B:C ratio, System Equivalent Yield and employment generation.

INTRODUCTION
The production system adopted during green revolution was explorative and the natural resources like soil and water were subjected to immense pressure beyond carrying capacity (Mahapatra *et al*., 2007). This leads to degradation of not only the crop system but also to the life supporting environment as whole. As a result sustainability of agricultural production system and the farming system has faced crisis (Dent, 1990). The objectives of farming system in general are converging on to the development of suitable location specific farm technology to raise and sustain the total farm productivity in terms of food, feed, fodder and fuel and to meet the felt needs of the farmers within the sphere of their agro-socio-political favourites and constraints (Channabasavanna, 2000). The sustenance of increased productivity must emphasize on the development of strategies aimed at maintaining improved yields without depleting natural resources or destabilizing the environment. Such strategies abound in IFS. Integrated farming (or integrated agriculture) is a commonly and broadly used word to explain a more integrated approach to farming as compared to existing monoculture approaches. It refers to agricultural systems that integrated crop production and livestock. Integrated farming system has revolutionized conventional farming of livestock, aquaculture, horticulture, agro-industry and allied activities. It could be crop-fish integration, crop-livestock integration, crop-fish-livestock integration or combinations of crop, livestock, fish and other enterprises like horticulture, agro-industry. The benefits of IFS over those of Traditional farming system cannot be over emphasized. Though agricultural systems are better practiced on large expanse of land, subsistence farmers notable for their small holdings can equally engage in them, especially those involving homestead fish ponds. This is because IFS has been confirmed to reduce cost of production and thus increase farmer's productivity, income, nutrition and overall welfare. If properly adopted with investment in agriculture, IFS improves the personal savings and health of farmers. Othman (2006) summarized the multifaceted benefits of IFS to include economic benefits in terms of increased food production; social function in terms of provision of employment opportunities for excess labour force displaced from other sectors in the urban areas. The IFS assumes greater importance for sound management of

farm resources to enhance the farm productivity, to reduce environmental degradation and to improve the quality of life of resource poor farmers and maintain the sustainability. This is the approach in which interactions among different enterprises in the system are taken in to consideration, while going for technological intervention (Pant *et al*., 2005); the by-product of the one enterprise becomes the input for other (Behera and Mahapatra, 1998; Behera *et al*., 2008)

There is dearth of information on the types, extent of adoption and benefits of IFS in agricultural zone of Northern Karnataka region. This study helps us to specifically identify types of IFS, determine the profitability of IFS and examine the impact of IFS on farm cash income in the study area. It is therefore justified because information generated there from will not only enrich literature on IFS but will inform policy on programmes that will encourage speedy adoption of full IFS in order to drastically reduce poverty and increase the standard of living of the farmers.

MATERIAL & METHODS

The IFS study was carried out at Agricultural Research Station, Siruguppa located 15^0 38^I N latitude and 76^o 54^I E latitude with a mean sea level of 380 msl. It received an average rainfall of 453.6 mm from 2011-12 to 2015-16 and it comes under semi-arid climate. The IFS model of 1 ha initiated under irrigated condition during 2010-11 and was in Vertisol with clayey in texture having more than 100 cm depth. The soil was low in available nitrogen (280 kg ha^{-1}), medium in organic carbon content (0.67 %) and available P (10.8) and rich in K (364 kg ha^{-1}) status. To meet out the basic components required for IFS model and small family (Six members) needs, the land was allocated under different components mainly on agriculture components including crop (Cereals and pulses) components in 0.74 ha, horticultural in 0.18 ha (Sapota, curryleaf, papaya, vegetables and floriculture) and fodder component in an area of 0.02 ha. The remaining land of 0.06 ha was allotted for allied activities of agriculture such as live stock unit including 2 cows, one buffalo and goatary (10 nos.), farm pond, kitchen garden, vermicompost unit (4), compost unit (1) and azolla unit (1). The boundary plantation with teak and glyricidia was established to protect the unit and to generate the biomass for further utilization (Fig 1). The internal bunds were also planted with pigeon pea, fig and banana to meet out nutritional security of a small family. While allocating the different components in IFS model, major cropping systems followed and animals suited to this region was considered and animal numbers/size, allocation of land resource for accommodating different enterprises was done as per the family needs (calculated for a family of 6 members) as per standard give by Swaminathan (1998).

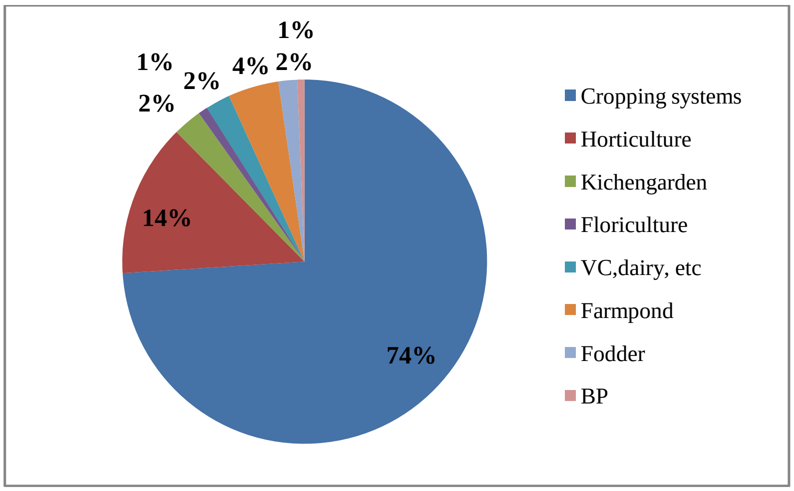

FIGURE 1: Area under different components in 1 ha IFS model (%)

The crop components consists of different cropping systems viz., paddy-paddy, which is the dominant cropping system in the TBP command area, Paddy followed by maize/sorghum/pulses were included to develop alternative cropping system to dominant cropping system, maize followed by chickpea and Bt cotton followed by greenmanure crops with a view to maintain soil fertility. In horticulture crops along with plantation crops vegetables like okra, cluster bean, beans and flowers grown in between the rows of perennials to utilize the land effectively and small portion of land was allotted for kitchen garden to grow leafy vegetables viz., spinach, fenugreek coriander etc. The fodder crop was introduced to provide green fodder for live stock feed and live stock comprise of 2 cows (HF crossed with Devoni), one buffalo (Murrah) and 14 Shirohi goats. The house for family, dairy and goat shed, vermicompost unit (4), Compost unit (1) and azolla unit (1) were established in the existing model. The data on cow dung, urine, goat manure, farm waste and crop residue were recorded regularly and were properly recycled in the system by composting and vermicomposting and were incorporated in to the soil and excess quantity were sold to the farmers in order to educate the importance of vermicompost in the crop production. Similarly azolla produced was used as animal feed. Plot wise yield and straw data was recorded along with cost of cultivation, gross returns, net returns and B: C ratio was computed and also number of man days generated in each system was calculated. The Total system equivalent yield (kg/ha) was calculated considering the farm gate price of each enterprise and rice crop.

Components of IFS model in 1 ha area is as follows

- **I. Crop components**: Rice-Rice, Rice-Maize, Rice-Sorghum, Bt cotton-Green manuring and Maize-bengalgram
- **II. Horticulture components**: Sapota- 5 years old, Curryleaf- 5 years old , Pappaya: 1 years old
- **III. Kitchen garden**
- **IV. Animal components**: One Buffalo, Two HF cow with calf
- **V.** Boundry planting with Teak + coconut+banana
- **VI.** Cattle and goat shed, Farm pond
- **VII. Fodder component**
- **VIII. Vermicompost unit**(6 pits)

RESULTS & DISCUSSION

Experimental results over the five years i.e. from 2011-12 to 2015-16 revealed that, the higher SEY of 29.05 t/ha was observed during 2014-15 when compared to initial year of 2011-12(10.75 kg/ha). There was three fold increases in SEY (29.05 kg/ha) during 2015-16 when compared to initial year (10.75 kg/ha). The average System Equivalent Yield (SEY) of the IFS model was 21.27 t/ha (Table 1). Similar results were also reported by Mohanty *et al*. (2010). Among the various components under 1 ha IFS model indicated that the higher Rice equivalent yield (REY) was observed in 2014-15 with crop component (6.84 t/ha) compared to rest of the years. Whereas, horticulture component registered maximum REY of 2.63 t/ha during 2015-16 and animal component produced higher REY of 17.12 t/ha during 2012-13 than rest of the years. The five years average data (Table 1) revealed that, REY was differed with different components, among the different components, the maximum REY (9.99 t/ha) was recorded with livestock component compared to other components and it was followed by crop component (6.16 t/ha).

TABLE 1: Total farm production (REY t/ha) details in 1 ha IFS Model

Year	Total farm production (Rice Equivalent Yield-t/ha)	Total production (REY t/ha) from crops unit	Total production (REY t/ha) from horticulture crops	Total production (REY t/ha) from livestock unit	Total Production (REY t/ha) From goat	Others Vermicompost /kitchen garden (REY t/ha)
2011-12	10.75	5.27	0.59	3.26	0.00	1.63
2012-13	24.20	5.75	1.08	17.12	0.00	0.25
2013-14	24.05	8.14	1.92	10.27	3.31	0.41
2014-15	29.05	6.84	2.51	13.50	1.52	4.68
2015-16	18.29	4.79	2.63	5.81	1.86	3.80
Average	**21.27**	**6.16**	**1.75**	**9.99**	**1.34**	**2.15**

The higher gross return of Rs, 375484/ha was recorded during 2015-16 when compared to initial year of 2011-12 (Rs.187576/ha) and it was followed by 2013-14 (Rs. 350861/ha). There was a two fold increase in the gross return in 2015-16 when compared to 2011-12. However, the gross return over a period of five years suggests that the increase in the gross return from Rs. 187576/ha (2011-12) to Rs. 375484/ha (2015-16) with a tune of 100 per cent increase over initial years. It also indicated that there is an ample scope for gross income in the 1 ha model (Table 2).

TABLE 2: Gross returns, net returns and B: C ratio of 1 ha IFS model in different years

Year	Gross returns (Rs/ha)	Net returns (Rs/ha)	B:C ratio
2011-2012	187576	95878	2.05
2012-2013	260252	132895	2.04
2013-2014	350861	194569	2.24
2014-2015	332373	160578	1.93
2015-2016	375484	208779	2.25
Average	301309	158540	2.10

Mohanty *et al*. (2010) at Orissa reported that higher profitability and sustainability was observed under IFS model as compared to the conventional farming system and earned 7 times higher Net Monetary Return (NMR) as compared to traditional method of farming. In the present study, the higher net return was observed during 2015-16 (Rs. 208779/ha) as compared to 2011-12 (Rs. 95878/ha). The per cent increase in net returns during 2015-16 was to the extent of 117 when compared to 2011-12 and it was followed by 2013-14 (Rs. 194569/ha). The higher B:C ratio was recorded during 2015-16 (2.25) compared to 2014-15 (1.93) and it was closely followed by 2013-14 (2.24). The per cent increase in B:C ratio was to the tune of 16.6 during 2015-16 compared to 2014-15 (Table 2). Over the five years the average gross returns (Rs.301309/ha), net returns (Rs. 158540/ha) and B:C ratio(2.10) was recorded in 1 ha IFS model (Table 2). These results are in line with Jayanthi *et al*. (2003); Ramrao *et al*. (2006); Ravishankar *et al*. (2007) and Veerabhadraiah (2007). In the present study, the higher employment generation of 563 total man days was recorded during the year 2014-15 (Table 3) and followed by 556 (2015-16) and lowest being during 2013-14 (354 man days). However, among the different components higher total man days generated in the dairy (225.5) followed by crop component (155.25) and lowest being in horticulture components (66.75). Similar results are also reported by Biswas (2010).

TABLE 3: Employment generation in different components of 1 ha IFS Model

Years	Enterprise- wise Employment Generated (Man days/year)			Total
	Crops	Dairy	Horticulture	Man Days
2011-12	-	-	-	-
2012-13	122	141	84	412
2013-14	96	219	39	354
2014-15	289	240	34	563
2015-16	114	302	110	556
Average	155.25	225.5	66.75	471.25

CONCLUSION

The results clearly revealed that Integrated Farming System plays a vital role in securing sustainable production of high quality food and fulfilling the other basic needs of household *viz*., food (cereal, pulse, oilseed, milk, vegetables, meat etc), fodder, fuel etc. This system helps not only in sustaining farm income by reducing the cost of production and also generate lot of agricultural waste (bio-waste) which efficiently recycled in the system in turn helps in reducing environmental pollution by lowering of Green House Gases, maintain soil fertility and agricultural sustainability and also generate the employment throughout the year and finally assures the nutritional security of small farmers.

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