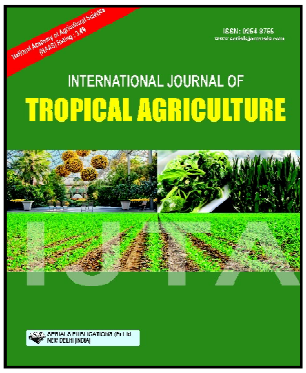

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Integrated Farming System: A Prospective Approach towards Sustainable Agriculture

Rohitashav Singh[1], Biswajit Pramanick[1*], AP Singh[2], Sumit Chaturvedi[1], Dinesh Kr. Singh[1], Neelam[3]and Gaurav Deep Singh[1]

[1] Department of Agronomy, [2] Department of Soil Science, [3] Department of Plant Pathology
G.B. Pant University of Agriculture & Technology, Pantnagar – 263145, U.S. Nagar, Uttarakhand
[*] E-mail of the corresponding author: bipra.its4u@gmail.com

Abstract: Owing to burgeoning population, industrialization and urbanization, agriculture land is decreasing day by day resulting in smaller and smaller land holdings. This has caused decrease in profit from traditional rice wheat cropping system. To overcome this problem of small land holding and decreasing margins, integrated farming system approach (IFS) can be a viable option. The study is being conducted from 2011-12, in an ongoing integrated farming system experiment under AICRP on IFS at Norman E. Borlaugh Crop Research Centre, Pantnagar. The IFS model comprises crops, dairy, biogas, vermicomposting, fishery, horticulture and agroforestry. The average farm production evaluated in terms of REY (t/ha) exhibits that total 30.49 t REY/ha/ annum was produced from the model during five years. Whereas, the average annual net returns was Rs. 221420.10 and the crop, horticulture, livestock, fishery and other units were sharing about 27.33, 25.03, 40.79, 0.09 and 7.01% to the net returns, respectively. Benefit: cost ratio in terms of economic point of view was 2.77/ annum during last 5 years. The average saving from the recycled farm products and by products and farm-labour engagement were 25.80 and 40.50 %, respectively to the average cost of production. It was also evaluated that during 2015-16, there was a handsome family savings of Rs. 236019.00 from the IFS unit.

Keywords: Integrated farming system, livelihood security, small farmers, sustainable production

INTRODUCTION

In India, out of 121 million agricultural holdings, 99 million are with small and marginal farmers, with a land share of just 44 per cent and a farmer population share of 87 per cent. With multiple cropping prevalent, such farmers account for 70 per cent of

all vegetables and 52 per cent of cereal output. According to National Sample Survey Office data, 33 per cent of all farm households have less than 0.4 hectares of land. About 50 per cent of agricultural households are indebted. Fall of average size of land holding by two to more than three folds in states like Bihar, Kerala, Andhra Pradesh, Karnataka, Madhya Pradesh and Maharashtra, results in a serious matter of concern in Indian Agriculture. This picture clearly depicts the population pressure in the nation. The declining trend of per capita land availability poses a serious challenge to the sustainability and profitability of farming (Siddeswaran *et al*., 2012 [1]). Due to ever increasing population and shrinking land resources in the country, practically there is hardly any scope for horizontal expansion of land for food production. Only vertical expansion is possible by integrating appropriate farming components that require lesser space and time to ensure reasonable periodic income to farm families (Gill *et al*, 2005 [2]). It is also matter of concern that during last decade the context in which farmers must manage their farm has changed rapidly, and often with little warning. Dramatic price swings for agricultural commodities, more stringent quality requirements, new environmental regulations, the debates surrounding genetically modified crops, extreme climatic events, the demand for energy crops, the revision of the Common Agricultural Policy and the consequences of the financial crisis all create uncertainty regarding future threats and potentials. During such turbulent times, a one-sided focus on efficient production is no longer enough. Farmers also need to be able to cope with unexpected events and to adapt to new developments. Integrated farming system approach consisting of crop, dairy, horticultural, agroforestry, fishery, biogas *etc*. components is one of such new development strategies for the small farmers concerning their sustainable livelihood development. A system approach is the need of the hour to fulfil the demand of ever increasing population without disturbing the ecological balance. The focal objectives of the study were increasing farm productivity vis-à-vis profitability and sustainability; providing balance food to the farm family; recycling of resources; generating income around the year and increasing employment generation.

MATERIALS AND METHODS

The study is being carried out from 2011-12 at Norman E. Borlaugh Crop Research Centre, Pantnagar (29° N, 79°30' E and 244m altitude). The IFS model comprises crops, dairy, biogas, vermicomposting, fishery, horticulture and agroforestry (Table 1). The soil of the experimental site was silty clay loam having pH 7.4. The available NPK content of soil was in medium range. The residues of one enterprise were utilized in other enterprises to save and recycle the resources. The crop residues were fed to cows, the cow dung was used to generate biogas, the biogas slurry was utilized for vermicomposting, the excess cow dung, urine, weeds and animal bedding was used to prepare FYM. The vermicompost and FYM were used in crops and horticulture. Observations about total farm production vis-à-vis production of different components under integrated farming system was calculated and averaged over five years (2011-12 to 2015-16). Profitability in terms of net returns of different farm enterprises in IFS Model and percent contribution of different farm enterprises to the net returns were recorded. Average B: C ratio over five years of the study as well as year wise was also estimated. Since, the study includes diversified enterprises like crops, dairy, horticulture, agroforestry the yield was converted into rice equivalent yield (REY). All the products under IFS model were sold at farm gate price for different years of the study. Observations regarding the values of residues recycled under different components of the farming system model were taken during 2012-13 to 2015-16. Mainly the residues were crop straw or stover, fallen leaves, cow dung and urine, bedding materials

etc. To calculate the values of such residues local market values were considered. Cost of fallen leaves, bedding materials *etc*. were negligible. Labour required under different components were met up by the farm-family itself. The farm-family is consisting of six members. Benchmark study for comparing the economics and livelihood security of the farming system developed for study at Pantnagar was done during the year 2010-2011 at Udham Singh Nagar, Uttarakhand. This study shows that the predominant cropping vis-à-vis farming system (rice-wheat) of the area produces a net income of Rs. 95,000.00/ year with employment generation of 200 mandays/ year.

Table 1
Integrated farming system model of 1.0 ha area

Particulars	*Area (m^2)*
Field crops	
A. Rice – veg. pea – maize/okra	1400
B. Rice – wheat – moong	1200
C. Sorghum multi – cut (fodder) – yellow sarson – urd	1100
D. Rice (TPR) – berseem+oat+mustard (fodder) – maize+cowpea (fodder)	1000
Total	4700
Agroforestry/Horticultural Crops	
A. Guava (80)+ Lemon (40)+ Karonda (100) on boundary	1900
B. Poplar+ Soybean +Wheat	1800
C. Eucalyptus+ Turmeric	500
Total	4200
Dairy (3 Cows**)**	300
Vermicompost + Biogas	100
Kitchen Garden	100
Total	500
Fishery	600
Grand Total	10000

RESULTS AND DISCUSSION

Production and profitability of the IFS model

The average farm production evaluated in terms of REY (t/ha) exhibits that total 30.49 t REY/ha/ annum was produced in the model (Table 2). The individual units such as, crop, horticulture, livestock, fishery and other units produced 8.85, 6.72, 13.54, 0.31 and 1.24 t REY/ ha/ annum on an average correspondingly. The average annual net returns from the model was Rs. 221420.10 and the crop, horticulture, livestock, fishery and other units were sharing about 27.3, 25.0, 40.8, 0.09 and 7.0 % to the net returns. Benefit: cost ratio in terms of economic point of view was 2.77/ annum during last 5 years (Table 3 and Figure 1). Comparing the benchmark

study of the area and the present IFS model of Pantnagar, it was clearly of recorded that the IFS model was capable enough to increase the net income by almost twice. Comparing the different components under the IFS model, it was also observed that the dairy component was most remunerative followed by crop unit. All these findings are in concurrence with the findings previously recorded by Gill *et al.*, 2009 [3] and Chnnabasavanna and Biradar, 2007 [4].

Table 2
Farm production details from IFS model

Year	*Production (in REY t/ha)*					
	Total	*Crops unit*	*Horticulture unit*	*Dairy unit*	*Fishery unit*	*Others viz.mushroom/ vermicompost/ boundary plantation/ kitchen gardening etc.*
2011-12	19.05	7.08	4.24	6.72	-	1.00
2012-13	25.73	9.31	7.87	8.20	-	0.35
2013-14	20.62	8.35	5.74	6.49	-	1.04
2014-15	33.17	9.67	7.20	14.83	-	1.47
2015-16	53.9	9.82	8.57	31.47	0.31	2.36
Average	30.49	8.85	6.72	13.54	0.31	1.24

Table 3
Net returns (Rs./ha) from the IFS model

Year	*Net returns*					
	Total	*Crops unit*	*Horticulture unit*	*Dairy unit*	*Fishery unit*	*Other enterprises*
2011-12	197685.0	58540.0 (29.6%)	54035.0 (27.3%)	72610.0 (36.7%)	-	12500.0 (6.3%)
2012-13	118958.5	41344.5 (34.8%)	51600.0 (43.4%)	22514.0 (18.9%)	-	3500.0 (2.9%)
2013-14	99563.2	56163.2 (56.4%)	31200.0 (31.3%)	-1300.0 (-1.3%)	-	13500.0 (13.6%)
2014-15	233577.6	69214.1 (29.6%)	55300.0 (23.7%)	89063.5 (38.1%)	-	20000.0 (8.6%)
2015-16	457316.0	77258.0 (16.9%)	85005.0 (18.6%)	268663.0 (58.8%)	414.0 (0.09%)	28084.0 (6.1%)
Average	221420.1	60504.0 (27.3%)	55428.1 (25.0%)	90310.1 (40.8%)	414.0	15516.8 (7.0%)

(Values in bracket represent the percent share of different unit to total net returns)

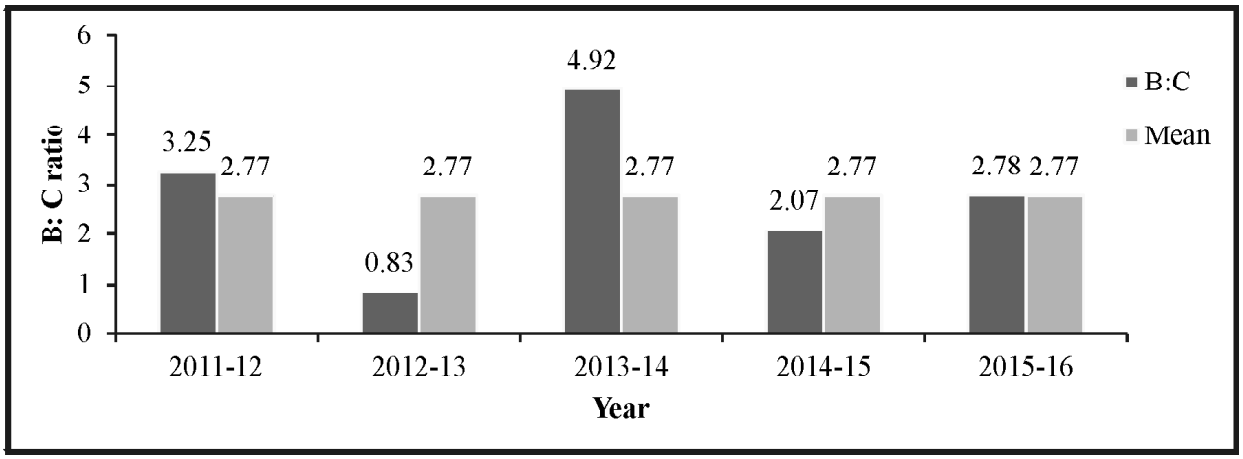

Figure 1: B: C ratio during the study period

Livelihood analysis of the IFS Model

The total value of products produced from the IFS unit was Rs. 714290.00 during 2015-16 among which values of commodities consumed within the family and commodities recycled within the system were Rs. 67093.00 and 154204.00, correspondingly (Table 4). So, there was a huge marketable surplus of Rs. 492993.0 from this IFS unit. There was a handsome family savings of Rs. 236019.00 from this unit too. These findings corroborated the findings previously reported by Varughese and Mathew, 2009 [5].

Table 4
Livelihood analysis of the IFS model during 2015-16

Farm enterprises	*Value of all the farm commodities produced (Rs.) (A)*	*Value of farm commodities consumedin family (Rs.)(B)*	*Value of all farm commodities recycled in system (Rs.)(C)*	*Marketable surplus (Rs.) (A-B-C)=D*	*Family savings (If any) (Rs.) (D-Cost of production)*
Crops	133581.0	26793.0	64636.0	42152.0	-14171.0
Dairy	422760.0	29200.0	38360.0	355200.0	201103.0
Horticulture	116455.0	7000.0	19864.0	89591.0	58141.0
Fishery	4250.0	600.0	100.0	3550	-286.0
Others	37244.0	3500.0	31244.0	2500	-8768.0
Total of all the farm produces	714290.0	67093.0	154204.0	492993.0	236019.0

Resource recycling and employment generation

The average cost of production of four years (2012-13 to 2015-16) was Rs. 329843.90/ annum and the average total value of recycled farm products was Rs. 75308.60/ annum in which the average value of recycled products and by products of different units like crop, dairy, horticulture, fishery and others were Rs. 17497.80, 26233.90, 6096.50, 100.00 and 8751.70 respectively (Table 5). The number and value of farm labour engaged in the system were 451/ annum and Rs. 81655.00/ annum correspondingly. So, the average saving from the recycled farm products vis-

à-vis by products and farm-labour engagement were 25.80 and 40.50%, respectively to the average cost of production. Enterprise-wise generated employment in man-days were 171.8, 162.5, 116.5 and 4 from crop, dairy, horticulture and fishery respectively (Table 6) and an average of total 451 man days were generated. Different components of the system only engaging family labour including women. As the farm women were directly involved in the farm activities, enabled them to make decisions on farm operation and the use of surplus produce. All these findings are in accordance with the findings previously recorded by Ansari *et al.*, 2014 [6] and Mahajan *et al.*, 2013 [7].

Table 5
Contribution of different farm enterprises in Resource Recycling and overall saving (%) in production cost

Year	*Cost of production (Rs.)*	*Enterprise Wise Value of Recycled Products and By-products (Rs.)*					*Total Value of Recycling*	*Farm Labour Engaged*	
		Crops	*Dairy*	*Horti.*	*Fishery*	*Others*		*Man days*	*Value*
2012-13	181623.0	2174.0	30163.5	2886.0	-	3500.0	38734.5	573	80220.0
2013-14	170634.9	16500.0	13500.0	1500.0	-	-	112700.0	406	81200.0
2014-15	217485.9	43500.0	20000.0	3000.0	-	5743.0	72343.0	417	83400.0
2015-16	254866.0	7817.0	41272.0	17000.0	100	17012.0	77457.0	409	81800.0
Average	329843.9	17497.8	26233.9	6096.5	100.0	8751.7	75308.6	451	81655.0

Table 6
Employment generation in IFS model

Years	*Enterprise- wise Employment Generated (Man days)*				*Total Man Days*	*Total Value @ Rs./Man Day*
	Crops	*Dairy*	*Horticulture*	*Fishery*		
2012-13	223	170	180	-	573	80220 @ Rs.140
2013-14	157	135	114	-	406	81200 @ Rs.200
2014-15	168	135	114	-	417	83400 @ Rs.200
2015-16	139	210	58	4	409	81800 @ Rs.200
Average	171.8	162.5	116.5	4	451.3	81655 @Rs.185

CONCLUSION

The small scale integrated farming system model resulted in increased on farm production of diversified food items resulting in nutrition security of household besides providing additional income and employment opportunities. The composting of farm wastes resulted in residue recycling within the system and to meet the nutrient requirement for crop production in home garden thereby reducing the dependence on external inputs. Such model can be emulated in other remote, isolated resource scarce areas to improve livelihood of the individual household. From the study it can be concluded that the IFS model can be efficient enough to save almost 25-30% of production cost as well as approx. 40% of labour cost. It can also be very

much effective to provide year round employment to the farm family.

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