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Impacts of Integrated Farming System on Socio-economics and Livelihood Sustainability of Small and Marginal Farmers in Chhattisgarh

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A B S T R A C T

The integrated farming system study was conducted at farmers field of village –Mohpur, Block-Kanker, District- Uttar Bastar Kanker (C.G.) under All India Coordinated Research Project on Integrated Farming System- On Farm Research, Indira Gandhi Krishi Vishwavidyalaya, Krishi Vigyan Kendra, Kanker during July, 2017- June, 2018 for finding the contribution of total income to the livelihood of farmers who practices integrated farming system. Study was conducted in crop + vegetable + dairy + Goatry + piggery + poultry + duck + fisheries + lac cultivation + minor forest produce + FYM & vermi-compost + *Azolla* production farming system in 1.0 hectare area under irrigated condition. Out of one hectare area, 0.606 ha was allotted for crop component i.e field crops (rice, blackgram, pigeon pea, sweet corn) & vegetables (tomato, brinjal, onion, potato, peas, chilly, cucubits etc), 0.2 ha for lac cultivation, 0.13 ha for fisheries, 0.006 ha for organic manure production, 0.03 ha for animal husbandry & poultry and 0.03 ha for residency & other. Growing field crops and vegetables with 60 percent area in order to meet the family food requirement and in addition to get better profit out of these produce. The results of one year study of integrated farming system indicated that the economic yield was 244.69 q with the highest been contributed by vegetables (116.52 q), followed by organic manure (87.65 q), field crops (30.80), animal husbandry (2.85 q), minor forest produce (2.80 q), *Azolla* production (1.44 q), lac cultivation (1.40 q), fisheries (0.70 q) and poultry (0.53 q). Similarly annual total net return of the IFS model was Rs. 217591.00 with the highest been contributed by vegetables (Rs. 101860), followed by field crops (Rs. 34067), organic manure production (Rs. 24130), lac cultivation (Rs. 17440), animal husbandry (Rs. 17010), poultry (Rs. 14530) minor forest produce (Rs. 5630), fisheries (Rs.4700) and *Azolla* (Rs. 1584). Effective recycling of farm by products and waste in terms of FYM (46.4 q), vermicompost (32 q), goat manure (7.6 q) and poultry manure (1.65 q) and can save Rs. 30150.00 per year. The total annual mandays generated for family members by IFS model was 619 and highest been contributed by vegetable production (265 mandays) followed by animal husbandry (108 mandays). Thus, we can conclude that adoption of integrated farming systems improves the profitability and achieve sustainable production by effective recycling of natural resource in addition to meeting family needs.

Introduction

Agriculture has always been considered as the back- bone of our country. In India 70 % of rural population is engaged in agriculture and 80% of population live, directly or indirectly on income delivered from agriculture. There are 115 million operational holdings in the country and about 80 % are marginal and small farmers (Manjunatha *et al.,* 2014). To fulfill the basic needs of house hold including food (cereal, pulses, oilseeds, milk, fruit, honey, meat, etc.), feed, fodder, fiber, etc. warrant an attention about Integrated Farming System. Undoubtedly, majority of the farmers are doing farming since long back but their main focus was individual components but not in a integrated manner. At the ICAR and State Agricultural Universities level, lot of efforts have been made aiming at increasing the productivity of different components of farming system i.e. crops, horticultural crops, live stock (dairy, goatry, piggery), poultry (chicken, ducks, quail, pigeons), lac cultivation, apiculture, sericulture, mushroom cultivation, organic manures production, bio-gas etc. individually but lacking in their integration by following farming system approach. The integration is made in such a way that product of one component should be the input for other enterprises with high degree of complimentary effects on each other.

The operational farm holding in India is declining and over 85 million out of 115 million are below the size of 1 ha (Manjunatha *et al.,* 2014). Due to ever increasing population and decline in per capita availability of land in the country, practically there is no scope for horizontal expansion of land for agriculture. Only vertical expansion is possible by integrating farming components requiring lesser space and time and ensuring reasonable returns to farm families. The Integrated Farming System therefore assumes greater importance for sound management of farm resources to enhance the farm productivity and reduce the environmental degradation, improve the quality of life of resource poor farmers and maintain sustainability. In order to sustain a positive growth rate in agriculture, a holistic approach is the need of the hour. Farming system is a mix of farm enterprises in which farm families allocate resources for efficient utilization of the existing enterprises for enhancing productivity and profitability of the farm (Varughese *et al.,* 2009). Integrated farming system approach is not only a reliable way of obtaining fairly high productivity with considerable scope for resource recycling, but also concept of ecological soundness leading to sustainable agriculture. One of the option to evaluate the potential of age- old mixed farming now as a IFS in enhancing income of farm families within the reasonable time period.

Materials and Methods

The integrated farming system study was conducted at farmers field of village – Mohpur, Block- Kanker, District- Uttar Bastar Kanker (C.G.) under All India Coordinated Research Project on Integrated Farming System- On Farm Research, Indira Gandhi Krishi Vishwavidyalaya, Krishi Vigyan Kendra, Kanker during July, 2017- June, 2018 for finding the contribution of total income to the livelihood of farmers who practices integrated farming system. Study was conducted in field crops + vegetable + dairy + Goatry + piggery + poultry + duck + fisheries + lac cultivation + minor forest produce + FYM & vermi-compost + *Azolla* production farming system in 1.0 hectare area under irrigated condition. Topography of soil was upland and midland with sandy loam soil. Out of one hectare area, 0.606 ha was allotted for crop component i.e. field crops (rice, blackgram, pigeon pea, sweet corn) &

vegetables (tomato, brinjal, onion, potato, peas, chilly, cucubits etc), 0.2 ha was taken for lac cultivation, 0.13 ha for fisheries, 0.006 ha for organic manure production, 0.03 ha animal & poultry and 0.03 ha for residency. Total gross cropped area was 1.51 ha wherein under vegetables (0.91 ha) and field crops (0.6 ha). Technical and some physical inputs of agriculture are given to farmer during the study period. All the activities regarding farming i.e. crops cultivation, livestock rearing, poultry, fish culture, lac cultivation, organic manures and *Azolla* production, minor forest produce collection, homestead components and spent time of family members recorded every day in data register by household members and the data were also recorded personally by the researcher by visiting the study area and interviewing the family members. All possible efforts were made to ensure the collection of reasonably accurate data from the farm household through face- to- face interview and recall basis.

Cost of cultivation of every farm enterprises calculated by sum of internal input cost, external input cost, labour cost and transportation cost. Gross returns from farm produce calculate on the basis of total produce and sold produce of farm enterprises separately. Also recorded the by products of every enterprises of farm and their recycling pattern within a farm and outside of farm. Forest trees are also in existing farming system; therefore data relevant to minor forest produce collection and income generation also recorded.

Results and Discussion

Economics of integrated farming system

The data after study indicated that adoption of integrated farming system by inclusion of crops based enterprises, animal husbandry (dairy, goatry, piggery), poultry (back yard poultry, ducks, pigeons), fisheries, lac cultivation, minor forest produce and organic manures production recorded annual total gross return of the IFS model was Rs. 347103.00 (Table 5) with the highest been contributed by vegetables (Rs. 165540), followed by field crops (Rs. 55199), organic manure production (Rs. 30150), animal husbandry (Rs. 28550), lac cultivation (Rs. 25200), poultry (Rs. 19210), minor forest produce (Rs. 10430), fisheries (Rs. 9800) and *Azolla* production (Rs. 3024). Integration of farm enterprises generated additional gross income Rs. 126364.00 per annum where in comparison to Rs. 220739.00 by field and vegetable crops.

Annual total net return of the IFS model was Rs. 217591.00 with the highest been contributed by vegetables (Rs. 101860), followed by field crops (Rs. 34067), organic manure production (Rs. 24130), lac cultivation (Rs. 17440), animal husbandry (Rs. 17010), poultry (Rs. 14530), minor forest produce (Rs. 5630), fisheries (Rs.4700) and *Azolla* (Rs. 1584). Integration of different farm enterprises generated additional net income Rs. 81664.00 per annum where in comparison to Rs. 135927.00 by field and vegetable crops. Average B: C ratio of the farming system was 2.69 and highest was under organic manure production (5.01) followed by poultry (4.10), lac cultivation (3.25), field crops production (2.61), vegetables production (2.60), minor forest produce (2.17), *Azolla* production (2.10), animal husbandry (1.96) and fisheries (1.92). Kumara *et al.*, (2017) also found that inclusion of enterprises in integrated farming system in 1 ha area gave average net returns of Rs. 186571.00 per annum with the highest been contributed by dairy (Rs. 47378), horticulture (Rs. 38526), and sheep (Rs. 17876). In Tamilnadu Jayanti *et al.*, (2001) found that the net return of IFS (Cropping +

fish + poultry) was on an average of Rs. 97731/ha/year over the arable farming (Rs 36190/ha/year). While in Goa Manjunath *et al.,* (2003) recorded that the net return of IFS (Rice-Brinjal (0.5 ha) + Rice- cowpea (0.5 ha) + mushroom + poultry) was Rs. 75360.00 per year over the cashew nut cultivation (Rs. 36330) alone. In Madhya Pradesh Tiwari *et al.,* (1999) found that the integrated farming gave a margin in net return of Rs 44913/ ha/year over the arable farming (Rs. 24093).

Annual total cost of cultivation of the IFS model was Rs. 129152.00 and highest was under vegetables production (Rs. 63680), followed by field crop production (Rs. 21132), animal husbandry (Rs. 14540), lac cultivation (Rs. 7760), organic manure production (Rs. 6020), fisheries (Rs. 5100), minor forest produce (Rs. 4800), poultry (Rs. 4680) and *Azolla* production (Rs. 1440). Integrated farming system (crop + dairy + horticultural + fishery + mushroom + apiary + vermicompost) study of 1.0 ha area conducted at western plain zone of Uttar Pradesh by Singh *et al.,* and recorded that total cost of cultivation of IFS model was Rs. 267295.00 per year, gross return Rs. 570705.00 per year and net return 303410.00 per year. Annual total gross income of the IFS model on the basis of sold farm produce was Rs. 274489.00 with the highest been contributed by vegetables (Rs. 159265), followed by field crops (Rs. 37174), animal husbandry (Rs. 25650), lac cultivation (Rs. 25200), poultry (Rs. 11850), minor forest produce (8630) and fisheries (Rs.6720). Due to integration of enterprises with in a farm generated additional gross income Rs. 78050.00 per annum on the basis of sold produce as compare to Rs. 196439.00 by crops only. Annual total net income of the IFS model on the basis of sold produce was Rs. 153567.00 and highest was under vegetables production (Rs. 95585), followed by lac cultivation (Rs. 17440), field crop production (Rs. 16042), animal husbandry (Rs. 11110), poultry (Rs. 7170), minor forest produce (3830) and fisheries (Rs.1620). Integration of farm enterprises generated additional net income Rs. 33710.00 per annum where in comparison to Rs. 111627.00 by field and vegetable crops. In Haryana, Singh *et al.,* (1993) conducted studies of various farming systems on 1 ha of irrigated and 1.5 ha of unirrigated land and found that under irrigated conditions of mixed farming with crossbred cows yielded the highest net profit (Rs 20,581/-) followed by mixed farming with buffaloes (Rs 6,218/-) and lowest in arable farming (Rs 4,615/-). Another study involving cropping, poultry, pigeon, goat and fishery was conducted under wetland conditions of Tamil Nadu conducted by Jayanthi *et al.,* (2001) three years results revealed that integration of crop with fish (400 reared in 3 ponds of 0.04 ha each), poultry (20 babkok layer bird), pigeon (40 pairs), and goat (Tellichery breed of 20 female and 1 male in 0.03 ha deep litter system) resulted in higher productivity, higher economic return of Rs 1, 31,118 (mean of 3 year) (Table 2).

Economic yield of enterprises in integrated farming system

Annual total economic yield of IFS model was 244.69 q (Table 4) with the highest been contributed by vegetables (116.52 q), followed by organic manure (87.65 q), field crops (30.80), animal husbandry (2.85 q), minor forest produce (2.80 q), *Azolla* production (1.44 q), lac cultivation (1.40 q), fisheries (0.70 q) and poultry (0.53 q). Annual total family consumption of economic yield of IFS model was 15.75 q and highest was under field crops (10.85 q), followed by vegetables (4.04 q), minor forest produce (0.60 q), animal husbandry produce (0.44 q), fisheries (0.22 q) and poultry (0.20 q). Organic manures 87.65 q used for crop production and *Azolla* 1.44 q used for feeding to poultry & pigs at own farm (Table 3).

Table.1 Productivity of farm enterprises in integrated farming system model

Enterprises	Area (ha)	Economic yield (q)	Family consumption (q)	Sold (q)	Rs./ q	Gross return (Rs.)	Cost of production (Rs.)	Net return (Rs.)	Straw (q)	Use of residue		Family labour (Man days)	B:C	On sold farm produce (Rs.)	
										Feed (q)	Composting (q)			Gross return	Net return
Field crops															
Rice	0.4	18.6	9.5	9.1	1590	29574	12140	17434	16.4	14.8	1.6	48	2.44	14469	2329
Blackgram	0.1	1.05	0.3	0.75	4500	4725	2120	2605	1.47	0.5	0.97	13	2.23	3375	1255
Pigeon pea	0	0.9	0.25	0.65	5000	4500	1480	3020	0.8	0	0.8	6	3.04	3250	1770
Sweet corn	0.1	10.25	0.2	10.05	1600	16400	5392	11008	8	0	8	25	3.04	16080	10688
Total	**0.6**	**30.8**	**10.25**	**20.55**	**0**	**55199**	**21132**	**34067**	**26.67**	**15.3**	**11.37**	**92**	**2.61**	**37174**	**16042**
Vegetables															
Vegetables	0.1	12.3	0.9	11.4	2000	24600	7800	16800	2.60	0	2.60	35	3.15	22800	15000
Vegetable. in *Badi*	0.006	1.72	0.75	0.97	2000	3440	1260	2180	0.80	0	0.80	9	2.73	1940	680
Tomato	0.2	28.2	0.32	27.88	1000	28200	13900	14300	2.45	0	2.45	59	2.03	27880	13980
Brinjal	0.2	29	0.38	28.62	1000	29000	13600	15400	2.30	0	2.30	53	2.13	28620	15020
Onion & potato	0.1	14.1	0.55	13.55	1500	21150	7600	13550	0.85	0	0.85	27	2.78	20325	12725
Peas	0.1	9.5	0.2	9.3	2500	23750	7400	16350	2.40	0	2.40	29	3.21	23250	15850
Chilly	0.1	8.2	0.09	8.11	3000	24600	8200	16400	1.55	0	1.55	36	3.00	24330	16130
Cucurbits	0.1	13.5	0.85	12.65	800	10800	3920	6880	1.80	0	1.80	17	2.76	10120	6200
Total	**0.906**	**116.52**	**4.04**	**112.48**	**0**	**165540**	**63680**	**101860**	**14.75**	**0**	**14.75**	**265**	**2.60**	**159265**	**95585**
Animal husbandry															
Cow	8	2.2	0.4	1.8	4000	8800	7200	1600	0	0	46.40	60	1.22	7200	0
Goatry	11	0.27	0.02	0.25	45000	12150	5400	6750	0	0	7.60	40	2.25	11250	5850
Pig	3	0.38	0.02	0.36	20000	7600	1940	5660	0	0	0	8	3.92	7200	5260
Total	**22**	**2.85**	**0.44**	**2.41**	**0**	**28550**	**14540**	**14010**	**0**	**0**	**54.00**	**108**	**1.96**	**25650**	**11110**
Poultry															
Back yard poultry	46	0.41	0.16	0.25	41000	16810	3940	12870	0	0	1.30	18	4.27	10250	6310
Duck	15	0.12	0.4	0.08	20000	2400	740	1660	0	0	0.38	2	3.24	1600	860
Total	**61**	**0.53**	**0.20**	**0.33**	**0**	**19210**	**4680**	**14530**	**0**	**0**	**1.68**	**20**	**4.10**	**11850**	**7170**

Table.2 Production and recycling of organic manures in integrated farming system model

Organic manures	Area (m^2)	Production (q)	Use in farm (q)	Gross return (Rs.)	Cost of production (Rs.)	Net return (Rs.)	Family labour (Man days)	B:C
FYM	40	46.4	46.4	3250	600	2650	6	5.42
Goat Manure	8	7.6	7.6	1000	120	880	1	8.33
Poultry manure	2	1.65	1.65	300	120	180	1	2.50
Vermi compost	12	32	32	25600	5180	20420	39	4.94
Total	**62**	**87.65**	**87.65**	**30150**	**6020**	**24130**	**47**	**5.01**

Table.3 Minor forest produces collection in integrated farming system model

Minor forest produces	Tree/ plants (Nos.)	Production	Family consumption	Gross return (Rs.)	Cost of collection (Rs.)	Net return (Rs.)	Family labour (Man days)	B:C
Mahua	3	2.40 q	0.60 q	7200	3600	3600	30	2.00
Chironji	5	0.40 q	0	1200	480	720	3	2.50
Tendu Patta	2910	1400 bundle	0	2030	720	1310	6	2.82
Total	**2918**		**0.60**	**10430**	**4800**	**5630**	**39**	**2.17**

Table.4 Farm production, utilization and recycling of produces in integrated farming system model

Enterprises	Area (ha)	Economic yield (q)	Family consumption/ use in farm (q)	Sold produce (q)	Straw yield (q)	Broken rice & husk/ other	Use (q)	
							Feed	Composting
Field crops	0.606	30.80	10.85	20.55	26.67	3.26	18.56	11.37
Vegetables		116.52	4.04	112.48	14.75	0	0	14.75
Animal husbandry	0.028	2.85	0.44	2.41	0	0	0	54.00
Poultry	0.002	0.53	0.20	0.33	0	0	0	1.68
Fisheries	0.13	0.70	0.22	0.48	0	0	0	0
Lac cultivation	0.20	1.40	0	1.40	7.80	0	0	7.80
Organic manures	0.006	87.65	87.65	0	-	0	-	-
Azolla	0.001	1.44	1.44	0	-	0	-	-
Minor forest produce	0n bunds	2.80	0.60	2.20	0	0.60	0.60	0
Total	**0.97**	**244.69**	**104.84**	**139.85**	**49.22**	**3.86**	**19.16**	**89.60**

Table.5 Economics and employment generation in integrated farming system model

Enterprises	Cost of production (Rs.)	Gross return (Rs.)	Net return (Rs.)	B: C ratio	On sold farm produce		Family labour (mandays)
					Gross return (Rs.)	Net return (Rs.)	
Field crops	21132	55199	34067	2.61	37174	16042	92
Vegetables	63680	165540	101860	2.60	159265	95585	265
Animal husbandry	14540	28550	14010	1.96	25650	11110	108
Poultry	4680	19210	14530	4.10	11850	7170	20
Fisheries	5100	9800	4700	1.92	6720	1620	12
Lac cultivation	7760	25200	17440	3.25	25200	17440	24
Organic manures	6020	30150	24130	5.01	0	-6020	47
Azolla	1440	3024	1584	2.10	0	-1440	12
Minor forest produce	4800	10430	5630	2.17	8630	3830	39
Total	**129152**	**347103**	**217591**	**2.69**	**274489**	**145337**	**619**

Resource recycling in integrated farming system

Annual total straw yield of IFS model was 49.22 q (Table 2) with the highest been contributed by field crops (26.67 q), followed by vegetables (14.75) and lac cultivation (7.80 q). Paddy straw 15.30 q used for feeding to animals and rest of the farm residues (33.92 q) utilized for compost production. Cow dung (46.4 q), goat vista (7.6 q) and poultry vista (1.68 q) of farm used for FYM, goat and poultry manure production respectively. Total organic manures production was 87.65 q with the highest been contributed by FYM (46.4 q) followed by vermicompost (32 q), goat manure (7.6 q) and poultry manure (1.65 q) and the total quantity (87.65 q) of organic sources of nutrients are being recycled from farm waste obtained from different components. Recycling of farm wastes in form of organic manures within the system itself was found very economical in saving Rs. 30150.00 per year as well as save the use of chemical fertilizers or its substitutes and also improve the soil health condition, there by enhanced the organic matter and microbial activity which resulted in sustainable production. Similar findings also recorded by Kumara *et al.,* (2017) that the total quantity (462.50 kg) of organic source of nutrients are being recycled from farm waste obtained from different components. More than 35 per cent of NPK requirement would be met through recycling of farm wastes in form of compost and vermi compost within the system itself. 1.44 q of *Azolla* produced in farm was utilized as supplement feed for poultry and pigs

Employment generation in integrated farming system

Integrated farming system has created more number of working hours in the system due to involvement of more enterprises than cropping system alone. Total employment generation of IFS model for family members was 619 mandays per annum (Table 5) with the highest been contributed by vegetable production (265 mandays) followed by animal husbandry (108 mandays), field crop production (92 mandays), organic manures production (47 mandays), minor forest produce (39 mandays), lac cultivation (24 mandays), fisheries (12 mandays) and *Azolla*

production (12 mandays). Integration of enterprises created the additional employment opportunity i.e. 262 mandays per annum as compare to only 357 mandays/ annum by cropping system alone. This has provided employment opportunity throughout the year due to involvement of more than one enterprise in the system. Kumara *et al.*,(2017) reported that 1.0 ha model has generated 515 mandays, 760 mandays, 1070 mandays and 932 mandays per hectare per year during 2012-13, 2013-14, 2014-15, 2015-16, respectively. Jayanthi *et al.*, also found that integration of enterprises created the employment opportunities where in comparison to 369 mandays/year generated in cropping alone system, cropping with fish and goat created additional 207 man days/annum.

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