The Pharma Innovation Journal 2023; 12(4): 205-208

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(4): 205-208

www.thepharmajournal.com
Received: 08-01-2023
Accepted: 11-02-2023

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Livestock based integrated farming system for socio-economic improvement and livelihood sustainability of small farmers in Chhattisgarh

AK Netam, MC Bhambri, SS Porte and S Kumar

Abstract
The integrated farming system study was conducted at farmer's farm of village –Bevarti, 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. IFS study was conducted with crop + vegetable + dairy (24 cow) + piggery (4) + poultry (47) + duck (20) + fisheries + organic manure production components in 2.0 hectare area under irrigated condition. Out of 2 hectare area, 1.701 ha was allotted for crop component *i.e.* field crops (rice, blackgram, maize, pigeon pea, chickpea, wheat, green gram and sweet corn) and vegetables (cow pea, okra, Indian bean, tomato, brinjal, onion, cucurbits etc.), 0.2 ha for fisheries, 0.072 ha for livestock shed, 0.01 ha for organic manure production, and 0.017 ha for residency & other. Growing field crops and vegetables with 85 percent area in order to meet the family food requirement and livestock feed. The results of one year study of integrated farming system modules indicated that the economic yield was 861.06 q with the highest been contributed by animal husbandry (535.58 q), followed by organic manure (192.7 q), field crops (98.85 q.), vegetables (29.6 q), fisheries (3.90 q) and poultry (0.43 q). Annual cost of production of IFS model was Rs. 1258470 and highest under animal husbandry (Rs. 1123600) followed by field crops (Rs. 93390), vegetables (Rs. 16440), fisheries (Rs. 12600), organic manure production (Rs. 7800) and poultry (Rs. 4640). Annual total net return of the integrated farming system model was Rs. 892277.00 with the highest been contributed by animal husbandry (Rs. 661850), followed by field crops (Rs. 121649), fisheries (Rs. 42000), organic manure production (Rs. 33013), vegetables (Rs. 24485) and poultry (Rs. 9280). Effective recycling of farm by-products and residues in the form of livestock feed (105.65 q) and organic manures *i.e* FYM (155 q), vermicompost (36 q) and poultry manure (1.7 q) and save Rs. 7187 of external fertilizers with reduce requirement of urea (255 kg), SSP (368 kg) and MOP (164 kg). The total annual employment generated for family members in IFS model was 914 manday and highest been contributed by animal husbandry (569 manday) followed by field crops (174 manday), vegetables (66 manday), organic manure production (58 manday), poultry (34 manday) and fisheries (13 day) Thus, we can conclude that adoption of livestock based integrated farming systems improves the profitability and achieve sustainable production of farm by judicious recycling of natural resource and farm residues in addition to meet family needs of farmers.

Keywords: Integrated farming system, production, socio-economics, livelihood, employment, resource recycling

Introduction
There are 115 million operational holdings in the country and about 80 % are marginal and small farmers (Manjunatha *et al.* 2014) [5]. Under the circumstances of shrinking land holding size, it is necessary to integrate enterprises such as dairy, goatry, piggery, poultry, fisheries, apiary, sericulture, agroforestry, mushroom production etc. along with field and horticultural crops so as to make farming a more profitable for the farmers. 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 components such as crops, livestock (dairy, goatry, piggery), poultry (chicken, ducks, quail, pigeons), lac cultivation, apiculture, sericulture, mushroom cultivation, organic manures production, bio-gas etc. and appropriate integration of components by IFS approach. The integration is made in such a way that product of one enterprise should be the input for other enterprises with high degree of complimentary effects on each other. We not only remove waste, but we also ensure an overall boost in production for agricultural systems as a whole.

Integration of enterprises not only helpful in ensuring food, nutrition and livelihood security but also ensures social, economic and environmental sustainability.

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) [5]. The declining trend in size of land holding and diversion of agricultural lands for other uses poses a serious challenge to Indian agriculture in terms of food and livelihood. With this continued trend the average size of holdings is expected to further decline to 0.32 ha by 2030 (Anonymous, 2015) [1]. Due to ever increasing population and decline in per capita availability of land in the country, practically there is no scope for horizontal expansion, only vertical expansion of agriculture is the possible way for ensuring food and livelihood security. Livestock provide dung or excreta, which could be sold directly or transformed into a value-added product, bringing money back into the business. Increasing agricultural production systems for improved sustainability and economic returns is a vital strategy for developing countries to increase income, food, and nutrition security. To meet the challenges given by the current economic, political, and technical environment, progress in production or sustained growth in output is required. In this context, integrated farming system approach is one of the most important solutions for dealing with this peculiar situation, as it allows for the careful management of various enterprises and the development of location-specific IFS models based on available resources, resulting in long- term development. 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. There is need to develop sustainable agricultural practices for the development of small and marginal farms to ensure food and nutritional security as well as socio-economic improvement.

Materials and Methods

The integrated farming system study was conducted at farmer's farm situated at Latitude: 20.25853 and Longitude: 81.54405 and Altitude: 413m of the village– Bevarti, Block- Kanker, District- Uttar Bastar Kanker (C.G.) under All India Coordinated Research Project on Integrated Farming Systems- 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 (24 cow) + piggery (4) + poultry (47) + duck (20) + fisheries + organic manure production component on 2.0 hectare area under irrigated condition. There were 4 adult and 2 child members in a farming family. Out of 2 ha area, 1.701 ha was allotted for crop component *i.e.* field crops (rice, blackgram, maize, pigeon pea, chickpea, wheat, green gram and sweet corn) and vegetables (cow pea, okra, Indian bean, tomato, brinjal, onion, cucurbits etc.), 0.2 ha for fisheries, 0.072 ha for livestock shed, 0.01 ha for organic manure production, and 0.017 ha for residency & other. Growing field crops and vegetables with 85 percent area in order to meet the family food requirement and livestock feed. The land topography was upland and midland with sandy loam soil. Total gross cropped area was 3.851 ha wherein under field crops (3.60 ha) and vegetables (0.251 ha). Technical and some physical inputs of agricultural given to farming family during the study period. All the activities regarding farming *i.e.* crops cultivation, livestock rearing, poultry, fish culture, organic manures, homestead component 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 enterprise 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 enterprise of farm and their recycling pattern within a farm and outside of farm.

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, piggery), poultry (back yard poultry, ducks), fisheries and organic manures production recorded annual total gross return of the IFS model was Rs. 2150747.00 (Table-5) with the highest been contributed by animal husbandry (Rs. 1785450), followed by field crops (Rs. 215039), fisheries (Rs. 54600), vegetables (Rs. 40925), organic manures (Rs. 40813) and poultry (Rs. 13920).

Annual total net return of the IFS model was Rs. 892277.00 with the highest been contributed by animal husbandry (Rs. 661850), followed by field crops (Rs. 121649), fisheries (Rs. 42000), organic manures (Rs. 33013) vegetables (Rs. 24485), and poultry (Rs. 9280). Average B: C ratio of the integrated farming system was 1.71 and highest was under organic manures production (5.23) followed by fisheries (4.33), poultry (3.0), vegetables production (2.49), field crops production (2.3) and animal husbandry (1.59). Kumara *et al.* (2017) [3] also found that inclusion of enterprises in integrated farming system in 1.0 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) [2] 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) [3] 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) [7] 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. 1258470.00 and highest was under animal husbandry (Rs. 1123600), followed by field crop production (Rs. 93390), vegetables production (Rs. 16440), fisheries (Rs. 12600), organic manure production (Rs. 7800), and poultry (Rs. 4640). 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. 2040575.00 with the highest been contributed by animal husbandry (Rs. 1758650) followed by field crops (Rs. 189419), fisheries (Rs. 50120), vegetables (Rs. 36086) and poultry (Rs. 6300). Annual total net income of the IFS model on the basis of sold produce was Rs. 789905.00 and highest was under animal husbandry (Rs. 635050) followed by field crops (Rs. 96029), fisheries (Rs. 37520), vegetables (Rs. 19646) and poultry (Rs. 1660). In Haryana, Singh *et al.* (1993) [6] 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) [2] 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).

Economic yield of enterprises in Integrated Farming System

Annual total economic yield of IFS model was 861.06 q (Table-4) with the highest been contributed by animal husbandry (535.58 q), followed by organic manures (192.7 q), field crops (98.85 q), vegetables (29.6 q), fisheries (3.9 q) and poultry (0.43 q). Annual total family consumption of economic yield of IFS model was 25.04 q and highest was under field crops (13.35 q), followed by animal husbandry produce (8.02 q), vegetables (3.14 q), fisheries (0.32 q) and poultry (0.21 q). Organic manures 192.7 q used for crop production at IFS farm.

Resource recycling in Integrated Farming System

Annual total straw yield of IFS model was 111.6 q (Table-2) with the highest been contributed by field crops (88.55 q), followed by vegetables (23.05 q). Crop straw 101.25 q and broken rice husk 4.4 q used for feeding to livestock and rest of the crop residues (14.75 q) utilized for compost production. Cow dung (691.2 q), and poultry vista (4.96 q) of farm used for FYM and poultry manure production respectively. Total organic manures production was 192.7 q with the highest been contributed by FYM (155 q) followed by vermicompost (36 q), and poultry manure (1.70 q) and the total quantity (192.7 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. 33013.00 per year as well as reduce 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. Effective recycling of farm by- products and residues in the form of livestock feed (105.65 q) and organic manures *i.e* FYM (155 q), vermicompost (36 q) and poultry manure (1.7 q) and save Rs. 7187 of external fertilizers with reduce requirement of urea (255 kg), SSP (368 kg) and MOP (164 kg). Similar findings also recorded by Kumara *et al.* (2017) [3] 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.

Employment generation in Integrated Farming System

Integrated farming system has created a greater 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 914 mandays per annum (Table-5) with the highest been contributed by animal husbandry (569 mandays), followed by field crop production (174 mandays), vegetable production (66 mandays) organic manures production (58 mandays), poultry (34 mandays) and fisheries (13 mandays). Integration of enterprises created the additional employment opportunity *i.e.* 674 mandays per annum as compare to only 240 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) [3] 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.* (2001) [2] 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.

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

Enterprises	Area (ha)/ Nos.	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	1.3	59.15	11.0	48.15	1590	94049	38350	55699	56.65	54.50	2.15	70	2.45	76559	38209
Blackgram	0.1	1.0	0.4	0.6	4500	4500	1750	2750	1.50	0.6	0.90	12	2.57	2700	950
Maize	0.3	16.30	0.3	16.0	1200	19560	11800	7760	11.20	0	11.20	17	1.66	19200	7400
Pigeon pea	On bunds	0.9	0.25	0.65	5000	4500	1480	3020	0.8	0	0.80	6	3.04	3250	1770
Chick pea	1.3	11.20	0.3	10.90	5900	66080	23660	42420	8.50	1.20	7.30	28	2.79	64310	40650
Wheat	0.3	8.0	0.8	7.20	2000	16000	9600	6400	7.30	6.50	0.80	23	1.67	14400	4800
Green gram	0.3	2.30	0.30	2.0	4500	10350	6750	3600	2.60	0	2.60	18	1.53	9000	2250
Total	3.60	98.85	13.35	85.5		215039	93390	121649	88.55	62.8	25.75	174	2.30	189419	96029
Vegetables															
Vegetables	0.101	13.00	2.80	10.20	1579	20525	8640	11885	3.55	0	3.55	34	2.38	16104	7464
Sweet corn	0.15	16.60	0.34	16.26	1229	20400	7800	12600	19.50	19.50	0	32	2.62	19980	12180

Total	0.251	29.6	3.14	26.46		40925	16440	24485	23.05	19.50	3.55	66	2.49	36086	19646
Fisheries	0.2	3.90	0.32	3.58	14000	54600	12600	42000	0	0	0	13	4.33	50120	37520
Animal husbandry															
Cow	24	534.50	8.00	526.5	3300	1763850	1117200	646650	691.2	0	691.2	547	1.58	1737450	620250
Pig	4	1.08	0.02	1.06	20000	21600	6400	15200	0	0	0	22	3.38	21200	14800
Total	28	535.58	8.02	527.56		1785450	1123600	661850	691.2	0	691.2	569	1.59	1758650	635050
Poultry															
Back yard poultry	47	0.28	0.18	0.10	39000	10920	3440	7480	4.96	0	4.96	22	3.17	3900	460
Duck	20	0.15	0.03	0.12	20000	3000	1200	1800	0	0	0	12	2.50	2400	1200
Total	67	0.43	0.21	0.22		13920	4640	9280	4.96	0	4.96	34	3.0	6300	1660
GT		668.36	25.04	643.32		2109934	1250670	859264	807.76	82.3	725.46	856	1.69	2040575	789905

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.)	B:C	Family labour (Man days)
FYM	90	155	155	11713	1800	9913	6.51	15
Vermi compost	12	36	36	28800	5880	22920	4.90	42
Poultry manure	2	1.7	1.7	300	120	180	2.50	1
Total	104	192.7	192.7	40813	7800	33013	5.23	58

Table 3: Farm production, produce utilization, economics and employment generation in integrated farming system model

Enterprise	Area (ha)	Economic yield (q)	Family consumption/use in farm (q)	Sold produce (q)	Straw/other (q)	Broken rice & husk	Use (q)	
							Feed	Composting
Field crops	1.701	98.85	13.35	85.5	88.55	4.40	81.75	11.2
Vegetables		29.6	3.14	26.46	23.05	0	19.50	3.55
Animal husbandry	0.07	535.58	8.02	527.56	691.2	0	0	691.2
Poultry	0.002	0.43	0.21	0.22	4.96	0	0	4.96
Fisheries	0.2	3.9	0.32	3.58	0	0	0	0
Organic manures	0.01	192.7	192.7	0	0	0	0	0
Total	1.983	861.06	217.74	643.32	807.76	4.40	101.25	710.91

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	93390	215039	121649	2.3	189419	96029	174
Vegetables	16440	40925	24485	2.49	36086	19646	66
Animal husbandry	1123600	1785450	661850	1.59	1758650	635050	569
Poultry	4640	13920	9280	3	6300	1660	34
Fisheries	12600	54600	42000	4.33	50120	37520	13
Organic manures	7800	40813	33013	5.23	0	0	58
Total	1258470	2150747	892277	1.71	2040575	789905	914

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