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Agricultural Economics Research Review
Vol. 30 (Conference Number) 2017 pp 233-240
DOI: 10.5958/0974-0279.2017.00037.4

Impact of Integrated Farming System Approach on Doubling Farmers' Income

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Abstract

The role and factors associated with integrated farming system have been studied as a potential option to improve farmers' income and ensure their sustainable livelihood in two districts of Tamil Nadu and four districts of Haryana. The contribution of different combinations of enterprises such as poultry, fishery, sheep and goat and horticulture; with crop and dairy as base enterprises have been analysed for their impact on farmers' total income. The financial benefit of adopting different enterprise combinations analysed through partial budgeting has been found ranging from ₹ 7880/ha to ₹ 57530/ha. A highly significant ($P<0.01$) and significant ($P<0.05$) positive correlations were observed between total income and socio-economic factors like landholding, permanent asset creation, food security, nutritional security, employment generation and marketing behaviour; and education and livestock holding, respectively. A demand and profit oriented shift in preferences of farmers towards keeping farm forestry, mushroom culture, fishery, goat and poultry rearing from 1994 to 2014 in Haryana was noticed by the trend analysis. The heavy investment in the initial years and non-availability of labour were observed as the major constraints in adopting integrated farming system. The farmers can realize the doubling of their income within a contemplated period of five years by adding livestock in the farming system and reap the consequent social and ecological benefits.

Key words: Integrated farming system, doubling farmers' income, Haryana, Tamil Nadu

JEL Classification: Q16, Q14

Introduction

In India, the farmers maintain different enterprises for their complimentary and supplementary nature and for ensuring sustainable livelihood from time immemorial. After the advent of green revolution in late-1960s and economic liberalization in early-1990s, the farmers gradually started focusing on a few enterprises due to several imposing factors including shrinking farm sizes, fluctuating commodity prices, livelihood diversification and shortage of labour during peak agriculture season. It had a severe impact on food and nutritional security of millions of poor farm households. The anguish of farmers is often expressed in terms of their agitation in one or the other part of the country, unwillingness to continue farming and increasing demands of compensating their economic loss. Although suggestions are pouring in from experts and leaders of organisation for strengthening the income base of farmers, the government cannot implement them entirely due to compulsions from socio-economic and political considerations. However, the Government of India has made an announcement about Doubling Farmers' Income by 2022. Experts are judging the options and strategies for achieving this enviable target. One of the options is to evaluate the potential of age-old integrated farming system (IFS) in enhancing income of farm families within the

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reasonable time period. This paper deals with dairy-based enterprise combinations for their contribution to sustainable livelihood of farm families with income enhancement as a major plank.

Data and Methodology

The study was conducted in two districts, namely Tiruvallur and Thanjavur of Tamil Nadu for finding the contribution of total income to the livelihood of farmers who practise integrated farming system. By proportionate random sampling, 150 farmers practising dairy-based enterprise combinations was identified in both the districts. The income from each combination was taken as the dependent variable which was computed from the yield of the component enterprises and price realised by the sample respondents. A correlation analysis was carried out to ascertain the association of income variation from enterprise combinations with other socio-economic parameters. Further, case study approach was followed for calculating the total income contribution through partial budgeting method in 2017. An estimate of income that could be realized from the manure and urine of different animal components in the IFS was made. To understand the trend of farmers in keeping multiple farm enterprises and identify the constraints associated with them, a study was conducted in four districts of Haryana, namely Karnal, Kaithal, Sonepat and Hisar. The constraints were identified on the basis of their rating them as severe, moderate and least in adopting different enterprise combinations and the number of farmers reporting the said constraint was multiplied by 3, 2 and 1, respectively to find the extent of severity. In addition, 20 extension functionaries had also rated the same constraints on the three point continuum. Finally, a model has been proposed for doubling farmers' income with dairy as a major component of the farming system based on the identified parameters from the study and the available literature.

Results and Discussion

Financial Gains of Adopting Different Enterprise Combinations

In adoption of improved agricultural practices for doubling the income of farm families, the farmers are sensitive to the financial gains of the practices. The higher the benefit obtained from the introduced enterprise combinations, the easier it is to persuade the farmers to adopt them in their farms. Though there is no practice of calculating the financial gains of new practices in the study area, the farmers estimate the benefit that they earn from adding the new enterprises comparing it with crops grown by them. Thus, it needs to scrutinize the financial increment of the new practices before disseminating and making the farmers to be aware of the impending benefits. In order to calculate the incremental benefit of adding enterprises, four progressive farmers were interviewed to calculate the net benefit in the study area. When farmers grew only paddy, they got a net benefit of ₹ 40755/ha by spending ₹ 45942/ha. When they added new enterprises, farmers realized their incremental benefits. It has been shown in Table 1 on the basis of partial budgeting method. The average daily milk production for two indigenous buffaloes was 10 litres. With the lactation period of 8 months, the total milk production was 2400 litres in a year. However, the dairy enterprise starts giving benefits only after three years. Table 1 revealed that incremental net benefit of adopting different enterprise combinations with improved management practices increased by ₹ 7880 for crop + dairy, ₹ 12680 for crop+ dairy+ poultry, ₹ 57530 for crop + dairy + poultry + fishery and ₹ 35840 for crop + dairy + poultry + sheep/goat. In this exercise, the backyard poultry was considered only for meat purpose, although farmers can keep the same for eggs also. The cost of family labour was not imputed in cost calculations as farmers traditionally follow farming systems from time immemorial and they become part of natural farming due to complimentary benefits of each enterprise including the contribution of family members. The Table 1 below is a model for a small farmer who possesses one ha land with three to four adult family members (say husband, wife, mother and father) while they are likely to have school-going children. Farmers can apply the total manure from dairy, backyard poultry and small ruminants (sheep and goat) and the soil gets enriched as one ha farm normally requires 12500 kg of farm yard manure every year. The freshwater fish farming with carps can employ one additional labour for only feeding occasionally and harvesting.

The adoption of IFS could generate additional income ranging from ₹ 9,000 to ₹ 2,00,000 per hectare, depending on inclusion of number and kind of

Table 1. Partial budgeting indifferent enterprise combinations

(in ₹)

Particulars	Enterprise combinations				Remarks
	Crop + Dairy	Crop + Dairy + Poultry	Crop+ Dairy+ Poultry+ Fishery	Crop + Dairy + Poultry + Goat/Sheep	
Added cost					Two calves 18 months aged (₹ 15000/-); 10 chicks (₹ 200/chick); Fish pond with a dimension of 30m×10m×1m can be dug with Govt. subsidy and 300 fingerlings of catla, rohu and mrigal can be purchased @ ₹ 2.50/ fingerling: andfour goat kids @ ₹ 1000/-
System cost	15000	17000	17750	21000	
Labour cost	-	-	5000	-	
Veterinary cost	2000	2000	2000	3000	
Feed cost	36500	37000	45000	40000	
Miscellaneous cost (Transport, net, polythene)	3000	3000	13000	3000	
Interest @ 8 % for 6 months only	27120	27552	47592	33792	
Total added cost (A)	83620	87320	122470	99160	
Added return					10 litres milk @ ₹ 35/litre can be sold for 240 days in a year; One calf can be sold in a year. Fish can be harvested five times/year @ 200kg/harvest and sold @ ₹ 80/kg. Poultry birds can be sold three times after reaching 2 kg weight @ ₹ 200/kg
Sale of milk	84000	84000	84000	84000	
Sale of calf	7500	7500	7500	7500	
Sale of chicken		8500	8500	8500	
Sale of fish/sheep/goat			80000	35000	
Total added return (B)	91500	100000	180000	135000	
Net return (B-A)	7880	12680	57530	35840	

additional farm enterprises and their effective combination as reported by Dawood *et al. (*1996), Shanmugasundaram and Balusamy (1993), Rangasamy *et al.*(1995), Meshram *et al.* (2003), Rautaray *et al.* (2005), Murugan and Kathiresan (2005), Ponnusamy (2006), Ponnusamy and Gupta (2009).

Economic Assessment of Manure and Urine from Animal Components

Based on the interaction with four farmers practising IFS in Karnal district of Haryana, it could be observed from Table 2 that large ruminants like cow and buffalo could provide 29 - 32 kg manure and 12-14 litres urine per day which in fact enriches the soil by way of structure, texture and nutrients, leading to ultimate productivity enhancement. Small ruminants also contribute in a similar fashion. The farmers reported that poultry manure has a higher market demand and returns from its sale. Table 2 in fact provides valuable information for progressive farmers to practise different enterprise combinations in an environment-friendly manner. The market price of one litre of cow urine after purification ranged from ₹ 85 to ₹ 150/-.

Income Enhancement of Farmers from Different Enterprise Combinations

The majority of the respondents operated on a combination of farming enterprises which gave them sustained cash flow to manage many of the farm activities. The total income obtained from all the enterprises owned by the respondents for the past one year was computed as annual gross income of family. The average of total income from six enterprise combinations was worked out and is shown in Figure 1. After that, based on the net income, classification was done. As expected, Crop+Dairy+Poultry+Fishery, Crop+Dairy+Poultry+Horticulture, and Crop+Dairy+ Poultry+Sheep and Goat+Horticulture systems were found to contribute a higher net income to the farm

Table 2. Estimation of economic contribution of manure and urine of animals in IFS

Animal	Manure (kg/day)	Urine (litre /day)	Manure (kg/year)	Urine production per year	Manure rate (₹/kg)	Manure rate (₹/year)	Urine rate/kg	Urine rate (₹/year)	Rate of manure (₹/tonne)
Cow	29.5	14.1	10767	5146	0.60	6460	0.60	3087	600
Buffalo	32.5	12.2	11862	4453	0.45	5100	0.43	1914	450
Goat	1.75	0.70	638	255	0.50	319	0.50	127	500
Piggery	4	1.5	1460	547	0.45	627	0.43	235	450
Sheep	1.75	0.87	638	317	0.50	319	0.50	158	500
Poultry	0.03	-	11.0	-	1.50	16	-	-	1500

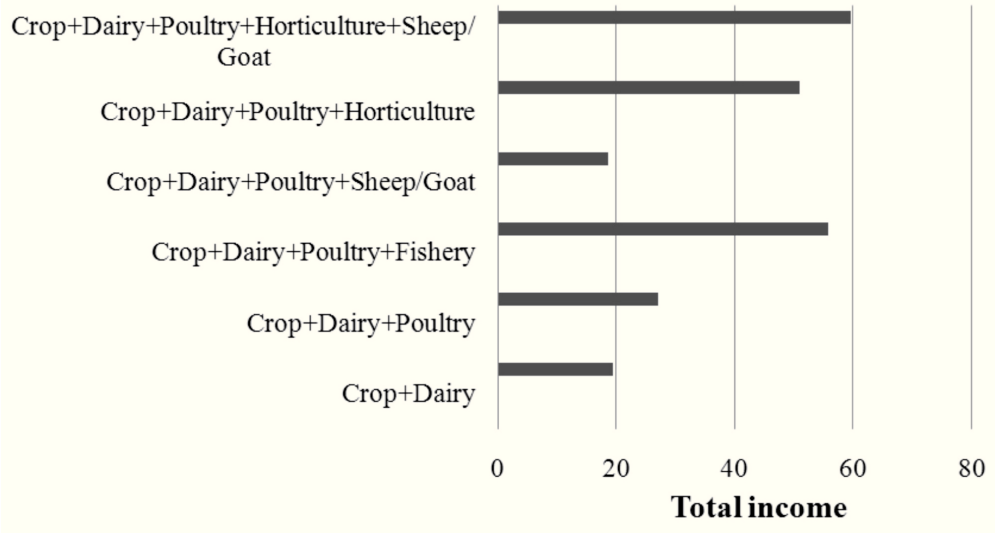

Figure 1. Contribution of different farming systems to the total income

families, since they were engaged in profit-oriented farming enterprises, including fisheries, vegetables, flowers, sugarcane, etc. Despite their small or medium holdings and small livestock holding, the farmers in study area earned a good income from such enterprises due to their intensive management, including the use of family labour. The substantial additional income could be generated by practising different enterprise combinations based on the location specificity and capability of farmers (Rangasamy *et al.*, 1995; Pushpa, 1996; Sivamurugan, 2001; Rautaray *et al.*, 2005; Murugan and Kathiresan, 2005, Ponnusamy, 2006).

Input Recycling from Integrated Farming System

Based on the cumulative square root frequency method, the farmers were classified based on their input recycling, as low, middle and high to understand their recycling pattern. A glance at data in Table 3 indicates that 42.67 per cent of respondents had medium level of input recycling, followed by low level (32.00%) and high level (25.33%). A closer integration of different components in a farming system enables an almost recycling of energy and nutrients within the system. The system such as Crop+Dairy+Poultry+Fishery was found to have high input recycling (5.33%) compared to the systems containing horticulture and sheep and goat components. Farmers perceived that seed replacement in every alternate year can ensure viability and enhanced germination. Having a low livestock density forced the farmers to either purchase the farmyard manure or simply leave the farm without applying any organic manure. It was observed that many groundnut and sesame cultivating farmers processed a portion of their produce into oil and used for home consumption and thereby reduced the external expenditure on oil and also got a by-product of cakes

Table 3. Distribution of respondents based on their input recycling in different farming systems (N=150)

Category	Systems						
	Crop+ Dairy	Crop+ Dairy+ Poultry	Crop+Dairy+ Poultry+ Fishery	Crop+Dairy+ Poultry+Sheep/ Goat	Crop+Dairy+ Poultry+ Horticulture	Crop+Dairy+Poultry+ Sheep/Goat+ Horticulture	Total
Low (<46%)	11 (7.33)	12 (8.00)	1 (0.67)	9 (6.00)	7 (4.67)	8 (5.33)	48 (32.00)
Medium (46-62%)	14 (9.33)	23 (15.33)	3 (2.00)	15 (10.00)	3 (2.00)	6 (4.00)	64 (42.67)
High (> 62%)	10 (6.67)	10 (6.67)	8 (5.33)	6 (4.00)	3 (2.00)	1 (0.67)	38 (25.33)
Total	35 (23.33)	45 (30.00)	12 (8.00)	30 (20.00)	13 (8.67)	15 (10.00)	150 (100)

Note: The figures within the parentheses indicate percentage

as cattle feed. The chaffy grains and other wastes obtained at the time of harvesting and threshing of paddy were also used as manure in some of the study villages. The lack of awareness and confidence about biological pest control methods made them to depend on only chemical pesticides. Small landholding and lack of sufficient irrigation facilities prohibit the farmers to produce sufficient feed and fodder. The meager profitability of systems like Crop+Dairy, Crop+Dairy+Poultry, etc. also forced them to rely on money lenders and financial institutions for the management of farm and family. Balusamy (1996) and Jayanthi *et al.* (2002) have reported similar findings.

Factors Associated with Total Income from Different Enterprise Combinations

The total income from different enterprise combinations being the major determinant for economic motivation of farmers, was taken as the dependent variable for 150 randomly selected farmers from Tiruvallur and Thanjavur districts of Tamil Nadu and the Pearson's correlation was worked out (Table 4). The coefficient values of correlation are given in Table 4. It indicates that education was significantly correlated with total income only for the overall IFS, but not with different enterprise combinations, indicating the incremental benefits of adopting multiple enterprises by the farmers. The social participation was highly correlated with total income in Crop+Dairy and Crop+Dairy+Poultry+Horticulture, depicting the role played by market forces in horticulture and field crops. Landholding is an important variable for keeping multiple enterprises. Due to the importance of manure for recycling within the farm, livestock holding emerged as a significant variable in combinations having fishery and sheep and goat enterprises. Employment generation and marketing behaviour were also found significantly correlated with the total income due to the proper engagement of family labour and immediate returns from sale of poultry birds for meeting the urgent expenses.

Shifting Preferences of Farmers in Adopting Different Farm Enterprises

To understand the trend of adopting different farm enterprises, 120 farmers from randomly selected four districts of Haryana, namely Karnal, Sonepat, Kaithal and Hisar, were asked to indicate their possession of enterprises during different periods of time. While there was no change in cultivation of paddy and wheat from 1994 to 2014 (Figure 2), they were gradually reducing the cultivation of vegetable crops, farm forestry was increasing, indigenous cattle and sheep were reducing, crossbred animals, goats and poultry were increasing, no change in buffalo-rearing while mushroom and fish farming were picking up. The decrease in horticulture crops was mainly due to getting assured price of paddy and wheat, higher labour requirement of horticulture crops and major price fluctuations in onion, tomato and potato. The poplar tree and eucalyptus provide quick returns within five to six years, are suitable for line planting on the farm boundary and have less

Table 4. Correlation coefficients of total income with other variables in different farming systems

Parameters	Crop+ Dairy	Crop+ Dairy+ Poultry	Crop+Dairy+ Poultry+ Fishery	Crop+Dairy+ Poultry+ Sheep/ Goat	Crop+Dairy+ Poultry+ Horticulture	Crop+Dairy+ Poultry+ Horticulture+ Sheep/Goat	Overall IFS
N	35	45	12	30	13	15	150
Age	-.116	-.004	.120	.067	.110	.229	.009
Education	.135	.101	.126	.539	.281	-.034	.209*
Farm experience	-.023	.030	.164	.099	-.039	.304	.053
Social participation	.532**	.205	-.034	-.167	.494**	.388	.139
Landholding	-.031	.417**	.512	.103	.095	.348	.315**
Cropping intensity	-.025	-.211	-.118	.305	-.068	.046	-.064
Livestock holding	.240	.071	.777**	-.376	.366*	-.342	.172*
Permanent asset creation	.366*	.627**	.274	.470	-.092	.707**	.447**
Food security	.399*	-.079	.481	.561*	-.193	.558*	.375**
Nutrient security	.511**	.138	.226	.139	.187	.628*	.403**
Input recycling	.002	.530**	.620*	-.430	-.164	-.464	.077
Employment generation	.376*	.161	.796**	.661*	.093	.597*	.618**
Marketing Behaviour	.277	.318*	.217	.114	.377*	.238	.374**

Note: *Significant at 0.05 level; ** significant at 0.01 level, N represents sample size

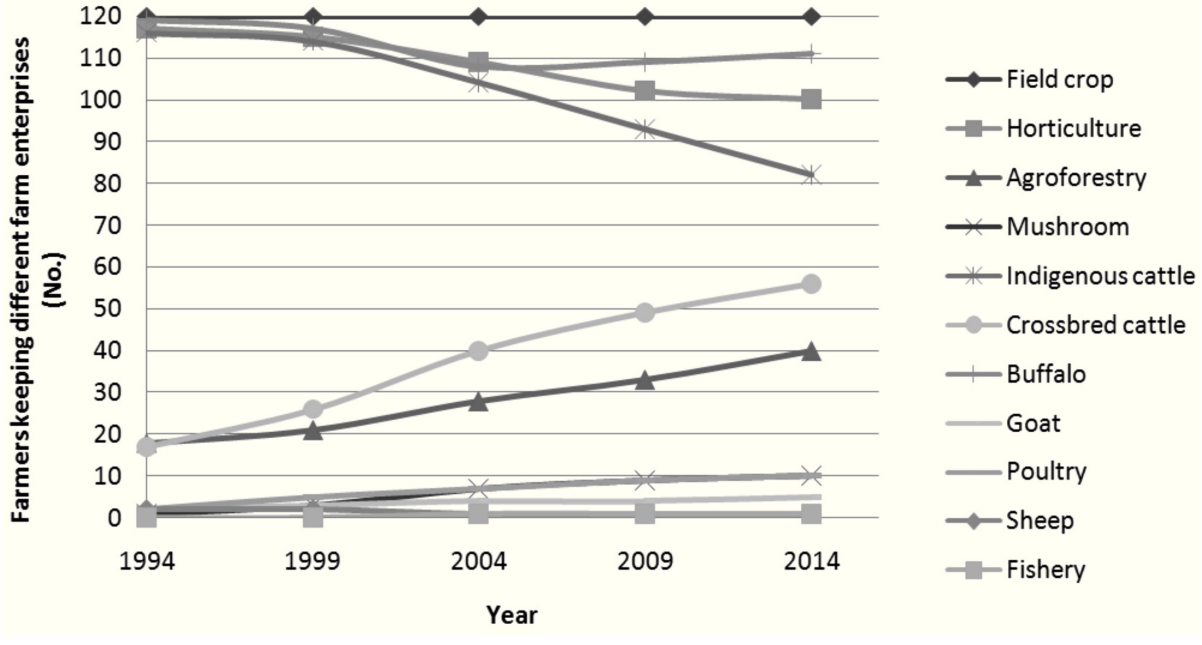

Figure 2. Shifting preferences of farmers in adopting different farm enterprises over the years

requirement of management inputs. The milk productivity was the major reason for shifting the preference from indigenous dairy animals to crossbreds and buffalo in addition to focus of government on commercial dairy farming with crossbred animals. While goat gets a higher market returns and higher fertility rate, sheep was seen with a lower preference. Mushroom was getting importance across the farmers due to higher market demand from the surrounding urban areas of Haryana state.

Table 5. Constraints faced by farmers in integrated farming systems (N=120)

Constraints in Integrated farming systems	Total	%	Farmers ranking	Experts ranking
Lack of marketing for produces from different enterprise	303	84.17	I	I
Heavy investment in the initial stage of starting	297	82.50	II	II
Labour unavailability and its high cost	295	81.94	III	III
Lack of infrastructure facility and scattered landholdings	291	80.83	IV	IV
Non-availability of improved varieties of seed /breeds at farm site	267	74.17	V	VII
Electricity supply problem for irrigation and farm purpose	266	73.89	VI	V
Lack of inputs availability	257	71.39	VII	VI
Lack of skill with family labour	254	70.56	VIII	VIII
Lack of know –how on effective utilization of farm produces	253	70.28	IX	IX
Water logging at low land area of farm	245	68.06	X	XIV
Insufficient water requirement for animals and irrigation and effect of water table	244	67.78	XI	XI
Higher care and management required for maintenance of different enterprises at same time	241	66.94	XII	XIII
Reduced grazing land for animals increases the cost of rearing	233	64.72	XIII	XII
Salty water and soil problems	223	61.94	XIV	X

Constraints in Practising Different Enterprise Combinations

Since farmers had a regular interaction with extension functionaries of the departments of agriculture, animal husbandry, horticulture and KVK, both farmers and extension functionaries opined almost similarly in Haryana that lack of remunerative returns for the products of different enterprises from the same farm, followed by heavy investment in the initial years of IFS and non-availability of labour were the major constraints (Table 5).

Conclusions

The adoption of multiple farm enterprises in an integrated manner can ensure a substantial income generation to sustain the livelihood of farmers over the meagre income from self-standing enterprises as revealed from this study. The integrated farming system once very popular among the farming communities started loosing its importance after green revolution in late-1960s and then further declined drastically after the economic liberalization in early 1990s. The focus of present government is on doubling farmers' income by 2022. The partial budgeting, economic estimation of manure and urine from animal components and factors associated with total income from different enterprise combinations have shown the directions for policy makers, extension functionaries and progressive farmers to prepare strategies for doubling farmers' income. Only livestock component would provide the facilitating inputs to enhance the income of farm families within a short period of five years in a synergistic mode. The adoption of IFS is the right approach in this direction and should be supported through institutional, extension, policy and marketing interventions in a system approach.

Implications of the Study

- System mode of production incorporating crop, livestock, fish, horticulture and agro-forestry is a potential option for doubling farmer's income.
- The severity of constraints experienced in the adoption of IFS could be reduced through market intelligence along with risk management, processing and value addition.
- The productivity and total production could be enhanced through supply of quality inputs including seeds, fingerlings, birds for backyard poultry and saplings.
- Empowering farmers with real time access to information and ICT tools and knowledge

networks like pashu sakhi model (Ponnusamy *et al.,* 2017) would effectively contribute to higher income realization.

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