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INTEGRATED FARMING SYSTEM: ENHANCING PRODUCTIVITY, PROFITABILITY AND EMPLOYMENT FOR SMALL AND MARGINAL FARMERS IN VIDARBHA REGION OF MAHARASHTRA, INDIA

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ABSTRACT

A field experiment on integrated farming system under irrigated condition was done at AICRP on Integrated Farming System, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola Maharashtra during 2022-23 to 2023-24. In present study various treatments were formulated by combining various enterprises with crop components for identification of the best-integrated farming system (IFS) in terms of higher cotton equivalent yield, system productivity, employment generation and profitability. It was found that treatment T_8 emerged as best treatment with highest GMR (` 921892 /ha), NMR (` 489509/ha), cotton equivalent yield (12401 kg/ha), system productivity (33.98 kg/ha /day), profitability (1340 ` /ha/day) and employment generation (561 Man days year^{-1}). According to the present findings, the IFS strategy can increase employment, profitability, and productivity of small and marginal farmers.

Key words : Cotton equivalent yield, System productivity, Aquaculture and Livelihood.

Introduction

The green revolution has led to an increased focus of farmers on single-crop agricultural systems. This shift has resulted in soil health deterioration, higher risks of crop failure, and declining productivity trends (Rahman and Sarkar, 2012). The growth rate of agriculture in the recent past is very slow in spite of the rapid economic growth in India. Over 85 million of India's 105 million operational farm holdings are smaller than one hectare, and the country's farm holdings are shrinking (GoI, 2014). The farm income from practicing conventional farming (mono-cropping or non-integrated farming) and it very difficult to meet the food and other basic requirements of small and marginal farmers in single farm enterprises.

Due to the country's increasing population and declining per capita land availability, there is practically no space for horizontal agricultural land expansion; only vertical expansion is possible by combining farming components that require less time and space while ensuring farm families reasonable returns (Gill *et al.*, 2009). As there lack plenty of other work options, more people are moving from rural to urban regions in quest of (Palsaniya *et al.*, 2012) livelihood. Under the current farming conditions, ensuring a sustainable livelihood appears to be a difficult undertaking. IFS seems to be the proper solution for it. This makes the Integrated Farming System (IFS) more important than ever to increase farm productivity, reduce environmental degradation, improve the quality of life for farmers with limited resources and maintain sustainability.

Materials and Methods

The present study was carried out in 2022-2024 at AICRP on Integrated Farming System Research, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, which

is situated in the subtropical region at 22^0 42′ North latitude and 77^0 02′ East latitudes and at an altitude of 307.42 m above MSL. The IFS model consists of a 1 ha area, including Crops, Horticulture, Livestock (Cow, Goat and poultry), Kitchen Garden, Aquaculture in farm pond and vermicompost. The cropping components were taken on an area of 0.70 ha, livestock on area of 0.03 ha and the remaining 0.02 ha area for a kitchen garden and 0.05 ha area for aquaculture in a farm pond. The percent allotted area of components in IFS has been given in Fig. 1. In treatments T_1- Crop components, T_2- Crop components + Dairy+ Vermicompost, T_3-Crop components + Goat, T_4- Crop components + poultry, T_5- Crop components + Kitchen Garden, T_6- Crop components + Horticulture, T_7- Crop components + Fishery and T_8- Crop components + Dairy + Vermicompost + Goat + Poultry + Kitchen Garden + Horticulture +Fishery were taken.

Cotton equivalent yield (CEY) : The cotton was used for comparable yield since it is the most widely grown commodity in the region and its price changes less than that of other crops included in the experiment. To compare the various components within an Integrated Farming System (IFS), all produce were converted to their cotton equivalent yield (CEY) based on the market prices of the respective products (De Wit, 1960).

$$CEY = \frac{\Sigma \text{ (Production } (q^{-1}) \text{ of } i^{th} \text{ crop/component} \times \text{price } (q^{-1}) \text{ of that } i^{th} \text{ crop/component}}{\text{Price of cotton } (q^{-1})}$$

System productivity based on CEY

$$\text{System Productivity (kg/ha/day)} = \frac{\text{Cotton Equivalent yield (kg/ha)}}{365}$$

System profitability

$$\text{System Profitability (` /ha/day)} = \frac{\text{Net return (` /ha)}}{365}$$

Table 1 : Details of the components in the Integrated farming system model.

A.	**Crop components**			
S. no.	**Season**			**Area (ha)**
	Kharif	***Rabi***	***Summer***	
1	Bt Cotton +Green gram	—	Groundnut	0.15
2	Soybean+ Pigeon pea (6:1)	Onion	—	0.15
3	Sweetcorn + Cluster bean(2:2)	Ajwain	—	0.15
4	Hy. Sorghum	Lucerne	Lucerne	0.05
5	Soybean	Wheat	Green gram	0.10
6	Sunflower	Chickpea +Linseed (4:2)	Sesame	0.05
7	Black gram	Mustard	Sesame	0.05
	Total			0.70
B.	**Horticulture (Mixed planting)**			0.20
8.	Custard apple (5m × 5m) (Balanagar)			
9.	Drumstick (2.5m × 2.5m) (Co 1)			
	Total			0.02
C	**Livestock**			0.03
10.	Cow (Crossbreed) + Goat (9 Does +1 Buck, Berari) +Poultry (100 birds, Vanaraj) +Vermicompost (4 Tetra vermibeds)			
	Total			0.03
D	**Others**			
11.	Kitchen garden			0.02
12.	Aquaculture in farm pond (Rohu, Catla and Mrigal)			0.05
13.	Boundary plantation of Glyricidia, Karonda, Hybrid Napier			—
	Total			0.07
	Total IFS model			1.00

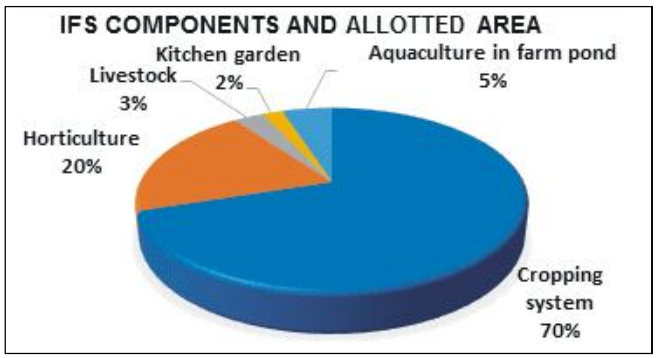

Fig. 1 : Percent allotted area to the IFS components.

Employment generation

Labour needs for various crop production tasks are quantified in man-days per hectare annually. A man-day represents an 8-hour workday by a man. Conversely, a woman working the same hours is regarded as contributing 2/3 of a man-day and this is also calculated in man-days.

Gross and Net return (` /ha)

The gross return in terms of rupees per hectare was worked out based on the grain and straw yield of each treatment and the prevailing market price of respective years. The cost of cultivation for each treatment was worked out by considering the expense incurred for all cultural operations as well as the cost of various inputs in respective years. The net return was worked out by deducting the cost of cultivation from the gross return for respective treatments.

Results and Discussion

The results of this two-year study (2022-23 to 2023-24) indicated that the integration of various enterprises on a one-hectare size of landholding was theoretically viable. Further, better utilization of land, water, and input and output resources was observed in the integrated farming model with cropping system, livestock, boundary plantation, kitchen garden and horticultural crops compared to each other.

Cotton equivalent yield

The yield of different crops of the system was converted into cotton equivalent yield is given in Table 2 and shown in Fig. 2. Data revealed that the T_8- Crop components + Dairy + Vermicompost + Goat + Poultry + Kitchen Garden + Horticulture +Fishery has registered highest CEY (12401 kg/ha), which was followed by T_7- Crop components + Fishery (6017 kg/ ha) and T_3- Crop components + Goat (5474 kg/ha). Similar results were found by Singh *et al*. (2006).

System productivity

The data pertaining to the effect of different cropping and farming system treatments on system profitability are presented in Table 2. Data revealed that in the pooled result of two years experiment, treatment T_8 was adopted and registered the highest system productivity of 33.98 kg/ha /day, which was followed by T_7 (16.48 kg/ha/day). A similar type of result was reported by Kharche *et al*. (2022).

System profitability

The system's profitability was different among the treatments (Table 2). The treatment T_8 gave the highest system profitability (1341 ` /ha/day), which was followed by $T_7$ (683 ` /ha/day) and T_3 (549 ` /ha/day).

Employment generation

In the present study it was found that the highest employment was generated in treatment T_8 (561 Man

Table 2 : Treatment-wise cotton equivalent yield, system productivity, system profitability, employment generation and economics in the integrated farming system.

Treatments	CEY (kg/ha)	System productivity (kg/ha/day)	System profitability (` /ha/day)	Employment generation (Man days Year^{-1})	Gross Return (` /ha)	Cost of cultivation (` /ha)	Net return (` /ha)	B:C
T_1: C	2883	7.90	304	112	208891	97860	111031	2.13
T_2: C+D+VC	5133	14.06	549	201	404106	203548	200558	1.99
T_3:C+G	5474	15.00	526	341	409749	217720	192029	1.88
T_4: C+P	3548	9.72	376	119	255385	118310	137075	2.16
T_5: C+KG	2986	8.18	318	115	216006	99979	116027	2.16
T_6: C+H	3658	10.02	410	126	262911	113280	149631	2.32
T_7: C+F	6017	16.48	683	186	418190	168846	249344	2.48
T_8: C+Total	12401	33.98	1341	561	921892	432383	489509	2.13

(C: Crop components, D: Dairy, VC: Vermicompost, G: Goat, P: Poultry, KG: Kitchen Garden, H: Horticulture and F: Fishery).

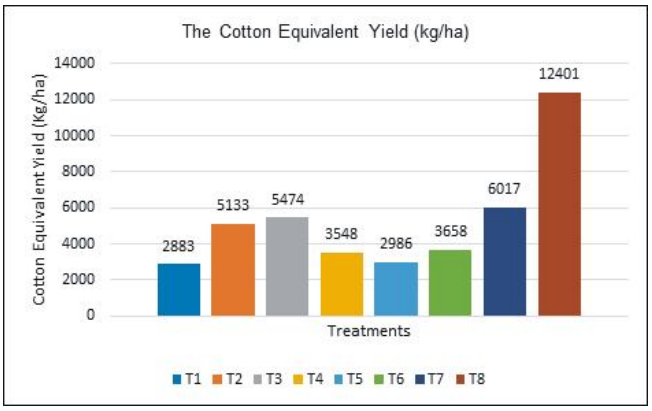

Fig. 2 : Cotton equivalent yield of various treatments in IFS.

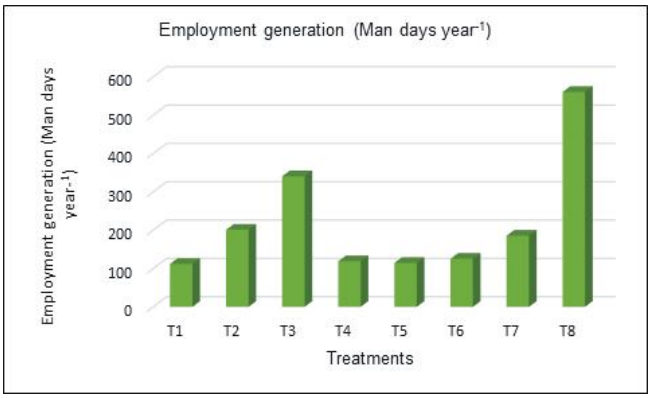

Fig. 3 : Employment generation (Man days year^{-1}).

days year^{-1}), which was followed by T_3 (341 Man days year^{-1}) and T_2 (201 Man days year^{-1}) given in Table 2 and shown in Fig. 3. Similar type of result was reported by Mynavathi and Jayanthi (2015), Kumar *et al*. (2011) and Pandey *et al*. (2019).

Gross returns : The total monetary value from the economic yield and by-products obtained in the cropping system was calculated based on the local market prices, as presented in Table 2. The treatment T_8 registered the highest gross return in pooled data (` 921892/ha), which was followed by $T_7$ (` 418190/ha) and T_3 (` 409749/ha). Integration of maximum components was found to be more beneficial in farming systems, similar with the findings of Kharche *et al*. (2022).

Net returns

On the basis of two years of experimentation (Table 2), pooled results discovered that highest net return were obtained in T_8 (` 489509/ha) which was followed by $T_7$ (` 249344/ha) and T_2 (` 200558). The net returns were less in the livestock for initial year because the fixed cost has been added to it of the construction of sheds and the purchase of animals. A similar type of result was reported by Kumar (2018), Sheokand *et al*. (2000) and Sharma *et al*. (2017).

Conclusion

The integrated farming system with cropping system along with other components like livestock, boundary plantation, kitchen garden, horticultural crops, vermicompost and farm pond are the most beneficial system which can augment the income of small and marginal farmers to improve their socioeconomic status with assured livelihood for long term in farmers in *Vidarbha* region of Maharashtra. Implementation of the Integrated Farming system approach increases profitability leds to sustainability, and act as a constant source of income with employment generation.

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