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Research Article

AN IDEAL FARMING SYSTEM FOR THE KYMORE PLATUE SATPURA HILLS REGION OF KATNI DISTRICT OF MADHYA PRADESH

GUPTA P.K.[1], SINGH S.K.*[2], MISHRA R.K.[3], TOMAR A.S.[4], BAIN R.P.[5] AND KUMAR S.[6]

[1]Department of Plant Pathology, ICAR-Krishi Vigyan Kendra, Katni, 483 442, Jawahar Lal Nehru Krishi Vishwa Vidyalaya, Jabalpur, 482004 Madhya Pradesh, India
[2]Department of Horticulture, ICAR-Krishi Vigyan Kendra, Tikamgarh, 472001, Jawahar Lal Nehru Krishi Vishwa Vidyalaya, Jabalpur, 482004 Madhya Pradesh, India
[3]Department of Animal Science, ICAR-Krishi Vigyan Kendra, Katni, 483 442, Jawahar Lal Nehru Krishi Vishwa Vidyalaya, Jabalpur, 482004 Madhya Pradesh, India
[4]Department of Food Science, ICAR-Krishi Vigyan Kendra, Katni, 483 442, Jawahar Lal Nehru Krishi Vishwa Vidyalaya, Jabalpur, 482004 Madhya Pradesh, India
[5]Department of Extension, ICAR-Krishi Vigyan Kendra, Katni, 483 442, Jawahar Lal Nehru Krishi Vishwa Vidyalaya, Jabalpur, 482004 Madhya Pradesh, India
[6]Department of Animal Science, ICAR-Krishi Vigyan Kendra, Tikamgarh, 472001, Jawahar Lal Nehru Krishi Vishwa Vidyalaya, Jabalpur, 482004 Madhya Pradesh, India
*Corresponding Author: Email - sksingh2011_12@rediffmail.com

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Abstract: The present study was carried out in adopted village of JNKVV, Krishi Vigyan Kendra, Katni during 2014–17 to develop an ideal eco-friendly approach from different integrated farming system models. Suitable combinations of different components like crop production, animal husbandry, horticulture, vegetables, fisheries, backyard poultry and water harvesting were followed to generate employment under lowland situations and doubling farmer's income. Due to adoption of improved package of practices and plant protection measures, the paddy yield increased to 4.15 t/ha in 2016-17 as compared to 3.59 t/ha in 2015-16 and 2.65 t/ha in 2014-15. Similarly, the other crop yields (onion, cauliflower, chilli, guvava, papaya) was increased by 13.5 to 49.1 percent after adoption of improved cultivation methods under integrated farming system. Livestock production (milk yield, egg and fish) was increased significantly in 2016-17 as compared to 2014-15. Integrated construction of water harvesting structures resulted meeting out the irrigation requirements of crops with fisheries. Integrated farming system also provided employment generation to the small and marginal rural households of Katni (central India) and entrusted sustainable development of livelihood in many ways like engaging more women in agriculture farming than men and providing higher net returns to the farmers as compared to traditional farming.

Keywords: Integrated farming system, Employment generation, Crop and livestock productivity, Interlinkage of components, Net income, Recycling

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Introduction

Farming system involves a suitable combination of different farm enterprises *viz*. cropping systems, horticulture, livestock, fishery, poultry, forestry as well as the other means available to increase the profitability and livelihood security of the farmers [1]. The farming system adequately helps in different ways to boost the economy of agriculture in general and living standard of the farmers. It is a mix of different enterprises. However, in farming, higher profitability is essential without altering ecological balance. Integrated farming system considers the concepts of minimizing risk, increasing production and profits whilst improving the utilization of organic wastes and crop residues [2]. The geographical area of Madhya Pradesh is 308,144 km2 which constitutes 9.38% of the land area of the country and second largest state of India by area. Its 74.7 percent of the people are rural and 49 percent of the land area is cultivable. Net sown area and gross cropped area are about 147.90 and 202.16 lakh hectares, respectively. State faces several problems like infertile, stony and barren soil; however, erratic and uneven distribution of rainfall is the major constraint for achieving targeted level of production with the average size of land holdings shrinking because of increasing fragmentation. Many marginal farms are becoming economically non-viable and oriented towards subsistence. Therefore, in case of failure of monsoon, the farmers need to use judicious mix up of agricultural enterprises like dairy, poultry, fishery, horticulture, veterinary *etc*., suited to their agro-climatic and socio-economic condition and dependent on the farm size. Furthermore, the emergence of Integrated Farming Systems (IFS) has enabled us to develop a framework for an alternative development model to improve the feasibility of small sized farming operations in relation to larger ones [3]. In this system, an inter-related set of different enterprises is used so that the "waste" from one component becomes an input for another part of the system, which reduces cost and improves production and/or income [4]. Since it utilizes wastes as resources, we not only eliminate wastes but we also ensure overall increase in productivity and subsequently decrease in cost involved for the whole agricultural systems. In the present study, farmers from Singhanpuri and Teori villages of Katni District, Madhya Pradesh were selected for the comparative study of integrated farming system development in Madhya Pradesh with the objectives to study the change in the farming techniques for maximum production in the cropping system as well as to evaluate the appropriate integration of different enterprises and recycling of farm waste in the IFS.

Materials and Methods

Study was carried out on the fields of Pursottam Thakur and Uttara bai Ramsingh Thakur (Tribal farmers) in Singhanpuri and Teori villages of Katni district, Madhya Pradesh, India during 2014-2017. Seven treatments (farming systems) involving crop production, animal husbandry, horticulture, vegetables, fisheries, backyard poultry and water management were considered for evaluation in different combinations to recycle the residues and by products of one component over the others.

Table-1 *Technology intervention under Integrated farming system*

Components	Farmers practices (before intervention)	Module changes	Technological interventions	Adapt the Crop varieties/molecules and animal breeds under different enterprises
Rice production	Local variety	Variety	Improved variety	MTU 1010
	No use of chemical for pest/ disease/ weed management	Plant protection practices	Use of new molecules for the management of diseases, insect pest and weed management	Pyrazosulfuron ethyl for weed management, antracol for seed treatment as well as foliar application and trizophos for pest management
	Old days seedling use for transplanting	Sowing methods	SRI	12-14 days old seedling used for transplanting of paddy as per SRI guideline
Animal husbandry	Local breed	Change in breed	Improved cross breed	Gir breed
	Feed based on household availability	Feed/ fodder management	Use of quality feed and fodder	Azolla, Mineral mixture, Barseem
	Rare health management	Health management	Proper deworming and timely vaccination	Ibermetrin and flebendazole, HS and BQ, Piprazin for calf
Poultry	Local breed	Improved breed	Improved birds	like Kadaknath, Krishna J and Narmadanidhi
	Scavenging	Feed	Quality and concentrated feed	Probiotic, vitamins, amino acids and toxin binder
	Rarely health check up	Health management	Timely vaccination	Lasota and R 2 B for Ranikhet
Horticulture/ Vegetables	No timely Care	Training and pruning	Timely and regularly	
	Manure & fertilizers below/ above the recommended dose	Fertilizer application	Optimum/ balanced dose	
	Irrigation not proper	Timely irrigation	Proper and on certain intervals	
	Uncertified seed / Local cultivars	Cultivars/ certified seed	Improved cultivars / Certified seed	Onion: AFLDR Cauliflower: Chilli: Pusa Jwala Guava: L 49 Papaya: Pusa Nanha
	Conventional methods	Method of cultivation	Improved methods	Planted in Ridge and furrow with well drainage system
Fisheries	Local	Fingerlings	Improved	Common carp (Lower layers) Grass carp (Upper layers)
	Pond management Rarely	Pond liming	Proper at certain interval	
	Below stocking density	Stocking density	Optimum stocking density	
	Natural feed	feed	Natural + Concentrated	Organic manure to improve phytoplankton/zooplanktoon in the pond
Water management	No water harvesting structure	Water harvesting unit	Jalkund/ Farm pond	For the construction of good quality jalkund, use of polythene sheet to avoid run off/seepage

Survey was conducted to collect the household information on socio-economic status and farming related information during 2013-14 and model was developed on farmers' field. The holding size of the farmer increased from 0.94 ha in 2014-15 to 1.78 ha in 2015-16 and 2.31 ha in 2016-17 due to technological interventions like cultivation of crops in fallow land. We kept the same enterprise which the farmer had earlier (rice and maize in kharif season, chickpea and wheat in rabi season, animal husbandry, fishery, backyard poultry, vegetable production, fruit cultivation and water management). Training and inputs given to the farmers for adoption of scientific management practices in the integrated farming system are mentioned in [Table-1].

Result and Discussion

Productivity and sustainability index

Integrated farming system offers an opportunity to increase yield and economics per unit area per unit time by intensification of crops and other enterprises. Rice is a very important crop in kharif season. After harvesting of rice, farmers grow pulses and summer greengram or vegetables with the harvested rain water in farmer pond. In Teori, farmers were cultivating rice since many decades. But they were not fully trained about the scientific cultivation practices. Therefore, lower yield of rice in 2014-15 was mainly due to use of poorquality seeds, that he had procured from neighbouring farmers and with the use of conventional methods in rice cultivation with very poor nutrient and weed management. In 2014-15, rice productivity was mere 2.65 t/ha as compared to 3.59 t/ha in 2015-16 and 4.15 t/ha in 2016-17, respectively, due to adoption of improved package of practices. However, the yield of rice, chickpea and summer Ggreengram increased by 56.48, 122.63 and 16.93 percent respectively in 2016-17 as compared to 2014-15 [Fig-1]. Our results are in close agreement with [1], who found that adoption of improved package and practices on farmer's field in Manipur, Himalayan region can increase the yield of crops as compared to usual system.

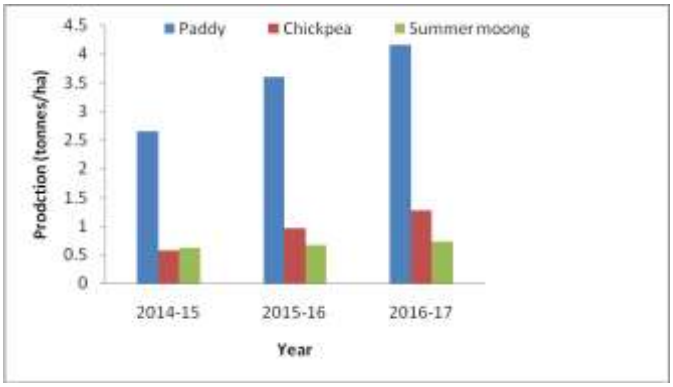

Fig-1 Sustainability index after adoption of improved package of practices

Adoption of horticultural (Vegetable & Fruits) production

Farmers of Katni are growing vegetables and fruit plants as kitchen gardening for self-consumption and for economic returns. In 2014-15, vegetable and fruit yield was poor due to use of local cultivars, imbalanced use of fertilization, poor maintenance of fruit plants, *etc.* Farmer was also not utilizing the space between the two rows and other plant protection practices. But, in 2016- 17 farmers got 49.14, 24.10 and 13.46 percent more onion, cauliflower and chilli yield due to adoption of improved cultivation practices and use of improved good quality seeds and new technological interventions under integrated farming system. He also grew papaya between the two rows of guava and during 2016-17, he got 204 and 47.22 percent more production in guava and papaya as compared to 2014-15 [Fig-2]. The increases in yield of vegetables and fruit crops are line with the findings [5 & 6].

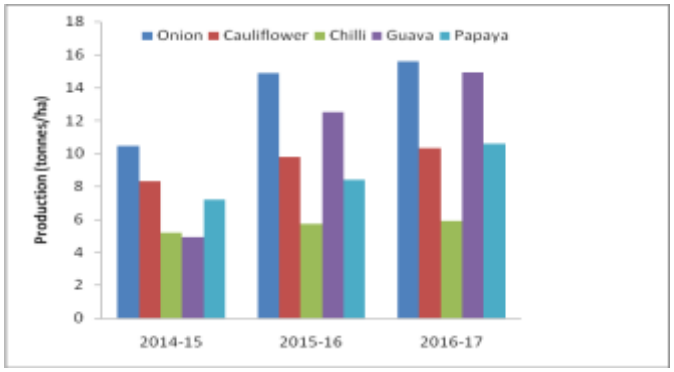

Fig-2 Adoption of horticultural (Vegetable & Fruits) production

Adoption of Animal husbandry

Rearing of cattle is one of the most integral enterprises in farming system in Katni, Madhya Pradesh. Majority of the people consume milk as butter, paneer, khoya *etc*. The indigenous breed of cow in Katni is less productive. The up-gradation of local cow through cross breeding with the exotic cow (Gir) has given a new dimension to the farming among the tribal farmers. In 2016-17, the milk yield increased from 0.75 to 3.95 tonnes lit per year per cow as compare to local breed. [Fig-3]. Some authors also reported poor feed conversion, high mortality rates, low productivity and the final product in pigs are very poor in conventional farming system, income as well as employment in rural areas of Meghalaya [7].

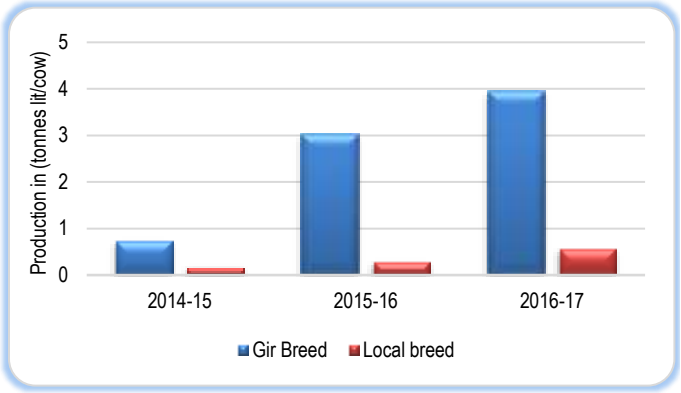

Fig-3 Adoption of Animal husbandry

Adoption of Backyard poultry

Backyard poultry has been adopted by most of the farmers for domestic consumption. Earlier, farmers were rearing local breed, but under the IFS approach, he started rearing of Kadaknath and Narmadanidhi. In the present study, 152.9 and 156.4 percent more egg production was recorded in Kadaknath and Narmadanidhi during 2016-17 as compared to local breed [Fig-4]. These findings are in line with the researcher [8].

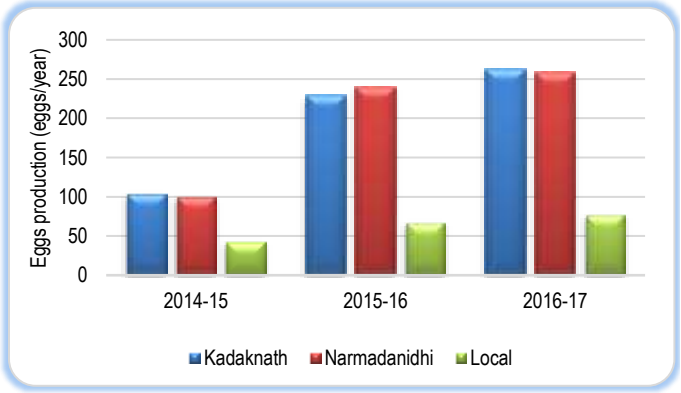

Fig-4 Adoption of Backyard poultry

Adoption of Fish production

Fishery is the highly preferred farming system component along with animal husbandry. Before 2014-15, the farmer was not having any farm pond. But, after adoption of integrated farming system, they dug two ponds in 2014 with the help of Department of Agriculture, Katni, Madhya Pradesh. In 2015-16, he started fish production programme (common carp and grass carp) and got very good remunerative returns.In 2016-17, they produced 10.9 and 10.2 tonnes per hec common and grass-Carp fish as compared to 6.8 and 5.2 t/ha in 2015-16, respectively [Fig-5]. In composite fish production, they were rearing common carp and grass carp, where grass carp was surviving on middle and upper layers of water and common carp in lower layers of water. [9 & 10].

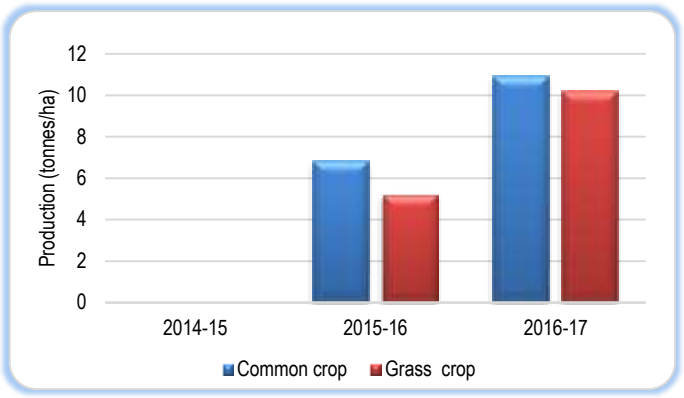

Fig-5 Adoption of Fish production

Adoption of Water harvesting tank

The major water source for cultivating agricultural crops in Katni is rain water. The rainfall in Katni district varies from 950 to 1140 mm. During kharif season, rain water is sufficient for agricultural crops. But, in rabi season, scarcity of water is prevalent. In previous years, the farmers had no water harvesting unit. In 2014-15, they stored 46 cubic litres of water in the pond and the water stored increased to 87 cubic litres in 2015-16 and 112 cubic litres in 2016-17, due to introduction of more number of rain water harvesting units [Fig-6].

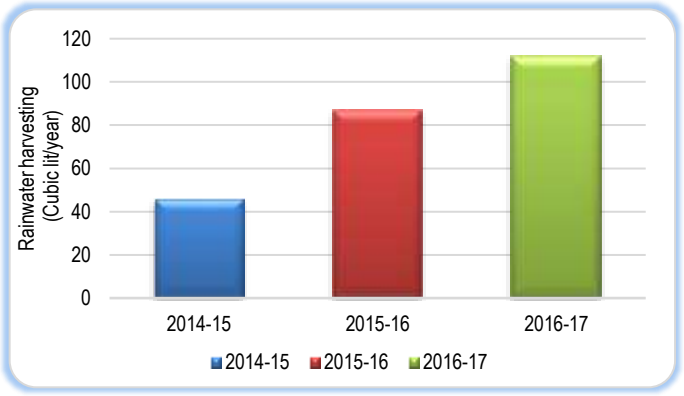

Fig-6 Adoption of Water harvesting tank

This harvested rain water was further utilized for raising of vegetables crops/fruit orchard/fodder for animals and rabi crops/summer green gram [11].

Economics of different components

Integrated farming system provides an opportunity to increase yield and income per unit area per unit time by intensifying crops and other applied enterprises. To compare the productivity of different components, average yield of each enterprises, *viz* crop production, animal husbandry, fruits and vegetable production, backyard poultry, fishery and rain water harvesting were calculated which gave more net returns from given area [Table-2]. The contribution of crops towards the system productivity increased by 56.0 % in paddy, 122.6% in chickpea and 16.9% in summer greengram as compared to 2014-15[Fig-1], while in case of vegetables, 49.1% in onion, 24.1% in cauliflower, 13.5 in Chilli whereas, 204 % in guava and 47.2% in papaya [Fig-2], and milk production (of Gir breed) ranged from 305 to 430 % [Fig-3], backyard poultry from 120 to 156%

Table-2 *Economics of different component of farming systems*

Components	Gross returns (Rs.)			Net returns (Rs.)			B: C ratio		
	2014-15	2015-16	2016-17	2014-15	2015-16	2016-17	2014-15	2015-16	2016-17
Paddy production	41675	54781	62876	24576	34578	46871	3.8	4.3	3.9
Animal husbandry	22567	87954	123762	11324	52361	71487	5	5.9	5.7
Poultry	5248	14982	27652	2673	7298	14596	5.09	4.87	5.27
Horticulture/ vegetables	21800	56971	99600	11876	29542	48982	5.44	5.18	4.91
Fisheries	-	22560	37543	-	10560	22890	-	4.68	6.09
Water harvesting	-	5200	1090	-	1576	2876	-	3.03	2.63

[Fig-4], fishery from 60.3 to 96% [Fig-5], and rain water harvesting ranged from 89.1 to 143.5% [Fig-6]. This high net returns difference was due to expansion of area under different components as well as better adoption and management practices under IFS. In 2015-16, this system also provided significantly higher return than in 2014-15 [Table-2]. The most profitable components were fruits and vegetable production followed by animal husbandry and backyard poultry. The higher cost in all the components during 2015-16 was mainly due to the use of quality seed material of improved varieties/breeds, optimum fertilization, proper plant protection measures, with better package of practices. In 2015-16, the higher gross returns, net returns and B:C ratios were due to higher production of high value products and expansion of area in respective components of IFS as compared to 2014-15, whereas these were low in 2014-15 due to use of poor quality seed material of local varieties/breeds with poor management practices just for subsistence farming for sustaining the family livelihood. Similar results were also reported [12 & 13].

Employment generation after adoption of IFS model

Family members were fully employed in the system due to the various components. They were mainly involved in the production and maintenance of various components. Main component was animal husbandry which involved 60-man days in one season whereas paddy production and poultry involved 43- and 39-man days respectively. Horticulture/vegetable production and animal husbandry contribute more in employment generation in terms of percentage increase than the base year (2014-15) as these components contribute around 24, 44 in 2015-16 and 11.6, 18.6% increase in 2016-17[Fig-7]. Thus, integrated farming systems may be used as the means of generating more income as well as for better livelihood security of the farming family and other labourers. Similar results were also reported [14].

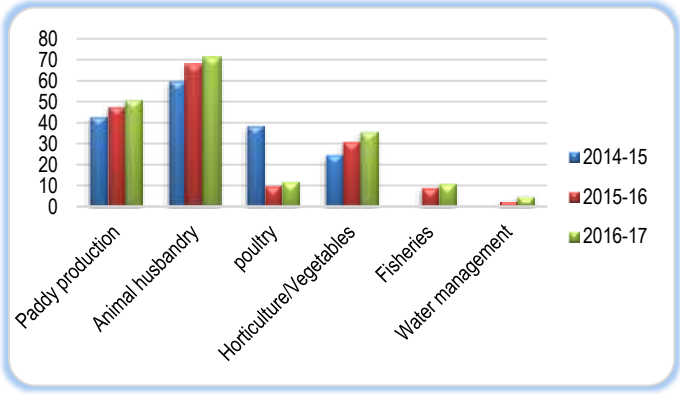

Fig-7 Employment generation after adoption of IFS model

Interlink age of by-products and their recycling

In an integrated farming system, considered as whole farming system, every component get some input from other components. For instance, cow dung, waste and straw obtained from animal husbandry and horticulture/vegetable production may be used as the material for compost preparation which may be further used as input for paddy production, horticulture/vegetable production. Similarly, waste obtained from poultry may be directly used as the feed for fishes in fishery component. This system also involved water management through rain water harvesting which is further used as the life saving means for other components including paddy production, horticulture/vegetable production and animal husbandry. Thus, all components play important role in providing some input for other components and may be considered as the system for sustainable production and livelihood security of the farmers [15].

Conclusion

The study highlighted the impact of IFS on farm income and livelihood security of the farmers. The farmers in the study area practised partial integration in 2014-15 and subsequent use of all components since 2015-16 onwards. Adoption of improved cultivars, better performing breeds/strains and good management practices under integrated farming system provided more production, higher income and employment opportunities throughout the year. Farmer who maintained crop-livestock-fish-horticulture integration on his field realized more net farm income.

Application of research: improved farming can play a significant role in increasing production, remunerative returns, and nutritional security as well as employment opportunities for tribal farmers.

Research Category: Agriculture Extension.

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***Research Guide or Chairperson of research: Dr Ajay Singh Tomar**
University: Jawahar Lal Nehru Krishi Vishwa Vidyalaya, Jabalpur, 482004, India
Research project name or number: KVK survey work

Author Contributions: All authors equally contributed

Author statement: All authors read, reviewed, agreed and approved the final manuscript. Note-All authors agreed that- Written informed consent was obtained from all participants prior to publish / enrolment

Study area / Sample Collection: Kymore Platue Satpura Hills Region of Katni

Cultivar / Variety / Breed name: Rice- MTU 1010

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.
Ethical Committee Approval Number: Nil

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