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Research Paper

Impact of Integrated Farming System (IFS) on crop production and farm income under temperate Hill Ecology

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ABSTRACT

Integration of crops with animals has proven its worth in all parts of the world especially in India. To test its significance for farmers with small land holding in temperate region of the country, Agriculture Science Centre (Krishi Vigyan Kendra)-Kulgam established an Integrated Farming System (IFS) model over an area of 1.0 ha in 2017 with agriculture, horticulture, dairy and vermicomposting as its components. The aim of the IFS model was to see the impact of integration on farm production and income, so that the model can serve the purpose of farm exposure and training of farmers. Income obtained from the IFS was substantially higher than that obtained from the conventional cereal-based crop production system. Net income from IFS showed a gradual increase from Rs. 238535/ha in 2017 to Rs. 718044/ha in 2021 which was 87.38% and 464.06% higher than conventional cropping, respectively. Net income analysis revealed that IFS attained a more profitable equilibrium with every passing year with the highest returns recorded during 2021. Benefit cost ratio of the Agri-Horticultural component of the IFS fluctuated from 2017 to 2021, with minimum (1.97) recorded during 2019 and maximum (2.96) during 2021. The striking feature of the IFS was the economic adversity coping up feature as observed from the higher returns from one component when the returns were not so good from other and vice versa.

Key words: Hills, Farm income, IFS

Intensification of input use during 1960's for obtaining higher crop productivity encouraged the accelerated spread of area under monoculture. It resulted in loss of agro-ecological diversity, specific to each agrarian region, besides having a harmful impact on soil health and nutrient balance. The high input, high risk and fragile monocrop-based agriculture became a norm in India, thus posing a serious threat to the natural resource base of rural India (Kumar *et al*, 2018). The prevalent agricultural seems unsustainable in terms of production and economics, especially under changing climate and marketing scenario. Serious implications of the intensive agriculture with low diversification are frequently being reported by the scientists from all over India. The soil analysis of the 2.30 crore soil samples carried out under National Soil Health Card Scheme indicated that 80 % of the samples were moderate to severely deficient in nitrogen, 63% were low in organic carbon and 48% were deficient in phosphorus (Vijayshankar, 2020). Moreover, decreased agro-ecological biodiversity associated with the prevalent agricultural production systems has resulted in increased frequency and virulence of pest attacks, with an increase of 500% in pest incidences in rice at all-India level from 1965 to 2000 (Krishnaiah, 2012). In hills fragmented land remains a challenge and an opportunity as well, as crop productivity and cropping intensity of small and marginal farmers may be better than that of the large farmers (Chand *et al*., 2011). On the other side, since most of the small and marginal farmers produce specialized crops, their farming systems are more susceptible to losses due to adverse climatic conditions and market flexibility. So Integrated Farming System approach through diversification of crops/enterprises is a potential solution to these problems (Mubarak and Sheikh, 2014). Keeping all these in consideration, KVK Kulgam established an Integrated Farming System model over an area of 1ha to study its impact on farm income and to expose the farmers to the system through live demonstrations and trainings

MATERIALS AND METHODS

Krishi Vigyan Kendra (KVK) Kulgam-SKUAST Kashmir is located at Pombay, in District Kulgam (Longitude: 75.331ºE Latitude: 33.644ºN) at an altitude of 1853 m above mean sea level (amsl). The site of study is characterized by temperate climatic conditions with mild summers and harsh winters. The maximum temperature (25-35ºC) is recorded during the months of May, June, July and August. The precipitation in the range of 75-100 mm per month is almost evenly distributed from the months of May to September and then decreases drastically from October to November (25 to 30 mm per month). The soil of experimental site is silty loam in texture and has moderate fertility status with slightly acidic pH and devoid of any hazardous salt accumulation.

In 2017 Integrated Farming System (IFS) unit was established by Kendra over an area of 1.0 ha with agricultural crops (0.70 ha), high density apple orchard (0.2 ha) and dairy unit (0.10 ha) as its components. The area under different agriculture crops (rice, maize, soyabean and moong) varied from 2017 to 2021. In 2021, in addition to other crops, brown sarson was cultivated over an area of 0.25 ha and vermicomposting was adopted over an area of 150 square feet (Table 1). Actual yield and income obtained from different farm enterprises from 2016 to 2021 was recorded and used for benefit cost analysis of the IFS as per the guidelines of Gittinger, 1972. The rates for different inputs and the IFS products varied over the years and the relative economics was calculated on the basis of the prevailing rates in the area. The seed and grain obtained from the field crops however was sold as seed at NSP SKUAST-Kashmir approved rates. The cost of farm resources utilized in the IFS components were included in the costs of cultivation of respective crops. The graphs were prepared through open-source statistical software JASP version 0.15 2021.

RESULTS AND DISCUSSION

Crop Yield: The data on different crop components (Table 1 & 2) indicates that there was no significant increase in yield per unit area over the years in case of field crops. Yields, however increased incrementally over the years in case of high-density apple. The increase in yield was 205% from 25q in 2017 to 76.3 q in 2021 from an area of 0.2 ha. This may be attributed to the increase in fruiting area with increasing age of the plants and short gestation period compared to traditional apple plants (Badiu *et. al.* 2015). Milk yield also increased by 104% from 3428 litres in 2017 to 7026 in 2020. Milk yield however decreased again (3899 litres) in 2021. The variation in milk production was due to number of cows in milking during respective years. An additional farm input from dairy unit was Vermicompost unit, which was made functional in year 2021. From 3 pit Vermicompost unit, 30 q of Vermicompost were obtained in year 2021 in one cycle. The integration of different components improved the overall productivity of the system (Table 1 &2). Badiyala *et al*., 2012 suggested the integration of field crops with horticulture, dairy and other farm enterprises to improve sustainability and factor productivity of these enterprises.

Impact on Farm Income: The income obtained from the IFS was substantially higher compared to conventional crop production system. Net income showed a gradual increase for IFS from Rs 238535/ha in 2017 to Rs.718044/ha in 2021. The increase in the net income from the integrated farming system over conventional cropping system was 87.38%, 157.81%, 234.25%, 497.18% and 464.06 % higher in 2017, 2018, 2019, 2020 and 2021, respectively (Table 3). Gross cost of cultivation was showed an increasing trend from 2017 to 2020. However, a decrease in gross cost of cultivation was recorded in year 2021(Fig 1). This may be attributed to the use of on farm inputs generated from IFS and less disease and pest incidence due to integrated approach. Gopinath *et al*., 2012 recommended integrated farming systems for production stability and economic viability of the farmers, especially small and marginal farms under changing climate scenario. The benefit cost ratio of the Horticultural component (HDP) and dairy increased in 2020 and 2021 (Table 2 & 3). As the income started to flow from the newly established diary unit and apple orchard the benefit cost ratio of IFS increased consistently from 2019 onwards (Fig 3), owing to better net returns. High Density apple orchard recorded highest B:C ration (Table 1) among all the components in 2020 (3.8) and 20021(3.59).B:C ratio of dairy unit increased from 1.59 in 2018 to 2.98 in 2021. Net income analysis revealed that IFS attaining a more profitable equilibrium with every passing year with the highest recorded during 2021(Table 3 & Fig 2). These findings are in agreement with Yogesh *et al*., 2016 and Kamble, *et. al.*,2017. Palsaniya *et al*, 2021 also reported that IFS ensured round the year supply of income while as double cropping provided income only twice in a year.

Table 1. Year wise crop production and income details from 1ha area before and after establishment of integrated farming system

Year	Rice					Maize					Soyabean					Moong				
	Area (ha)	Yield (q)	Cost of cultivation (Rs.)	*Net Income (Rs)	B:C Ratio	Area (ha)	Yield (q)	Cost of cult (Rs.)	Net Income (Rs)	B:C Ratio	Area (ha)	Prod (q)	Cost of cult (Rs)	Net Income (Rs)	B:C Ratio	Area (ha)	Prod (q)	Cost of cult (Rs)	Net Income (Rs)	B:C Ratio
2016	0.8	32	**42720**	102000	2.39	0.2	8	**14200**	25300	1.78	-	-	-	-		-	-	-	-	
2017	0.3	12	**16820**	38330	2.28	0.25	8	**18320**	35900	1.96	-	-	-	-		0.25	2.5	14980	28950	1.93
2018	0.2	12	**16820**	38330	2.28	0.2	8	**18320**	35900	1.96	0.1	3	**11900**	21810	1.83	-	-	-	-	-
2019	0.25	12	**17170**	42280	2.46	0.2	8	**18450**	38820	2.1	0.2	6	**21220**	37950	1.79	-	-	-	-	-
2020	-	-	-	-		0.23	11	**32380**	54720	1.69	0.2	6	**21220**	37950	1.83	0.2	2	12320	22450	1.82
2021	-	-	-	-		0.15	5	**12250**	24300	1.98	0.05	2	**9410**	16780	1.78	0.2	2	14800	24300	1.64
Year	**Brown Sarson**					**Oats**					**High Density Apple**					**Vermicomposting**				
	Area (ha)	Yield (q)	Cost of cultivation (Rs)	Net Income (Rs)	B:C Ratio	Area (ha)	Yield (q)	Cost of cult (Rs)	Net Income (Rs)	B:C Ratio	Area (ha)	Prod (q)	Cost of cult (Rs)	Net Income (Rs)	B:C Ratio	No of Pits (8 x 4 x 2.5 ft)	Prod (q)	Cost of cult (Rs)	Net Income (Rs)	B:C Ratio
2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2017	-	-	-	-	-	-		-	-	-	0.2	-	-	-	-	-	-	-	-	-
2018	-	-	-	-	-	0.3	10	**15670**	35980	2.3	0.2	25	32930	79070	2.4	-	-	-	-	-
2019	-	-	-	-	-	0.15	4.5	**8320**	16130	1.94	0.2	35.4	57190	105810	1.85	-	-	-	-	-
2020	-	-	-	-	-	0.17	5.5	**9300**	19450	2.09	0.2	51.2	63850	246150	3.86	-	-	-	-	-
2021	0.25	3	3350	7450	2.22	0.15	4.6	**8510**	17450	2.05	0.2	76.3	77320	277680	3.59	3	30	13000	30000	2.31

Table 2. Year wise production cost and income details from dairy unit of the integrated farming system

Year	No. of Animals	Milk yield (L)	Net income (Rs)			Total net income (Rs.)	Gross Cost (Rs)	B:C Ratio
			Sale of Milk	Sale of Animals	FYM			
2017	2	3428.5	102855	25000	7500	135355	68298	1.98
2018	4	3903.5	117105	0	0	117105	73480	1.59
2019	5	4567	137010	0	47500	184510	83480	2.21
2020	6	7026	245892	83600	50000	379492	160370	2.37
2021	5	3899	136484	101600	75050	327534	109790	2.98

Table 3. Overall cost and income scenario of the Integrated Farming System** (remove **)

Year	Gross returns (Rs.)			Gross cost of cultivation (Rs.)			Net profit (Rs.)			Total net returns from system (Rs.)	Total Gross Cost of system (Rs.)	B:C ratio
	Agri/ Hort unit	Dairy unit	Vermi compost unit	Agri/ Hort unit	Dairy	Vermi compost unit	Agri/Hort unit	Dairy unit	Vermi compost unit			
2016*	184220	-	-	56920	-	-	127300	-	-	127300	56920	2.24
2017	153300	203653	-	50120	68298	-	103180	135355	-	238535	118418	2.01
2018	306730	190585	-	95640	73480	-	211090	117105	-	328195	169120	1.94
2019	363340	267990	-	122350	83480	-	240990	184510	-	425500	205830	2.07
2020	519790	539440	-	139070	160370	-	380720	379492	-	760212	299440	2.54
2021	462824	437324	57650	135290	109790	12650	390510	327534	45000	763044	257730	2.96

*Before Diversification

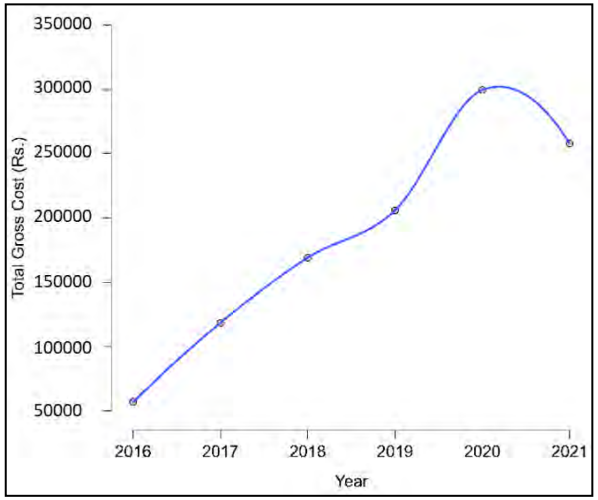

Fig. 1. Change in Gross cost with crop diversification (IFS)

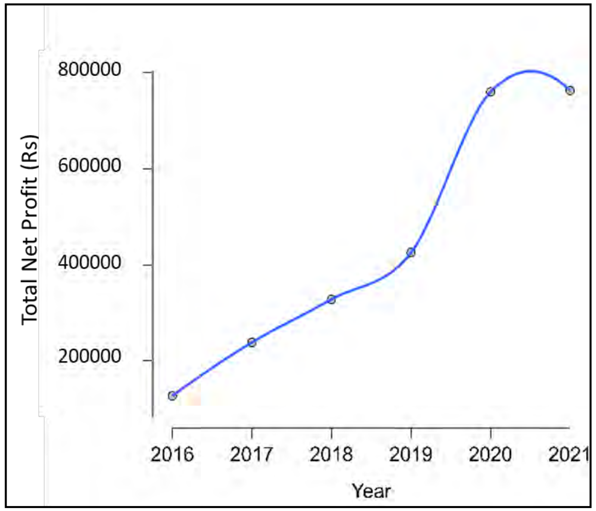

Fig 2. Change in in Net Profit with crop diversification(IFS)

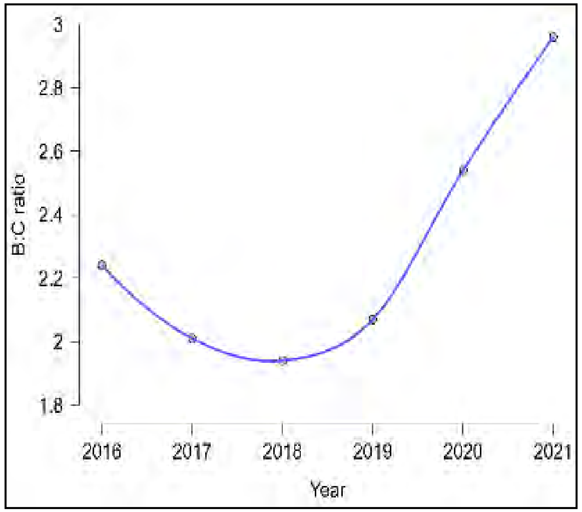

Fig 3. Change in B: C ratio with crop diversification (IFS)

CONCLUSION

Under the changing climate and marketing scenario, the mono-cropping and double cropping systems are susceptible to the adverse impacts of abrupt climatic events, new insect pest damages, new diseases and market related risks. Diversification of the farm enterprises in IFS result in resilience and sustainability of the system. Efficient utilization of the farm by-products, their optimum recycling within the system, round the year availability of work and steady monthly flow of income makes the IFS a more stable and sustainable agricultural production system as compared to the conventional one. Standardization and popularization of location specific IFS models is therefore vital to sustain production and farm income and at the same time reduce various risks associated with farming.

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