Comparative performance of traditional and improved integrated farming systems in the hills of Jammu & Kashmir

ABSTRACT

Climatic change and market risks make integrated farming a good choice for farmers. It is therefore vital to standardize and suggest location suitable IFS models through on farm testing programmes. With this aim a study was conducted to evaluate the performance of traditional and improved integrated farming systems in comparison to the existing conventional mono-cropping systems under three ecologies viz. lower plains, mid altitudes and high altitudes under Kashmir valley conditions, situated the North western Himalayas. The impact analysis of these systems was carried out after five years of establishment of Improved Integrated Farming Systems (IIFS) at farmers' field. Yields were higher in improved Integrated farming system in comparison to both conventional copping systems and traditional IFS. Horticulture based cropping systems were more profitable than agriculture based. Net profit ranged between ₹38312 to ₹271223 acre-1 in agriculture based cropping systems and between ₹184547 to ₹431722 acre-1 in horticulture based cropping systems. IIFS gave an additional income of ₹240043 acre^{-1} and ₹119725 acre^{-1} in comparison to the conventional farming and traditional IFS,respectively. Lower System Economic Efficiency (SEE) of ₹ 104.96 day^{-1} was recorded in agriculture based conventional farming system and highest SEE (₹1182.8 day^{-1}) was registered in horticulture based Improved IFS. The present study shows that in hills integration of suitable animal component with fruit crops may help farmers to substantially improve their income.

Keywords: Integrated farming; Economics; System economic efficiency; Hills.

1. INTRODUCTION

Climate change, increasing costs of cultivation and poor net returns are some of the serious issues farmers face in different parts of world and more so with respect to the small and marginal farmers. It is rightly said that agriculture in India is a gamble in climate and market. Studies show that integration of farming enterprises can help in addressing these issue. In conventional agriculture, farmers concentrate mainly on mono cropping which often is subjected to a high degree of uncertainty in income and employment to the farmers due to unforeseen events especially related to weather vagaries and market risks (Mubarak and Sheikh 2014). Besides outbreak of diseases and pests, which are very common in mono cropping system, may have serious impact on production, quality of produce and costs involved in the cultivation. So a judicious integration of agricultural enterprises suited to the specific agro-climatic and socio-economic situation of the farmer is considered beneficial in addressing major issues related to farming. In hills particularly, fragmented land remains a challenge. Proper resource management may however result in better crop productivity and cropping intensity (Chand et al. 2011). It is well established that diversification of the farm enterprises in Integrated Farming System (IFS) results 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. This makes IFS a more stable and sustainable agricultural production system in comparison to the conventional ones. Integration of agriculture, horticulture and animal components in the diversified farming systems offers a lot of advantages particularly in the hills. The components are interactive and farm wastes are better recycled for productive purposes. The other advantages are better soil health, fertility and productivity through on-farm recycling of organic wastes, nutritional security due to year round availability of nutritious food enriched with protein, carbohydrate, fat, minerals and vitamins, a clean environment as a result of effective recycling of waste from animal activities, reduced production cost of components and increased farm income through input recycling from the byproducts of allied enterprises, regular income through the diverse agri- products and generation of regular employment for the farm families. Horticulture based integrated farming systems with livestock as component are viable and sustainable in hills (Mubarak et al 2023a). Thus judicious integration of crop enterprises suited to the specific ago-climatic and socioeconomic situation of the farmer is essential for augmenting the income of a farm and increasing the family labour employment. Integrated Farming is a very old practice followed by the farmers, but up-scaling them by adding some suitable components based on understanding and knowledge about resources available at a particular location can help boost the existing production, cropping intensity and farm income. A farmer for instance possessing apple, rice/ maize, dairy/sheep or poultry can improve his farming by choosing best available varieties and breeds of respective crop components. So in some cases a complete diversification from mono cropping may be needed and in others putting some science into the existing components and adding few updated and compatible components can do the needful.With this aim a study was conducted to evaluate the performance of traditional and improved integrated farming systems in comparison to the conventional mono-cropping based systems.

2. MATERIAL AND METHODS

Farm Science center- Kulgam of Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir is situated in the lap of Pir Panjal Himalayan Range in Jammu & Kashmir. With the objective to evaluated the performance of Improved Integrated Faming System over conventional farming and traditional IFS a five year study was carried out by the center from 2017 to 2022 and the impact analysis was done after five years. Study area is characterized by temperate climatic conditions with mild summers and harsh winters. In total eighteen farming families were selected, six each for conventional, traditional agriculture/horticulture based IFS and Improved agriculture/horticulture based IFS from across three agro-ecologies *viz* lower plains, mid belt and high altitudes (Table 1). The conventional cropping system was based on mono-cropping of agriculture/horticulture crops, traditional IFS on integration of agriculture/horticulture crops and animal component with traditional varieties , breeds and practices while as improved IFS includes latest varieties of

Table 1: Farming systems evaluated under the study from 2017-2022

Cropping systems	Code	Crops and Ecologies			
		Low Plains	Mid altitude	High altitude	Varieties and breeds used
Conventional (Agriculture based)	CAS	Rice-Brown sarson	Rice -Brown sarson/oats	Maize	Rice:Ch-1039,K-39,K-332. Maize: Anantnag local Sarson:Gulchin and mixtures Oats:Kent, sabzar
Conventional (Horti-based)	CHS	Apple	Apple	Apple	Apple: Red delicious

Traditional IFS(Agriculture based)	TIFS-A	Rice-Brown sarson+ Cattle	Rice -Brown sarson/oats+ sheep	Maize+ Apple+ Sheep	Rice=Ch-1039,K-39,K-332. Maize:Anantnag local and mixtures Sarson=Gulchin and mixtures. Oats= Kent,sabzar Cattle/Sheep: Local breeds Apple: Red delicious
Traditional IFS (Horti-based)	TIFS-H	Apple+ sheep	Apple+ cattle	Apple + Cattle	Apple: Red delicious Cattle/Sheep: Local breeds
Improved IFS (Agriculture based)	IIFS-A	Rice -Brown sarson+cattle	Rice-Brown sarson/oats+ Apple+Sheep	Maize+Apple+ Sheep+Poultry	Rice: K448 Brown sarson: Shalimar sarson -2 Oats:Shalimar oat-1,2 & 3 Cattle:Cross bred Sheep: Marino Apple: Red delicious Poultry: Wanraja
Improved IFS (Horti-based)	IIFS-H	Apple+sheep	HDP Apple +sheep+cattle	Apple+Cattle+Poulty+ Vermi-compost	Apple: Gala,superchief, redvelox, golden reender Cattle/Sheep: Crossbred /Marino

agriculture/horticulture crops, animal breeds and other technologies promoted by the Kendra. The land holding under different farming practices varied between 0.8 to 2.3 acres, so the economics was calculated by converting data to per unit area (acre) for the purpose of comparison. Economics was calculated based on the rates of inputs and outputs, existing in the market. Economic efficiency of each cropping system (SEE) was also calculated by dividing the net returns with 365 and expressed in ₹ day -1 as adopted by Kumar et al (2018).The data was calculated through face to face interviews, questionnaires designed for the purpose and validation through random field visits.

3. RESULTS AND DISCUSSION

3.1 Crop yield

Since the cropping systems were evaluated on the basis of economics with the objective to ascertaining the impact on farm income, so the data was collected in line with this objective. However information related to the yields of different crop components was recorded for calculating the economics. The results with regard to different cropping systems evaluated under three ecologies are presented in tables 2 to 4 and figures 1 to 5. The data indicates variability in the crop yield under different cropping systems and ecologies given to variation in the microclimate conditions and availability of farm inputs.

Table 2: Production and economics of different cropping systems in lower plains

Conventional Cropping systems???	Crop components	Area under crop (Acre)/No	Production of commodities(q)	Net returns	B : C Ratio
CAS	Rice (Kharief)	1.0	18	29640	1.5
	Sarsoon (Rabi)	1.0	5.2	19830	1.4
	Total of the cropping system	1.0 Acre	-	49470	1.5

CHS	Apple	1.3	77.2	219180	2.3
	Economics per unit area (acre)	1.0	-	168600	2.3
TIFS-A	Rice	0.75	17.6	33556	1.9
	Sarsoon	0.75	5.4	22120	1.9
	Cattle(Two cows and a calf)	2+1 No	53.90 (Milk) 61.89 (Manure) Calf (1 No)	133481	1.4
	Total of the system	0.8 Acre	-	198141	1.6
	Economics per acre	1.0	-	247676	1.6
TIFS-H	Apple	1.5	87.5	196100	2.2
	Sheep	15 No	2.35(mutton) 176(Manure)	114897	1.2
	Total of Cropping System	1.7 acre	-	310997	1.7
	Economics per unit area (acre)	1.0	-	182939	1.7
IIFS-A	Rice	1.0	25.3	54310	2.5
	Sarsoon	1.0	5.8	23500	1.6
	Cattle	2 No	47.4(Milk) and 67.2(Manure)	105430	1.1
	Apple	1.0	122	324550	3.3
	Total of Cropping System	2.3 acre	-	507790	2.3
	Economics per unit area (acre)	1.0	-	220778	2.3
			132	354880	3.8
	Apple	1.5			
IIFS-H	Sheep	17 No	2.69(mutton) 195(Manure)	145330	1.5
	Total of Cropping System	1.7 acre	-	500210	2.6
	Economics per unit area (acre)	1.0	-	294241	2.6

CAS: Conventional agriculture based; CHS: Conventional horticulture based;TIFS-A: Traditional integrated farming system(Agri.based) ;TISF-H: Traditional integrated farming system (Horti. based) , IIFS-A: Improved integrated farming system(Agri. based) ; IIFS-HT: Improved integrated farming system(Horti. based).

Yields were higher in the improved integrated farming system in comparison to both conventional cropping system as well as traditional integrated farming system. This shows that up-scaling of the farming system through the use of new technologies, based on the knowledge and understanding of the location can help in improving the crop productivity and lead to proper exploitation of farm resources (Mubarak and Sheikh 2014). According to Yadev et al (2013) use of improved seeds and practices can substantially improve the crop yields and integration of field crops with horticulture, dairy and other farm enterprises improves sustainability and factor productivity of these enterprises (Badiyala et al.,2012). Similar results were reported by Mubarak et al (2023a) during their study on integrated farming system under similar conditions. According to them The integration of different components improved the yield and quality of produce and overall productivity of the system. The authors concluded their study with the observation that 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 IFS a more stable production system as compared to the conventional one.

Table 3: Production and economics of different cropping systems in mid altitude.

Conventional Cropping systems???	Crop components	Area under crop(Acre)/No	Production of commodities(q)	Net returns	B : C Ratio

CAS	Rice (Kharief)	1.0	16.9	27574	1.5
	Sarsoon (Rabi)	0.5	2.8	10678	1.4
	Oats	0.5	68.3	8690	1.6
	Total of CS	1.0	-	46942	1.5
CHS					
	Apple	1.5	97.3	288780	2.3
	Economics of CS per acre	1.0	64.8	192520	2.3
TIFS-A					
	Rice	0.83	14.2	23428	1.5
	Fodder oat	0.83	116.6	14425	1.6
	Sheep	8	0.79(mutton) 97.5(Manure)	54865	1.6
	Total of CS	0.85	-	92718	1.5
	Economics of CS per acre	1.0	-	109080	1.5
TIFS-H					
	Apple	1.2	72.9	169182	2.5
	Sheep	13 No	2.15(mutton) 165 (Manure)	92515	1.3
	Total of CS	1.21	-	261697	1.8
	Economics of CS per acre	1.0	-	216278	1.8
IIFS-A					
	Rice	1.2	26.7	45497	1.6
	Sarsoon	1.2	6.4	24280	1.4
	Sheep	16 No	1.64(mutton) 186(Manure)	84360	1.3
	HDP Apple	0.5	72.4	278020	2.4
	Traditional apple	0.4	45.28	108860	1.3
	Total of CS	2.0	-	541017	1.8
	Economics of CS per acre	1.0	-	270508	1.8
IIFS-H					
	HDP apple	0.75	113.6	499370	2.7
	Cattle	2 No	47.0 (Milk)	100870	1.6
	Vermicompost Unit	1No	37	3680	2.2
	Backyard poultry	15 No	Meet =0.35 Eggs= 698	9368	2.0
	Total of CS	1.7	-	613288	2.3
	Economics of CS per acre	1.0	-	376646	2.3

3.2.1 Economic evaluation of different cropping systems.

Major driving force for the adoption of a technology or practice is its economic feasibility and monitory benefits. Integration of crops has been reported to work across ecological, temporal, spatial and economical scales and are widely recommended to cater to the emerging challenges in agriculture (Gill et al 2010; Kumar et al 2011; Puste et al 2013; Mubarak et al 2023b).The data related to different economics indices of cropping systems under study are presented in tables 2 to 4 and fig 1 to 6. In general horticulture based cropping systems were found more profitable than agriculture crop based cropping systems irrespective of ecologies and type of farming(conventional, traditional IFS and Improved IFS). In agriculture based cropping systems the net profit ranged between ₹18523 acre-1 under conventional farming in the high altitudes to ₹322382 acre-1 under improved integrated farming system under same ecology. It was evident that in agriculture based cropping systems, integration of fruits and animal component brought substantial improvement in the income . Evaluation of horticulture based cropping systems revealed that net profit ranged between ₹168600 $acre^{-1}$

Table 4: Production and economics of different cropping systems in high altitudes.

Conventional Cropping systems???	Crop components	Area under crop Acre) /No	Production of commodities(q)	Net returns	B : C Ratio
S	Maize (Kharief)	1.3	18.7	33080	1.6
	Economics of CS per acre	1	--	18523	1.4
CHS	Apple	1.4	86.7	274350	2.4
	Economics of CS per acre	1	64.8	192520	2.4
TIFS-A	Maize	1.5	23.3	41217	1.6
	Apple	0.75	66.3	210848	3.1
	Sheep	12	0.97(mutton) 118 (Manure)	55000	1.6
	Total of CS	2.30 Acre	-	307065	2.4
	Economics of CS per acre	1.0	-	133507	2.4
TIFS-H	Apple	1.0	74.6	221170	2.9
	cattle	2 No	49.3(Milk) 69.5 (Manure)	122655	1.6
	Total of CS	1.05 acre	-	343825	2.3
	Economics of CS per acre	1.0	-	327452	2.3
IIFS-A	Maize	1.0	23.9	43100	1.8
	Apple	0.75	113.3	467180	2.8
	Sheep	21 No	2.58(mutton) 227(Manure)	118880	1.5
	Poultry	30	Meet =0.64 Eggs= 1323	15605	2.1
	Total of CS	2 acre	-	644765	2.3
	Economics of CS per acre	1.0	-	322382	2.3
IIFS-H	Apple	1.15	139.5	490330	2.9
	Cattle	3 No	89.3 (Milk)	207890	1.9
	Vermicompost Unit	1No	43	46450	2.6
	Backyard poultry	50 No	Meet =0.78 Eggs= 2430	35680	2.3
	Total of CS	1.25 acre	-	780350	2.6
	Economics of CS per acre	1.0	-	624280	2.6

CAS=Conventional agriculture based; CHS= Conventional horticulture based;TIFS-A= Traditional integrated farming system(Agri. based) ;TISF-H= Traditional integrated farming system (Horti. based) , IIFS-A= Improved integrated farming system(Agri. based) ; IIFS-HT = Improved integrated farming system(Horti. based)

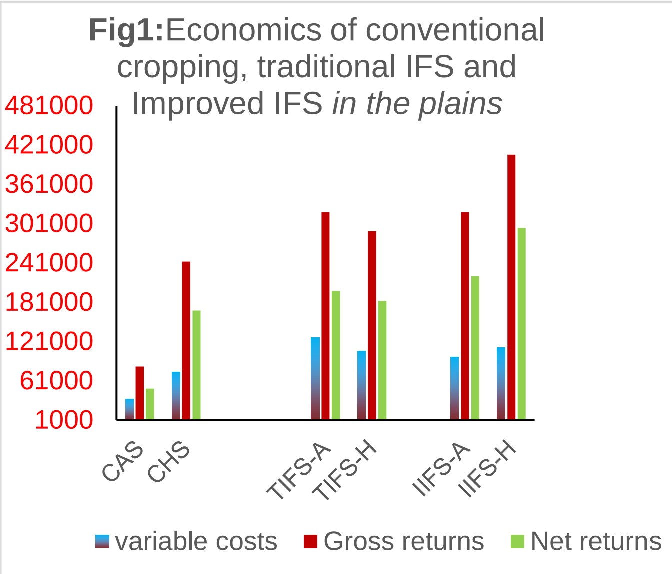


Fig1: Economics of conventional cropping, traditional IFS and Improved IFS *in the plains*

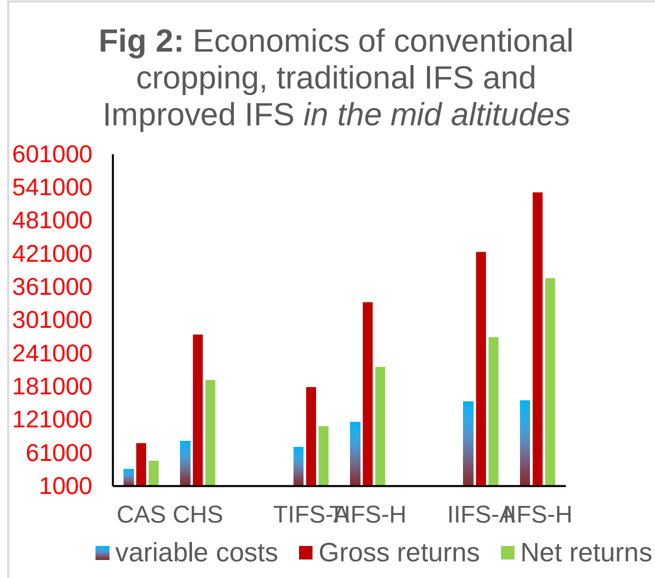


Fig 2: Economics of conventional cropping, traditional IFS and Improved IFS *in the mid altitudes*

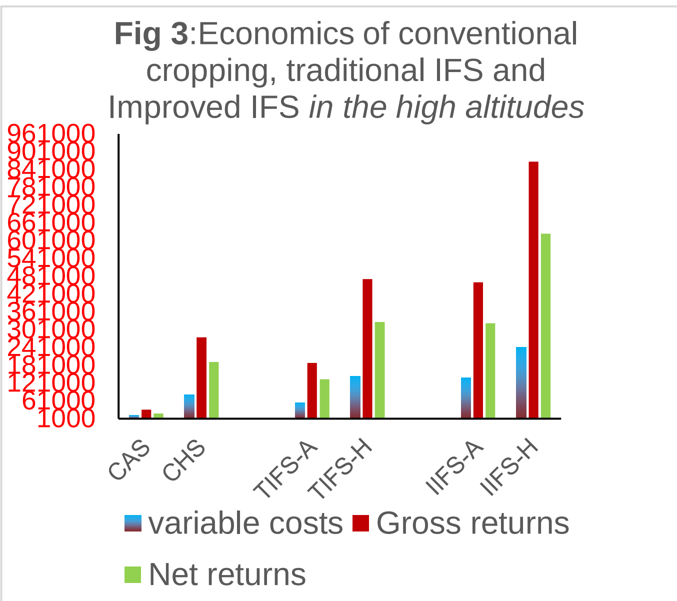


Fig 3:Economics of conventional cropping, traditional IFS and Improved IFS *in the high altitudes*

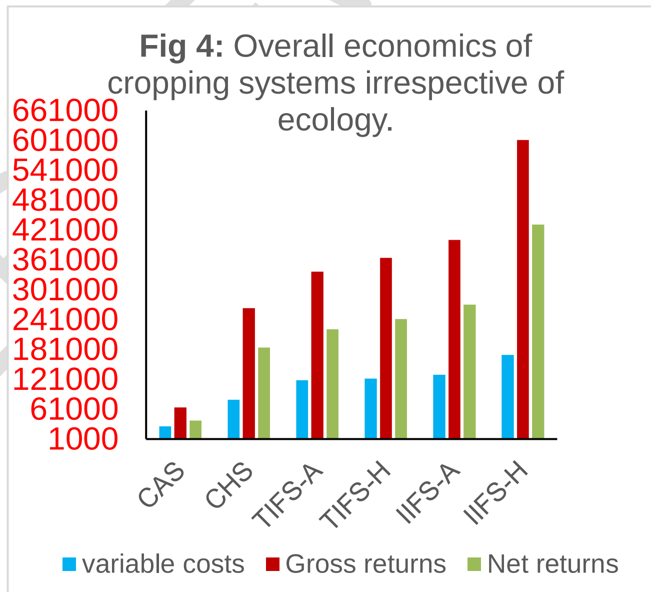


Fig 4: Overall economics of cropping systems irrespective of ecology.

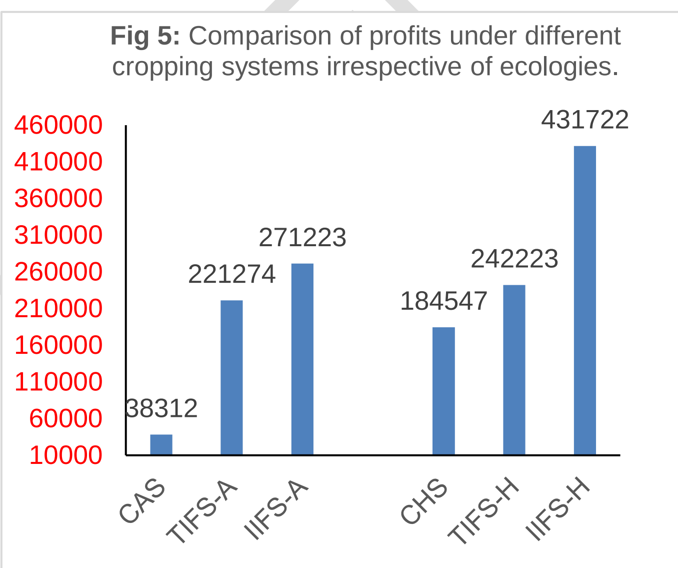


Fig 5: Comparison of profits under different cropping systems irrespective of ecologies.

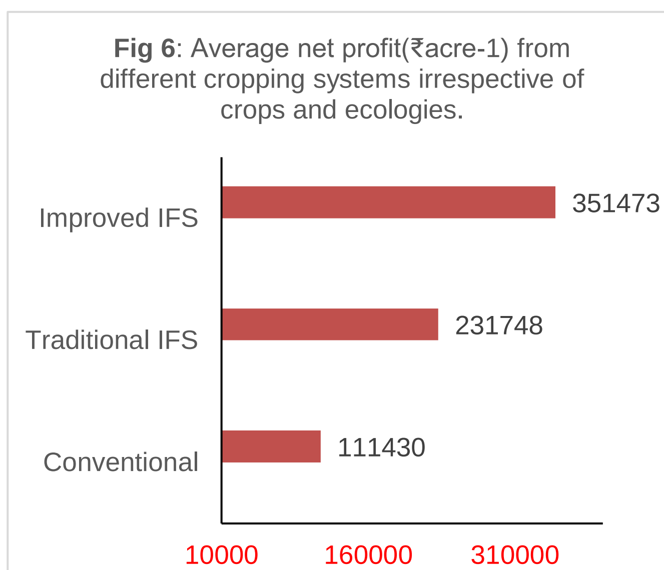


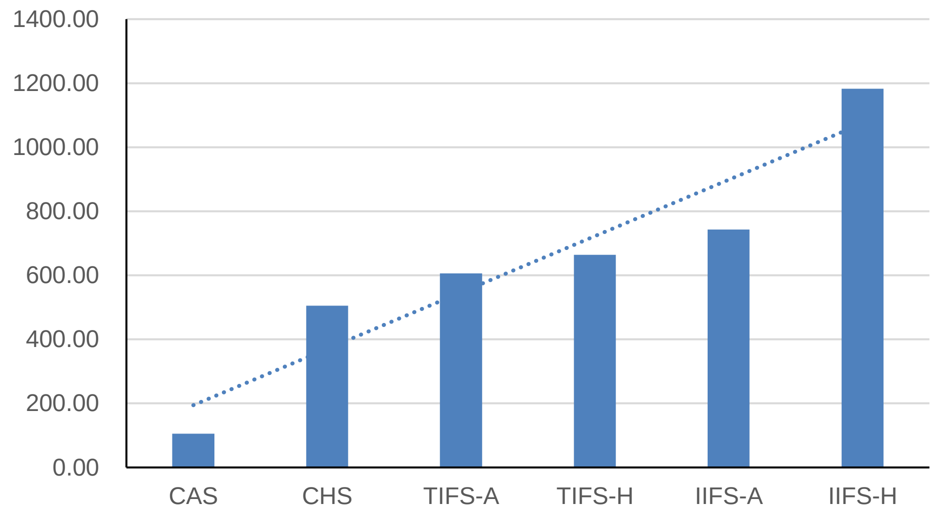
Fig 6: Average net profit(₹acre-1) from different cropping systems irrespective of crops and ecologies.

under conventional farming in the lower plains to ₹624280 acre^{-1} under improved integrated farming system in the high altitudes. The higher returns in the high altitudes under improved horticulture based integrated farming system was due to higher rates of produce owing to its better quality. The high altitude area is considered more suitable for both fruit crops and the animal raring in Kashmir Valley. In general horticulture based cropping systems were more profitable than field crop based cropping system (Fig 5) and the B:C ratio was also higher in these cropping systems (Tables 2-4). Improved Integrated farming system was found more profitable than other cropping systems in all the three ecologies (Fig 1-4). The data presented in Fig 6 clearly shows the impact of improved technical inputs on farm income. It revealed that improved integrated farming system gave an additional income of ₹240043 acre^{-1} and ₹119725 acre^{-1} in comparison to the conventional farming and traditional integrated farming, which was 215% and 51.6% higher, respectively. These results are in line with those reported by Yadev et al (2013); Ansari et al. (2013) Kumar et al (2018) and Mubarak et al (2023a).

3.2.2 System Economic Efficiency

Generating regular income is very important criterion for assessing the suitability of a cropping system. It is not only the production but also the income per unit area which motivates farmers to adopt a particular cropping system. So knowing the economic efficiency of a cropping system is vital to suggest a remunerative farming systems for further promotion among farming community. As evident from Fig 7 different cropping systems showed variability in terms of System Economic Efficiency. There was gradual increase in the SEE from conventional to improved integrated farming system. The data clearly indicates that with the integration of fruit crop and animal component, there was increase in the SEE. In general SEE was better in horticulture based cropping systems in comparison to field crop based cropping system irrespective of ecologies. Lowest SEE (₹ 104.96 day^{-1}) was recorded in agriculture based conventional farming system, while as the highest SEE (₹ 1182.8 day^{-1}) was registered in horticulture based improved integrated farming system(IIFS-2). This was due to the introduction of new varieties and techniques as also reported by Sheikh et al (2013) and Mubarak et al (2023b). It may also be attributed to better returns from the fruit and animal components (Mubarak et al. 2023a)

Fig 7: System Economic Efficiency(Rs day^{-1}) of different farming systems .



4. CONCLUSION

Integrated farming presents solution to many challenges farming faces in the country. Thus standardization of location specific IFS models can help in resolving many of these. With the present study it can be concluded that in the hills, integration of suitable animal component with fruit crops may be more profitable and a better choice irrespective of ecology, particularly for the small and marginal farmers which represent more than 80% of the total farming families.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPIL**OT, etc)** have been used in this study

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