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Strengthening of traditional farming systems with small and large ruminants in arid region of Andhra Pradesh

D LAKSHMI KALYANI[1]✉, SAHAJA DEVA[2], M VIJAYSANKAR BABU[3], KC NATARAJ[4], I BHASKAR RAO[5], K LAKSHMAN[6], B SAHADEVA REDDY[7] and J V N S PRASAD[8]

Acharya N G Ranga Agricultural University, Andhra Pradesh- 522 034, India

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ABSTRACT

The study explores the demonstrative performance of Livestock based Integrated Farming System (IFS) with different technologies or interventions under rainfed and partially irrigated conditions in farmers' fields of Ananthapuramu district, Andhra Pradesh during 2023 and 2024. The objective of the study was to strengthening the traditional IFS system for marginal and small farm holdings, with small and large ruminants focusing on improving productivity, profitability and employment generation in arid region of Andhra Pradesh. A total of 36 farmers were selected and categorized into rainfed and partially irrigated farming situations. Various IFS models, including crop + small ruminants (CSR), crop + large ruminants (CLR) and crop + large + small ruminants (C + LR + SR) were demonstrated with and without scientific interventions. Improved management practices, such as use of high-yielding crop varieties, moisture conservation practices, drought mitigation techniques, nutritional feeding for livestock, perennial tree module and capacity building programmes were introduced. The results demonstrated that the IFS models with scientific interventions significantly increased yields, economic returns and employment opportunities compared to traditional farming systems. Specifically, net returns and productivity were markedly higher in the improved IFS models. The study concluded that integrating scientific agricultural practices within traditional IFS frameworks can substantially improve sustainability and economic viability of farming in scarce rainfall zone of Andhra Pradesh.

Keywords: Diversification, Employment generation, Food security, Integrated farming system partially irrigated, Rainfed

Predominantly, India's rural and agrarian economy faces major challenges in achieving profitable and sustainable farming due to the continuous decline in landholding sizes. Small (1–2 ha) and marginal (< 1 ha) farmers form the backbone of the rural economy, comprising about 86% of the total farming community, but owned only 44% of the total arable land in 2015–16 (Dev S.M .(2020). The average operational size of landholdings has also declined significantly over the years. During the last 30 years, the cultivated area in Anantapuramu district in Andhra Pradesh, India, has dropped by 50%, from 30 lakh acres to roughly 15 lakh acres, as the drought pattern changed from once every three years to almost every year (Bommakanti, U. 2021). Even though as per IMD data the district received deficient or scanty annual rainfall on 10 of the 20 years since 2000, the Government of India has declared Anantapuramu district as drought-affected as over 18 of these 20 years rains have been unevenly distributed within the district (Bommakanti, U. 2021).

Therefore, any farming approach that requires fewer inputs while providing higher outputs is considered more efficient and sustainable. There is evidence of positive and economic benefits from livestock-based cropping systems with ecological sustainability (Walia and Kaur, 2020). Similarly, Gill *et al*. (2009), Yadav and Sharma (2013) had also reported that the integration of crops with livestock in a farming system is highly productive, profitable, and environmentally sustainable. In this context, Rainfed Integrated Farming Systems (IFS) approach are vital for Anantapuramu drought-prone region by diversifying

Present address: [1]Agricultural Research Station, DCMS Building,Kamala Nagar Anantapuramu, Andhra Pradesh-515 001. [2] Scientist (Agronomy),Regional Agricultural Research Station,Tirupati, Andhra Prades- 517502. [3]Principal Scientist and Head, Agricultural Research Station, DCMS Building, Kamala Nagar, Ananthapuramu, Andhra Pradesh- 515 001.[4]Scientist, Agricultural Research Station, DCMS Building, Kamala Nagar, Ananthapuramu, Andhra Pradesh-515 001. [5]Scientist (Agricultural Engineering), Agricultural Research Station, DCMS Building, Kamala Nagar, Ananthapuramu, Andhra Pradesh-515 001. [6]Scientist (Agronomy), Agricultural Research Station, DCMS Building, Kamala Nagar, Ananthapuramu, Andhra Pradesh- 515 001. [7]Principal Scientist (Agronomy), Regional Agricultural Research Station, Maruteru, West Godavari, Andhra Pradesh. [8]Project Coordinator, AICRPDA, ICAR- Central Research Institute for Dryland Agriculture, Santosh Nagar, Hyderabad. Corrresponding author email: d.lakshmikalyani@angrau.ac.in

income and reducing risk from crop failures. Promoting IFS can support livelihood security in arid conditions of Anantapuramu district by creating multiple income streams when single crops fail. Mixed cropping+ small ruminants is the most prevalent in Anantapuramu district and is mainly rainfed and diversified, combining crops with livestock and other allied activities. Because the district lies in a scarce rainfall zone with low and erratic rainfall, farmers adopt integrated farming systems to reduce risk and ensure stable income by providing inputs and technical support to the farmers. Hence, it is imperative to improve the existing farming systems to enable adequate employment and income generation, especially for small and marginal farmers. With this background, this study attempted to identify the existing traditional farming systems and develop an efficient farming system for increasing and stabilizing the farm income and employment.

MATERIALS AND METHODS

Site description and prevailing weather conditions: During 2023–2024 and 2024–2025, on-farm research with farming systems perspective (OFR) module was adopted for the present study at Niluvurai village, Narpala mandal by the Agricultural Research Station, Ananthapuramu, Acharya N.G.Ranga Agricultural University, Andhra Pradesh in collaboration with ICAR- CRIDA. ICAR-Central Research Institute for Dryland Agriculture). The village is situated at 14.73^0 N latitude, 77.79^0 E longitude and 327 m above mean sea level. The site comes under arid agro-ecological zone, characterized by a hot and dry climate, low annual rainfall (around 536 mm) and a high percentage of rainfed agriculture.

Soil characteristics: The composite soil samples were collected and analysed from 0–15 cm of soil depth for the analysis of soil mechanical and chemical properties. The soil texture was red sandy loams with a pH value of 6.6, low in electrical conductivity (0.02 dsm^{-1}), low in organic carbon (0.29%), available nitrogen (170 kg/ha) and medium in available phosphorous (48 kg/ha) and medium in available potassium (294 kg/ha), deficient in micronutrients like copper (0.13 ppm), manganese (1.90 ppm), iron (0.70 ppm) and zinc (0.05 ppm).The soil mechanical analysis (hydrometer method) showed a red sandy loam texture of the soil with sand, silt, and clay proportions of 46.2, 35.6, and 18.2%, respectively.

The villagers largely depended on agriculture for livelihoods. Fig. 2 clearly depicted that 69% of area was under rainfed situation followed by irrigated area (21%) and 10% of the area was uncultivated. The village was rich in livestock, mainly dominated with small ruminants

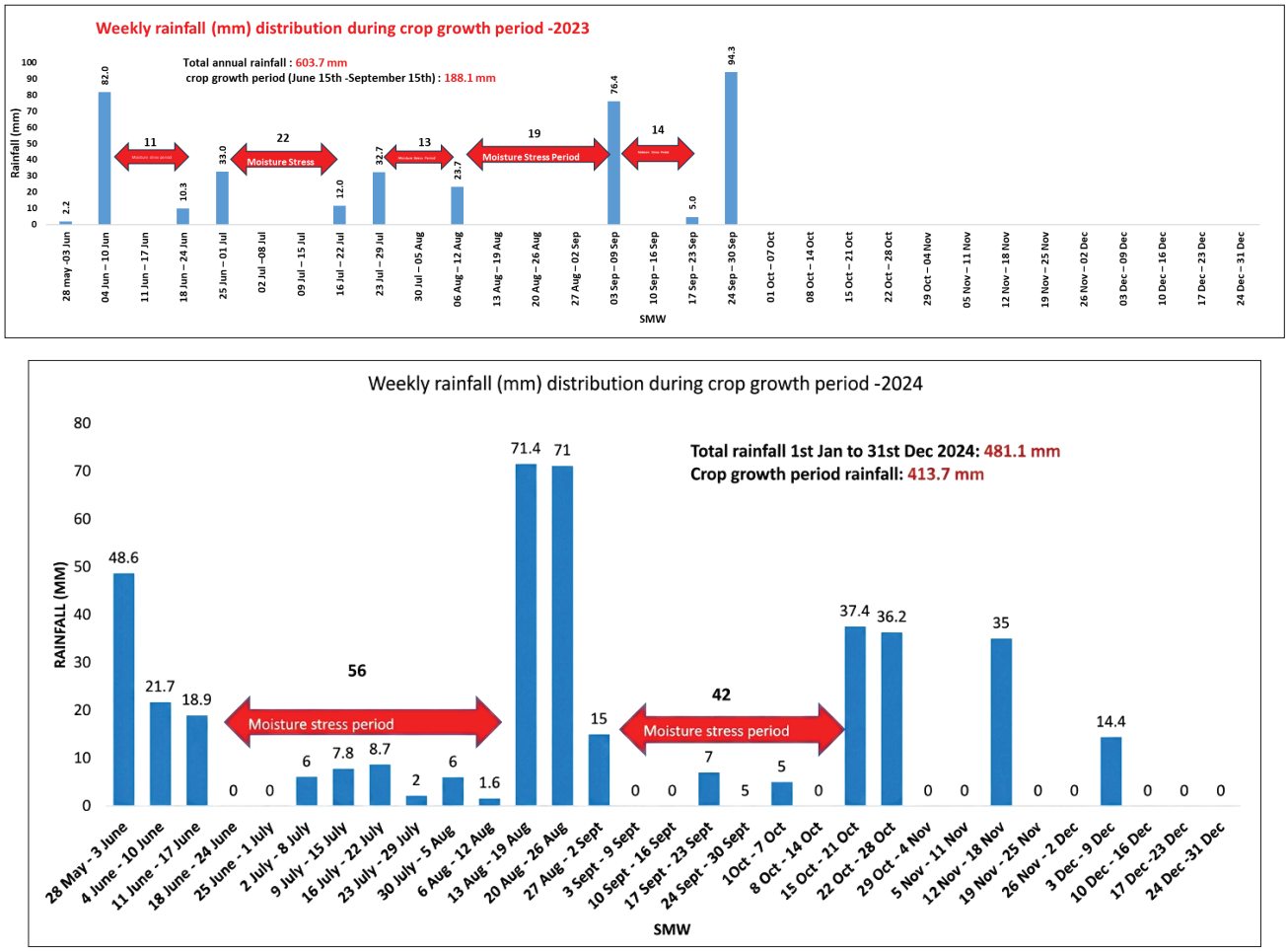

Fig. 1. Rainfall pattern during crop growth period and dry spells at On-Farm Research (OFR) village during 2023and 2024.

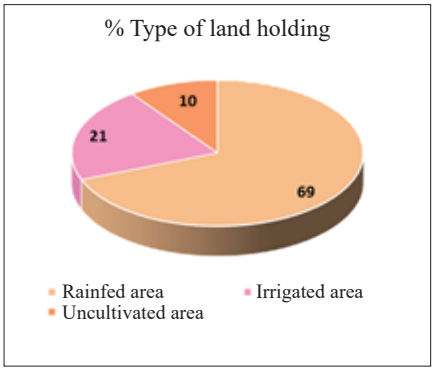

Fig. 2. Type of land holding,2018

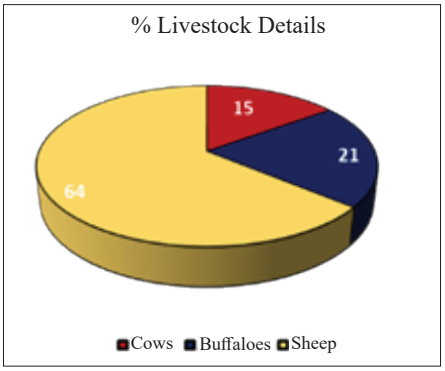

Fig. 3. Livestock details,2018

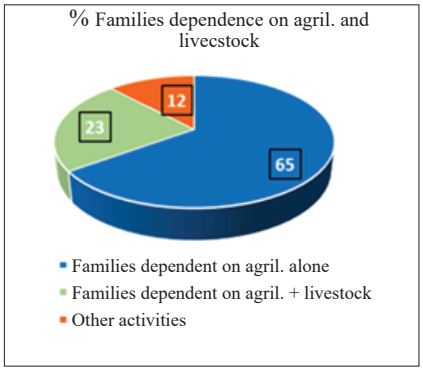

Fig. 4. Family dependence for income, 2018

with 64% (Fig. 3) population followed by buffaloes (21%) and cows (15%). Fig. 4 indicated agriculture as the primary source of income to the farmers as 65% of the families were dependent on agriculture alone, 23% of the family's dependent on agriculture + livestock and 12% on other activities like jobs, business, auto driving etc. The traditional major crops were groundnut + redgram(15: 1), maize, vegetables during *kharif* season, and groundnut and maize in *Rabi* season. Irrigation was being provided through borewells and farm ponds whenever required.

A dry spell significantly reduces the yields of rainfed groundnut and redgram crops, with impacts varying by crop stage, leading to yield loss and crop failure due to insufficient soil moisture. This stress reduces overall agricultural productivity, contributing to income instability for farmers and affecting the food supply. For animals, especially livestock dependent on these crops or grazing lands, the dry spell means reduced fodder availability, increased risk of malnutrition, reduced milk and meat production, forcing them to migrate further for water and grazing resources. Improved technologies like deep ploughing, drought resistant varieties, formation of moisture conservation furrows and supplemental irrigation through farm ponds are very helpful with their impact visible when the crop was subjected to prolonged dry spells. Crops were subjected to dry spells from vegetative stage to harvesting stage and details are presented in Fig 1.

Problem identification and prioritization: Crops: Prolonged dry spells, non-adoption of soil and water conservation practices, Lack of poor adoption of improved varieties, poor mechanization (no tractors), poor soil health management.

Cattle: Shortage of green fodder, improper feeding of available green and dry fodder, no concentrate feeding to milch animals, no practice of legume feeding, improper calf rearing.

Sheep: Nellore brown with mixtures of Bellary breeds were predominant and migratory with in the district, illiterates shepherds / farmers, lacking of awareness on scientific management practices for feeding of ram lambs.

Selection of farmers, farming situation and farming system: The study involved the implementation of scientific interventions through seven modules, namely natural resource management, crop production, fodder development, livestock management, perennial tree component, optional enterprises, and capacity building, with the objective of improving productivity, profitability, and sustainability of the farming systems. Marginal and small farmers were equally selected for this study under two farming situations *viz.*, Rainfed and partially irrigated conditions and three farming systems *viz*., Crop +Small ruminants system (CSR), Crop +Large ruminants system (CLR), Crop + Large ruminants + Small ruminants (CLSR) based farming systems with and without scientific interventions Fodder, Livestock, Perennial tree module, Optional module, and capacity building modules**.**

Selection of Farmers at On-Farm Research village

Farming situation	Farming systems	Farmer category	No of farmers selected	
			With interventions	Without interventions
Rainfed	Crop+ Small ruminants	Marginal	3	3
		Small	3	3
Partially irrigated	Crop+ Large ruminants	Marginal	3	3
		Small	3	3
	Crop+ Large + Small ruminants	Marginal	3	3
		Small	3	3
		Total	18	18

Treatment details/ modules adopted for rainfed IFS research: The details of the various modules, existing system/ practising system in the study area, constraints in existing system and diversified system of Rainfed Integrated Farming System in the study area have been provided below.

System equivalent productivity calculation: Yield of crops was calculated separately for each intervention, sheep by weight @ Rs 380/kg, cattle by milk @ Rs 30 /lit. Employment generation was calculated as 8 hours per day

Details of constraints in existing farming system and interventions implemented in diversified system

S. No	Module	Existing system	Constraints in Existing system	Diversified system
1	NRM module	Sole Redgram and castor	Not adopting insitu moisture conservation practices	1.Deep tillage with chisel plough *2.Insitu* moisture conservation through conservation furrows at 35 DAS 3.Supplemental irrigation through farm pond
2	Arable Crops module	1.Sole Redgram and castor. 2.Groundnut + Redgram intercropping system	Old varieties, Prolonged dryspells	1.Redgram improved varieties – LRG 52, LRG 105 and PRG176 2.Groundnut improved varieties Kadiri Lepakshi and Vishista 3. Castor improved varieties-ICH 5 and ICH 66 4. Drought mitigation through KNO3 spray @ 5 ml/lit twice at 1 week interval. 4.
3	Livestock module	Rearing of Ramlambs, cow, buffaloes	Grazing on open lands, Avoiding mineral feeding	1.Improved method for Ramlambs: Feeding of ramlambs with grazing + GN Ground nut haulm 300 g + Total Mixed Ration 300-400 g/day for 4 months 2. Improved method for Cows: Feeding of cow/day @ Ground nut haulm 5 kg + fodder sorghum 15 kg + Total Mixed ration 6 kg/day for 4 months 2.Animal health camp 3.Deworming, vaccination
4	Fodder crops module	Horsegram after kharif groundnut	Cultivating local horsegram variety	Introduced improved fodder sorghum Co FS 31
5	Perennial trees module	Barren field bunds, Tamarind	No boundary plantation, Oldest trees with less fruit bearing	Planting tamarind grafts i.e., short duration var like Thettu Amalika and Ananta Rudhira in backyard and on field bunds @ each species 2 no.
6	Optional module	Limited vegetable production	Purchasing vegetables from local shops	Introduced nutri kitchen garden kits (NHRDF National horticultural research and development foundation) to the farm women
7	Capacity building module	Traditional cultivation	Lack of knowledge on improved crop management practices	Need based trainings and awareness programmes to farmers

as one man day. For economics, cost of inputs and outputs prevailing in the market were considered and calculated for the year 2023 and 2024 Groundnut is the predominant crop in the village. The yield obtained from individual modules in a farming system was expressed in Groundnut equivalent yield and were added together to obtain the system equivalent productivity of each module.

$$\text{Groundnut equivalent yield (GEY)} = \frac{\text{Yield of a crop} \times \text{Market value of the crop}}{\text{Market value of Groundnut}}$$

$$\text{System Groundnut equivalent Yield (SGEY)} = \Sigma \text{ Groundnut equivalent yield of all modules in a Farming system}$$

System Benefit cost ratio was also calculated by dividing the system gross returns by the system cost of production.

$$\text{System benefit cost ratio (B:C)} = \frac{\text{System gross returns}}{\text{System cost of production}}$$

RESULTS AND DISCUSSION

Integration of rainfed crops with allied modules like natural resource management, crop, livestock, fodder, perennial tree, kitchen garden module and capacity building module resulted in higher productivity than existing system productivity in rainfed as well as partially irrigated conditions for marginal and small farmers in the study area. The results of comparison of rainfed integrated farming system with existing system production pertaining to marginal and small farmers under CSR, CLR and CLSR farming system are presented in tables from 1 to 6.

Groundnut equivalent yield (Kg): In 2023-24, the additional benefits through IFS interventions were substantial, with productivity of Groundnut Equivalent Yield (GEY) advantage ranging from 294 to 411 kg for marginal farmers and 372 to 437 kg for small farmers. In 2024-25, GEY ranged from 300 to 347 kg for marginal farmers and 403 to 476 kg for small farmers in all farming systems (Table 4,5,6 and Fig: 5). An increase in productivity was observed during 2024-25 over 2023-24 due to more number of dry spells in each farming system, with a similar trend of productivity response. Productivity

Table 1. Strengthening traditional IFS for marginal and small farm holdings under Crop + Small Ruminants (CSR) based farming system in rainfed situation (Mean of 3 farmers).

Module	Components of farming system	Details of interventions	Marginal farmers							Small farmers						
			Area (ha)	2023	2024	2023	2024	2023	2024	Area (ha)	2023	2024	2023	2024	2023	2024
				GEY (kg)		Net returns (Rs)		EG (Man days)			GEY (kg)		Net returns(Rs)		EG (Man days)	
NRM	Sole Pigeonpea	Deep tillage with chisel plough Moisture conservation furrows Supplemental irrigation	0.4	342	340	12365	12850	57	53	0.4	360	368	13505	14620	59	56
Crop	Groundnut+ Redgram (15:1)	Groundnut improved varieties Drought mitigation through KNO_3 spray Redgram improved varieties -	0.4	399 312 321	265 262 274	11137 5287 11635	3225 2780 7810	61	56	0.6	599 432 458	397 425 300	16690 7827 15957	4805 6375 9000	97	89
	Castor	Castor improved varieties	-	-	-	-	-	-	-	0.2	166	169	7071	5522		
Fodder	Fodder Sorghum	Improved variety-Co FS 31	0.1	59.5	63	1925	2270	17	15	0.2	120	124	3910	4460	28	28
Livestock	Ramlambs-10 n	Improved feed method		1210	1280	42220	50080	120	125	8	1045	1075	38660	43475	120	120
Perennial tree	No boundary plantation/very old tamarind trees	Planting of improved varieties on field bunds @ each species 2 no.	-	Fruit setting initiated				1	1	-	Fruit setting initiated				1	1
Optional	No vegetable production	Nutri kitchen garden kits	$40m^2$	44	40	2650	2440	18	19	40	47	140	2810	3305	17	16
RIFS productivity			0.9	2688	2524	87219	81455	274	268	1.4	3227	97653	106430	91562	322	310
Existing system productivity (Without intervention)		Sowing of groundnut + pigeonpea (15:1) , fodder sorghum and rearing of ramlambs	0.9	2294	2332	75942	71580	234	230	1.4	2790	79000	92095	79275	278	272
Additional Benefit Net returns						11277	9875	40	38				14335	12287	44	38

Table 2. Strengthening traditional IFS for marginal and small farm holdings under Crop + Large Ruminants (CLR) based farming system under partially irrigated situation (Mean of 3 farmers)

Module	Components of farming system	Details of interventions	Area (ha)	Marginal farmers						Area (ha)	Small farmers					
				2023	2024	2023	2024	2023	2024		2023	2024	2023	2024	2023	2024
				GEY (kg)		Net returns (Rs)		EG (Man days)			GEY (kg)		Net returns (Rs)		EG (Man days)	
NRM	Sole Pigeonpea	Deep tillage with chisel plough Moisture conservation furrows Supplemental irrigation	0.4	332	359	11700	13835	61	56	0.4	350	379	12840	15435	54	51
Crop	Groundnut+ Redgram (15:1)	Groundnut improved varieties Drought mitigation through KNO_3 spray Redgram improved varieties -	0.4	397 315 327	360 278 283	11011 5330 12015	8900 3970 9395	58	54	0.6	595 429 443	450 402 340	16485 7787 15030	8750 7479 12100	83	80
Fodder	Fodder Sorghum	Improved variety- Co FS 31	0.2	119	127	3850	4843	32	30	0.4	240	240	7820	8350	42	35
Livestock	Jersey cow – 1 no.	Improved feed method		552	500	26202	23800	262	258	1	535	547	25122	26855	260	255
Perennial tree	No boundary plantation/very old tamarind trees	Planting of improved varieties on field bunds @ each species 2 no.		Fruit setting initiated				1	1		Fruit setting initiated				1	1
Optional	No vegetable production	Nutri kitchen garden kits	40 m^2	38	43	2250	2645	15	15	40	41	47	2410	2925	16	14
RIFS productivity			1.0	2080	1950	72358	67388	429	414	1.4	2633	2405	87494	81845	456	436
Existing system productivity (without intervention)		Sowing of groundnut + pigeonpea (15:1), fodder sorghum and rearing of Jersey cow	1.0	1783	1650	60039	57388	368	374	1.4	2261	2002	77295	68812	392	371
Additional Net returns						12319	10000	61	50				10199	13033	64	65

Table 3. Strengthening traditional IFS for marginal and small farm holdings under Crop + Large+ Small ruminants (CLSR) based farming system in partially irrigated situation (Mean of 3 farmers)

Module	Components of farming system	Details of interventions	Marginal farmers							Small farmers					
			Area (ha)	2023	2024	2023	2024	2023	2024	Area (ha)	2023	2024	2023	2024	2023	2024
				GEY (kg)		Net returns (Rs)		EG (Man days)			GEY (kg)		Net returns (Rs)		EG (Man days)	
NRM	Sole Pigeonpea	Deep tillage with chisel plough Moisture conservation furrows Supplemental irrigation	0.4	347	353	12650	13745	60	62	0.4	372	366	14265	14790	59	54
Crop	Groundnut+ Redgram (15:1)	Groundnut improved varieties	0.4	401	420	11263	13300				602	550	16895	15250		
		Drought mitigation		309	302	5244	5380	62	58	0.6	464	431	7866	7015	89	79
		Redgram improved varieties		315	290	11255	9650				473	340	16883	12600		
Fodder	Fodder Sorghum	Improved variety	0.2	119	120	3850	4400	34	30	0.4	238	240	7700	8400	45	30
Livestock	Ramlambs- no.	Improved feed method	8	1133	1227	44210	53255	120	122	8	1110	1309	42730	58585	120	117
	Jersey cow – no.		1	523	484	24372	22660	256	245	1	540	535	25482	25975	256	245
Perennial tree	No boundary plantation/very old tamarind trees	Planting of improved varieties		Fruit setting initiated				1	1		Fruit setting initiated				1	1
Optional	No vegetable production	Nutri kitchen garden kits	40 m^2	36	44	2225	2710	17	15	40m^2	39	46	2330	2840	15	13
RIFS productivity			1.0	3183	3240	115069	125100	550	533	1.4	3838	3817	134151	145455	585	539
Existing system productivity (without intervention)		Groundnut + pigeonpea (15:1),fodder sorghum and rearing of livestock	1.0	2772	2836	102595	107940	479	480	1.4	3447	3380	123044	125200	525	487
Additional Net returns						12474	17160	71	53				11107	20255	60	57

Table 4. Comparison of RIFS productivity with existing system productivity of Crop + Small ruminants-based farming system under rainfed situation during 2023 and 2024

Farming system	Marginal farmers									Small farmers								
	2023	2024	Mean	2023	2024	Mean	2023	2024	Mean	2023	2024	Mean	2023	2024	Mean	2023	2024	Mean
	Groundnut equivalent yield (Kg)			Net Returns (Rs)			Employment generation (Man days)			Groundnut equivalent yield (Kg)			Net Returns (Rs)			Employment generation (Man days)		
Existing system	2294	2232	2263	75942	68510	72226	234	230	232	2790	2435	2612	92095	79275	85685	278	272	275
RIFS	2588	2533	2560	85674	77749	81711	274	268	271	3227	2911	3069	106430	91562	98996	322	320	321
Additional Benefit	294	301	297	9732	9599	9665	40	38	39	437	476	456	14335	12287	13311	44	48	46

Table 5. Comparison of RIFS productivity with existing system productivity of Crop + Large ruminants-based farming system under Partially irrigated situation during 2023 and 2024

Farming system	Marginal farmers									Small farmers								
	2023	2024	Mean	2023	2024	Mean	2023	2024	Mean	2023	2024	Mean	2023	2024	Mean	2023	2024	Mean
	Groundnut equivalent yield (Kg)			Net Returns (Rs)			Employment generation (Man days)			Groundnut equivalent yield (Kg)			Net Returns (Rs)			Employment generation (Man days)		
Existing system	1783	1650	1716	60039	57388	58713	368	374	371	2261	2002	2131	77295	68812	73053	392	371	382
RIFS	2080	1950	2015	72358	67388	69873	429	414	421	2633	2405	2519	87494	81845	84669	456	436	446
Additional Benefit	297	300	298	12319	10000	11159	61	50	55	372	403	388	10199	13033	11616	64	65	64

Table 6. Comparison of RIFS productivity with existing system productivity of Crop + Large+ Small ruminants-based farming system under Partially irrigated situation during 2023 and 2024

Farming system	Marginal farmers									Small farmers								
	2023	2024	Mean	2023	2024	Mean	2023	2024	Mean	2023	2024	Mean	2023	2024	Mean	2023	2024	Mean
	Groundnut equivalent yield (Kg)			Net Returns (Rs)			Employment generation (Man days)			Groundnut equivalent yield (Kg)			Net Returns (Rs)			Employment generation (Man days)		
Existing system	2772	2836	2804	102595	107940	105267	479	480	479	3447	3380	3642	123044	125200	124122	525	482	503
RIFS	3183	3240	3211	115069	125100	120084	550	533	541	3838	3817	3827	134151	145455	139803	585	539	562
Additional Benefit	411	404	407	12474	17160	14817	71	53	62	391	437	414	11107	20255	15681	60	57	58

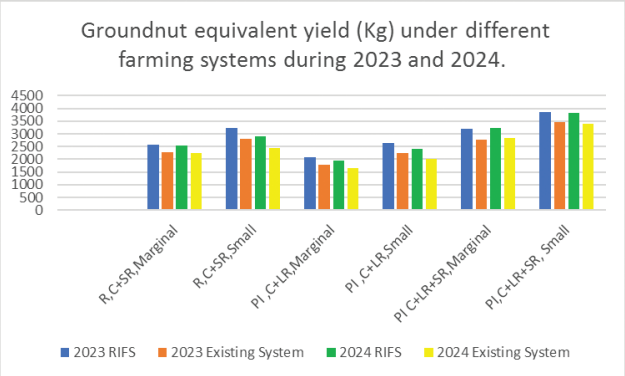

Fig. 5. Groundnut equivalent yield(kg) under different farming systems during 2034 2023 and 2024

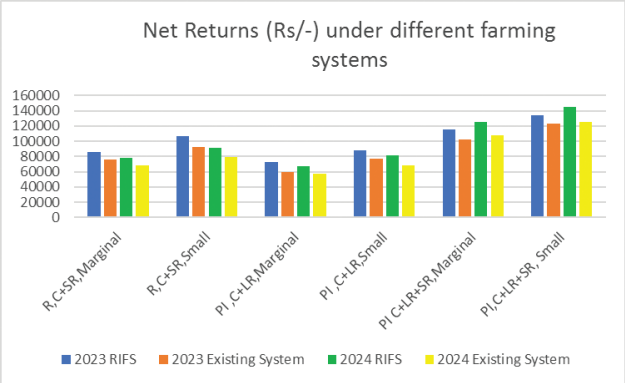

Fig. 6. Net returns(Rs/-) under different farming systems during 2034 2023 and 2024

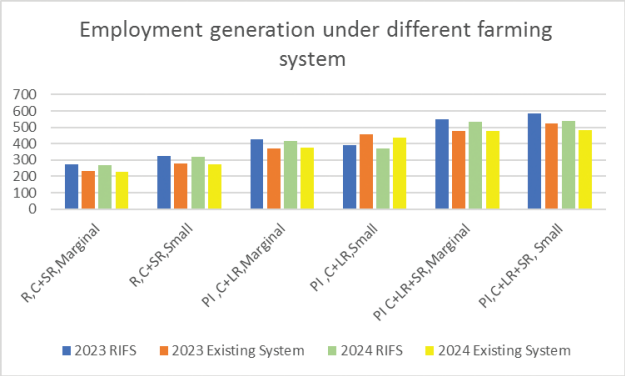

Fig. 7. Employment generation(man days) under different farming systems during 2034 2023and 2024

increased during 2024–25 compared to 2023–24 across all farming systems, possibly due to the occurrence of 3 more dry spells, and the results showed a similar trend in productivity response.

These findings aligned with literature suggesting that IFS, which combine multiple agricultural activities, optimizes resource use and enhances productivity (Singh *et al.* 2011). Deep tillage has been documented to improve soil structure, reduce compaction and enhance root growth, leading to higher crop yields (Aikins and Afuakwa, 2012). Improved crop varieties are known to be more resilient to pests and diseases and have higher productivity, which aligns with the increased yields observed (Ortiz *et al*. 2007). Drought mitigation techniques such as KNO_3 sprays help in managing water stress, thus improving crop performance (Ashraf, 2010). In Anantapur district of Andhra Pradesh, IFS involving crop production (Groundnut + Pigeonpea intercropping) and rearing of small ruminants (90 sheep and 30 goats) was found to be better with a net return of `1,57,855/year, than the other farming systems (Gopinath *et al.* 2025).

Economics: Rainfed IFS models generate multiple income streams, thereby stabilizing farmers earnings throughout the year. The cost of production increased slightly due to the interventions but was offset by the significant increase in gross and net returns. While the cost of production increased with the interventions, the net returns were significantly higher, indicating that the investments in scientific farming practices and inputs are economically viable. For marginal and small farmers additional monetary benefit of Rs. 9,732 to Rs.17,160 and Rs. 10,199 to Rs. 20,255, respectively were obtained with the interventions (Table 4,5,6 and Fig. 6). Results followed a similar trend in both the years. Livestock integration into cropping systems provided multiple benefits, including manure for soil fertility, additional income from animal products and efficient use of farm resources (Thornton & Herrero, 2010)

Employment generation (EG): The integration of various activitie provided year-round employment opportunities for the farm families and rural labourers, reducing seasonal migration and enhancing rural livelihoods. Additional advantage of 38- 71 man days and 44- 65 man days were recorded for marginal farmers and small farmers, respectvely (Table 4,5,6 and Fig. 7). According to Radhamani (2001), the additional employment gained through integrated farming system with crop + goat was 314 man days $ha.^{-1}$. $year^{-1}$ under rainfed vertisols. A herd of 200 goats under integrated farming system provided full time employment for two persons throughout the year (Ramasamy *et al.* 2007).

Moisture conservation practices are scientifically proven and beneficial for drought mitigation and yield stabilization, although their implementation at the field level remained constrained by economic limitations, labor scarcity, small landholdings, and lack of technical support among farmers. Need-based training programmes need to be organized to equip farmers with knowledge on modern agricultural techniques, organic farming practices, farm mechanization, animal husbandry, and market intelligence. These programmes can be effectively implemented through the Department of Agriculture and the Agricultural Technology Management Agency, ensuring location-specific and practical learning for farmers.

In addition, awareness programmes also can be conducted to educate farmers about important government schemes such as Pradhan Mantri Kisan Samman Nidhi, Pradhan Mantri Fasal Bima Yojana, Farmer Producer

Organizations (FPOs), Soil Health Management, sustainable farming practices, subsidies, and crop insurance. These initiatives are highly essential for farmers as they enhance their knowledge, improve decision-making ability, and enable them to effectively utilize available resources and institutional support.

The present finding prove, the rainfed integrated farming system as the most promising enterprise for the small and marginal farmers, particularly, those with smaller farm holding. These technological interventions have indicated an overall improvement in the farming system with increased economic status of the farmers. Integrated farming systems approach is profitable and more sustainable than the conventional mono cropping system because it not only enhance the nutritional and economic status of the farmers but also increases the employment generation and makes maximum use of farm resources through recycling, without disruption to environment. Hence, in the present scenario of Indian agriculture sector, IFS is the most effective approach

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