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Profitability assessment of small ruminant-based integrated farming systems of Telangana

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Abstract

The study evaluates the economic performance of a small ruminant-based Integrated Farming System (IFS) in Telangana, where mixed farming remains the primary livelihood strategy for smallholders. Primary data from 480 farm households were collected using a multi-stage sampling technique and analysed through descriptive statistics and profitability assessment methods. The results indicate that the farming system is strongly livestock-oriented, with small ruminants forming the core enterprise supported by crops, dairy and backyard poultry. Cost and returns analysis revealed substantial variation in profitability across enterprises. Crop enterprises, which included kharif and rabi paddy, generated modest net returns owing to high input costs and climatic vulnerability. Dairy enterprises offered stable supplementary income, while backyard poultry exhibited exceptionally high efficiency despite minimal investment. Small ruminants emerged as the most profitable component, recording the highest net returns and return per rupee invested, reflecting their low input needs and strong market demand. Overall, the findings demonstrate that small ruminant-based IFS enhances farm income, reduces production risk and strengthens overall economic resilience, supporting the promotion of livestock-led integrated systems in semi-arid regions.

Keywords: Small ruminants, economic analysis, profitability, integrated farming system

Introduction

Agriculture in India has traditionally been characterized by mixed farming, where crops and livestock coexist as complementary components of rural livelihoods. Over time, population pressure, shrinking farm sizes, market volatility and climate variability have increased the vulnerability of small and marginal farmers. In this context, Integrated Farming Systems (IFS) have gained renewed importance as a strategy for improving economic efficiency, ensuring resource recycling, diversifying income sources and strengthening farm resilience (Bhat *et al.*, 2023) ^[1]. IFS is based on the principle that the outputs of one enterprise serve as inputs for another, thereby increasing overall productivity while reducing external input dependency. By interlinking crops, dairy, small ruminants and backyard poultry, farmers are able to create a more robust and sustainable production system compared to monocropping or isolated enterprises (Kumar *et al.*, 2018; Singh *et al.*, 2017) ^[1, 7]. In many regions of the country, livestock plays a central role in IFS, especially among smallholders whose agricultural incomes alone are insufficient to sustain household needs. Among livestock species, small ruminants primarily goats and sheep have emerged as critical assets due to their adaptability, low maintenance costs and steady market demand. They are well suited for rainfed and semi-arid conditions where cropping risks are high and fodder resources are limited (Singh *et al.*, 2017) ^[7]. These characteristics make small ruminants an attractive enterprise for farmers with limited landholding and restricted capital investment capacity.

Small ruminant-based integrated farming systems differ significantly from conventional mixed farms because the economic structure is more strongly influenced by animal-based revenues than crop-based returns. In such systems, income from goat or sheep rearing often constitutes a major share of total farm income, while crops and other livestock enterprises serve supportive roles (Singh *et al.*, 2017) ^[7]. Crop residues are used as roughage for animals, while animal manure enhances soil fertility and crop performance. As a result, the financial stability of

smallholders improves through multiple, diversified income channels that are not restricted to specific cropping seasons.

Despite the growing relevance of small ruminant-centric IFS models, empirical studies focusing on their economic performance remain limited. Much of the existing literature concentrates either on enterprise-wise economics of crop cultivation or on livestock production in isolation. Studies that examine the integrated performance of a farm system where interactions between crops, small ruminants, dairy and poultry jointly influence farm profitability are relatively scarce. This creates a knowledge gap for policymakers and extension agencies who aim to promote suitable IFS models in different agro-ecological conditions. Understanding the cost-return structure of each enterprise within such a system is crucial for designing targeted interventions, improving resource allocation decisions and guiding farmers towards more profitable combinations. Given this background, the present study focuses on a detailed assessment of a small ruminant-based Integrated Farming System, evaluating its economic performance and the relative contribution of each enterprise to the total farm income.

Materials and Methods

The study was conducted in the state of Telangana, located in the southern part of the Indian peninsula. Geographically, the state lies between 15°46' N to 19°47' N latitudes and 77°16' E to 81°43' E longitudes, covering an area of 1,12,077 km². Telangana occupies a strategic position on the Deccan Plateau, functioning as a transitional zone between the northern and southern agro-ecological regions of India. The physiographic and agro-ecological diversity across Telangana produced heterogeneous resource endowments and production environments. Such diversity provides a strong basis for the evolution of varied combinations of crops, livestock and allied activities, making the state well suited for a study on Integrated Farming Systems (IFS). To adequately represent this diversity, the entire state was stratified into its three agro-climatic zones, namely, Northern Telangana Zone (NTZ), Central Telangana Zone (CTZ) and Southern Telangana Zone (STZ). From each zone, two districts were randomly selected to ensure spatial representativeness. Accordingly, Jagtial and Peddapalli were chosen from NTZ, Jangaon and Siddipet from CTZ and Rangareddy and Nagarkurnool from STZ. From each selected district, two mandals were randomly chosen based on their predominance of agricultural activity and the existence of diversified farming systems. From each mandal, four villages were randomly selected, giving a total of 48 villages (4 villages × 12 mandals). In the final stage, from each selected village, ten farmers were randomly chosen, giving a total of 480 farmers (10 farmers × 48 villages).

The primary data were collected through personal interviews using a comprehensive and structured questionnaire. The schedule was designed to capture multi-dimensional information and included sections on the socio-economic characteristics of households, landholding details, irrigation sources and cropping pattern, enterprise composition with respect to crops, dairy, small ruminants and backyard poultry, cost of cultivation and livestock maintenance and labour utilization including both family and hired labour. For data analysis, a combination of descriptive statistics and profitability assessment techniques was employed to assess the economic performance of the small ruminant-based Integrated Farming System.

Analytical tools

Descriptive statistics such as averages, percentages and ratios

were used to summarize land-use patterns, livestock composition and enterprise characteristics. Comparative analysis across enterprises helped identify the most profitable components and the economic significance of small ruminants within the IFS.

Cost assessment

Total Variable Costs (TVC)

Variable costs included all expenses that changed with output levels. For crop enterprises, TVC included human, animal and machine labour, seeds or planting material, fertilizers, manures and plant protection chemicals, weedicides and irrigation charges, miscellaneous and operational expenses, interest on working capital at 7 percent, charged for half the crop period. For livestock enterprises, feed and fodder costs, medical/veterinary expenses, labour for feeding, cleaning, milking and fodder collection, interest on working capital at 7 percent. All variable expenses relating to an enterprise were aggregated to obtain TVC on an annual per-farm basis.

Total Fixed Costs (TFC)

Fixed costs were those incurred irrespective of output levels. For crop enterprises, TFC included, depreciation on implements, buildings and irrigation structures, imputed rental value of owned land or actual rent paid, interest on owned fixed capital at 10 percent, apportioned based on crop share in total area. For livestock enterprises, TFC included, depreciation on cattle sheds, troughs and other durable structures, interest on owned fixed capital.

Total Cost (TC): $TC = TVC + TFC$

Gross Returns (GR): Gross returns were estimated by multiplying the quantity of each output with the corresponding market price. Outputs retained for household consumption were imputed at prevailing local market prices.

$$GR_j = \sum (Q_{ij} \times P_{ij})$$

Where, Q_{ij} is the quantity of the i th output of enterprise and P_{ij} is its price.

Net returns (NR): $NR = GR - TC$

$$\text{Returns per Rupee Investment (RRI): } RRI = \frac{GR}{TC}$$

Results and Discussion:

The resource-use pattern depicted in Table 1 of these farms clearly reflected the structure of a small ruminant-based integrated farming system. Households cultivated 0.94 hectares during the kharif season (61.84%) and 0.58 hectares in the rabi season (38.16%). Livestock composition strongly confirmed the small ruminant-dominant nature of the system. Each household maintained an average of 16 small ruminants, of which 11.56 (72.25%) belonged to the primary species group and 4.44 (27.75%) to the secondary group. Dairy animals were present in moderate numbers, with 1.89 cows (66.55%) and 0.95 buffaloes (33.45%), totalling 2.84 dairy units. Backyard poultry flocks averaged 1.07 birds, indicating their role as a supplementary enterprise. Overall, the resource structure shows that small ruminants form the economic nucleus of these farms, with crops, dairy and poultry positioned as complementary activities. Similar structural patterns were identified by Kumar.

Table 1: Land and livestock use pattern of sample households

S. No.	Particulars	Area (Hectares)	Percent
1	Crop		
	Kharif season	0.94	61.84
	Rabi season	0.58	38.16
	Gross Cropped Area (GCA)	1.52	100.00
2	Dairy		
	Cow (No.)	1.89	66.55
	Buffalo (No.)	0.95	33.45
	Sub total	2.84	100.00
3	Small ruminants		
	Sheep (No.)	11.56	72.25
	Goat (No.)	4.44	27.75
	Sub total	16.00	100.00
4	Backyard poultry		
	No. of birds	1.07	100.00

The economic assessment of the different farm enterprises presented in Table 2 revealed the substantial variation in cost structure, income generation and overall profitability, reflecting the heterogeneous contribution of crops and livestock within the integrated farming system. The cost profile showed that crop cultivation, particularly paddy in both kharif and rabi seasons, involved high operational expenses dominated by human labour, machine labour, fertilizers and plant protection chemicals. Kharif paddy demanded a total investment of Rs.1,04,594.22, while rabi paddy required Rs.65,875.47. Despite these expenditures, the net returns realized from these crops were modest, amounting to Rs.19,397.28 in kharif and only Rs.3,792.99 in rabi. The corresponding return per rupee invested (1.19 in kharif and 1.06 in rabi) underscored the relatively low profitability of cereal-based cropping, a pattern consistent with previous findings that highlight the vulnerability of seasonal crops to high input costs, limited irrigation and climatic variability in semi-arid regions (Hikmah *et al.*, 2024) [4]. These outcomes reaffirmed the broader understanding that crop enterprises in such environments often serve more as subsistence and support components rather than primary income drivers. In contrast, livestock enterprises demonstrated markedly stronger economic performance. Dairy enterprises, especially cow-based milk production, generated substantial returns despite relatively high feed and fodder costs. With total costs amounting to Rs.1,23,267.50 and gross returns of Rs.2,16,967.76, cow enterprise yielded net returns of Rs.93,700.25 and a return per rupee of 1.76. Buffaloes also performed well, producing net returns of Rs.42,265.91 and a return per rupee investment of 1.61. These results aligned with earlier studies that emphasized the stabilizing role of dairy in diversified farming systems by providing consistent daily cash flow and buffering seasonal fluctuations in crop income (BIRTHAL & NEGI, 2012; Singh *et al.*,

2017) [2, 7]. Nevertheless, dairy profitability remained lower than that of small ruminants due to higher recurring feed costs and labour intensity. Small ruminants emerged as the most economically viable enterprise within the integrated farm structure. The enterprise operated with comparatively low total costs (Rs.56,979.97), benefiting from minimal concentrate feeding, low depreciation, efficient utilization of crop residues and dependence on open grazing. Revenue was derived mainly from the sale of animals (157.71 kg) and manure (98.08 quintals), resulting in gross returns of Rs.1,62,451.48 and net returns of Rs.1,05,471.51. The return per rupee invested (2.85) was significantly higher than that of crops and dairy, reaffirming earlier evidence that goats and sheep provide superior returns in resource-scarce environments owing to their high adaptability, low maintenance needs and strong market demand (Tanwar & Chand, 2013) [9]. These findings support the argument that small ruminants function as an “income insurance” mechanism for rural households by offering quick liquidity and resilience against climatic and market risks (BIRTHAL *et al.*, 2015) [3]. Backyard poultry, despite being a microenterprise within the system, exhibited extraordinary efficiency. With negligible costs of only Rs.140.84 and gross returns of Rs.1,182.20, the enterprise generated net returns of Rs.1,041.36 and the highest return per rupee invested (8.39) among all enterprises considered. This outcome aligns with Singh *et al.* (2018) [8], who noted that backyard poultry contributes disproportionately to household income relative to its scale, owing to its low capital requirements and ability to utilize household scraps and freely available feed resources. Thus, in terms of overall profitability, backyard poultry ranked the highest, followed by small ruminants, dairy (both cows and buffaloes), kharif paddy and finally rabi paddy. This gradient reinforces the theoretical and empirical understanding that livestock-centered diversification delivers more stable and higher economic returns than crop-dependent systems in semi-arid regions (Patil, 2014; BIRTHAL *et al.*, 2015) [5, 3]. The interaction among enterprises wherein crop residues are cycled into livestock feed, livestock manure enhances soil fertility and poultry provides quick household-level cash illustrates the ecological and economic complementarities that underpin integrated farming systems (Singh *et al.*, 2017) [7].

Overall, the results strongly indicate that profitability within the integrated farming framework is driven primarily by livestock, particularly small ruminants and backyard poultry, while crops contributed essential but secondary functions related to household food security. The findings underscore the strategic importance of promoting livestock-led integrated systems for enhancing income, reducing production risk and supporting sustainable livelihoods in regions characterized by climatic uncertainty and resource constraints.

Table 2: Enterprise-wise cost and return structure of the identified farming system (Rs./farm/year)

S. No.	Particulars	Kharif Paddy	Rabi Paddy	Cow	Buffalo	Small ruminants	Backyard poultry
Cost structure							
1.	Human labour	37292.36	25003.49	48660.15	26295.08	45343.02	96.30
2.	Bullock labour	0.00	0.00	-	-	-	-
3.	Machine labour	18304.36	11384.46	-	-	-	-
4.	Seeds/Planting material	3721.47	2158.65	-	-	-	-
5.	Fertilizers and manures	9545.56	5277.64	-	-	-	-
6.	Pesticides and insecticides	9112.33	4771.23	-	-	-	-
7.	Concentrates	-	-	26364.10	15891.34	0.00	0.00
8.	Roughages	-	-	7144.45	3966.24	0.00	0.00
9.	Green fodder	-	-	22895.35	12054.16	0.00	0.00

10.	Medical care expenses	-	-	3143.70	1668.70	410.56	0.00
11.	Miscellaneous costs	1787.19	1755.59	0.00	0.00	4532.30	20.33
12.	Interest on working capital @ 7%	4285.64	2586.24	7574.54	4191.29	3520.01	8.16
13.	TVC	84048.91	52937.30	115782.29	64066.81	53805.89	124.79
14.	Rental value of owned land	18458.18	11619.59	-	-	-	-
15.	Depreciation	311.95	192.77	5756.49	3973.77	1524.32	10.70
16.	Interest on fixed capital @ 10%	1775.18	1125.81	1728.72	1013.95	1649.76	5.35
17.	TFC	20545.31	12938.17	7485.21	4987.72	3174.08	16.05
18.	Total costs	104594.22	65875.47	123267.50	69054.53	56979.97	140.84
Returns profile							
1.	Yield of main product (Qtls)	55.61	32.37	-	-	-	-
2.	Price of main product (Rs./Qtl)	2200.00	2127.03	-	-	-	-
3.	Yield of byproduct (Qtls)	32.99	16.33	-	-	-	-
4.	Price of byproduct (Rs./Qtl)	50.00	50.00	-	-	-	-
5.	Sale of milk (lts)	-	-	6199.20	1970.22	-	-
6.	Price of milk/litre	-	-	33.43	53.80	-	-
7.	Sale of manure (Qtls)	-	-	194.57	118.28	98.08	0.02
8.	Price of manure (Rs./Qtl)	-	-	50.00	45.00	55.00	150.00
9.	Sale of animals/birds (Kg)	-	-	-	-	157.71	3.52
10.	Price per animal/bird (Rs./Kg)	-	-	-	-	995.86	335.00
	Gross returns	123991.50	69668.46	216967.76	111320.44	162451.48	1182.20
	Net returns	19397.28	3792.99	93700.25	42265.91	105471.51	1041.36
	Returns per rupee investment	1.19	1.06	1.76	1.61	2.85	8.39

Conclusion

The study clearly demonstrated that within the integrated farming structure, small ruminants play a pivotal role in enhancing farm profitability. While crop enterprises such as kharif and rabi paddy contributed to household food security and provided essential residues for livestock feeding, their net returns were relatively modest. In contrast, livestock enterprises, particularly small ruminants, generated substantially higher income due to their low input requirements, efficient use of on-farm resources and strong market demand. Dairy enterprises provided steady supplementary income, and backyard poultry, despite its small scale, proved to be the most efficient enterprise in terms of return per rupee invested. Overall, the results confirm that the profitability of the farming system is driven primarily by livestock, with small ruminants serving as the central economic component. The integrated nature of the system characterized by resource recycling and enterprise complementarity further strengthens economic resilience, in line with earlier findings on the advantages of integrated farming. Promoting small ruminant-based IFS models can therefore be an effective strategy for improving household income and reducing production risks in semi-arid regions like Telangana.

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