

International Journal of Agriculture Extension and Social Development

Volume 8; Issue 11; November 2025; Page No. 377-381

Received: 05-09-2025
Accepted: 07-10-2025

Indexed Journal
Peer Reviewed Journal

Perceived efficiency of Rice based integrated farming systems: A comparative analysis

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DOI: <https://www.doi.org/10.33545/26180723.2025.v8.i11e.2655>

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Abstract

The study was conducted to assess farmers' perception on the efficiency of rice-based integrated farming systems (IFS) in terms of productivity, profitability, and employment generation. A structured schedule containing 12 items developed through expert consultation was used to measure the perceived efficiency. The research adopted a multistage random sampling method, selecting 240 farmers in total *i.e.* 180 from Telangana (Jagityal, Nalgonda, and Khammam districts) and 60 from Kerala (Palakkad and Kuttanad regions). Reliability of the scale was confirmed with Cronbach's alpha values of 0.865 for Telangana and 0.839 for Kerala. Results revealed that the majority of farmers in both states fell into the medium category of perception (58.33% in Telangana and 60.00% in Kerala). Farmers from Khammam and Palakkad exhibited higher levels of perception due to greater enterprise diversification and higher net returns, while farmers from Nalgonda and Kuttanad showed relatively lower perception levels, largely attributed to limited diversification in Nalgonda and environmental constraints such as soil salinity and flooding in Kuttanad. The findings underscore the significance of diversification and location-specific interventions to enhance the perceived and actual efficiency of rice-based IFS.

Keywords: Rice-based Integrated Farming System (IFS), perceived efficiency, productivity, profitability, employment generation, diversification

Introduction

Rice-based Integrated Farming Systems (IFS) play a vital role in ensuring sustainable agricultural production, particularly in regions where rice is the principal crop. The continuous practice of rice mono-cropping has led to several challenges such as declining soil fertility, stagnating productivity, and vulnerability to climatic and market fluctuations. Integrated Farming Systems offer a holistic approach that combines various agricultural enterprises such as crops, livestock, fisheries, horticulture, and poultry within the same farm unit to optimize resource utilization, enhance productivity, and generate sustainable livelihoods (Kumari *et al*, 2025) ^[4]. The efficiency of any farming system, however, is not solely determined by its technical or economic performance but also by the farmers' perception of its benefits and feasibility. Perceived efficiency reflects how farmers evaluate the effectiveness of IFS in improving productivity, profitability, and employment opportunities (Uddin and Takeya, 2006) ^[7]. Understanding farmers' perceptions is crucial for the successful promotion and adoption of integrated farming models, as it directly influences their decision-making behaviour and willingness to sustain such systems.

The IFS model is based on the concept that the waste produced by one component serves as an input for another,

ensuring effective recycling of farm and animal residues within the integrated system. This approach enhances yield per unit area by promoting crop intensification and diversification. Additionally, IFS aids in the natural management of pests, diseases, and weeds, reducing the dependency on harmful agrochemicals. Overall, Integrated Farming Systems provide a sustainable agricultural strategy that balances environmental, economic, and social objectives. Majority *i.e.* 55.00 percent of the farmers were in medium level of perception, followed by 24.67 percent of them were in high level and 20.33 percent were in low level of perception. The item wise analysis revealed that the items IFS helps to increase income diversification, IFS ensures livelihood security of farm family and IFS provides employment to the farm family round the year were given higher mean percent score by the farmers (Kumar. *et al*, 2025) ^[2].

Previous research has demonstrated that integrated farming systems provide multiple economic and environmental advantages. For instance, studies have shown that these systems enhance land productivity by leveraging the complementary relationships between crops and livestock farmers. Farmers had a positive perception about the integrated farming system, which they believe that it can improve production efficiency, environmental sustainability,

and economic benefits (Widadie *et al.* 2025) [8]. They also minimize dependence on external inputs such as chemical fertilizers, thereby lowering production costs and mitigating adverse environmental effects. Moreover, other studies suggest that integrated farming systems contribute to improved food security in rural areas by diversifying agricultural production and increasing farmers' income (Kumar. *et al.*, 2022) [3].

The unfavorable weather, especially monsoon flooding, is the major challenge for Kuttanad farmers, making livestock rearing difficult despite coping measures like raised cattle sheds. Labour shortage and rising wages due to migration and the pandemic have further impacted agriculture and dairy. Bird flu has discouraged large-scale poultry and duckery farming. Soil acidity and salinity from poor drainage and saltwater intrusion continue to affect rice cultivation despite interventions like liming. Overall, these factors severely constrain agricultural productivity in the region (Prema and Baiju, 2023) [5].

Agronomic research that deals with multi-component crop production systems is conceptually and technically complex with respect to field experimental designs that would minimise the risk of reaching flawed or biased conclusions. However, because of the raised expectations and pressures to generate quick and spectacular results, some scientists appear increasingly tempted to overlook and/or bypass the experimental complexities involved (Stoop *et al.*, 2009) [6].

Methodology

The study employed a multistage random sampling method to assess farmers' perceptions on the efficiency of rice-based Integrated Farming Systems (IFS) in terms of

productivity, profitability, and employment generation. A structured schedule consisting of twelve items was developed through expert consultation to measure perceived efficiency on a five-point continuum ranging from strongly agree to strongly disagree. A total of 240 farmers were selected for the study, comprising 180 from Telangana and 60 from Kerala. In Telangana, three districts representing different agro-climatic zones, Jagityal from the north, Nalgonda from the south, and Khammam from the central region were chosen. From each district, three mandals were selected, and two villages were chosen from each mandal. Ten farmers practicing rice-based IFS were randomly selected from each village, totalling 180 farmers. In Kerala, two major rice tracts, Palakkad and Kuttanad, were selected, and from each, two gram panchayaths were chosen, with 15 farmers from each included in the sample, making a total of 60 farmers. The reliability of the scale was tested using Cronbach's alpha, which yielded values of 0.865 for Telangana and 0.839 for Kerala, confirming high internal consistency. The collected data were analyzed using descriptive statistics, quartile classification, and the Kruskal Wallis test with Dunn's post hoc analysis to compare mean scores among the study locations.

Results and Discussion

The Table 1 represents the item rest correlations of all the items and it has been observed from the table that all the values for all the statements is above 0.2 satisfying the reliability of the item (Cicchetti and Sparrow, 1981) [1]. The cronbachs' alpha value is >0.7 for both the states. Hence, all the items were retained for further analysis.

Table 1: Item reliability statistics of Telangana and Kerala

Items	Telangana item reliability statistics		Kerala item reliability statistics	
		If item dropped		If item dropped
	Item-rest correlation	Cronbach's α	Item-rest correlation	Cronbach's α
Rice-based Integrated Farming System results in optimum utilization of resources	0.841	0.832	0.517	0.825
Rice-based Integrated Farming System is best to get maximum farm productivity	0.749	0.843	0.487	0.827
It enhances productivity through efficient integration of enterprises	0.562	0.854	0.646	0.814
Rice-based Integrated Farming System adequately protects against risk and uncertainties	0.324	0.866	0.502	0.829
Rice-based IFS is not always the most effective way to maximize farm income	0.399	0.865	0.539	0.824
Practicing rice-based IFS helps minimize production costs, thereby increasing profit and improving the B:C ratio	0.365	0.865	0.410	0.833
Rice-based IFS provides greater opportunities to produce a diverse range of profitable products	0.305	0.868	0.433	0.831
Integration of different farm components necessarily stabilize farm income	0.376	0.866	0.208	0.850
It enables farmers to achieve reasonable savings from farm operations	0.827	0.832	0.583	0.820
Higher income generation is ensured through year-round marketing of diversified products from rice-based IFS	0.768	0.837	0.678	0.811
Ensures year-round employment for family members	0.476	0.859	0.531	0.824
Generates additional employment opportunities for hired labourers	0.547	0.854	0.531	0.824

Table 2 represents the state wise distribution of farmers based on their perceived efficiency of rice based IFS. It can be observed that majority of the farmers i.e. 58.33 percent in

Telangana and 60.00 percent in Kerala belong to medium level of perception.

Table 2: State wise distribution of farmers based on their perceived efficiency of rice based IFS

Telangana (overall)				Kerala (overall)			
Category	Quartile	No.	Percentage	Quartile	No.	Percentage	
Low	41	42	23.34	43	12	20.00	
Medium	47	105	58.33	48	36	60.00	
High	51	33	18.33	52	12	20.00	

Similarly, the data presented in Table 3 gives the region wise farmer distribution. More than half of the farmers from

Jagityal and Nalgonda (53% each), 70.00 percent of Khammam farmers, 66.67 percent of Palakkad farmers and 46.67 percent of Kuttanad farmers belong to medium level of perception. This can be attributed to the fact that the farmers of both states were having medium to high level of farming experience, medium level of risk management and are aware about the benefits that rice based IFS offers to the farming household in terms of profitability, productivity and employment generation. The results are in conformity with the findings of Kumar *et al.* (2025) [2].

Table 3: Region wise distribution of farmers based on their perceived efficiency of rice based IFS

Category	Jagityal (n=60)			Nalgonda (n=60)			Khammam (n=60)			Palakkad (n=30)			Kuttanad (n=30)		
	Q	No.	%	Q	No.	%	Q	No.	%	Q	No.	%	Q	No.	%
Low (Q1)	39.75	15	25.00	36	14	23.34	47	12	20.00	49	6	20.00	38.5	8	26.67
Medium (Q1-Q3)	46.50	32	53.33	43	32	53.33	50	42	70.00	51.50	20	66.67	44	14	46.67
High (Q3)	49	13	21.67	49	14	23.33	52	6	10.00	54	4	13.33	47.75	8	26.67

Q = Quartile range, No= Frequency, %= Percent

Table 4: Item wise perception of farmers

S. No.	Item	Jagityal (n=60)*	Nalgonda (n=60)*	Khammam (n=60)*	Palakkad (n=30)*	Kuttanad (n=30)*	P value	Chi square value
		Mean	Mean	Mean	Mean	Mean		
1.	Rice-based Integrated Farming System results in optimum utilization of resources	4.42 ^{bc}	3.68 ^a	4.87 ^b	4.30 ^{ac}	3.67 ^a	0.000	62.686
2.	Rice-based Integrated Farming System is best to get maximum farm productivity	3.93 ^{abc}	3.68 ^a	4.23 ^{bc}	4.37 ^b	3.77 ^{ac}	0.000	27.273
3.	It enhances productivity through efficient integration of enterprises	3.42 ^a	3.43 ^a	3.92 ^b	4.13 ^b	3.37 ^a	0.000	32.725
4.	Rice-based Integrated Farming System adequately protects against risk and uncertainties	2.90 ^c	3.40 ^{ab}	3.35 ^a	3.80 ^b	3.40 ^{ab}	0.000	43.962
5.	Rice-based IFS is not always the most effective way to maximize farm income	3.15 ^a	3.33 ^a	4.18 ^b	3.63 ^a	3.47 ^a	0.000	47.311
6.	Practicing rice-based IFS helps minimize production costs, thereby increasing profit and improving the B:C ratio	4.20 ^a	3.95 ^a	4.33 ^a	4.07 ^a	3.40 ^b	0.000	31.100
7.	Rice-based IFS provides greater opportunities to produce a diverse range of profitable products	3.88 ^a	4.05 ^{ab}	4.10 ^a	4.50 ^b	4.00 ^a	0.002	16.608
8.	Integration of different farm components necessarily stabilize farm income	3.00 ^{ab}	2.65 ^a	3.27 ^{bc}	3.77 ^c	3.03 ^{ab}	0.000	28.921
9.	It enables farmers to achieve reasonable savings from farm operations	3.73 ^a	3.25 ^a	4.33 ^{bc}	4.53 ^b	3.77 ^{ac}	0.000	43.057
10.	Higher income generation is ensured through year-round marketing of diversified products from rice-based IFS	3.70 ^{ab}	3.63 ^a	4.45 ^c	4.33 ^{bc}	3.47 ^a	0.000	37.312
11.	Ensures year-round employment for family members	4.55 ^{ab}	4.27 ^a	4.67 ^{ab}	4.80 ^b	4.37 ^{ab}	0.005	14.834
12.	Generates additional employment opportunities for hired labourers	3.57 ^{ab}	3.30 ^a	3.40 ^a	4.73 ^c	4.10 ^b	0.000	62.895
	Average	3.70	3.55	4.09	4.24	3.65		

*Kruskal-Wallis post hoc Dunn's test, groups sharing the same letters are not significantly different in their mean ranks

The data in Table 4 presents the statement wise perceptions among farmers across different study locations on rice-based IFS and it also indicates that there are significant differences in farmers' perceptions (p-value <0.05). This finding suggests that farmers' perceptions are region-specific and are influenced by factors such as net gains obtained from the farming system, the level of awareness, and degree of farm diversification.

The average mean values in Table 4 indicates that the Palakkad farmers had higher mean value of 4.24, followed by Khammam with a mean value of 4.09. The farmers from Palakkad and Khammam exhibited higher levels of perceived efficiency. The greater enterprise diversification and higher net returns from the rice based IFS could be the possible reasons for farmers of those regions to have higher

perception. The findings are in line with Widadie *et al.* (2025) [8]. Jagital farmers had medium level of perception with 3.70 mean value. Conversely, the farmers of Kuttanad and Nalgonda exhibited lower mean values with 3.65 and 3.55 respectively.

Farmers of Kuttanad recorded lower perception levels due to limited diversification as they face environmental constraints such as frequent flooding, soil salinity, and acidity. This can be attributed to the fact that the farmers in Kuttanad face severe hardships as the area gets flooded during the monsoon making it difficult for them to raise cattle, poultry and duckery. Although farmers have come up with coping strategies like constructing cattle shed on raised platforms, these have not received widespread acceptance. Similar findings were reported by Prema and Baiju (2023)

[5]. While farmers of Nalgonda had lower awareness and adoption about enterprise diversification.

Further the item wise mean analysis also revealed that out of the twelve statements the item ensures year-round employment for family members (4.55), rice-based Integrated Farming System results in optimum utilization of resources (4.42), practicing rice-based IFS helps minimize production costs, thereby increasing profit and improving the B:C ratio (4.20), rice-based Integrated Farming System is best to get maximum farm productivity (3.93), rice-based IFS provides greater opportunities to produce a diverse range of profitable products (3.88), it enables farmers to achieve reasonable savings from farm operations (3.73), and higher income generation is ensured through year-round marketing of diversified products from rice-based IFS (3.70) were above the average mean of 3.70 in case of Jagityal district farmers. While on the other hand the statements that had less score than the average are generates additional employment opportunities for hired labourers (3.57), it enhances productivity through efficient integration of enterprises (3.42), rice-based IFS is not always the most effective way to maximize farm income (3.15), integration of different farm components necessarily stabilize farm income (3.00), and rice-based Integrated Farming System adequately protects against risk and uncertainties (2.90).

In case of Nalgonda farmers, the items ensures year-round employment for family members (4.27), Rice-based IFS provides greater opportunities to produce a diverse range of profitable products (4.05), practicing rice-based IFS helps minimize production costs, thereby increasing profit and improving the B:C ratio (3.95), rice-based Integrated Farming System results in optimum utilization of resources (3.68), rice-based Integrated Farming System is best to get maximum farm productivity (3.68), and higher income generation is ensured through year-round marketing of diversified products from rice-based IFS (3.63) were having mean score above the average mean of 3.55. on the other hand, it enhances productivity through efficient integration of enterprises (3.43), rice-based Integrated Farming System adequately protects against risk and uncertainties (3.40), rice-based IFS is not always the most effective way to maximize farm income (3.33), generates additional employment opportunities for hired labourers (3.30), it enables farmers to achieve reasonable savings from farm operations (3.25), and integration of different farm components necessarily stabilize farm income (2.65) had lower values than average mean.

The items rice-based Integrated Farming System results in optimum utilization of resources (4.87), ensures year-round employment for family members (4.67), higher income generation is ensured through year-round marketing of diversified products from rice-based IFS (4.45), practicing rice-based IFS helps minimize production costs, thereby increasing profit and improving the B:C ratio (4.33), it enables farmers to achieve reasonable savings from farm operations (4.33), rice-based Integrated Farming System is best to get maximum farm productivity (4.23), rice-based IFS is not always the most effective way to maximize farm income (4.18), and rice-based IFS provides greater opportunities to produce a diverse range of profitable products (4.10) showed values above the average mean of 4.09. While the statements such as it enhances productivity

through efficient integration of enterprises (3.92), generates additional employment opportunities for hired labourers (3.40), rice-based Integrated Farming System adequately protects against risk and uncertainties (3.35), and integration of different farm components necessarily stabilize farm income (3.37) had lower values than the average mean in case of Khammam district farmers.

In Palakkad the items that had higher mean values are ensures year-round employment for family members (4.80), generates additional employment opportunities for hired labourers (4.73), it enables farmers to achieve reasonable savings from farm operations 4.53), rice-based IFS provides greater opportunities to produce a diverse range of profitable products (4.50), rice-based Integrated Farming System is best to get maximum farm productivity (4.37), higher income generation is ensured through year-round marketing of diversified products from rice-based IFS (4.33), and rice-based Integrated Farming System results in optimum utilization of resources (4.30). Contrastingly, the items such as it enhances productivity through efficient integration of enterprises (4.13), practicing rice-based IFS helps minimize production costs, thereby increasing profit and improving the B:C ratio (4.07), rice-based Integrated Farming System adequately protects against risk and uncertainties (3.80), integration of different farm components necessarily stabilize farm income (3.77), and rice-based IFS is not always the most effective way to maximize farm income (3.63) showed lower mean values.

While on the other hand in case of Kuttanad farmers the statements that had higher mean values above the average are ensures year-round employment for family members (4.37), generates additional employment opportunities for hired labourers (4.10), rice-based IFS provides greater opportunities to produce a diverse range of profitable products (4.00), rice-based Integrated Farming System is best to get maximum farm productivity (3.77), it enables farmers to achieve reasonable savings from farm operations (3.77), and rice-based Integrated Farming System results in optimum utilization of resources (3.67). The statements such as rice-based IFS is not always the most effective way to maximize farm income (3.47), higher income generation is ensured through year-round marketing of diversified products from rice-based IFS (3.47), rice-based Integrated Farming System adequately protects against risk and uncertainties (3.40), practicing rice-based IFS helps minimize production costs, thereby increasing profit and improving the B:C ratio (3.40), it enhances productivity through efficient integration of enterprises (3.37) and integration of different farm components necessarily stabilize farm income (3.03) were having lower mean values than the average mean.

Mostly the items rice-based Integrated Farming System results in optimum utilization of resources, rice-based Integrated Farming System is best to get maximum farm productivity, rice-based IFS provides greater opportunities to produce a diverse range of profitable products and ensures year-round employment for family members were having higher mean values above the average mean of different regions revealing that the farmers were aware of the benefits that rice based IFS offers in terms of productivity, profitability and employment generation. Similar findings were found in the study by Kumar *et al.*

(2025)^[2].

Conclusion

The study concluded that most farmers in both Telangana and Kerala perceived rice-based Integrated Farming Systems as moderately efficient, with 58.33 percent of farmers in Telangana and 60.00 percent in Kerala falling in the medium perception category. Farmers from Khammam and Palakkad exhibited higher levels of perceived efficiency, which could be attributed to greater enterprise diversification and higher net returns from IFS. Conversely, farmers from Nalgonda and Kuttanad recorded lower perception levels due to limited diversification and environmental constraints such as frequent flooding, soil salinity, and acidity. The findings highlight the importance of promoting diversification and implementing location-specific interventions to enhance both the perceived and actual efficiency of rice-based Integrated Farming Systems. Increasing the awareness of the farmers regarding the benefits of IFS through trainings, capacity building programmes, localised weather forecasting and warning systems, strengthening of risk minimising strategies like insuring the crops and livestock and support for taking up allied activities like mushroom cultivation, vermicomposting that yield better income to the farmers. Encouraging enterprise integration and addressing region-specific challenges can significantly contribute to improving productivity, profitability, and sustainability in rice-based farming systems.

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