***Original Research Article***

**Constraints in Adoption of Integrated Farming Systems in Telangana State,India: A Quantitative Assessment Using Garrett’s Ranking and Concordance Analysis**

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**Abstract**

This study investigates the key constraints hindering the adoption of Integrated Farming Systems (IFS) among 480 farmers across three districts in Telangana. Utilizing Garrett’s ranking and Kendall’s coefficient of concordance, The analysis revealed that lack of credit availability was the most significant constraint to IFS adoption, with the highest mean Garrett score of 68.50, followed by unavailability of remunerative prices (54.00) and labour shortage (52.50) with variations in perception across landholding categories. The moderate but significant concordance (W = 0.46, p< 0.01) suggests shared constraints among farmer groups. Findings highlight the need for targeted policy measures such as credit facilitation, price assurance mechanisms and labour-saving interventions to promote IFS adoption and enhance farm sustainability.

**Keywords:** Integrated farming, Constraint Analysis, Garrett’s Ranking Technique,Kendall’s coefficient of concordance,Sustainable Agriculture, Farm Diversification,Mixed Farming Systems

**Introduction**

Agriculture is the cornerstone of Telangana's economy, with approximately 50 percent of the state's population engaged in farming activities. However, the sector faces significant challenges, including declining landholdings, erratic rainfall patterns and market volatility. The average size of operational landholdings in the state has dropped to 0.89 hectares, rendering conventional monoculture systems economically and ecologically unsustainable, especially for small and marginal farmers who account for more than 90 percent of total operational holdings in the region (Government of Telangana, 2024) (Jayanthi & Sankaran, 2005). These challenges threaten the livelihood security of farming communities and underscore the need for more resilient and diversified agricultural practices.

Integrated Farming Systems (IFS) have emerged as a promising strategy to address the multifaceted challenges of modern agriculture. By promoting the integration of crop production with allied enterprises such as livestock, poultry, fishery, horticulture and agroforestry, IFS aims to enhance resource recycling, diversify income sources and increase employment opportunities on the farm (Behera & France, 2014; Panwar et al., 2021) ( Adhikari & Bhattarai, 2020) (Hossain & Ahmed, 2017). Scientifically validated as a low-input and eco-friendly system, IFS contributes to improved nutrient cycling, reduced dependence on external inputs and greater farm resilience in the face of climate variability (Patil et al., 2024)( Altieri & Nicholls, 2017). Several field-level studies have reported higher sustainability indices for IFS-based farms compared to those practicing monoculture (Das et al., 2021). Recognizing these advantages, policymakers and agricultural institutions in India have emphasized the promotion of IFS models, especially under programs such as the Rashtriya Krishi VikasYojana (RKVY) and the National Mission on Sustainable Agriculture (NMSA).

Despite its conceptual appeal and policy push, the adoption of IFS in Telangana remains suboptimal, indicating a significant gap between awareness and implementation. Multiple studies have underlined a variety of adoption constraints ranging from technological and economic to institutional and socio-cultural (Choudhary & Aditya, 2020; Dey & Dutta, 2023). These constraints often vary with the scale of farming operations and the socio-economic status of cultivators, making a quantitative assessment essential to capture the distinct challenges faced by marginal, small, medium and large farmers.

Against this background, the present study was undertaken to systematically examine the constraints affecting the adoption of Integrated Farming Systems among farmers of different landholding categories in Telangana. Such quantitative assessments are essential in identifying policy bottlenecks and tailoring support mechanisms specific to the needs of regional stakeholders (Sai et al., 2022) (Kalra & Soni, 2018). The insights derived from this research can contribute to refining extension strategies, designing capacity-building modules and reorienting financial and infrastructural support towards enabling a smoother transition to integrated systems. The findings are particularly relevant for policymakers, development planners and agricultural extension personnel who are engaged in promoting sustainable farming systems in resource-constrained environments.

**Materials and Methods**

The present study collected data from 480 farmers across 3 districts of the state. A multi-stage stratified random sampling technique was employed to select the sample farmers. Three districts namely Mahabubnagar, Karimnagar and Suryapet were purposively selected based on the predominance of integrated farming systems and from each district, a stratified random sample of farmers was drawn, ensuring representation across four farm-size categories: marginal, small, medium and large. In each district, 40 farmers from each category were selected, resulting in 160 farmers per district. This led to a total sample size of 480 farmers. Primary data were collected through face-to-face interviews and direct field observations conducted by the researcher. Respondents were asked to rank a predefined list of constraints, which was developed based on expert consultations and a review of relevant literature (Archana et al., 2022). Additionally, farmers were encouraged to mention any other constraints they experienced beyond those listed and these responses were duly recorded. The ranks assigned by the farmers were subsequently utilized for quantitative analysis to determine the relative severity and priority of each constraint across different farming categories and regions.

Constraint analysis was done by employing two step framework involving Garret’s ranking technique followed by Kendall’s Concordance analysis. This methodological approach allowed for the prioritization of constraints across different landholding categories marginal, small, medium and large farmers while also assessing the degree of agreement in constraint perception among these groups. The combination of these techniques provides a statistically robust understanding of both the intensity and uniformity of constraints faced by farming communities. Similar kind of methodology was adopted by Kumar *et al.* (2021), Mallick *et al.* (2023), Ameh&Danladi (2024).

1. **Garrett’s ranking technique**

Garrett’s ranking technique was employed to prioritize the various constraints faced by farmers in the adoption of IFS. This technique transforms the ranks given by respondents into scores based on the relative percent position which is computed as follows (Sai*et al.,* 2022):

Percent position = $\frac{(R\_{ij}-0.5)x100}{N\_{j}}$ (1)

The constraints were finally ranked based on their mean Garrett scores. A higher mean score indicates a more severe or widely perceived constraint. Unlike simple frequency distribution, Garrett’s method considers the position of each rank and provides a more precise estimation of the importance assigned to each factor (Garrett & Woodworth, 1969).

1. **Kendall’s Coefficient of Concordance**

Kendall’s Coefficient of Concordance (W) was employed to measure the degree of agreement among different groups of farmers regarding the ranking of constraints in adopting IFS. This non-parametric statistical tool assesses consensus among multiple respondents when ranking a set of constraints (Kendall *et al.*, 1939). The coefficient of concordance was calculated using the formula:

W = $\frac{12 S}{P^{2}(n^{3}-n)}$ (2)

Where, S = Σ (Ri – R)2 is the sum of squared deviations of rank sums Ri from the mean rank sum R, *P* is the number of respondents and *n* is the number of constraints ranked. The value of W ranges between 0 and 1, where 0 indicates no agreement (random rankings) and 1 represents complete agreement among the respondents. Higher values imply stronger consensus on the prioritization of constraints. To test the significance of the observed concordance, the Chi-square test was applied as:

ꭓ2 = *p* (n-1) W

A significant chi-square value confirms that the agreement among respondents is unlikely to be due to chance. By applying Kendall’s W, this study quantified the level of uniformity in perception of constraints among different farmer groups, thereby providing insights into the shared and divergent challenges faced in adopting IFS.

**Results and discussion:**

1. **Constraints perceived by farmers in the adoption of IFS:**

The analytical results of constraints that hinder the farmers in adoption of IFS are presented in the Table 1.

**Table 1: Results of Garrett’s ranking across various farmer groups**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S.No.** | **Constraint identified** | **Marginal farmers**  | **Small** **farmers** | **Medium** **farmers** | **Large** **farmers** | **Overall**  |
| **Score**  | **Rank**  | **Score**  | **Rank**  | **Score**  | **Rank**  | **Score**  | **Rank**  | **Score**  | **Rank**  |
| 1 | Labour Shortage | 29.00 | 8 | 37.00 | 7 | 72.00 | 1 | 72.00 | 1 | 52.50 | 3 |
| 2 | Remunerative price | 46.00 | 6 | 60.00 | 2 | 51.00 | 3 | 59.00 | 3 | 54.00 | 2 |
| 3 | Low yielding livestock breeds | 53.33 | 4 | 51.00 | 4 | 40.00 | 7 | 48.00 | 5 | 48.08 | 6 |
| 4 | Availability of credit | 76.00 | 1 | 76.00 | 1 | 69.00 | 2 | 53.00 | 4 | 68.50 | 1 |
| 5 | Forage availability | 57.67 | 2 | 49.00 | 5 | 48.67 | 4 | 42.33 | 7 | 49.42 | 5 |
| 6 | Technical advice | 54.00 | 3 | 44.33 | 6 | 42.00 | 6 | 44.67 | 6 | 46.25 | 7 |
| 7 | Marketing facilities | 46.67 | 5 | 51.67 | 3 | 46.67 | 5 | 60.00 | 2 | 51.25 | 4 |
| 8 | Infrastructure facilities | 37.33 | 7 | 31.00 | 8 | 30.67 | 8 | 20.00 | 8 | 29.75 | 8 |

The analysis revealed that lack of credit availability was the most significant constraint to IFS adoption, with the highest mean Garrett score of 68.50, followed by unavailability of remunerative prices (54.00) and labour shortage (52.50). The prominence of credit-related challenges highlights the financial limitations faced by farmers in adopting capital-intensive integrated systems. In the absence of assured market access and price incentives, farmers are reluctant to diversify beyond staple crops a trend also reported by Tasneem*et al.* (2023), who emphasized the critical role of robust value chains in ensuring the viability of diversified agriculture. The issue of labour scarcity, particularly in the context of labour-intensive IFS operations like livestock management and composting is further intensified by rural youth migration and rising wage costs. This is especially burdensome for marginal and smallholders, who lack the capacity to mechanize or hire external labour.

 With regard to landholding-specific perceptions of constraints, a clear divergence emerges across farm size categories. Marginal and small farmers, who together represent nearly 85 percent of Telangana’s agricultural population, predominantly cited challenges such as lack of credit availability, inadequate forage supply, limited access to technical guidance and absence of remunerative prices and proper marketing infrastructure. These findings reflect the resource limitations and institutional bottlenecks typically faced by small cultivators, making them more vulnerable to both financial and informational hindrances in adopting IFS. On the other hand, while medium and large farmers also identified credit constraints and poor market returns as notable barriers, the most critical challenge reported by them was labour shortage, which was particularly pronounced due to their larger operational land size and the labour-intensive nature of integrated systems. This is substantiated by a Garrett score as high as 72, indicating the severity of labour scarcity as a constraint among these groups. These findings resonate with the work of Kaur*et al.* (2021), Reddy *et al.* (2021) and Innazent*et al.* (2022), who noted that mechanization remains limited in integrated models and larger farmers face disproportionate difficulty in securing consistent labor, especially amid rising wage costs and rural-urban migration.

1. **Consensus among farmer categories - Kendall’s concordance results:**

The summary of Kendall’s test for concordance is presented in the Table 2. The analysis yielded a Kendall’s W value of 0.46, based on responses from 480 farmers. This value indicates a moderate level of agreement among the farmer groups on the ranking of identified constraints. According to Legendre (2005), a W value closer to 1 indicates strong agreement, while values below 0.3 denote weak consensus. Therefore, the obtained value suggests that while there is some divergence in prioritization of constraints, a reasonable level of consistency exists in how farmers across landholding sizes perceive key barriers. Furthermore, the Chi-square value of 12.83 with an asymptotic significance of 0.005 confirms that the observed agreement among the groups is statistically significant at the 1 percent level. This supports the reliability of the constraint rankings derived through Garrett’s method and indicates that the constraint perceptions are not random, but rather systematically aligned across the different farming categories. Similar findings have been reported by Kumar *et al.* (2021) and Mallick*et al.* (2023), who used Kendall’s W in their analyses of farming system constraints and found moderate concordance among farmer categories with statistically significant Chi-square values. This statistically validated consensus lends further strength to the argument that common bottlenecks such as credit limitations, labour scarcity and market constraints are widely felt, though with varying intensity across landholding sizes. These insights are critical in informing broad-based policy measures that address shared challenges, while also considering the heterogeneity in constraint severity among different farmer groups.

**Table 2: Results of Kendall’s coefficient of concordance**

|  |  |  |
| --- | --- | --- |
| **S.No.** | **Test statistic**  | **Value** |
| 1. | N | 480 |
| 2. | Kendalls W | 0.46 |
| 3. | Chi-Square  | 12.83 |
| 4. | Asymptotic significance | 0.005 |

1. **Policy interventions and practical recommendations**

The foremost constraint reported by all categories of farmers, especially marginal and smallholders was the **lack of access to institutional credit** (mean Garrett score = 68.5). This highlights a pressing need to **expand formal credit outreach** through interest subvention schemes, collateralfree credit instruments, inclusion of IFS specific modules in Kisan Credit Cards (KCCs).

The second highest ranked constraint (score = 54.00) reflects the lack of remunerative price realization for integrated farm products. Policy responses must aim at **price assurance** through MSP extension to IFS relevant outputs like pulses, milk, vegetables and poultry, strengthening cold storage facilities and promoting contract farming. These interventions are crucial in reducing price volatility and incentivizing long-term adoption of IFS models, as emphasized bySoni*et al***. (2014).**

Labour shortage, especially among **medium and large farmers** (score = 52.5), was found to be a significant operational bottleneck. This challenge can be addressed through a multi-pronged strategy which includes promoting custom hiring centres, incentivizing labour saving technologies like drip irrigation and creating convergence between MGNREGA and IFS for addressing seasonal labour demand. In addition to these, establishment of village level fodder banks, dissemination high yielding livestock breeds, **deployment of IFS specialist extension personnel** at block levels could help overcome these hindrances.

**Conclusion:**

The study clearly demonstrated that the adoption of IFS in Telangana is hindered by a set of multifaceted constraints that vary by farm size. Lack of institutional credit emerged as the most critical barrier, particularly for marginal and smallholders, followed by low price realization for IFS outputs and acute labour shortages in larger farms. The moderate yet statistically significant agreement among farmer categories underscores the relevance of common interventions, while also necessitating landholding-specific strategies. To address these issues, policy support must focus on expanding credit access through innovative instruments, providing market incentives for diversified outputs and alleviating labour bottlenecks through mechanization and convergence schemes. A differentiated yet integrated policy approach is essential for fostering the adoption of IFS, enhancing farm resilience and ensuring livelihood sustainability in Telangana’s diverse agrarian landscape.

Disclaimer (Artificial intelligence)

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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