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An actor-centric analysis of constraints in the jackfruit value chain in Kerala

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Abstract

Jackfruit has substantial potential for value addition, rural enterprise development, and livelihood diversification in Kerala. Yet the conversion of production into stable value-chain returns remains constrained by market, post-harvest, financial, and institutional limitations. This study prioritised constraints in the jackfruit value chain in Thiruvananthapuram and Idukki districts using respondent-level Garrett ranking data from 150 participants, comprising 90 jackfruit-growing farmers and 60 value chain stakeholders. Twelve constraints were ranked by respondents, converted into Garrett scores, analysed at the constraint, Lack of reliable market information received the highest Garrett mean score (67.31), followed by weak market linkages (58.86), price fluctuation and demand uncertainty (58.11), high post-harvest losses (55.80) and poor access to finance and credit (55.07). First-rank selections were highly concentrated (Pearson chi-square (11) = 440.24, $p < 0.001$) with 55.3% of respondents selecting lack of reliable market information first. District-wise priorities were strongly associated (Spearman rho = 0.923, $p < 0.001$), but important local differences were observed i.e.) price and demand uncertainty was more prominent in Thiruvananthapuram, whereas finance and buyer linkages were more prominent in Idukki. The results suggest that interventions should move beyond production support towards coordinated market intelligence, buyer linkage platforms, post-harvest management, decentralised processing capacity, and value-chain-oriented credit and extension support.

Keywords: Jackfruit, value chain, Garrett ranking, market information, post-harvest losses

Introduction

Jackfruit is a multipurpose tropical fruit crop with nutritional, culinary, and enterprise potential. In Kerala, where jackfruit is widely integrated into homesteads and mixed farming systems, the crop can support household consumption, local food systems, and value-added products (Ranasinghe *et al.*, 2019) [5]. However, the availability of jackfruit does not automatically translate into higher farmer income because marketing channels, processing capacity, quality systems, and institutional coordination remain uneven.

The crop is bulky, seasonal, and perishable. These features make harvesting, aggregation, transport, storage, and processing central to value realisation. Farmers and market actors therefore face a linked set of constraints like limited market information weakens bargaining power, weak buyer linkages reduce access to remunerative outlets, price and demand uncertainty increase the risk of distress sales and inadequate processing and finance restrict the capacity to absorb surplus production.

Previous studies on jackfruit production, processing and entrepreneurship in India have identified issues relating to

market accessibility, intermediary dependence, technology cost, perishability, finance, skilled labour, and institutional support (Reddy *et al.*, 2019; Swathy and Anitha, 2023; Raghi *et al.*, 2024) [1, 7, 4]. What remains less developed is a respondent-level prioritisation of these constraints from a value chain perspective in Kerala. This paper addresses that gap by analysing Garrett ranking data from two major jackfruit-producing districts and translating the results into an intervention framework for market-led value-chain strengthening.

Analytical Framework

The study uses a constraint-prioritisation framework linking individual respondent rankings to value-chain intervention domains. The framework treats constraints as interdependent rather than isolated. Market information and buyer linkages influence price discovery and bargaining power; post-harvest and processing capacity determine whether farmers can delay sale or diversify outlets; finance and institutional support shape the ability to invest in handling, aggregation, and value addition; and data, standards, manpower, and coordination affect long-run chain upgrading.

Table 1: Analytical framework linking ranked constraints to value-chain intervention domains

Framework domain	Constraint codes	Interpretive lens	Intervention implication
Market coordination	C1, C7, C11	Information access, buyer connectivity, price and demand risk	Market intelligence, digital price information, collective marketing, farmer-buyer platforms
Post-harvest and technology	C3, C4	Loss reduction, processing capacity, storage and handling	Harvesting protocols, decentralised processing units, preservation and packaging support
Finance and enterprise capacity	C9, C10, C12	Credit, skilled labour, value-chain advisory support	Credit linkage, working-capital products, training and hand-holding
Institutional and standards system	C2, C5, C6, C8	Organisation, reliable data, quality norms, coordination	FPO/SHG platforms, district data systems, grading norms, convergence among agencies

Materials and Methods

Study Area and Sampling

Idukki and Thiruvananthapuram districts were purposively selected as these are the leading producers of Jackfruit in Kerala, with an annual production of 51 Million Nos in Idukki and 23 Million Nos in Thiruvananthapuram (FIB, 2024) ^[2]. Primary data were collected during March to May 2026. In each district, 75 respondents were selected, including 45 jackfruit growers and 30 value-chain actors such as wholesalers, retailers, traders, processors, and collectors. Overall, the sample comprised 150 respondents, consisting of 90 farmers and 60 value-chain actors. Farmers were identified from lists of jackfruit growers obtained from agricultural offices. From these lists, 45 farmers were selected from each district using a random sampling procedure, ensuring representation of jackfruit-growing farmers in the respective study areas. The value-chain actors were identified through snowball sampling, wherein initial respondents identified through field contacts were asked to recommend other actors actively involved in the jackfruit value chain. This process was continued until the required number of 30 value-chain actors per district was reached.

Garrett ranking procedure

Respondent rankings were converted into percentage positions using the Garrett ranking formula: percentage position = $100 (R_{ij} - 0.5) / N_j$, where R_{ij} is the rank assigned to the i th constraint by the j th respondent and N_j is the number of constraints ranked by that respondent. Percentage positions were then converted to Garrett scores using the standard Garrett conversion table developed by Garrett and Woodworth (1969) ^[3]. For each constraint, Garrett scores

were summed and divided by the number of respondents to obtain the Garrett mean score. Constraints were ordered in descending Garrett mean score, with the highest score representing the most severe constraint.

The analysis was conducted for the pooled sample and separately for the two districts. Rank agreement between district-level priority orders was assessed using Spearman's rank correlation. The workbook was checked against the respondent-level sheets and the district and overall summary sheets before incorporation into the manuscript. As an additional check, the observed first-rank frequencies were compared with an equal-probability benchmark using Pearson's chi-square goodness-of-fit test. Cohen's w was reported as an index of concentration, and a 95% Wilson confidence interval was calculated for the proportion selecting the leading constraint. Kendall's tau-b was also calculated as a robustness check on district-level rank agreement.

Results

Overall priority of value-chain constraints

The pooled Garrett ranking results show that the most severe constraints were concentrated in market coordination and commercialisation rather than production alone. Lack of reliable market information was the dominant constraint, with a Garrett mean score of 67.31 and 83 first-rank responses. Weak market linkages ranked second by Garrett mean score, narrowly ahead of price fluctuation and demand uncertainty. This indicates that respondents viewed access to market channels and market information as the primary bottleneck in converting production into remunerative returns.

Table 2: Overall Garrett ranking of constraints in the jackfruit value chain ($n^* = 150$)

Rank	Code	Constraint	Total score	GMS	Mean rank	Rank-1 count
I	C1	Lack of reliable market information	10,096	67.31	3.580	83
II	C7	Weak market linkages	8,829	58.86	4.733	5
III	C11	Price fluctuation and demand uncertainty	8,716	58.11	4.727	4
IV	C3	High post-harvest losses	8,370	55.80	5.167	6
V	C9	Poor access to finance and credit	8,260	55.07	5.373	11
VI	C2	Fragmented and unorganized value chain	7,423	49.49	6.540	6
VII	C12	Inadequate extension and advisory support	7,420	49.47	6.653	5
VIII	C4	Inadequate processing infrastructure	7,238	48.25	7.040	6
IX	C6	Poor availability of reliable data	6,479	43.19	8.133	3
X	C10	Lack of skilled manpower	6,192	41.28	8.373	5
XI	C8	Limited institutional coordination	5,576	37.17	9.033	4
XII	C5	Lack of standard indicators and quality norms	5,551	37.01	8.647	12

Note: GMS = Garrett mean score. Ranking is based on descending GMS. n^* = number of respondents

Concentration of first-rank selections

The distribution of first-rank selections was strongly concentrated rather than evenly spread across the 12

constraints. Against an equal-probability benchmark of 12.5 first-rank selections per constraint, Pearson's chi-square goodness-of-fit test was significant, chi-square (11) = 440.24,

$p < 0.001$, with Cohen's $w = 1.71$. Lack of reliable market information alone received 83 of 150 first-rank selections (55.3%; 95% Wilson CI: 47.3%-63.1%). This confirms that its leading position is not merely a small difference in mean Garrett score but reflects a pronounced concentration of respondents' highest-priority choices.

District-wide differences

Both districts ranked lack of reliable market information first,

confirming it as a cross-cutting bottleneck. However, district-specific priorities differed after the first rank. Thiruvananthapuram placed price fluctuation and demand uncertainty second, while Idukki placed weak market linkages second and poor access to finance and credit third. These patterns suggest that market-risk management may require stronger emphasis in Thiruvananthapuram, while Idukki may need greater attention to buyer connectivity and finance.

Table 3: District-wise Garrett ranking of constraints

Code	Constraint	TVM GMS	TVM rank	Idukki GMS	Idukki rank	Difference (TVM GMS-Idukki GMS)
C1	Lack of reliable market information	65.93	I	68.68	I	-2.75
C11	Price fluctuation and demand uncertainty	60.77	II	55.44	V	+5.33
C7	Weak market linkages	57.24	III	60.48	II	-3.24
C3	High post-harvest losses	55.41	IV	56.19	IV	-0.78
C9	Poor access to finance and credit	53.39	V	56.75	III	-3.36
C12	Inadequate extension and advisory support	49.97	VI	48.96	VIII	+1.01
C2	Fragmented and unorganized value chain	48.87	VII	50.11	VI	-1.24
C4	Inadequate processing infrastructure	47.52	VIII	48.99	VII	-1.47
C6	Poor availability of reliable data	43.04	IX	43.35	IX	-0.31
C10	Lack of skilled manpower	42.91	X	39.65	X	+3.26
C5	Lack of standard indicators and quality norms	40.08	XI	33.93	XII	+6.15
C8	Limited institutional coordination	35.87	XII	38.48	XI	-2.61

TVM-Thiruvananthapuram, GMS-Garrett Mean Score

Association between district-level rank orders

The district ranking orders were strongly and positively associated (Table 4). Spearman's rho was 0.923, with a t value of 7.589 and a reported two-tailed p value below 0.001. This indicates a strong positive association between the district-level priority orders, while still leaving room for targeted district-level intervention where individual constraints

differed in intensity. Kendall's tau-b gave the same substantive conclusion (tau-b = 0.788, exact two-tailed $p < 0.001$), providing a robustness check based on concordant and discordant pairs. These statistics establish strong rank association; they do not constitute a test that district score levels or rankings are identical.

Table 4: Spearman rank correlation between district-level priority rankings

Statistic	Result	Interpretation
Number of constraints	12	Twelve constraints were compared across districts
Sum of squared rank differences	22	Small total difference between district rank orders
Spearman rank correlation	0.923	Strong positive association
t value	7.589	Test statistic for rank association
Degrees of freedom	10	$n-2$
Two-tailed p value	< 0.001	Strong evidence of positive rank association; this is not an equivalence test
Kendall's tau-b	0.788	Strong pairwise concordance between district rank orders
Exact two-tailed p value for tau-b	< 0.001	Robust evidence of positive rank association

Discussion

The results point to a value-chain coordination problem. The first-ranked constraint, lack of reliable market information, affects price discovery, buyer identification, and bargaining power. For a seasonal and perishable crop such as jackfruit, information delays can quickly convert into physical losses or low-price sales. This finding is broadly consistent with earlier studies on jackfruit marketing and value addition, which reported problems related to market information, intermediary dependence, limited market accessibility, and inadequate guidance for value addition (Chandranth Reddy *et al.*, 2019; Raghi *et al.*, 2024) ^[1, 4].

Weak market linkages and price/demand uncertainty form the second layer of the problem. Even where farmers know that demand exists, the absence of structured relationships with processors, traders, organised retailers, or institutional buyers limits their ability to plan harvesting and aggregation. The

close scores for C7 and C11 show that linkages and demand stability should be treated together in policy design, not as separate issues.

High post-harvest losses ranked fourth, showing that physical handling constraints intensify marketing risk. Jackfruit's size, perishability, and processing requirements make value addition and loss reduction central to chain efficiency (Saxena *et al.*, 2012) ^[6]. Processing infrastructure ranked eighth overall, but its lower rank should not be read as low importance; rather, respondents appear to experience market and finance problems as more immediate. Processing investments are likely to have the highest payoff when paired with reliable procurement, assured markets, and working capital.

Poor access to finance and credit ranked fifth overall and third in Idukki. This constraint can reinforce several others because finance is needed for aggregation, transport,

packaging, storage, processing machinery, labour, and market participation. Financial products for jackfruit should therefore be aligned with seasonal working-capital needs and the cash-flow timing of fresh and processed products. The lower-ranked constraints-poor availability of reliable data, lack of skilled manpower, limited institutional coordination, and lack of standard indicators and quality norms-remain important for long-term upgrading. As the value chain shifts from informal fresh-fruit sales to organised processing and wider markets, data systems, skills, grading, and coordination will become more consequential. Their

lower Garrett scores indicate lower immediate salience, not irrelevance.

Intervention framework

The findings support a phased intervention strategy. The first phase should reduce information asymmetry and connect farmers to buyers. The second should lower post-harvest and price-risk exposure through aggregation, handling, and processing. The third should strengthen institutions, standards, data, and skills for long-term value-chain upgrading.

Table 5: Policy and programme framework derived from the ranking analysis

Time horizon	Priority constraints	Strategic focus	Recommended actions
Immediate	C1, C7, C11	Market intelligence and buyer linkage	District-level price and demand information, buyer directories, seasonal procurement calendars, farmer-buyer meetings
Short term	C3, C9, C4	Loss reduction and investment capacity	Harvesting and handling training, aggregation points, credit linkage, small-scale processing and preservation support
Medium term	C2, C12, C10	Organised participation and advisory support	FPO/SHG-based marketing, value-chain extension modules, skill development for processing and quality management
Long term	C5, C6, C8	Standards, data, and institutional convergence	Quality grades, production and market data systems, coordination among agriculture, industry, finance, and marketing agencies

Conclusion

The study demonstrates that the most important constraints in the jackfruit value chain in Thiruvananthapuram and Idukki districts are concentrated in market coordination, price stability, post-harvest management, and finance. Lack of reliable market information ranked first in both districts and in the pooled analysis, making it the most urgent entry point for intervention. Weak market linkages, price and demand uncertainty, post-harvest losses, and credit constraints followed closely, indicating that fragmented commercialisation rather than production scarcity is the central challenge. The strong Spearman correlation between district-wise rank orders shows that the overall constraint structure is shared across Thiruvananthapuram and Idukki. At the same time, the differences in the ranking of price uncertainty, finance, and market linkages justify location-specific programming. A practical development strategy should therefore combine common state-level systems-market information, quality norms, finance linkage, and processing support-with district-level implementation tailored to local market geography and stakeholder capacity. The analysis is based on perceived rankings from two districts and should be interpreted as a prioritisation exercise rather than a causal impact assessment. The sample includes farmers and value-chain stakeholders, but it does not separately estimate priorities by actor category. Future research can extend the analysis by comparing farmer, trader, processor, and retailer perspectives; estimating the economic loss associated with each constraint; and modelling how coordinated interventions affect price realisation, post-harvest loss reduction, and enterprise viability.

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