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RESEARCH ARTICLE

Consumer perceptions and supply chain dynamics of millets in the western undulating agroclimatic zone of Odisha, India

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Abstract

Research on the effects of supply chain constraints on product availability, perceived quality, convenience, and repeat purchasing in Odisha's western undulating agroclimatic zone is limited. Therefore, a multistage sampling design was employed to study the production and marketing of finger millet in Kalahandi district, Odisha. Three major millet-growing blocks, i.e., Lanjigarh, M. Rampur and Narla, were purposively selected, with three villages randomly chosen from each. From every village, ten growers were surveyed (n = 90), stratified by farm size. Additional data were collected from farmers, processors, distributors, retailers, millet cafés and agricultural produce market committee (APMC)s through focus group discussions and key informant interviews to examine supply chains and consumer behaviour. Among 60 consumers surveyed, the majority were male (71.67 %) and 53.33 % in the middle age group (31-50 years). Most respondents were married (80 %), lived in nuclear families (73.33 %) and engaged in agriculture (61.67 %). Health benefits emerged as the primary factor influencing purchase decisions (Garretts'mean score 41.79), followed by social media influence, relatives' suggestions and doctors' advice. Analysis of supply chains revealed two input channels and three marketing channels, with channel I (formal) preferred for finger millet due to assured minimum support price (MSP). The implementation of the Odisha millet mission (2017) strengthened community-based organisations (CBOs) like farmer producer organizations (FPOs), farmer producer companies (FPCs), farmers' associations (FAs) involvement. Community based organisations (CBO) satisfaction was highest for market information (94.44 %) and technical skill promotion (92.22 %), but low for credit linkage (6.67 %) and transportation support (4.44 %). Overall, the findings indicate that finger millet marketing is dominated by formal channels, while consumer choices are driven by nutritional awareness, social influence and affordability.

Keywords: community-based organisations; consumer perception; finger millet; marketing channels; nutritional awareness; Odisha millet mission; value chain analysis

Introduction

Millets are nutrient-rich and resilient grains with the potential to strengthen Indias' food and nutritional security (1). India is the worlds' largest producer of millets: pearl millet (bajra), sorghum (jowar), ragi (finger millet), along with other cereals such as buckwheat, together contributing over 18 % of global millet production in 2023-24 (2). However, despite this agronomic advantage, both consumer demand and supply chain efficacy remain inconsistent across regions.

Numerous studies indicate growing awareness of millets' health benefits yet reveal persistent barriers like higher price, inconsistent quality, taste preferences and dietary habits, etc., to broader adoption Vizianagaram district, Andhra Pradesh, 96 % of respondents reported awareness of millets like sorghum, bajra and korra and recognised their comparative benefits in managing type 2 diabetes and overall health. Nonetheless, product accessibility remains limited, with consumers primarily relying on word-of-mouth and social media for information (2). Similarly, research in Bengaluru indicates that demographics such as age, income and

education (especially postgraduates) significantly influence consumer behaviour toward millet-based value-added products. Popular items include millet cookies, flour, malt powder and idli/dosa mixes, with emphasis on shelf life and convenience (3). A study from Rajasthan focusing on value-added pearl millet products (such as cookies, cakes, ready-to-eat items like khakhra and dhokla, batters and lassi) found that educated consumers, even with modest incomes, prefer items perceived as nutritious. Their purchasing decisions were most influenced by nutritional value, with lesser emphasis on price, flavour, packaging, or colour (4). A recent national-level survey by the world food programme and nutri hub (Indian Council of Agricultural Research - Indian Institute of Millets Research (ICAR-IIMR)) across five major states (Maharashtra, Karnataka, Rajasthan, Uttar Pradesh, Madhya Pradesh) revealed several consumer behaviour patterns. It found that taste was the dominant factor (91 %) guiding millet selection, only occasional consumption occurred among 90 % of respondents who consumed millets occasionally and a significant 75 % were unaware of their nutritional benefits**.** Additionally, myths-such as millets being suited only for winter or difficult to cook-persist and only 34 % were aware of government initiatives promoting millet consumption (5). These findings reveal a dual narrative: awareness of millets' health advantages is rising, yet entrenched perceptions, accessibility constraints and limited institutional promotion continue to inhibit regular consumption. Parallel to perception gaps, structural inefficiencies in the millet supply chain further impede both producer and consumer benefits. The detailed value chain analysis of pearl millet in India and observed a significant shift from human consumption toward industrial uses (e.g., cattle feed, poultry, breweries, starch production) (6). This shift reduces both profitability for small-scale producers and supply for human consumption. Aggregation, particularly through farmer groups or self-help groups, was found to enhance market access and bargaining power (7).

Efforts to strengthen local value chains through institutional mechanisms have shown promise. Farmer producer organisations (FPOs) enabled better farmer price share and increased value-chain efficiency (8). Moreover, policy-driven initiatives such as the National millet mission (2018 onward), inclusion of millets under the minimum support price (MSP) system, the Millet-Smart Nutritious Food Programme and the Eat Right India campaign-aimed at improving access have potential. In South India, inclusion of millets within the public distribution system (PDS) and mid-day meal programs can enhance nutritional security while bolstering demand and processing incentives. However, practical challenges persist. A women-led millet processing unit in Uttarakhand once achieved commercial success by supplying millet biscuits under government schemes, but its closure during and after the pandemic underscores the fragility of such initiatives when long-term institutional support is lacking (5).

Odisha, located in eastern India, encompasses diverse agro-climatic zones that significantly influence its agricultural practices and crop patterns. Among these, the Western Undulating Zone, characterised by heat, moisture, sub-humid conditions and lateritic, red and black soils, covers districts such as Kalahandi, Nuapada, Bargarh and parts of Sambalpur and Boudh. Rainfed crops, including millets such as ragi (finger millet) and minor millets, have traditionally thrived under the regions' undulating terrain and variable rainfall.

Materials and Methods

A multistage sampling design was used to study finger millet in Kalahandi district, Odisha, in 2023-24 following standard agricultural and socio-economic research methodologies (9). Three major millet-growing blocks, such as Lanjigarh, M. Rampur and Narla, were purposively selected, with three villages randomly chosen from each. From every village, 10 growers were sampled, totalling 90 respondents, stratified by farm size. Additional data were collected through visits and interviews with farmers, processors, distributors, retailers, processing units, millet cafés and agricultural produce market committees (APMCs). Participatory tools such as focus group discussions, structured questionnaires and key informant interviews were used to analyse supply chains and consumer behaviour. In the Kalahandi district of Odisha, consumer perceptions and millet consumption patterns were studied using primary data through personal interviews. Information was collected on food habits, demographic profile, family income, consumption expenditure and factors influencing millet consumption. Data were analysed using descriptive statistics, frequencies, percentages, graphs, SPSS and Garrett ranking to identify key determinants. Farmers and processors ranked challenges and priorities using Garretts' method, converting ranks into scores for analysis. Supply chain assessment revealed that millet inputs are mainly supplied via FPOs, farmer producer companies (FPCs) and facilitators (channel I) or through wholesalers and traders (channel II), providing seeds, credit and machinery. Thus, supply chain identification covered input provision, post-harvest handling and marketing channels, essential for strengthening millet production and consumption linkages.

The study identified and analysed supply chains in millet marketing through field surveys, interviews and secondary data. Three channels were mapped:

1. Producers → tribal development cooperative corporation (TDCC) / large-sized adivasi multi-purpose cooperative societies (LAMPS) → PDS → consumers
2. Producers → commission agents/traders → retailers → consumers
3. Producers → retailers → consumers

Stakeholders included farmers, mandis, traders, retailers and consumers. Specific domains such as technology adoption, input supply, credit, storage, logistics and market linkages were assessed to evaluate efficiency. Further, ragi was found largely marketed through PDS, while non-ragi millets followed private channels. Data were analysed to trace product flow and identify key constraints.

Results and Discussion

General information about consumers of finger millet products

The general profile of the respondents is presented in Table 1. Out of 60 consumers surveyed, the majority were male (71.67 %), while females accounted for 28.33 %. With respect to age, 53.33 % belonged to the middle age group (31-50 yr), followed by 38.33 % above 50 years who exhibit traditional preferences and only 8.33 % were young (18-30 yr). The middle-aged consumers often exhibit greater health awareness, while older consumers show stronger familiarity with traditional grains. As younger consumers tend to prefer modern, convenience-oriented food options, this potentially restricts them from consuming millet.

Table 1. General information of consumers of finger millet products

S. No.	General information	Category	No. of respondents	% of total respondents
1	Gender	Male	43	71.67
		Female	17	28.33
		Total	60	100
2	Age	Young (18-30 years)	5	8.33
		Middle (31-50)	32	53.33
		Old (>50)	23	38.33
		Total	60	100
3	Education	Illiterate	2	3.33
		Primary school	5	8.33
		High school	26	43.33
		Pre university course	18	30
		Graduation and above	9	15
		Total	60	100
4	Marital status	Married	48	80
		Un-married	12	20
		Total	60	100
5	Family type	Nuclear	44	73.33
		Joint	16	26.67
		Total	60	100
6	Occupation	Agriculture	37	61.67
		Business	2	3.33
		Self employed	8	13.33
		Employees	10	16.67
		Housewife	3	5
		Total	60	100
7	Food habit	Vegetarian	39	65
		Non-vegetarian	21	35
		Total	60	100

Regarding education, 43.33 % had studied up to high school, 30 % up to pre-university course (PUC) and 15 % had graduated or above, while a small fraction (3.33 %) was illiterate. Most respondents were married (80 %) and the majority lived in nuclear families (73.33 %). In terms of occupation, 61.67 % were engaged in agriculture, followed by employees (16.67 %), self-employed (13.33 %), housewives (5 %) and business (3.33 %). Concerning food habits, 65 % of respondents were vegetarian, while 35 % were non-vegetarian.

The results indicate that millet consumption was more common among middle-aged and elderly groups, which is consistent with the findings of a previous study on millet. Research indicates that older consumers tend to prefer traditional coarse cereals due to their familiarity and health benefits (10). The predominance of agricultural households (61.67 %) suggests that producers themselves are significant consumers, aligning with the observation previous study that farm households often retain part of millet produce for home consumption (11). The higher proportion of nuclear families (73.33 %) is in line with current rural demographic shifts reported by the study (12). Educational status also plays a vital role, as moderately educated groups (high school and PUC) showed higher consumption, emphasising that awareness and basic literacy are key determinants of millet consumption. Moreover, the dominance of vegetarian respondents (65 %) reflects dietary patterns in many Indian regions where millets are integrated into staple foods.

Factors affecting the purchase of millet (finger millet) products by the sample consumers

The factors influencing consumer purchase decisions of finger millet products were analysed using the Garrett ranking method and the results are presented in Table 2. Among the factors, health benefits emerged as the most important determinant with the highest Garrett mean score (41.79). This was followed by the influence of social media (40.18), suggestions from relatives and friends (38.81) and doctors' advice (38.28). Other notable factors included price (35.89), taste (26.26) and seasonal availability (24.83). These findings indicate that consumer choices are primarily driven by perceived nutritional and health advantages of millet products, while social influences and affordability also play a key role. Fig. 1 depicts the factors that influence consumers towards the consumption of finger millet products.

The results highlight that health consciousness is the strongest motivator for millet consumption, which supports the findings previous study, which reported that increasing awareness of nutritional and therapeutic benefits has significantly influenced the demand for millets as functional foods. The influence of social media ranked second, suggesting that digital platforms are crucial in shaping consumer behaviour. This aligns with a previous study, which found that social media marketing greatly impacts food choices, especially among urban consumers (10, 11, 13).

Table 2. Factors that influence consumers towards the consumption of finger millet products

S. No.	Constraints/factors	Rank							Total	Avg. score	Rank
		I	II	III	IV	V	VI	VII			
1	Influence of social media	24	14	8	6	5	2	1	3857	40.18	II
2	Suggestions from relatives and friends	18	14	10	9	8	1	0	3726	38.81	III
3	Doctors' advice	17	15	13	6	4	3	2	3675	38.28	IV
4	Price	11	12	14	11	7	3	2	3445	35.89	V
5	Health benefits	26	16	8	6	4	0	0	4012	41.79	I
6	Taste	4	5	7	8	8	10	18	2521	26.26	VI
7	Seasonal availability	2	4	5	10	9	11	19	2384	24.83	VII

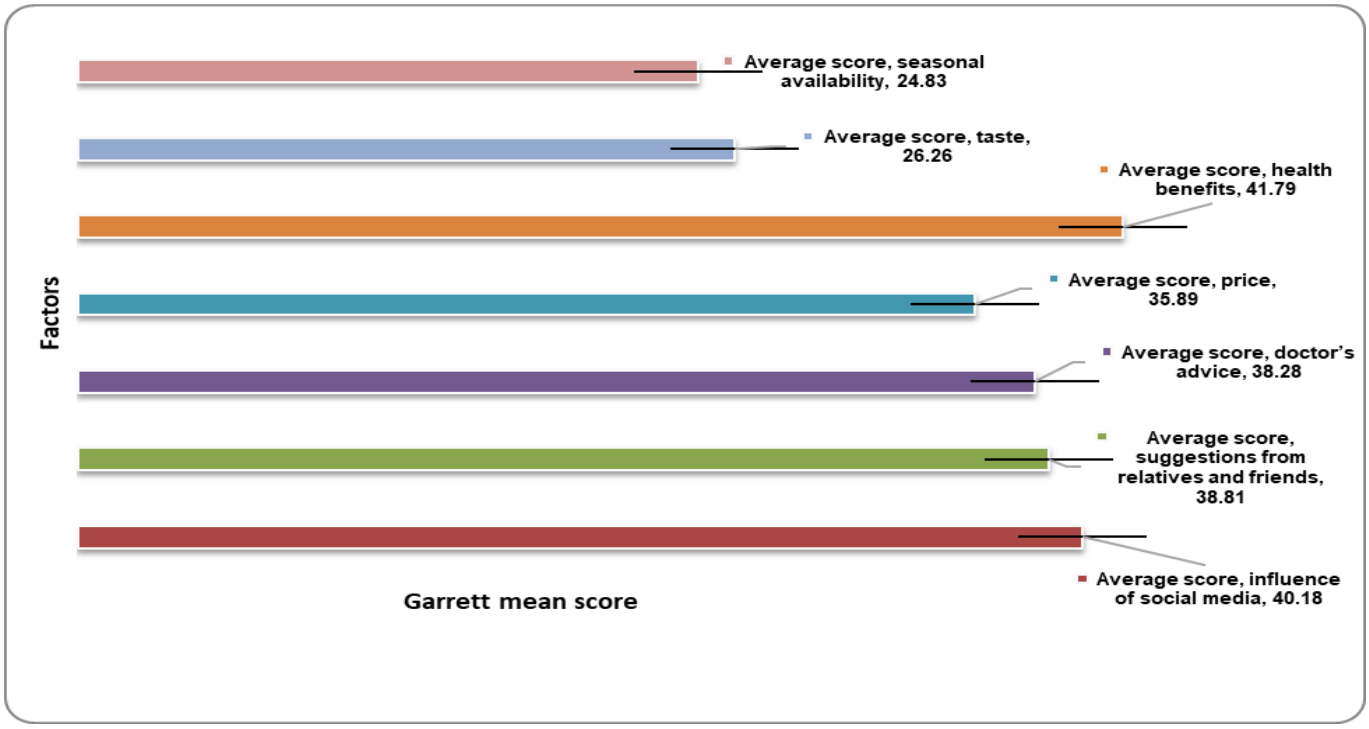

Fig. 1. Factors that influence consumers towards consumption of finger millet products.

Advice from relatives, friends and doctors also significantly contributed to consumer preferences. Similar findings were observed by a previous study, which reported that family and peer recommendations often encourage the adoption of traditional and healthy foods. Price was ranked fifth, indicating that affordability still matters, especially for middle-income and low-income households, consistent with a previous study that noted that millet consumption remains sensitive to pricing compared to rice and wheat (11, 13).

Taste and seasonal availability ranked lower, suggesting that consumers prioritise health and social influence over sensory attributes. However, research indicates that improving taste and ensuring year-round availability are critical for sustaining millet consumption (14). These insights suggest that policymakers and marketers should focus on health-based promotions, social media campaigns, affordable pricing strategies and product diversification to enhance millet consumption.

The relation between profile characteristics of consumers and their perception towards millet consumption

The association between the profile characteristics of millet consumers and their perception towards millet consumption was analysed using the chi-square test of goodness of fit. The results are presented in Table 3, which shows the chi-square values, degrees of freedom, *p*-values, critical values at both 5 and 1 % levels, contingency coefficients and their respective levels of significance.

Gender

The chi-square value for gender was 11.27 ($df = 1$, $p = 0.0008$), which is significant at the 1 % level (Table 3). The contingency coefficient (C = 0.398) indicates a moderate association between gender and perception towards millet consumption. The findings suggest that male consumers were relatively more dominant, reflecting their active role in household food-related decision-making, including the preference for millets.

Age

The chi-square value for age was 18.90 ($df = 2$, $p = 0.00008$), significant at the 1 % level. The contingency coefficient (C = 0.489) indicates a moderately strong association. The middle-aged group (31–50 years) formed most respondents, suggesting that this age group is more health-conscious and aware of the nutritional importance of millets compared to younger or older groups.

Education

Education recorded a chi-square value of 32.50 ($df = 4$, $p = 1.5e\text{-}06$), highly significant at the 1 % level. The contingency coefficient (C = 0.593) reflects a strong association. As observed in Table 3, respondents with high school and PUC education were more prominent. This implies that better-educated individuals are more likely to perceive millets positively due to increased awareness of health and dietary benefits.

Marital status

The chi-square value for marital status was 21.60 ($df = 1$, $p = 3.4e\text{-}06$), significant at the 1 % level. The contingency coefficient (C = 0.514) shows a moderately strong association. Most respondents were married, suggesting that marital responsibilities and family well-being influence dietary preferences, including millet consumption.

Family type

Family type yielded a chi-square value of 13.07 ($df = 1$, $p = 0.0003$), significant at the 1 % level. The contingency coefficient (C = 0.423) indicates a moderate association. As reported in Table 3, nuclear families outnumbered joint families, implying that smaller family units tend to adopt more conscious and individualized food preferences, including millets. Similar findings have also been reported in a previous study (15).

Occupation

Occupation showed the highest chi-square value (68.83, $df = 4$, $p = 4.0e\text{-}14$), which is highly significant at the 1 % level. The contingency coefficient (C = 0.731) indicates a very strong association. As noted in Table 3, agriculture was the predominant occupation among respondents. This finding suggests that those engaged in farming are more aware of and positively inclined towards millet consumption, given their familiarity with production and local availability.

Table 3. Association between profile characteristics of the millet consumers and their perception towards millet consumption

S. No.	Variable	X^2 Value	df	*p*-value	X^2 (5 %)	X^2 (1 %)	Contingency coefficient (C)	Level of significance
1	Gender	11.27	1	0.0008	3.84	6.63	0.398	Significant at 1 %
2	Age	18.90	2	0.00008	5.99	9.21	0.489	Significant at 1 %
3	Education	32.50	4	1.5e-06	9.49	13.28	0.593	Significant at 1 %
4	Marital status	21.60	1	3.4e-06	3.84	6.63	0.514	Significant at 1 %
5	Family type	13.07	1	0.0003	3.84	6.63	0.423	Significant at 1 %
6	Occupation	68.83	4	4.0e-14	9.49	13.28	0.731	Significant at 1 %
7	Food habit	5.40	1	0.0201	3.84	6.63	0.287	Significant at 5 % (not at 1 %)

df = Degrees of freedom, χ^2 value= Calculated chi-square value**, 5 %** = at 5 % level of significance, **1 %** = at 1% level of significance.

Food habit

Food habits recorded a chi-square value of 5.40 (*df* = 1, *p* = 0.0201), which is significant at the 5 % level but not at the 1 % level. The contingency coefficient (C = 0.287) indicates a relatively weak association compared to other variables. As seen in Table 3, vegetarianism was more common among respondents, but the association between food habits and millet perception was weaker, suggesting that dietary choices are influenced by cultural traditions rather than solely by nutritional awareness.

The findings in Table 3 demonstrate that most socio-economic and demographic characteristics of millet consumers-namely gender, age, education, marital status, family type and occupation, showed highly significant associations at the 1 % level with consumer perception towards millet consumption. Among these, occupation (C = 0.731) and education (C = 0.593) emerged as the strongest determinants, highlighting that livelihood sources and literacy levels play a crucial role in shaping food preferences. Food habit was the only variable significant at the 5 % level but not at the 1 % level, indicating that while dietary choices influence millet consumption, they are comparatively less decisive than socio-economic factors. Overall, the results suggest that perception towards millets is largely driven by demographic and occupational backgrounds, with education and agricultural involvement acting as major influencing factors.

These results suggest that socio-economic and demographic factors substantially shape consumer perception, with agriculture-based occupations and higher education levels being the most decisive. On the other hand, food habits, though significant, play a comparatively minor role. Hence, efforts to promote millet consumption should focus on enhancing awareness through educational campaigns and leveraging the agricultural base of rural communities. Thus, the analysis confirms that socio-economic characteristics are not evenly distributed but display distinct patterns that have implications for agricultural participation, decision-making and policy interventions. For example, targeted extension programmes that provide millet-based nutrition and processing training specifically for women in nuclear households can enhance both household dietary diversification and on-farm value addition.

This finding is consistent with earlier studies that reported socio-demographic characteristics significantly affect the acceptance and consumption of nutritious cereals. Age, education, occupation, income, family size and information sources were significantly related to awareness and utilisation of millets (16). Similarly, high levels of awareness regarding common millets such as sorghum and bajra were recorded, whereas awareness of minor millets was comparatively lower, with health benefits emerging as a major influencing factor (2). In Ludhiana, strong awareness of certain millets, with most consumers purchasing millet flour was noticed and also highlighted the role of social media and word-of-mouth as key sources of information (17). Furthermore, research indicates that gender, caste, education, occupation and social class significantly influenced knowledge of the nutritional and health benefits of millets, although some knowledge–consumption gap was evident (18). In addition, research indicates that consumer preferences for value-added pearl millet products and reported that individual preferences played a significant role in shaping buying behaviour (15).

Constraining factors in the existing supply chain of finger millet

The analysis of the existing supply chain in Kalahandi district revealed two distinct input supply channels and three marketing channels for finger millet. For input provision, channel I consisted of state seed corporations supplying certified seeds to FPOs/FPCs/ facilitating agencies (FAs). These agencies further provided fertilisers, pesticides, technical expertise, credit and machinery support to farmers. Channel II involved commission agents or traders who supplied seeds, credit and machinery to small farmers, particularly those without access to institutional finance. Channel I was dominant for all millet types, including finger millet, as it ensured improved technology and production inputs, whereas channel II was mostly utilised for non-ragi millets and some ragi. For marketing, three channels were identified. In channel I, farmers sold their produce to TDCC or LAMPS, which facilitated procurement at MSP and distributed through PDS. Channel II involved informal sales to commission agents or traders, who often supported farmers during production and decided on price negotiations. Channel III was characterised by direct sales from producers to local retailers. Channel I was largely preferred for finger millet due to assured procurement and timely payment. Fig. 2 shows the schematic representation of channel I and channel II of the supply chain in millet production.

The findings indicate that the millet supply chain in the study area faces several constraints related to input access, institutional support and market linkages. Farmers with access to FPOs/FPCs benefited from certified seeds, technical guidance and credit, which are in line with the observations where farmer collectives play a crucial role in improving input delivery and reducing transaction costs (19). However, smallholders dependent on traders and commission agents were found to be vulnerable to informal credit arrangements and unfavourable pricing, like the constraints in millet -producing regions of Rajasthan (20). On the marketing front, the assured procurement through TDCC and LAMPS under MSP provides stability to finger millet producers, encouraging production (21). However, for non-ragi millets, weak procurement mechanisms and reliance on traders limit farmers' bargaining power and income security. Direct marketing through retailers, though beneficial for local consumption, was observed to have limited reach and scale, a

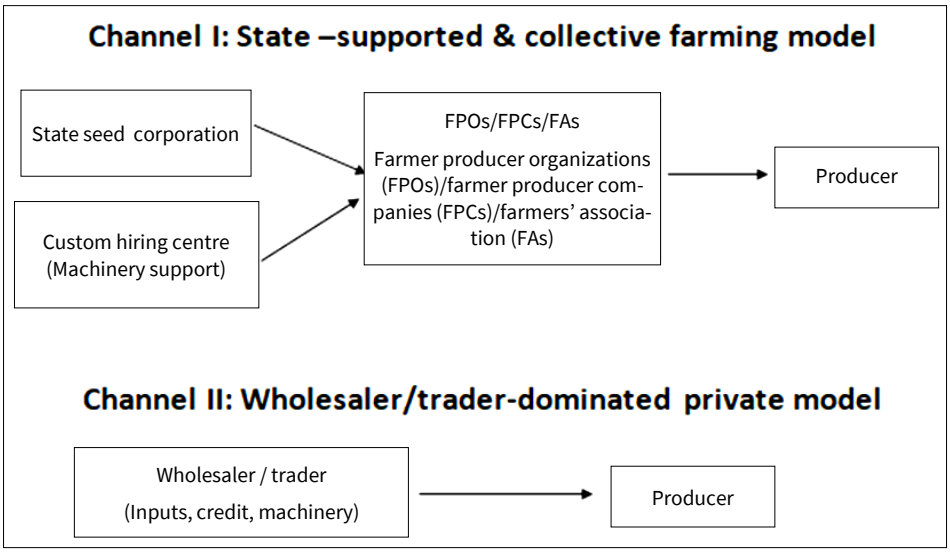

Fig. 2. Schematic representation of channel I and channel II of the supply chain in millet production.

constraint also reported in coarse cereals (22). Overall, while formal institutions ensure some level of stability for finger millet, dependence on informal channels for non-ragi millets highlights the need for strengthening procurement, expanding institutional credit and improving storage and logistics facilities. Promoting FPO-led aggregation and establishing better value chains can enhance market efficiency and farmer income.

Identification of the existing supply chain in millet marketing

The study revealed that millets are marketed in Kalahandi district through three channels, as shown in Fig. 3. In channel I (formal), farmers sell produce to TDCC or LAMPS, which then supply retailers and PDS. In channel II (semi-formal), farmers sell directly to commission agents or traders who provide input and credit support and in channel III, producers sell directly to local retailers. Finger millet was mainly marketed through channel I due to the assured MSP, while non-ragi millets were predominantly marketed through channels II and III. With the implementation of the Odisha millet mission (OMM) in 2017, the supply chain was further strengthened through the involvement of community-based organisations (CBOs) such as FPOs, FPCs and FAs. These interventions improved aggregation, ensured assured procurement at fair prices and enhanced local processing capacity, thereby creating a more decentralised and farmer-driven supply-chain ecosystem. The most efficient supply chain for finger millet was identified as channel I (production and marketing), while for non-ragi millets, channel I for production and channel II for marketing were preferred. The analysis of domains of CBOs showed that the highest satisfaction was reported for market information and linkage (94.44 %), followed by technical skill promotion and awareness (92.22 %), timely supervision (83.33 %) and provision of machinery facilities (83.33 %) (Table 4). Moderate satisfaction was reported for input supply (70 %), training and exposure (82.22 %) and incentive linkage (58.89 %), while the least satisfaction was found for credit linkage (6.67 %), manpower availability (20 %) and transportation/logistics support (4.44 %). Fig. 4 represents the domains of the selected supply chain of millets in Odisha.

The findings suggest that institutional mechanisms such as FPOs and FPCs play a pivotal role in strengthening millet supply chains by ensuring improved input access, training, market linkage and collective bargaining power. Farmer collectives reduce transaction costs and enhance market access (5). The high

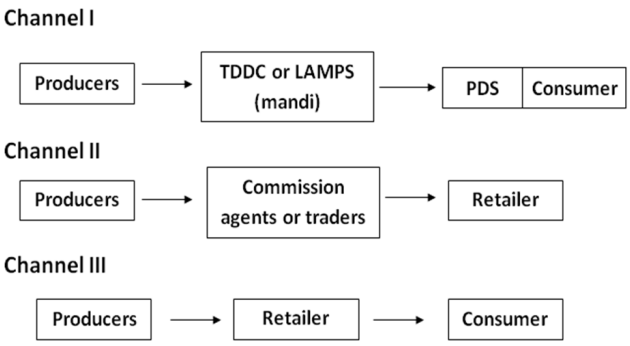

Fig. 3. Schematic representation of channel I, channel II and channel III of the supply chain in millet marketing.

satisfaction with market information and awareness promotion confirms the role of OMM in disseminating knowledge. Information delivery is key for increasing the adoption of nutritious cereals (23).

However, major constraints such as poor credit linkage, inadequate logistics and limited manpower highlight systemic weaknesses. Similar challenges were reported in Rajasthan, where the lack of institutional finance and transportation hindered millet marketing (24). The low satisfaction with incentive linkage reflects delays in disbursement (23).The heavy reliance on formal channels (channel I) for finger millet underlines the importance of MSP-based procurement. Assured procurement significantly improved farmer participation in millet cultivation (20). For non-ragi millets, dependence on traders and commission agents exposes farmers to market risks, indicating a need for expanded institutional procurement and stronger FPO interventions. Overall, while the OMM has significantly strengthened the supply chain, enhancing credit access, transportation facilities and timely incentive disbursement remains essential for sustaining farmer participation and improving efficiency.

Conclusion

The study concludes that finger millet production and marketing in Kalahandi district are influenced by institutional mechanisms and local socio-economic conditions. The formal channel involving TDCC and LAMPS was found to be most effective due to assured procurement and timely payments, while informal channels serve mainly non-ragi millets. The OMM and community-based

Table 4. Domains of the selected supply chain of millets in Odisha

S. No.	Facilities / Domain	CBO	Lanjigarh	M. Rampur	Narla	Total farmers satisfied	% Farmers satisfied
1	Latest technology & skills/awareness/ promotions	FPO/FPC	31	28	24	83	92.22
2	Timely supervision and evaluation	FPO/FPC	29	24	22	75	83.33
3	Need-based input supply (seeds, fertilisers & pesticides)	FPO/FA/FPC	23	21	19	63	70.00
4	Credit linkage	FPO/FPC	3	0	3	6	6.67
5	Provision of machinery facility (processing units, custom hiring centres)	FPO/FPC	30	23	22	75	83.33
6	Market information and linkage	FPO/FPC	34	27	24	85	94.44
7	Manpower availability	FPO/FPC	7	9	2	18	20.00
8	Training /demonstration/ exposure	FA	28	27	19	74	82.22
9	Incentive linkage	FA	19	14	20	53	58.89
10	Transportation/ logistics support	FPO/FPC	0	4	0	4	4.44
		Comprehensive benefit (%)					59.56

CBO- Community based organisations, **FPO**- Farmer producer organizations, **FA**- Farmers' associations, **FPC**- Farmer producer companies.

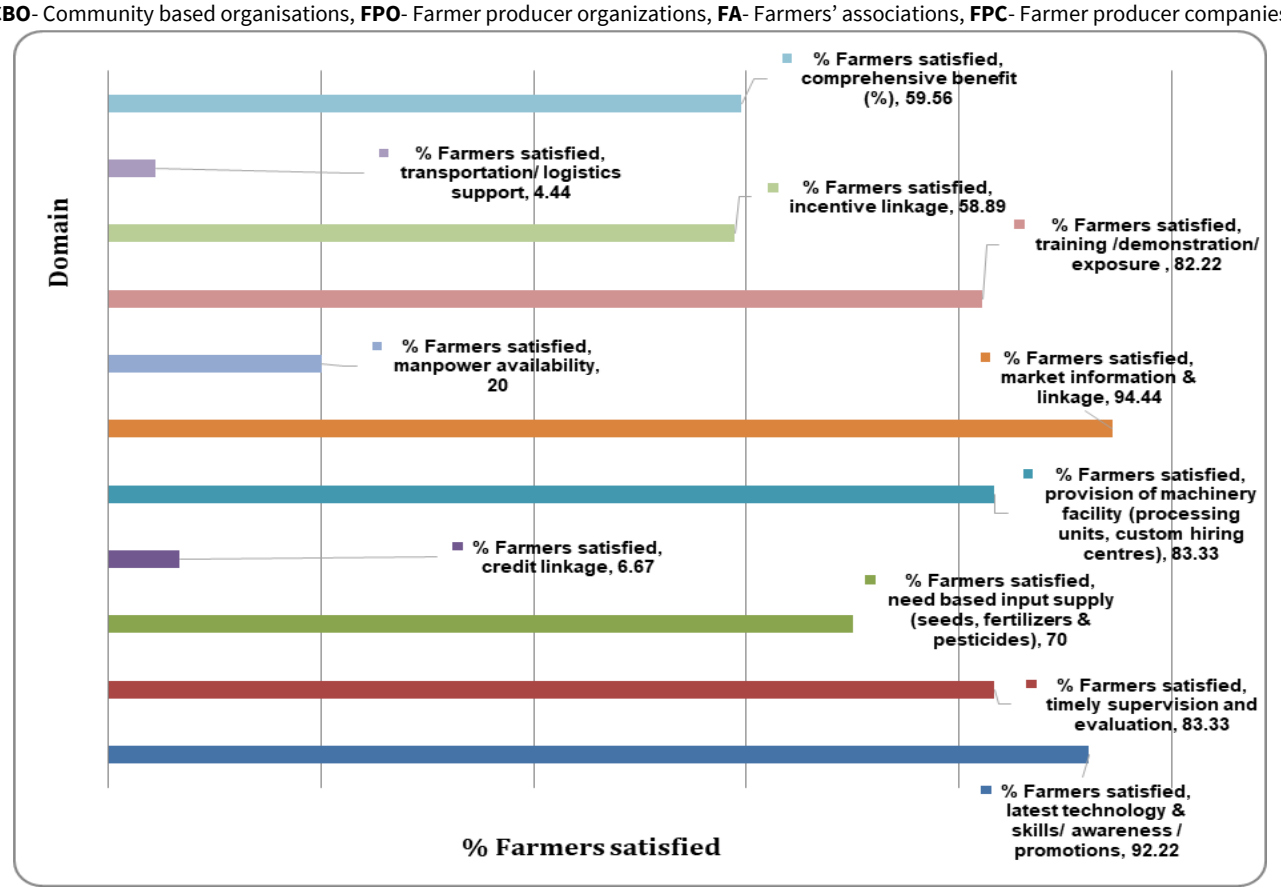

Fig. 4. Domains of the selected supply chain of millets in Odisha.

organisations have strengthened market linkages, technical support and capacity building. However, persistent gaps in credit access, logistics and manpower hinder full efficiency. Strengthening institutional credit, logistics infrastructure and awareness initiatives, along with scaling successful community-based models, will be vital for sustainable growth and enhanced farmer income in the millet sector.

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Authors' contributions

BKM, RKR, PPT and AD contributed to conceptualisation, methodology design, data validation, manuscript refinement, statistical analysis, interpretation of results and visualisation. LKD, BPG, RLM, SD, SKB and NR contributed to methodology development, data validation and manuscript refinement. KAB and SKS contributed to drafting the manuscript and ensuring coherence in the discussion. AK and MD participated in the study design and coordination. All authors actively participated in reviewing, editing and approving the final manuscript. All authors read and approved the final version of the manuscript.

Compliance with ethical standards

Conflict of interest: Authors do not have any conflict of interest to declare.

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