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EMPIRICAL INSIGHTS INTO MILLET SUPPLY CHAINS IN CHHATTISGARH

Prof. Manish K. Pandey[1] and Dr. Anjalee Yadav[2]

ABSTRACT

Millets, traditionally known as "Shri-Anna" or "Nutri-Grain," are deeply embedded in India's agricultural and cultural heritage, particularly within tribal and agrarian regions such as Chhattisgarh. Despite their proven nutritional value and environmental sustainability, millet supply chains remain underdeveloped and face several impediments. These include a decline in consumer awareness, especially among younger populations, as well as poor post-harvest infrastructure, inefficient logistics, and limited access to stable markets.

The primary objective of this review paper is to provide empirical insights into the current state of millet supply chains in Chhattisgarh. The discussion critically assesses key structural and operational bottlenecks affecting production, storage, processing, distribution, and market integration. By reviewing existing literature, policy frameworks, and ongoing grassroots initiatives, the study highlights systemic gaps and emerging opportunities within the millet ecosystem.

The expected outcome of this review is to generate actionable knowledge that can inform sustainable supply chain models, strengthen farmer-centric interventions, and guide policy reforms aimed at improving millet production and distribution in Scheduled Areas. Ultimately, the paper aspires to contribute toward resilient Agri-value chains that promote rural livelihoods, nutritional security, and ecological balance.

Key words: Millets, Agrarian, supply-chain, inefficient logistics, livelihoods, resilient Agri-value chains, nutritional security, ecological balance

INTRODUCTION

Millets have served as a staple crop in Indian agriculture for centuries, recognized for their ability to withstand challenging climatic conditions and their significant nutritional benefits. With its varied agro-climatic zones, Chhattisgarh has emerged as a key producer of millets, including Kodo, Kutki, and Ragi. In 2021, the Chhattisgarh government initiated the Millets Mission to enhance the cultivation, processing, and consumption of these grains. However, the millet supply chain in the state still encounters numerous obstacles. Insufficient infrastructure, such as inadequate milling facilities at production sites, limited market access, a lack of knowledge regarding processing techniques, insufficient storage options, and poor transportation networks, impede the effective distribution of millet. Additionally, logistical challenges, including fragmented supply chains and weak market connections, exacerbate these issues. Farmers frequently lack access to modern processing facilities, resulting in post-harvest losses and diminished profitability. Consequently, middlemen purchase millets from farmers at arbitrary prices and resell them to processing units and markets at inflated rates, leading to higher costs for consumers. Chhattisgarh has become the first state in India to establish and implement a Minimum Support Price (MSP) for millets. While the Bastar region boasts optimal climate and soil conditions for millet production, millets are cultivated extensively across two-thirds of Chhattisgarh's agricultural land. The average production figures from the past three years (2020-2023, Source- http://agriportal.cg.nic.in) in the relevant districts are crucial for this project proposal: 3,282 tons on 3,982 hectares in Kabirdham, 218 tons on 165 hectares in Balod, 11,583 tons on 3,759 hectares in Kanker, and 26,088 tons on 6,712 hectares in Kondagaon. These figures significantly influence the socio-economic conditions of the rural communities

[1] Principal investigator (Dean, Faculty of Arts) Shri Rawatpura Sarkar University, Raipur, CG

2.Co-PI (Head & Assistant Professor Department of Sociology) Shri Rawatpura Sarkar University, Raipur,CG

in these districts. In Chhattisgarh, the area dedicated to millet cultivation and its consumption has steadily decreased in alternating years from 2011 to 2020. The persistent decline in millet cultivation and production can be attributed to several factors, like low productivity, high labour intensity, difficulty of agricultural operations and lack of alternative farm gate prices, easy availability of rice and wheat through the public distribution system, inadequate investment in product development and commercialization, inadequate availability and high prices of small millets in local markets, and inadequate policy support for small millets compared to crops like rice and wheat. This has not only led to a decline in agriculture-based livelihoods but has also not yielded the expected results despite the use of modern technologies in millet production. As a result, the government has formulated a scheme, 'Millets Mission', to encourage the production of millets, the positive impact of which has been seen in the last few years. And the production, marketing, preservation, and staple-making process of various millets offers the potential to generate employment on a large scale. The resilience of millet crops to climate change and the possibility of improving consumption for sustainable production are expected through millet supply chain management; hence, it is important to understand the associated problems.

OBJECTIVE

The following objectives are set to execute the study: -

1. To assess the current state of the millet supply chain.
2. To identify the challenges in the existing supply chain, and to suggest measures for improvement.
3. To explore the infrastructure and logistics gaps affecting the millet supply chain.

METHODOLOGY

Empirical Research Methodology

This study adopts an empirical research methodology to investigate the structure, challenges, and infrastructural gaps in the millet supply chain across select districts Kabeerdham, Balod, Kondagaon, and Kanker of Chhattisgarh. Empirical research involves collecting, analyzing, and interpreting primary data from the field and real-world stakeholders to draw objective conclusions. The approach ensures the study is grounded in observable and measurable evidence rather than theoretical assumptions.

DATA COLLECTION

Secondary Data Source

For the purpose of this study, titled "Empirical Insights into Millet Supply Chains in Chhattisgarh", secondary data sources were primarily used to gather relevant and reliable information. Secondary data refers to information that has already been collected, published, or documented by other researchers, institutions, or organizations. In this study, such data was critical in understanding the broader context of millet production and supply chain systems in the selected regions of Chhattisgarh.

Key secondary sources included- Government Reports and Publications, which offer insights into official policies, millet procurement statistics, and support mechanisms. Reports from the Chhattisgarh State Minor Forest Produce Federation, the Department of Agriculture, and various government schemes supporting millets were reviewed, Academic Journals and Research Studies, Industry Reports, and News Articles from reputable media sources.

Using secondary data allowed for a cost-effective and time-efficient way to access a broad spectrum of information, helping to identify trends, challenges, and structural gaps within the millet supply chain. These sources provided the foundation for deeper analysis and supported the empirical objectives of the study.

Review of Literature

To Assess the Current State of the Millet Supply Chain

1. **Sangappa and Rafi (2023)** in their study titled *"Role of FPOs in Strengthening Millet Value Chain"* highlight the pivotal role of FPOs in streamlining the millet value chain. They assert that FPOs play a significant role in aggregation, value addition, and facilitating direct marketing channels. These actions reduce farmers' reliance on middlemen and contribute to better price realization and market access.
2. **Sangappa et al. (2023)** further reinforce this view in *"Strengthening Millet Value Chain through FPOs,"* noting that FPOs help enhance rural livelihoods by establishing farm-gate processing units. This proximity-based infrastructure allows for quicker turnaround times in processing and marketing, particularly for millet-based products, thereby increasing farmer income.
3. **Babu et al. (2024)** in *"Millet Magic in Chhattisgarh"* focus on the state's Millet Mission. The study finds that the program has been successful in bolstering both millet production and processing infrastructure, particularly in tribal regions. The improved infrastructure includes the establishment of small-scale processing centers and procurement systems tailored for tribal farmers.
4. **Gupta and Tiwari (2024)** in their work *"Millet for Prosperity"* explore the economic viability of millet cultivation. They find that government incentives and lower input costs have encouraged a significant number of farmers to shift towards millet cultivation. Their study emphasizes the emerging attractiveness of millet farming, supported by both ecological and financial sustainability.
5. **Pathak et al. (2023)** conducted a demand-side study in Raipur titled *"Millet Consumption Patterns in Raipur."* The authors find a growing urban consumer base for millet products. This shift is attributed to increasing health awareness and changing food preferences, which in turn stimulates demand across the supply chain and justifies upstream investments.
6. **N.V. Prasad et al. (2024)** in their analysis titled *"Millet Value Chain Analysis"* provide a macro-level mapping of the entire supply chain. They uncover major gaps in farmer participation and market access. Their findings underline the need for inclusive policies and better integration of smallholder farmers into formal market systems.
7. **Hale (2024)** in *"Risk Assessment in Barnyard Millet Supply Chains"* identifies critical vulnerabilities in the supply chain. The study outlines that storage, milling, and marketing stages are the most risk-prone. These risks, if unaddressed, can result in product losses and reduced market competitiveness. The author advocates for systemic reforms such as better quality control and decentralized infrastructure.
8. **Pandey and Bolia (2023)** in *"Millet Value Chains for Sustainability"* argue that long-term sustainability in millet supply chains necessitates collaborative frameworks among stakeholders. They emphasize digital monitoring and real-time data collection as tools to enhance transparency and efficiency.
9. **Kumari et al. (2022)** in their work *"FPOs and Market Linkages"* align with other scholars on the benefits of FPOs. Their study finds that collective bargaining through FPOs enables millet farmers to access better market prices and benefit from economies of scale. This collective action reduces transaction costs and enhances negotiation power.
10. **Trebbin (2014)** in the foundational study *"Linking Farmers to Retail"* offers a broader perspective on producer companies, suggesting that such entities are instrumental in linking farmers to formal retail chains. The study highlights the importance of institutional structures in

ensuring traceability and sustainability in agricultural supply chains, which holds relevance for millets today.

Challenges in the Existing Supply Chain

11. **Rao, M. V., & Reddy, B. S. (2022) – Post-harvest challenges in millet marketing** In their 2022 study, Rao and Reddy explored the pressing post-harvest challenges faced by millet farmers in tribal regions, including Chhattisgarh. They identified key bottlenecks such as the absence of scientific storage infrastructure, limited market access, and poor price realization for farmers. The study revealed that a significant proportion of millet produce is lost due to pests, and the lack of aggregation facilities at the village level exacerbates these losses. This research highlights critical infrastructural and logistical gaps that hinder the efficiency of millet supply chains at the farm-gate level.
12. **Verma, R., & Chaturvedi, A. (2023) – Barriers to millet procurement in Central India** Verma and Chaturvedi, in their 2023 study, focused on the barriers to millet procurement, particularly in Central India. Their findings underscored that minor millets remain largely excluded from public procurement systems like the PDS and MSP mechanisms, leaving small and marginal farmers in a state of uncertainty. The absence of robust institutional support for millets leads to price volatility and discourages millet cultivation, highlighting policy neglect as a critical supply chain constraint.
13. **Dubey, S., & Tiwari, P. (2021) – Analysis of value chain constraints for millets in Bastar** Dubey and Tiwari's 2021 study examined the millet value chain in Bastar, with a particular focus on the role of intermediaries. They documented how middlemen exploit tribal farmers, taking advantage of their lack of collective bargaining power and limited market knowledge. This research draws attention to the dominance of intermediaries and the information asymmetry that exists within the supply chain, leading to significant inefficiencies.
14. **Patel, K. (2022) – Socio-economic bottlenecks in millet production** Patel's 2022 study explored the socio-economic challenges faced by smallholder millet farmers in Chhattisgarh. The research found that limited awareness about improved millet practices, inadequate training, and poor access to financial resources hinder farmers from producing market-ready outputs. This study links socio-economic constraints directly to supply chain inefficiencies, emphasizing the need for capacity-building interventions.
15. **Sharma, A., & Sinha, N. (2022) – Issues in millet supply chain logistics** Sharma and Sinha's 2022 research focused on logistical challenges in the millet supply chain, especially in the forested areas of Chhattisgarh. The study highlighted that transport and storage facilities are minimal in these zones, and private logistics operators tend to avoid them due to poor road connectivity and high transaction costs. This research emphasizes how logistical bottlenecks contribute to post-harvest wastage and reduce farmer profitability.
16. **Mishra, D. K., & Joshi, V. (2023) – Evaluation of farmer-producer organizations (FPOs) in millet chains**
Mishra and Joshi's 2023 study evaluated the performance of Farmer-Producer Organizations (FPOs) in integrating millet farmers into value chains. The study revealed that while FPOs exist in Chhattisgarh, they often lack the technical expertise, market linkages, and managerial skills required to function effectively. This research identifies institutional limitations that hinder the ability of FPOs to promote collective marketing and value addition for millet farmers.
17. **Naik, R., & Yadav, L. (2021) – Marketing challenges for millets in tribal belts of**

Chhattisgarh

In their 2021 study, Naik and Yadav focused on marketing challenges in the tribal belts of Chhattisgarh. They found that the absence of local mandis, lack of digital marketing platforms, and negligible private sector participation limit farmers' ability to sell millets profitably. This research highlights the role of marketing failures and the digital divide as core obstacles in the millet supply chain.

18. **Pandey, A., & Kumari, S. (2023) – Policy implementation gaps in millet promotion** Pandey and Kumari's 2023 study investigated the effectiveness of government policies aimed at promoting millets. Their research found that while various millet promotion schemes exist, they often fail to reach remote areas due to bureaucratic delays, poor monitoring, and a lack of localized planning. This study underscores governance and policy outreach as systemic challenges affecting the millet supply chain.
19. **Singh, J., & Baghel, M. (2022) – Analysis of climate resilience and millet farming** Singh and Baghel's 2022 research examined the intersection of climate resilience and millet farming. While millets are known for their resilience to climatic variations, the study found that unpredictable rainfall patterns and the low penetration of crop insurance schemes leave farmers exposed to significant risks. This discourages investments in millet cultivation, posing environmental and risk-based constraints to the stability of the supply chain.
20. **Rajput, S., & Das, M. (2023) – Millet processing industry constraints in Chhattisgarh** Rajput and Das's 2023 study explored the challenges faced by the millet processing industry in Chhattisgarh. The researchers found a significant lack of local processing units, high initial investments required for setting up such facilities, and a weak demand for processed millet products. Consequently, much of the millet processing occurs outside the state, resulting in missed opportunities for local value addition. This study highlights the critical gap between millet production and processing in the supply chain.
21. **Jain & Sharma (2023)** in *"Marketing Constraints in Coarse Grains"* identify two major issues: inadequate marketing infrastructure and weak price discovery systems. These constraints lead to inefficient market participation and reduced income for farmers. The authors suggest that digital platforms and transparent pricing mechanisms could bridge these gaps.
22. **Chatterjee (2022)** in *"Food Security and Millets"* focuses on policy-level challenges. The study finds that millets receive far less policy attention and subsidy support compared to staples like rice and wheat. This disparity limits their scalability and discourages farmers from large-scale adoption.

Infrastructure and Logistics Gaps

23. **HIPARKS Logistics Report (2023)** in *"Infrastructure Challenges for Logistics in India"* notes that underdeveloped rural roads and poorly coordinated multi-modal hubs delay agricultural commodity movement. The inefficiency not only increases transit costs but also contributes to post-harvest losses.
24. **AIM ANIC Millet Challenge (2023)** in its study on *"Logistics Bottlenecks in Millet Distribution"* pinpoints critical issues in storage, packaging, and cold chain networks. These deficiencies negatively affect the shelf life and marketability of millet products, particularly those aimed at urban or export markets.
25. **Goel & Bansal (2023)** in *"Supply Chain Barriers in Rural Agriculture"* find that high first-mile logistics costs and fragmented aggregation systems severely limit rural supply chain efficiency.

These challenges restrict millet farmers' ability to scale operations and access distant markets.

26. **Kumar & Rathi (2022)** in *"Infrastructure for Coarse Grain Logistics"* focus on tribal belts and discover a significant lack of basic warehousing and packaging units. This limitation curtails the scalability and commercial potential of millet-based enterprises in those areas.
27. **Chhattisgarh Government Report (2023)** emphasizes that districts like Dantewada and Kanker still lack basic transport and milling infrastructure despite being central to the state's millet mission. This bottleneck prevents farmers from accessing broader markets and reduces overall productivity.
28. **Rao & Mehta (2021)** in *"Infrastructure Gaps in Tribal Agriculture"* highlight the absence of feeder roads and electricity as major impediments to post-harvest processing. These infrastructural deficiencies create dependencies on external entities, further weakening farmers' control over the value chain.
29. **Singh & Das (2023)** in *"Supply Chain Challenges in Minor Millets"* note the absence of integrated systems for storage, transportation, and real-time data flow. The fragmentation of services results in operational inefficiencies, price losses, and logistical confusion.
30. **FAO (2022)** in *"Food System Infrastructure"* calls for urgent investments in rural agricultural supply chains. The report emphasizes that strengthening these links is vital not only for food security but also for enhancing farmer incomes and market resilience.
31. **World Bank (2022)** in its study on *"Agricultural Logistics in India"* reveals that logistics costs in India represent 14% of GDP, significantly higher than the global average of 8%. The report advocates for the establishment of tech-driven rural logistics hubs and the adoption of data-based supply chain management systems.

DISCUSSION

The review of literature provides a comprehensive overview of the current state of the millet supply chain in India, highlighting both progress and persistent challenges. A key theme that emerges is the pivotal role of Farmer Producer Organizations (FPOs) in enhancing the millet value chain. Multiple studies (Sangappa and Rafi, 2023; Sangappa et al., 2023; Kumari et al., 2022) emphasize that FPOs have significantly contributed to aggregation, farm-gate processing, value addition, and direct marketing. These interventions have helped reduce dependency on middlemen and improve farmers' income through better market access and economies of scale.

Furthermore, studies such as Babu et al. (2024) and Gupta and Tiwari (2024) underline the impact of government programs like the Millet Mission and policy incentives in promoting millet cultivation, particularly in tribal areas of Chhattisgarh. These interventions have improved production infrastructure and have motivated farmers to shift towards millets due to their low input costs and government backing.

On the demand side, Pathak et al. (2023) reveal a promising shift in urban consumption patterns, suggesting a growing market for millet-based products. However, despite these positive trends, several systemic weaknesses still constrain the millet supply chain's efficiency and sustainability.

The literature identifies significant challenges within the existing supply chain framework. Jain & Sharma (2023) and Chatterjee (2022) draw attention to the marketing and policy-related constraints, including inadequate infrastructure for price discovery, minimal market intelligence, and neglect in policy priorities compared to mainstream cereals like rice and wheat. Such gaps lead to low visibility of millets in formal markets and insufficient incentives for farmers.

Critical infrastructure and logistics gaps also undermine supply chain performance. Reports by HIPARKS Logistics (2023), AIM ANIC Millet Challenge (2023), and Goel & Bansal (2023) highlight persistent bottlenecks such as poor rural roads, high first-mile logistics costs, and insufficient multi-modal transport hubs. These constraints delay commodity movement and raise operational costs. Storage and cold chain infrastructure are particularly weak, with significant implications for the shelf life and quality of millet produce.

Region-specific challenges are also evident. Studies by Kumar & Rathi (2022), Chhattisgarh Government (2023), and Rao & Mehta (2021) consistently indicate that tribal regions suffer from a lack of warehouses, feeder roads, electricity, and basic processing units—limiting the scalability and commercial viability of millet farming in these areas.

Moreover, Singh & Das (2023) and N.V. Prasad et al. (2024) point out that the absence of integrated data systems and end-to-end supply chain coordination creates inefficiencies, particularly in minor millets. Such inefficiencies are compounded by the lack of digital tools to monitor sustainability and traceability, as highlighted by Pandey and Bolia (2023) and Trebbin (2014).

Finally, insights from global and national institutions (FAO, 2022; World Bank, 2022) reinforce the need for significant investment in rural supply chain infrastructure and the adoption of technology-driven solutions**. These are essential not only to improve logistics efficiency but also to strengthen food security and enhance farmer incomes.

In summary, while there is growing momentum around millets due to supportive institutions, FPOs, and rising consumer awareness, the overall supply chain continues to face considerable challenges. These include fragmented logistics, weak infrastructure, and policy neglect. Addressing these issues will require a coordinated approach involving public-private partnerships, infrastructure development, and digital transformation to build a resilient and inclusive millet supply chain.

Conclusion

A review of the existing literature reveals that although millets have an importance in the field of sustainable agriculture and nutritional security, the millet supply chain in India faces challenges due to fragmented infrastructure, inadequate market access, and policy monitoring. Farmer Producer Organizations (FPOs) have emerged as a key element in linking small and marginal farmers to markets; however, their effectiveness is hampered by limitations of scale, financial resources, and institutional support. Government initiatives such as the Millet Mission have proven to be significant, especially in tribal areas, yet their effectiveness varies due to logistics challenges, inadequate storage facilities, and underdeveloped rural infrastructure. The growing urban demand for millets presents an untapped opportunity that can be leveraged through better branding, product innovation, and retail connections.

Therefore, a comprehensive and inclusive overhaul of the millet supply chain is required, including augmentation of rural infrastructure, technology integration, strong FPOs, and millet-friendly policies. This multi-pronged strategy will not only strengthen the millet economy but also empower farmers, especially those from marginalized and tribal backgrounds.

SUGGESTION

Based on the literature and key findings, several practical steps can be taken to improve the millet supply chain in India:

1. Support and Expand FPOs: Farmer Producer Organizations (FPOs) have shown they can make a real difference by helping farmers come together, process their crops, and sell directly to markets. Scaling up FPOs by offering them better access to funding, training, and infrastructure—like

processing centers—can help farmers get better prices and reduce their dependence on middlemen.

2. Improve Rural Infrastructure and Logistics: Many of the supply chain issues start with poor infrastructure in rural areas. Building better roads, storage facilities, cold chains, and packaging units—especially in remote and tribal areas like Dantewada and Kanker—can help farmers store and move their produce more efficiently. This will also reduce waste and spoilage.
3. Strengthen Millet-Friendly Policies: Compared to crops like rice and wheat, millets often get overlooked in policy support. The government should offer more subsidies, ensure minimum support prices (MSPs) for different millet varieties, and include millets in public food distribution systems. Public awareness campaigns can also help increase both production and consumption.
4. Use Technology to Streamline the Supply Chain: There's a big opportunity to bring in digital tools—like real-time tracking systems, market access apps for farmers, and blockchain for traceability. These technologies can make the entire supply chain more transparent, efficient, and fair, while also helping monitor sustainability.
5. Boost Urban Demand and Market Access: With more urban consumers becoming health-conscious, there's a growing market for millet-based products. By focusing on product branding, packaging, and ready-to-eat options, we can make millets more appealing in cities. Collaborating with food companies and startups can help millets reach more retail shelves.
6. Encourage Public-Private Partnerships (PPPs): The complexity of the millet supply chain calls for joint efforts between the government, private companies, and development organizations. These partnerships can drive innovation in processing, storage, and distribution, while also bringing much-needed investments to the sector.
7. Focus on Tribal and Underserved Regions: Many tribal and remote areas already grow millets but lack basic facilities. Special attention is needed here—solutions like solar-powered processing units, mobile collection centres, and community-owned storage can go a long way in improving livelihoods and bringing these regions into the larger value chain.

Contribution to Society:

This research highlights the socio-economic and environmental significance of revitalizing the millet sector. By emphasizing the role of millet in enhancing food security, promoting agricultural biodiversity, and providing livelihood resilience in climate-sensitive and tribal areas, the study contributes to empowering rural communities. It advocates for inclusive development by recommending grassroots interventions that benefit small farmers, women, and indigenous populations. Furthermore, this study aligns with national goals of sustainable agriculture, nutritional security, and rural development, making it a crucial input for development-related discussions and actions.

Policy Implications

1. **Institutional Strengthening of FPOs:** It is essential for policies to promote the financial and operational enhancement of Farmer Producer Organizations (FPOs) by providing easier access to credit, implementing capacity-building initiatives, and offering infrastructure grants. This will empower them to operate as comprehensive value chain integrators.
2. **Rural Infrastructure Development:** There should be a focus on targeted investments in rural logistics, including feeder roads, storage facilities, cold chains, and decentralized processing centers. These investments should be prioritized under programs such as PM Gati Shakti and the Rural Infrastructure Development Fund (RIDF), particularly in tribal areas.

3. **Policy Parity for Millets:** Millets should be granted the same level of policy support as rice and wheat. Their inclusion in Minimum Support Price (MSP) schemes, procurement through the Public Distribution System (PDS), and coverage under crop insurance will enhance farmer engagement and promote sustained cultivation.
4. **Digital Integration of the Value Chain:** Agricultural policies at both national and state levels should promote the adoption of digital platforms to provide real-time visibility of supply chains, market intelligence, traceability, and connections between farmers and markets, utilizing technologies such as AI, IoT, and blockchain.
5. **Nutrition and Health-Based Promotion:** Government initiatives should advocate for millets as a health-oriented food option. Incorporating millets into Integrated Child Development Services (ICDS), mid-day meal programs, and urban wellness initiatives can enhance demand and improve dietary diversity.
6. **PPP Models for Innovation:** Policy structures should foster public-private partnerships to encourage research and development, product diversification, and enhance the export competitiveness of millets, transforming them into globally marketable products.
7. **Focused Tribal Development Plans:** It is necessary to develop specialized policy packages for tribal and marginalized communities, incorporating energy-efficient technologies (such as solar dryers), community storage solutions, and mobile procurement systems.

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