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A Review on Value Chain Analysis of Millets

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Review Article

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ABSTRACT

Millets, a group of small-seeded grasses, are essential crops cultivated for their resilience and ability to thrive in arid regions where other crops often fail. Globally, millets are predominantly grown in Asia and Africa, with India being the largest producer, contributing over 40% of the world's millet production. This review article employs a comprehensive and systematic approach to analyze the economic aspects of millet production and marketing, focusing on value chain analysis. The methodology involves a thorough examination of existing literature, including peer-reviewed journal articles, research reports, and relevant books published over the last two decades. The review process is guided by a conceptual framework that outlines key components such as production, productivity, market dynamics, marketing strategies, marketing channels, and price spread. The literature search and selection involve systematic searches of academic databases using relevant keywords, with a focus on studies published within the last 20 years and those addressing the specified value chain components. Relevant data is extracted and categorized according to the framework, allowing for the identification of patterns, trends, and gaps in the existing literature. This

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analysis provides insights into the current state of the millet value chain, highlights challenges and opportunities, and suggests strategies for improving its efficiency and sustainability. The findings aim to inform policymakers, researchers, and practitioners about the economic viability of millet production and marketing, promoting millets as a sustainable and nutritious food source globally.

Keywords: Value chain analysis: millets; production; marketing; consumer preferences.

1. INTRODUCTION

Millets are a group of small-seeded grasses that are widely cultivated for food and fodder. They are particularly valued for their resilience and ability to thrive in arid and semi-arid regions where other crops may fail. Globally, millets are predominantly grown in Asia and Africa, with India being the largest producer [1]. India contributes to over 40% of the world's millet production, followed by Niger, China, and Mali [2]. These grains have been a staple food in many cultures for thousands of years due to their nutritional benefits and adaptability to harsh climatic conditions. The millet yield in India has more than doubled since 1966. In 2021-22, the average yield was 1208 kg per hectare [3]. Despite a 7% increase in millet production from 1966 to 2022, the area used for millet cultivation has consistently declined since 1971-72, with a significant drop between 2006 and 2016 [4].

In terms of consumption, millets are integral to the diets of millions of people in developing countries, particularly in regions prone to food insecurity. They are known for their high nutritional value, providing essential nutrients such as proteins, vitamins, and minerals. In India, millets are consumed in various forms, including traditional dishes like rotis, porridges, and snacks. The rising awareness of the health benefits of millets, such as their low glycemic index and high fiber content, has led to a resurgence in their popularity, not only in rural areas but also in urban markets globally [5].

The importance of millets extends beyond nutrition. They are environmentally sustainable crops requiring less water and more resistant to pests and diseases than other cereals like wheat and rice. This makes them a crucial component in the fight against climate change and in efforts to achieve food security. Additionally, millets play a vital role in maintaining soil health through their short growing season and ability to grow in poor soils without significant chemical inputs.

The value chain of millets encompasses a series of processes and activities that add value from production to consumption [6]. It starts with input supply, followed by cultivation, harvesting, processing, marketing, and distribution. Each stage involves various stakeholders, including farmers, traders, processors, and retailers [7]. Understanding the value chain is essential for identifying opportunities to improve efficiency, reduce losses, and enhance the overall profitability and sustainability of millet production.

This review article aims to analyze the economic aspects of the millet value chain, focusing on production, productivity, market dynamics, marketing strategies, marketing channels, and price spread. By systematically reviewing the existing literature, the article will provide insights into the current state of the millet value chain, highlight the challenges and opportunities, and suggest strategies for enhancing its performance. This comprehensive analysis is crucial for policymakers, researchers, and practitioners aiming to promote millets as a sustainable and nutritious food source globally.

2. METHODOLOGY

This review article employs a comprehensive and systematic approach to analyze the value chain of millets, focusing on economic aspects of production and marketing. The methodology is designed to ensure a thorough examination of existing literature, including peer-reviewed journal articles, research reports, and relevant books published over the last two decades and the systematic approach of the review article has been shown in Fig. 1.

2.1 Conceptual Framework

The review process is guided by a conceptual framework (Table 1) that outlines the key components of millet value chain analysis. These components include production, productivity, market dynamics, marketing strategies, marketing channels, and price spread. This framework serves as an organizational tool for synthesizing diverse literature on millet value chains, facilitating a structured and comprehensive review.

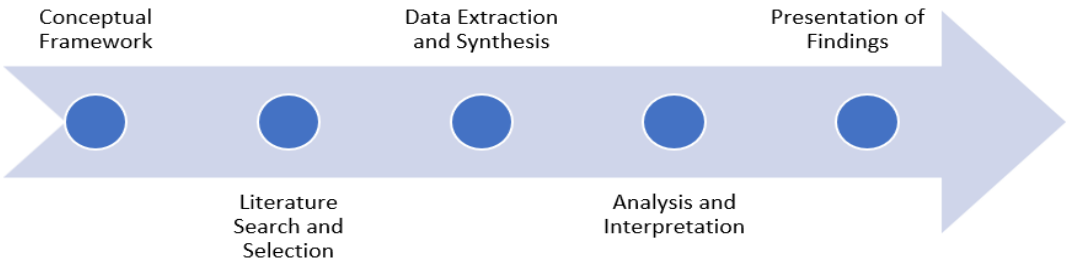

Fig. 1. Systematic approach

Table 1. Conceptual framework

Review of Concepts	Review of Past Studies
Farmer Producer Organization	Value Chain
Farmers Organization	Value Chain Analysis
Supply chain	Producer Companies
Value Chain	Farmer Producer Organization
Value Chain Map	Value Chain Actors
Value Chain Analysis	Consumer preference
Value Addition	Value Addition
Market intermediaries	
Commission agent	
Wholesaler	
Retailing	
Retailer	
Consumer	
Marketing	
Marketing cost	
Marketing margin	
Marketing Efficiency	
Price Spread	
Garrett's ranking technique	

2.2 Literature Search and Selection

The literature search involves a systematic and exhaustive review of academic databases, such as Scopus, Web of Science, and Google Scholar. Keywords and phrases such as "millet value chain," "millet production," "millet marketing," "economic aspects of millets," and "millet market dynamics" are used to identify relevant studies. The selection criteria include:

- Peer-reviewed journal articles, research reports, and books published within the last 20 years.
- Studies that specifically address the value chain components outlined in the conceptual framework.
- Research conducted in diverse geographical contexts to ensure a comprehensive understanding of the global millet value chain.

2.3 Data Extraction and Synthesis

Relevant information from the selected literature is extracted and categorized according to the components of the conceptual framework. This includes detailed data on:

- Production and Productivity
- Marketing Strategies
- Marketing Channels
- Price Spread

2.4 Analysis and Interpretation

The extracted data is analyzed to identify patterns, trends, and gaps in the existing literature. This involves:

- Comparing findings across different studies to highlight commonalities and divergences.

- Identifying key success factors and challenges in the millet value chain.
- Evaluating the impact of various marketing strategies and channels on the economic viability of millet production.

2.5 Presentation of Findings

The findings are organized and presented in a manner that aligns with the conceptual framework. Each component of the millet value chain is discussed in detail, supported by evidence from the reviewed literature. The chapter also presents related concepts and how they have been applied in previous studies, providing a deeper understanding of the research problem at an appropriate scale.

By employing this systematic and comprehensive methodology, the review aims to develop a positive and deeper understanding of the economic aspects of the millet value chain, ultimately contributing to enhanced knowledge and informed decision-making in this field.

3. REVIEW OF CONCEPTS

3.1 Farmer Producer Organization

Joshi and Choudhary [8] emphasized that Farmer Producer Organizations (FPOs) can protect small farmers from the adverse effects of liberalization and encourage their participation in modern markets. FPOs connect unorganized farmers to organized sectors, providing services such as farm inputs, custom hiring centers, and output market linkages, including value addition, processing, handling, and branding of products. Karthik et al. [9] described FPOs as collectives of small and marginal farmers that form viable alliances to tackle agricultural challenges like access to investment, innovation, inputs, and markets. Stockbridge et al. [10] highlighted that FPOs support small farmers' effective market participation, enhancing agricultural production, productivity, and profitability.

3.2 Farmers Organization

Tolno et al. [11] highlighted the crucial role of Farmers Organizations in empowering smallholder farmers, boosting their production and incomes. These organizations are vital for promoting pro-poor economic growth. Markelova and Mwangi [12] described Farmers Organizations as collective activities undertaken by groups investing time and money to achieve shared goals, thus addressing common agricultural challenges.

3.3 Supply Chain

Jensen et al. [13] described a supply chain network as encompassing activities related to the transformation, processing, and movement of goods from raw materials to finished products. Kanaka [14] defined the supply chain as a complex network of producers, traders, agents, wholesalers, processors, exporters, retailers, and consumers intricately linked in product creation, distribution, and utilization, though their roles in improving the value chain require more exposure and training. Hertz [15] characterized the supply chain as the organizational chain supplying products from raw materials to final customers, aiming for productivity and efficiency.

3.4 Value Chain

Miller and Jones [16] defined the value chain as encompassing all activities and actors involved in product development from raw material suppliers to end-consumers. Janssen and Feenstra [17] viewed it as interconnected, value-creating activities undertaken by enterprises or groups to produce, deliver, and service products. Joshi and Gurung [18] described it as a sequence of related business functions from input provision to production, processing, and distribution to the final customer.

3.5 Value Chain Map

Reddy Amarender [19] defined a value chain map as depicting the interlinkages between successive stages in the value chain. Subramanian [20] described it as a tool to illustrate all activities, actors, and relationships within the chain, highlighting connections between producers and intermediaries.

3.6 Value Chain Analysis

Sahoo and Sarangi [21] emphasized value chain analysis as a strategic tool for analyzing internal firm activities, transforming products from their initial state to more significant states. Joshi and Gurung [18] described it as a strategy for accounting and presenting the value created in products or services from raw inputs to final consumption. Richard and Besigye [22] used it to establish a joint vision, identify essential requirements, and analyze supply limits and market barriers to develop intervention

strategies. Donaldson et al. [23] focused on the full range of activities needed to bring a product or service from conception to end use, involving various actors in a vertical chain.

3.7 Value Addition

Shukla and Raj [24] defined value addition as enhancing under-utilized foods' nutritive worth, variety, and utilization through better processes. Goyal and Sharma [25] viewed value addition as transforming fruits and vegetables into more useful and convenient products. Joshi and Gurung [18] included simple tasks like bulking, cleaning, grading, packaging, transporting, processing, and marketing additions that improve product appeal to buyers.

3.8 Market Intermediaries

Ocholi et al. [26] defined market intermediaries as individuals or organizations specializing in marketing operations like assembling, sorting, cleaning, packaging, transportation, and holding products until purchase. They buy farm products at lower costs and sell them at higher prices.

3.9 Commission Agent

Palanichamy et al. [27] referred to "Arthi" as local intermediaries facilitating crop transactions between farmers and buyers in grain markets, charging a commission based on the sale price. In this study, commission agents are viewed as middlemen who trade millets for fees without taking ownership of the crops.

3.10 Wholesaler

Kotler [28] defined a wholesaler as one who performs all activities involving goods or services for resale or business use. Dhanapal [29] described a wholesaler as someone who buys produce from farmers or village merchants and sells it to retailers at the best price.

3.11 Retailing

Stichter [30] defined retailing as selling goods to end clients for use and consumption rather than resale. Pradhan [31] viewed retailing as all activities involved in marketing goods and services directly to consumers for personal or household use.

3.12 Retailer

Kotler and Lee [32] defined a retailer as a business primarily involved in selling goods or services directly to final consumers for non-business use. Skytte and Bove [33] described retailers as intermediaries or cooperatives buying from wholesalers or producers and selling to end consumers.

3.13 Consumer

Levy et al. [34] defined a consumer as an individual who consumes goods and services manufacturers or retailers provide.

3.14 Marketing

Nair [35] described marketing as activities, organizations, and processes that value providers, clients, partners, and society develop, connect, distribute, and exchange offerings.

3.15 Marketing Cost

Naphade and Tingre [36] defined marketing cost as including sorting, grading, packing, and transporting. Acharya [37] described it as the cost of moving products from producers to consumers, encompassing various marketing functions at different stages.

3.16 Marketing Margin

Palanichamy et al. [38] explained marketing margin as the profit earned by middlemen in moving products from producers to consumers. Vilas and Chinnappa [39] defined it as the difference between sale and purchase prices at different marketing stages.

3.17 Marketing Efficiency

Zinyoro [40] defined marketing efficiency as the adequacy with which a marketing system operates. Venkatesa Palanichamy et al. [41] referred to it as the market's effectiveness in performing various functions.

3.18 Price Spread

Baba et al. [42] noted an inverse relationship between the producer's share of farm product prices and the price spread. Acharya [37] defined price spread as the difference between the price paid by consumers and the price received by producers for a comparable amount of produce.

3.19 Garrett’s Ranking Technique

Senthilkumar et al. [43] used Garrett's ranking technique to identify challenges faced by

capsicum growers in Tamil Nadu, finding high establishment costs, lack of technical knowledge, and skilled labor shortages as major constraints. Singh [44] applied the technique to assess production and marketing issues of pulses in Uttar Pradesh, identifying input availability, agro-climatic problems, post-harvest pest infestations, price fluctuations, government policies, viral attacks, demand assessment, and technical knowledge gaps as significant issues.

4. REVIEW OF PAST STUDIES

4.1 Value Chain

Odongo and Etany [45] mapped the cassava value chain and assessed marketing margins, revealing that cassava is primarily sold as value-added products like flour, chips, and fresh tubers. Fresh tubers were the most marketed due to a lack of market data on other products. Sanjana Reddy [46] found that producer companies in India excel in consolidating pearl millet for breweries. Golban and Doga [47] provided extensive information on Moldova's tomato value chain, covering end markets, production advances, post-harvest practices, investment needs, and relevant policies. Kirimi et al. [48] emphasized that improving Kenya's maize value chain requires coordinated efforts from diverse actors due to its complex market structure. Trienekens [49] proposed a framework for analyzing developing country value chains, focusing on network structure, value addition, and governance. Rieple and Singh [50] analyzed the cotton value chain, detailing the stages of value addition in organic cotton garment production.

4.2 Value Chain Analysis

Sahoo and Sarangi [21] developed a theoretical model for the organic turmeric value chain, stressing the importance of collective producer action for accessing international markets and eliminating intermediaries. Naik and Hosamani [51] studied the financial aspects and marketing channels of turmeric in Northern Karnataka. Kleih et al. [52] detailed the cassava value chain in Ghana, highlighting its end-use in high-quality flour, industrial-grade flour, and animal feed. Trienekens [49] identified constraints in value chain upgrading, focusing on value addition, network structure, and governance. Umagowri and Chandrasekaran [53] found that the Producer-Commission Agent-Wholesaler-Retailer-Consumer channel was most effective for Nendran bananas in Tamil Nadu.

4.3 Producer Companies

Franz et al. [54] showed that producer companies can improve farmers' livelihoods by building relationships with supermarket chains, balancing welfare and business orientations through a consortium of NGOs, input suppliers, and potential buyers. Trebbin and Hassler [55] argued that producer companies, though profit-oriented, benefit the public and originated from the farming community.

4.4 Farmer Producer Organization

Salokhe [56] highlighted the role of Farmer Producer Organizations (FPOs) in bringing small and marginal farmers together for better market participation and profitability. Sawairam [57] emphasized that FPOs help small farmers transition to market-oriented institutions, facilitating participation in modern retail and export markets. Shiferaw and Muricho [58] noted that producer organizations improve market access, reduce production and marketing costs, and incentivize active participation from farmers.

4.5 Value Chain Actors

Okech et al. [59] revealed that pearl millet actors had limited access to credit due to weak affiliations, resulting in poor coordination between producers and other value chain actors. Mmasa and Msuya [60] mapped the sweet potato value chain in Tanzania, identifying two significant value-added products and direct market sales by 44% of producers.

4.6 Consumer Preference

Harshitha and Jayaram [61] observed that finger millet is popular for its health benefits and versatility in products like flour, pudding, porridge, and roti. Alekhya and Shravanthi [62] emphasized the need to understand consumer acceptance and buying behavior towards millet products for better nutritional consumption. Kalaiselvi et al. [63] stressed the importance of awareness programs to promote millet consumption. Nath et al. [64] highlighted the value addition in products like sugar, gur, and khandsari to meet consumer needs. Amadou et al. [65] reviewed the nutritional benefits of millets, noting their high energy content and potential to

address amino acid deficiencies when combined with other proteins.

4.7 Value Addition

Nath et al. [64] concluded that value addition in products like sugar, gur, and khandsari is crucial for sustaining profitability. Hoq et al. [66] emphasized improving vegetable quality through activities like upgrading, packaging, and processing. Babu and Verma [67] compared the value chains of milk products in private and cooperative dairies, identifying high-value products like ice-cream, frozen yogurt, ghee, and Mysore pak in private dairies.

5. CONCLUSION

In conclusion, the value chain of millets is a complex and multifaceted system involving numerous stakeholders and processes from production to consumption. The continuous improvement in yield suggests better farming practices have been adopted in recent decades. Although India remains the largest millet producer, significant progress has been lacking in the past twenty years. Since 1966, millet production has shown an erratic trend, and per capita availability has fluctuated, reaching its lowest point since a peak in 2019 [68]. In 2021, the per capita availability of millet was approximately 12.3 kg. The analysis reveals that while millets hold significant potential due to their nutritional benefits, environmental sustainability, and adaptability to harsh climates, several challenges hinder their optimal utilization and market penetration. Key issues include low productivity due to traditional farming practices, inadequate access to modern agricultural inputs and technologies, limited market access, and inefficient marketing channels. The economic viability of millet production can be significantly enhanced through targeted interventions aimed at improving production techniques, facilitating better access to inputs and technologies, and strengthening market linkages. Developing robust marketing strategies and efficient channels can help in reducing the price spread and ensuring afair returns to farmers. Additionally, promoting value addition through processing and branding can increase the market appeal of millet products and cater to the growing health-conscious consumer segment. Policy support is crucial in addressing these challenges, with emphasis on research and development, extension services, and infrastructure development. Strengthening Farmer Producer Organizations (FPOs) can empower small and marginal farmers, enabling them to participate more effectively in the market and benefit from economies of scale. Furthermore, creating awareness about the health benefits of millets can drive demand, both domestically and internationally, contributing to better nutritional outcomes and enhanced food security. The review underscores the need for a holistic approach that integrates production, marketing, and policy interventions to unlock the full potential of the millet value chain. By doing so, millets can play a pivotal role in sustainable agriculture, rural development, and global food security, ensuring that this ancient grain continues to nourish and sustain populations worldwide.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

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 writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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