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A Systematic Review of Literature on Apple Production and Value Chain Analysis

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Abstract: *Value chain analysis is extensively used as a diagnostic tool to identify and tackle complex challenges throughout value chains in the context of agricultural development. Although, the method is mainly qualitative and static, offering limited capacity to capture the dynamic interactions and connections between components from production to consumption within a complex system. We carried out a systematic literature review through PRISMA Methodology to synthesize the fundamental reasons for applying system dynamics in value chain analysis to identifying the value chain functions, actors, efficiency, constraints, and to assess the value added along the value chain, explore how it has been implemented. Based on the review of various studies related to the fruit value chain and the key insights identified, the following important factors contribute to the development of the value chain and market performance of fruit: Strengthening the connections between value chain actors is essential to enhance the efficiency of the chain. This linkage allows the actors to learn from each other and share experiences about market conditions, especially when these connections are sustained throughout the chain. Building on this, the paper highlights gaps in existing agricultural value chain research: 1) The integration of the SCP analysis framework with other approaches is lacking; 2) There has been little investigation into the causes of mark ups through actors or their market power.*
Keywords: *Value chain dynamics, Apple Production, Efficiency of Actors*

I. Introduction

Fruits and vegetables have a unique role in economical and social life in developing countries like India because it can improve the level of income and nutrition of the population, especially in rural areas. The creation of orchards not only guarantees the presence of a variety of fruits to be consumed but also the creation of ecological balance and diversification of crop patterns. Fruit farming needs to be planned over time taking into account such aspects as land, labour and capital resources. Although the establishment costs are high initially, the cost of maintaining is similar to that of the field crops during the period of fruiting (Bakhru, 1985).

In places such as the Western Himalayas, Jammu and Kashmir, U.P. hills, and Himachal Pradesh, the development of horticulture is given priority because of the good climates, better returns, the ecological and soil conservation advantages and the effective utilization of the farm wastes. Himachal Pradesh, specifically, devotes a rather much share of its geographical space to fruit production than other regions of the country. Fruits, such as the apple, apricot, peach, plums, cherry, citrus, and mango, are the most common fruit grown in these hilly regions, with apple alone taking a major share (AERC report).

Horticulture is an important activity to most farmers in Himachal Pradesh, being their main source of livelihood. This importance is not confined to the region, but is also of national importance. Apples are the most popular fruit farmed in the state and are regarded as better than other fruits. Fine apples are naturally sweet, and will provide you with instant energy, as well as being crisp, juicy and rich in minerals, vitamins, proteins, and carbs. Since the food of people living in hills is usually inadequate in the content of proteins, minerals and vitamins, the production of apples becomes the priority to enhance the nutrition of the population. Beyond nutritional benefits, there are several reasons to enhance apple cultivation and explore new production potentials. Apple farming offers higher income, aids in soil conservation by reducing erosion, generates supplementary income, and being labor-intensive, it creates more employment opportunities. As of 2022-23, apples accounted for 49 per cent of the area and 85 per cent of the production of all fruits in the state (statistical Abstract 2023-24). From 1994-95 to 2021-22, the apple cultivation area increased at a rate of 3.23 per cent per annum. While Shimla district has the maximum apple cultivation area, Lahul & Spiti, Chamba, and Kinnaur districts showed the highest growth rates. The apple production in the state increased significantly during this period, with Shimla district alone contributing to 60 per cent of the total production. However, the productivity of apples in the state remains lower compared to global.

In contrast, the Value Chain concept was introduced by Michael Porter in the 1980s in his book "Competitive Advantage: Creating and Sustaining Superior Performance". Porter described the value chain as "an interdependent system or network of activities, connected by linkages" (Porter, 1990). Value Chain Management focuses on creating added value at each link in the chain, thereby providing businesses with a sustainable competitive advantage. According to Porter (1985), value is created by differentiating activities at every step of the value chain, which can result in products and services that either lower buyers' costs or enhance their performance. Value chain analysis separates a company's operations into primary and support categories. Production-related activities are classified as primary, while background operations—like human resource management—provide the framework required for the organization to operate effectively and efficiently.

II. Materials And Methods

Systematic literature review (SLR)

The SLR is a way to identify, analyze and interpret all available studies related to a single research question or phenomena of interest (Keele, 2007). In this study, we chose to use a systematic literature review (SLR) because of its organized, transparent, and reproducible methods for selecting and compiling a database for the review. The process was guided by the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) Statement (Moher et al., 2009), along with the methodologies outlined in the works of Hoque et al. (2017) and Hanvold et al. (2019). The review followed the steps presented in Figure 1.

Document Research: We conducted a search for relevant literature on apple production and value chain analysis using three accessible scholarly electronic databases: Google Scholar, Scopus, and Web of Science.

Data Synthesis and Analysis Methods:

The data synthesis was conducted using thematic analysis to organize the findings into categories based on the identified challenges and opportunities. This process allowed for the identification of patterns, similarities, and differences across the studies. A narrative synthesis was then carried out to provide a comprehensive summary of the findings in relation to the research questions and objectives of the review.

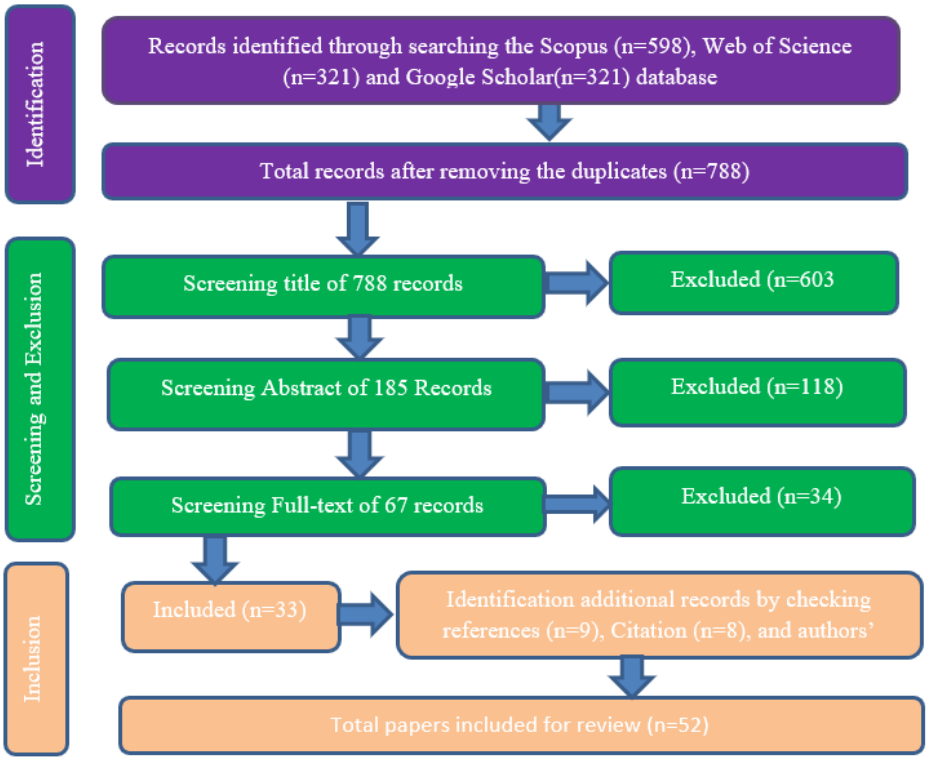

Fig. 1. Flow chart showing the systematic process followed for the identification of relevant studies for review

Data extraction was carried out using a standardized template to maintain consistency and ensure completeness. The extracted data included the author(s), publication year, research title, objectives, methodology, key findings related to challenges and opportunities in the horticulture supply chain, and recommendations for stakeholders. This structured approach enabled a comprehensive analysis and synthesis of the findings.

III. Results and discussion

An Overview of Apple production

Studies on apple farming in Himachal Pradesh have been increasingly advanced in covering different aspects that contribute to the development of the sector. Initial studies focused on the economic opportunities of fruit plantations in the mountain regions and their contribution to the development of the regions (Negi, 1963). Experiments in districts such as Kullu indicated that topography has a direct influence on the yields and profitability of apples and therefore it would be possible to maximize returns by maximizing the utilization of resources based on topography (Mehta, 1966). Additional studies were done to determine the most important productivity factors with the advent of factors such as labor input, fertilizer application and orchard age being the most important in increasing apple yields (Rana et al., 1978). These researches pointed out the intricacy of interactions between these factors, providing the understanding of the effective orchard management. An analysis of the cost structures revealed that a significant percentage of the costs incurred in the process of cultivating apples was related to the cost of harvesting and marketing and that cost-effective methods were required to enhance profitability (Verma and Singh, 1982). Profitability analysis showed that apple cultivation brings in greater economic benefits as compared to field crops, not only in providing rural labor, but also in packaging resources, which is also heavily reliant on forest products, a situation with broader socio-economic consequences (Sikka and Swarup, 1985). The current reports have exhibited constant growth in the area of production and the production of apples especially in high-density orchards in districts such as Shimla, Kullu and Kinnaur which have been on an upward trend of the sector (Singh, 2012). Research also reported the tendencies in productivity and such issues as agro-climatic conditions and infrastructure requirements, which is essential to maintain the growth (Pratap et al., 2013; Kireeti et al., 2015). Quantitative methods have also shown correlation between cultivation area and productivity, which identified strategic areas to further enhance the same (Wani and Songara, 2018). The sector needs to be resilient to such issues, which can be achieved by tackling climate and infrastructure (Yasmin et al., 2023). According to recent studies, there are increased tendencies of high density plantations in apples particularly in Shimla, Kullu, and Kinnaur regions that has contributed to the consistent rise in production. Research is ongoing on the trends in productivity and how these issues can be overcome like agro-climatic differences and infrastructure requirements. Such lessons are critical towards ensuring sustainable growth and economic stability in the apple industry.

Dynamics of Apple Marketing Channels;

A number of studies have been conducted over the years in the production, marketing channels, and the economic aspect of apple farming in areas such as Himachal Pradesh and Jammu & Kashmir. It was found that the most lucrative marketing channel which was the most profitable to the apple growers in Himachal Pradesh was direct sales to consumer but due to various reasons such as the variable prices in wholesale, limited transport means and insufficient storage sites, farmers had to sell directly at the orchard sites (Thakur and Johl, 1967). In the Kullu Valley, the majority of the growers sold their apples via contracts although it was proposed that producers pursue more direct marketing to increase their profits (Sidhu and Kahlon, 1969). Differences in producer share in consumer price were observed amid various temperate fruits plus marketing avenues (Sharma and Sharma, 1978). Inter-market price differentials indicated that growers received a greater rate of remuneration in markets such as Delhi and Lucknow and there was concern that the marketing system was inefficient and that cooperative societies and improved transport were the way to go (Rana et al., 1983; Swarup et al., 1985). The profitability of Kinnow plantations as well as the possibility of increased producer shares via cooperative support was also mentioned (Saibabu, 1986). The research on the costs of production has implied that though start up costs were very expensive, the mature apple trees would yield high returns (Kanwar, 1987; Sikka and Vaidya, 1987). Additional studies showed that small farmers tended to get less percentage of consumer rupees than large producers, and the marketing system was inefficient, especially depending on intermediaries (Sikka and Nadda, 1989; Mehta et al., 2013). More recent research has focused on the need to have lean marketing channels that minimize intermediaries and maximize returns to producers, as well as overcome the issues of poor infrastructure, shortage of skilled labour and cold storage (Mir et al., 2019; Sharma and Guleria, 2020; Wani et al., 2021). Another recent study has also mentioned that in Himachal Pradesh, farmers preferred to sell through channels that provided higher prices and controlled prices, yet they were limited due to poor road connectivity and lack of labor (Bharti et al., 2023). Overall, these works indicate that enhancing infrastructure, decreasing the presence of intermediaries and market efficiency are the main factors to help the apple growers in these areas to gain higher profit.

Supply Chain;

The concept of Supply Chain Management (SCM) emerged in the 1980s as an integrated approach to overseeing the entire flow of goods from suppliers to the end users (Feller et al., 2006). This approach evolved to encompass a wide integration of business processes along the supply chain. The term "Supply Chain

Management" was coined by Keith Oliver in 1982 to develop a comprehensive inventory management system that balances trade-offs between inventory levels and customer service goals. Initially, SCM aimed to manage the supply chain as a single entity rather than a collection of separate functions, with the primary goal of resolving suboptimal inventory and capacity development caused by conflicts between different functional groups within a company (Beth et al., 2003). Hertz (2001) defined supply chain as "part of a network that supplied a specific product from raw material to final customer. It included a whole commercial chain embedded in the network with a common objective of efficiency and effectiveness". Perreault and McCarthy (2002) defined supply chain as "complete set of firms, facilities and logistical activities that were involved in procuring raw materials, transforming them into intermediate or finished products and distributing them to customers". "Rajoo (2002) described the supply chain as the entire network or sequence of links that connects the farm to the consumer for the final product. Chase et al. (2005) defined the supply chain as the interconnected system of organizations (suppliers, manufacturers, distributors, and customers). Chopra and Meindl (2005) explained that the supply chain includes all parties involved, either directly or indirectly, in meeting a customer's needs. This encompasses producers, suppliers, carriers, storage facilities, merchants, and end users, covering every task required to fulfill a customer's order". Mentzer (2005) referred to the supply chain as a network of three or more companies directly linked by one or more flows of products, services, finances, and information from the source to the customer. Kanaka (2007) defined the supply chain as a complex network of entities, including producers, pre-harvest contractors, local traders, commission agents, wholesalers, processors, exporters, retailers, and consumers, all intricately involved in production, distribution, and consumption processes. These actors needed further exposure and training since they were still unsure of their role in strengthening the value chain. Jensen (2010) stated that supply chains were concerned with transformation, processing, and movement of goods from raw materials to finished products. The research discovered that the supply chain in banana cultivation involves the conversion, processing, and transportation of bananas from farmers, facilitated by input suppliers and market intermediaries, to end consumers. Wani et al. (2015)**,** examined "Supply Response of Horticultural Crops: The Case of Apple and Pear in Jammu & Kashmir" covered the period from 1981 to 2013 based on secondary sources, Nerlovian model has been used to estimate supply response, Engle- Granger test and Vector Error Correction Model have been used to estimate the long-run and short-run dynamics. They observed that the price of apples exhibits greater variability compared to the price of pears. They also found a high coefficient of determination (R2 = 95%) and estimated own-price elasticities of 0.32 (short-run) and 0.33 (long-run) for apples, and 0.03 (short-run) and 0.28 (long-run) for pears. Additionally, their findings showed that the price of pears positively and significantly influences the price of apples, as evidenced by their respective coefficients. The correlation between apple and pear prices indicates both short-term and long-term relationships between these commodities. They concluded that an increase in the price of apples could lead consumers to consider pears as an alternative crop.

Value chain analysis;

Value Chain Analysis (VCA) is a tool used to identify potential sources of economic advantage for companies by breaking down their activities to understand cost structures, value addition, and differentiation. The analysis focuses on how a firm's value chain interacts with those of its suppliers, customers, and competitors, allowing companies to gain a competitive edge by performing these activities more cost-effectively or with greater differentiation. The value chain encompasses all activities required to bring a product or service from conception, through production, to delivery and final disposal (Kaplinsky and Morris, 2001).

The value chain is also seen as a series of relationships between actors involved in productive activities, with the aim of adding value at each stage of the process. This approach encourages a shared vision among actors, helping to identify mutual needs, share risks and benefits, and invest resources to achieve common goals (Richard and Besigye, 2005). For Handfield and Nichols (2005), VCA is a method to analyze activities within the chain to perform them more efficiently and economically. Baker (2006) further defines it as a way to trace product flows, identify key actors, and understand their relationships. Value addition, particularly in agriculture, has gained attention, especially when products are altered in form, color, or other attributes to increase value (Savita et al., 2006).Bammann (2007) outlines the value chain as a network of actors, from input suppliers to final buyers, who collaborate to bring a product from inception to end use. Capon (2008) views the value chain as a framework to analyze the configuration of organizational resources in order to create value at minimal cost and achieve competitive advantage.

In this context, the present study applies value chain analysis to apples, identifying value added at each stage of the chain to perform activities more efficiently and economically. Miller and Jones (2010) broaden this concept by including all activities and participants involved in moving agricultural products from suppliers to consumers. Sanogo (2010) emphasizes identifying actors, firms, services, and institutional support in the value chain analysis. Reddy et al. (2010) highlight value addition through product differentiation based on factors like

quality or size, as well as more efficient post-harvest processing, such as trimming, cleaning, sorting, grading, and packing.

The importance of value addition technologies has grown due to the increasing commercial demand for fruits and vegetables, with an emphasis on enhancing the quality and appeal of produce (Padma and Rathakrishnan, 2011). In Ethiopia, a study on the apple value chain by Getahun et al. (2018) found that the direct value chain actors included input suppliers, producers, traders, and consumers, with varying net marketing margins along the chain. Similarly, Roy and Hazari (2023) studied the agricultural value chain in Northeast India, exploring challenges and recommending strategies for agribusiness expansion and value chain development in the region.

Efficiency of Actors in the Value Chain;

Data Envelopment Analysis (DEA) is a mathematical programming tool to estimate the productive efficiency of firms and other decision-making units. It evaluates the efficiency of an organization in using its resources to generate products by comparing it with the most efficient organizations thereby determining areas of weaknesses (Farrell, 1957). The economic efficiency has been believed to be a combination of both technical and allocative efficiency whereby the aim is to minimize the cost per unit of output, which is possible when firms achieve both technical efficiency (optimal use of inputs) and price efficiency (optimal input prices) (Yotopoulos and Lau, 1973). Banker et al. (1984) added to the DEA model the variable returns to scale (VRTS) which is that the constant returns to scale (CRTS) model might give an inappropriate efficiency measure when the decision-making units (DMUs) are not operating at an optimal scale. The VRTS specification enables a more explicit insight into technical efficiency, removing the scale effects. The two-stage chain model presented by Sexton and Lewis (2003) to DEA enables a more comprehensive insight into how decision-making unit (DMU) works in both phases, using inputs, and producing outputs (intermediate products).

Lu (2006) performed a study on vegetable marketing in Nanjing and estimated using a two-stage DEA model, with the overall efficiency of vegetable supply chains at 74 per cent, direct marketing at the lowest and wholesale market chains at the highest. It was also discovered that transaction costs were a significant efficiency hindrance in local tomato supply chains and that reducing their costs would motivate farmers to work harder to exploit resources and enhance productivity and ultimately raise incomes (Ruben et al., 2006). In a study, Banerjee (2010) compared the economics of organic and inorganic banana production and discovered that organic farming incurred lower costs of cultivation, whereas health-conscious consumers were ready to pay higher premiums to organic plantation, leading to more profits in the long-term to organic plantation owners. On the same note, Biswas (2010) analyzed densities of banana planting and proposed a planting density of 4444 tissue culture plantlets per hectare resulting in high yields and profits. Charyalu (2010) used DEA to estimate the technical efficiency of organic input unit and determined that there was low technical, allocative and economic efficiency on DEA-CRS model, but it was better on DEA-VRS model. DEA was employed by Kuah et al. (2010) to determine the efficiency of quality management, thereby indicating that inefficient management practices might be enhanced through specific strategies. Sathya (2011) used DEA to investigate technical and scale efficiency in tomato production under drip and conventional irrigation and established that there was great potential to increase output, with a potential increase of 46 and 47 percent under drip and conventional irrigation respectively. The importance of operating at an optimal scale to enhance efficiency was also identified by Asogwa et al. (2011) who used stochastic frontier production and cost functions to determine technical and allocative efficiency of the Nigerian rural farmers. Odemero (2013) examined efficient factor combinations in banana production in Nigeria, and discovered that labor, fertilizers, price, and education were important determinants of output. He advised that more labor and fertilizers should be used together with availability of credit facilities and better production techniques which would increase production. Ebiowei et al. (2013) examined allocative efficiency in banana and plantain production in Nigeria, which they found to be inefficient in terms of the allocation of family and hired labor, and plantain suckers. They recommended that better allocation of resources could be realized by the government and non-governmental organizations, including provision of credit, rural infrastructure, better varieties of suckers, and better delivery of extension services. Finally, Guleria et al. (2022) also explored the marketing effectiveness of apples in Kullu District, Himachal Pradesh, where they determined that three primary marketing channels are involved, the most effective being the producer-retailer-consumer channel. Most of the growers employed the producer-wholesaler-retailer-consumer channel in marketing their apples.

IV. Conclusion

Through the discussion above, it is concluded that value chain approach in business can enhance profitability and product quality that will help all the stakeholders in the chain such as the consumer. The distribution strategies are important in the distribution of apples because apples are very perishable and easily damaged or bruised. The majority of the studies have applied Data Envelopment Analysis (DEA) to evaluate the

efficiency of distribution channels and actors and provide a good comparative point of view on the performance. Nevertheless, in discussing the perceptions of orchardists on various distribution channels, commission agents and wholesalers were the most effective according to most growers.

Resting on the examination of several studies about the fruit value chains and on the main insights provided, the following crucial points can be mentioned to enhance the development of value chains and the ability to perform in the market: It is crucial to strengthen the interrelation of the value chain actors as an uninterrupted connection enables the actors to learn and exchange experience as far as the conditions in the market are concerned. Moreover, it is crucial to strengthen cooperative systems in the fruit value chain to promote integration, which would allow actors to engage in activities of the value chain effectively. The proponents of the concept of fruit value chain should keep working by targeting the producers of fruits to enhance their output and market share in order to ensure that the producers reap the fruits of the value chain.

In addition, studies on supply chains show that integrated management at different parts of the chain, such as the farm to consumer chain, can enhance efficiency and minimize losses. Value chain analysis has also provided the opportunity of value addition especially in product differentiation, enhanced post-harvest processing, and enhanced market linkages. Although a large number of studies have evaluated marketing channels within the apple market, few have been done to determine the factors that affect participation in different apple value chain channels and this is a major gap in research.

One of the methodological gaps that have been found in the literature on the value chain analysis of apple production is that there are no standardized methods of assessing the efficiency and performance of various stages in the value chain. Current research tends to adopt different methods and it is not easy to compare findings and come up with general conclusions. The rigor and consistency of the research in this area would be improved by developing a common methodology that would be applied to the specifics of the apple production value chain.

Scope of study:

I. Investigating Market Power and Mark-ups: Although many studies examine price, value-added, and profits among actors in the value chain, the underlying causes of mark-ups and market power have not been sufficiently explored. Research could delve into understanding how and why certain actors exert market power, which could help explain pricing disparities and provide guidance for improving fairness and efficiency in the value chain.

II. Standardization of Methodologies: A notable gap in the existing literature is the lack of standardized methodologies for assessing the efficiency and performance of the various stages in the apple value chain. Future studies could focus on developing consistent and replicable methodologies tailored to apple production, allowing for more reliable cross-comparisons and a more comprehensive understanding of the value chain's dynamics.

III. Exploring Distribution Channel Dynamics: Distribution strategies are critical in the apple value chain due to the perishable nature of the product. While existing studies have focused on efficiency and performance, there is still limited research on the factors influencing the choice of distribution channels. Future work could explore the preferences and perceptions of growers regarding distribution channels, especially in relation to commission agents and wholesalers, to identify optimal distribution strategies for improving efficiency and reducing losses.

IV. Market Linkages and Post-Harvest Processing: Research could further investigate opportunities for value addition through improved post-harvest processing and better market linkages. Studies could focus on innovative methods for product differentiation and the role of marketing channels in creating value for consumers and producers alike.

V. Stakeholder Participation and Engagement: There is limited research on the factors influencing stakeholders' participation in different channels of the apple value chain. Future studies could explore the decision-making processes of various stakeholders, such as farmers, traders, processors, and consumers, to better understand their motivations and improve participation in value chain activities.

VI. Impact of Technological Advancements: Given the rapid advancements in technology, future research could investigate the role of technology in enhancing apple production, distribution efficiency, and post-harvest processing. The integration of new technologies could play a significant role in addressing inefficiencies and improving the overall performance of the value chain.

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