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An Analysis of Supply Chain Management of Wheat on Kangra Farms

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ABSTRACT **Original Research Article**

This study looks at how wheat is managed in the supply chain (SCM) in the Kangra district of Himachal Pradesh, which is a very important agricultural area in the state. Kangra is the main district for growing wheat, accounting for around 27% of the total area and output. This means that the effectiveness of its wheat supply chain is very important for the food security of the region and the livelihoods of farmers. The study looks at the socio-economic traits of wheat farmers, figures out the costs and profits of growing wheat, looks at the costs, margins, and value added at different points in the supply chain, and finds the main problems that wheat farmers and marketing middlemen face in the Kangra Valley. A multistage random sample method was used to choose 80 wheat growers at random from 10 villages, with five villages each from two randomly determined development blocks. The research utilized both primary and secondary data sources. Structured and pre-tested schedules were used to conduct human interviews to acquire primary data about input use, output costs, and returns. Additionally, marketing-related data were collected from chosen market intermediaries, comprising traders, wholesalers, processors, and retailers, with five respondents selected from each category to evaluate marketing strategies and limitations. We got secondary data from official government reports and the Statistical Abstracts of Himachal Pradesh. We used the right statistical methods, like basic averages, percentages, and ratios, to analyze the data and figure out applied cost concepts and farm-level economic performance.

The results revealed that farmers in Kangra farms are small typically holding less than one hectare. This suggested that a limited capacity for large scale mechanization and a need for subsistence- focused agricultural strategies. Literacy rates among farm heads are generally high exceeding 90 per cent with large farms having slightly higher literacy percentage than small farms implying that farmers are educated and trained and are likely receptive to technical and improved production technology. Agriculture remains a primary occupation in the study area. The land use pattern of the sampled households suggested that wheat growers in the region were primarily relied on cultivated land which was 81.43 per cent in overall farm situation, with irrigation support (around 81 per cent) playing a crucial role in crop production. The cropping structure showed wheat occupied the major share in the rabi season across all farm categories, an overall proportion of 39.04 per cent of the gross cropped area. Among kharif crops, maize emerged as the dominant cereal, covering 25.27 per cent of the total cropped area, followed by paddy accounting for 12.83 per cent. The cropping intensity was worked out to be 187.67 per cent for small farmers and 192.34 per cent for large farmers, with an overall value of 190.32 per cent, indicating multiple cropping practices in the study area. The average family size was approximately 5.7 to 6.0 members with a high proportion of adults nearly 65 per cent in overall farm situation. This indicated that a strong availability of family labour, which is critical for labour intensive hill agriculture. Nuclear families were more prevalent comprising of 58.75 per cent of households in the overall farms situation. Investment in farm implements

and tools is a critical factor enhancing agricultural productivity by improving operational efficiency and reducing labour costs. In this regard, it was found that an investment in farm machinery and implements in the study area had an increasing trend and positive correlation with farm size. The small farms invested on an average of Rs. 2, 76,977.81 per farm, whereas large farms invested substantially more, averaging Rs. 3, 65,758.23 per farm.

The economic and profitability assessment of wheat cultivation in the Kangra Valley showed that the district is the most important part of the state's wheat economy. It has 86,493 hectares of land under cultivation and produces 192,804 metric tonnes of wheat, which is a big part of the state's total production. The analysis showed that the total cost of cultivation (Cost C3) was ₹71,496.46 per hectare for small holdings and ₹77,510.80 per hectare for large holdings, with a mean of ₹74,278.09 per hectare. The total cost for Cost A1 was ₹43,854.31 per hectare, and for Cost B2 it was ₹59,740.48 per hectare. The average yield of wheat on farms was 38.35 quintals per hectare, which brought in gross returns of ₹115,735.95 per hectare. The highest gross profits were for large farms (₹121,718.00 per hectare), followed by small farms (₹110,588.61 per hectare). Farm business income, farm labor income, net farm income, and farm investment income were all used to measure production efficiency. All of these were highest among large-scale farmers. The overall output–input ratio was 1.56, and the break-even yield and break-even revenue were 30.95 quintals per hectare and ₹52,968.26 per hectare, respectively. These results indicate that larger agricultural holdings attain slightly enhanced efficiency and profitability in wheat production relative to smaller farms.

The study aimed to identify the primary wheat supply chains in the mid-hill regions of the Kangra Valley and to analyze the functions of various market intermediaries responsible for transporting wheat from producers to end consumers, including their marketing expenses, profit margins, price differentials, marketing effectiveness, and the producer's share of the consumer's expenditure. Supply chains were classified based on the creation of form, place, time, and possession utilities, leading to the identification of three distinct marketing channels within the study area. Channel II, which goes from producer to primary wholesaler to secondary wholesaler to retailer to consumer, was the most popular way to buy and sell wheat, making up 56.86% of all transactions. The study showed that Channel III (producer → local trader/commission agent → flour miller → retailer → consumer) had the biggest pricing spread since it had the most marketing margin (19.84%). Channel I, on the other hand, where producers sold directly to customers, had the largest producer's share in the consumer's rupee (97.73%) and the lowest in Channel III (62.88%). This shows how having more middlemen can affect the price. Channel I also had the best marketing efficiency (42.99%) since there were fewer middlemen, which cut expenses and helped farmers get better prices. The findings show that having more middlemen makes marketing more expensive and less profitable for producers, which lowers their returns and makes the whole channel less efficient.

The amount of value added to wheat was very different in the several supply chains that were found. The results showed that the largest value was added at the processing stage, especially in Channel III, where it reached 23.79%. The least value was added at the trader level, where it was just 4.90%. So, Channel III, which includes processing operations, had the most value added overall. In Channel II, intermediaries added value at different stages, from 5.50% at the retailer stage to 7.28% at the secondary wholesaler level. Channel III, on the other hand, showed a greater range, with value addition going from 4.90% at the trader level to 23.79% at the wheat miller stage before the goods got to stores and then to customers. These findings indicate that prolonged marketing chains, encompassing merchants and processors, yield enhanced value addition within the wheat supply system of the research area. The results show that farmers could benefit from making direct connections with processors or flour

mills. This would let them take part in value-added activities and get a bigger share of the value created, which would increase their income and overall returns.

Analysis of the supply chain in Kangra reveals several bottlenecks: While, cultivators were mainly constrained by production risks, dependency on middlemen, and limited bargaining power; intermediaries encountered transportation challenges, price volatility and infrastructural hurdles. The analysis thus indicated that both production and marketing hurdles significantly affect productivity and profitability and efficiency of wheat supply chain. Addressing these constraints through improved seed distribution, labour management, better market linkage, and development of infra-structure and processing facilities could enhance the overall performance of wheat sector.

Keywords: Wheat growers, Family size, Age and education of the head, Literacy rate, Occupation, Cropping pattern, Investment, Inventory, Landholding, Costs, Returns, Marketing channel, Processor, Wholesaler, Retailer, Consumer, Price spread, Producer's share, Marketing efficiency, Value addition, Constraints.

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Introduction

Supply chain management of wheat is crucial for ensuring global food security, reducing post-harvest waste, enhancing farmer profitability, and promoting sustainable environmental practices. It manages the entire process from farming and storage to distribution, mitigating risks from climate change or geopolitical issues while ensuring quality.

Effective supply chain management ensures a steady supply of wheat, a critical staple food, preventing shortages and stabilizing prices. Proper management minimizes inventory holding costs and reduces losses through better logistics and storage, increasing profitability for farmers. Efficient handling, storage, and transportation are essential to maintain the quality of wheat from farm to consumer, preventing spoilage. Advanced supply chain management practices can reduce greenhouse gas emissions by up to 48% through better resource management (e.g., optimized fertilizer use).It mitigates risks associated with climate change, transportation, and geopolitical conflicts that can disrupt global supply chains. It directly affects the income of stakeholders in the agricultural sector, particularly in countries with large agricultural economies. Effective, technology-driven, and sustainable wheat supply chain management plays a vital role in balancing supply with consumer demand and ensuring food safety.

In Kangra district of Himachal Pradesh, the analysis of supply chain management of wheat focuses on a critical agricultural sector, as Kangra holds the top position in the state for wheat area (86,493 ha) and production (1,92,804 MT), contributing to roughly 27% of the state's total output. The supply chain involves a complex interplay of farmers, intermediaries (middlemen), millers, and consumers, with major bottlenecks identified in input access, logistics, and market integration. The district is a vital hub for wheat production in the mid-hill region of Himachal Pradesh. The primary aim is to analyze the costs, returns, and value addition at each stage of the supply chain to improve farmer income and local agricultural resilience. The study often stems from the need to understand how to improve the efficiency of the supply chain, which is hampered by fragmented, small-scale farming and inadequate infrastructure.

The wheat supply chain in Kangra generally moves from producers to consumers through three main channels, with varying degrees of efficiency: **Channel I (Direct):** Producer →Consumer; **Channel II (Intermediate):** Producer →Retailer/Small Trader →Consumer; and **Channel III (Processing):** Producer →Wholesaler →Flour Millers (Processor) →Retailer →Consumer. The highest degree of value addition is typically found in the processing channel (flour millers), whereas it is lowest at the trader level

The supply chain faces several bottlenecks at different levels: At production level, Low availability of quality seeds (ranked as the top constraint), Labour shortages during peak agricultural seasons, Unpredictable weather conditions leading to erratic production. At Marketing level, Transportation challenges in the hilly terrain, Lack of adequate storage and processing units, Middlemen exploitation and limited bargaining power of farmers, delayed payments from buyers impacting cash flow.

While gross returns can be high net returns are often affected by high marketing and processing costs. Enhancing direct links between farmers and processors (flour mills) can significantly improve the farmer's share in the consumer price and reduce the dominance of middlemen.

To enhance the supply chain, the government of Himachal Pradesh has introduced procurement of naturally grown wheat under the 'Him-Bhog' bran, A fixed MSP of ₹60 per kg for wheat, designed to support farmers using natural methods

and Investments in storage and transportation to boost the rural economy.

In this context, the current study conducts a thorough investigation of the socio-economic attributes of wheat growers in the Kangra area of Himachal Pradesh, as well as an evaluation of production expenses and profitability. The research also looks at the costs and profits of different marketing channels, the costs and profits of processing and adding value at different points in the supply chain, and the main problems and limitations that wheat farmers and market intermediaries in the district face.

Methodology

Selection of the Study Area

The study was intentionally conducted in the Kangra area of Himachal Pradesh because of its prominent position in the state's wheat production. The Statistical Abstract of Himachal Pradesh (2021–22) says that the district produced about 135,247 metric tonnes of wheat, which makes it a good place to study wheat-related supply chains. The district also had a well-developed network of agricultural markets and middlemen, which made it easier to find and look into the several marketing channels that are linked to growing wheat [6], [5], [1], [2].

Sampling Design and Sample Selection

Kangra district has fifteen development blocks, and a multistage random selection method was used to choose the study sample from these blocks. First, a complete inventory of all the blocks in the district that grew wheat was made. Then, two blocks—Indora and Nurpur—were chosen at random. At the first step of sampling, these blocks were chosen because they had the most wheat-growing land and output levels in the district [6].

During the second round of sampling, officials from the Department of Agriculture helped make detailed lists of villages that grow wheat in the two selected blocks. Then, five villages from each block were chosen at random. In the third stage, full lists of wheat farmers from the chosen villages in both Indora and Nurpur blocks were made. Eight farmers were then chosen at random from each village, bringing the total number of farmers in the sample to 80. For analytical purposes, respondents were classified based on landholding size utilizing the cumulative square-root frequency approach [6], [5], [1], [2], and were divided into two categories of farm size: small holdings (less than 1 hectare) and big holdings (1–3 hectares). Table 1 shows how the sampled farmers are spread up throughout different groups.

Table 1: Distribution of sampled households according to their size of land holding

S. No.	Category of farmers	No. of Farmers
1	Small	37
3	Large	43
4	Overall	80

Data Collection

Both primary and secondary data were used to achieve the study's goals. A field survey employing a carefully planned and pre-tested schedule was used to acquire primary information about wheat production and marketing techniques. The survey was done through personal interviews with a small group of selected farmers. Moreover, to comprehend the dynamics of the wheat supply chain, data were gathered from essential market intermediaries—namely wholesalers, merchants, flour millers, and retailers—utilizing a structured questionnaire with five respondents selected from each category. Secondary data were obtained from official government reports, publications, and pertinent departmental websites to enhance and corroborate the primary findings.

Analytical Frameworks

In order to achieve the stated objective, the data were analyzed by using appropriate mathematical and statistical tools. Simple tabular analysis was done so as to present the socio-economic profile of the wheat growers. Various budgeting techniques like averages, percentages and ratio were computed to present the social and economic status of wheat growers.

Cost and Return Analysis

The estimation of production costs and returns for wheat cultivation was carried out using the cost concepts prescribed by the Commission for Agricultural Costs and Prices (CACP), Government of India (2004) [6].

Cost A_1 Includes

1. Cost of planting material
2. Cost of manures, fertilizers and plant protection chemicals
3. Cost of hired human labour
4. Irrigation charges
5. Depreciation on implements
6. Interest on working capital
7. Other miscellaneous charges

Cost A_2: Cost A_1 + Rent paid to leased in-land

Cost B_1: Cost A_1 + interest on the fixed capital

Cost B_2: Cost B_1 + rental value of owned land

Cost C_1: Cost B_1 + imputed value of family labour

Cost C_2: Cost B_2 + imputed value of family labour

Cost C_3: Cost C_2 + management cost (10%)

Farm Income Measures

1	Net farm income	Gross income- Cost C_3[6]
2	Farm business income	Gross income- Cost A_1[6]
3	Family labour income	Gross income- Cost B_2[6]
4	Farm investment Income	Farm business Income- Imputed value of family labour[6]

Computation of Benefit-Cost Ratio

The benefit-cost ratio shows how much money you get back for every rupee you spend on inputs utilized in the production process. It is calculated by dividing the gross return from total costs [6].

Break-Even Analysis

Break-even output is the least amount of goods that must be made to cover all production costs. If farmers don't make this much, they lose money. To get it, you divide the total fixed costs (TFC) by the difference between the average variable cost (AVC) and the unit price of wheat (Py). To get the average variable cost, divide the total variable costs by the total amount of wheat produced [6].

Data pertaining to marketing-related aspects, such as marketing costs, mode of transportation, and marketing-related challenges faced by the respondents were gathered from stakeholders including farmers, traders, commission agents, and wholesale market personnel regarding the wheat supply chain, using pre-tested schedules and personal interviews. The analysis focuses on four important factors: marketing costs, marketing margins, pricing spread, and the producer's share of the consumer's rupee. These factors help find the best way to promote wheat in the Kangra Valley. We used the right math and statistics to put together and look at the data for the agricultural year 2024–25. Descriptive budgeting methods, such as averages, percentages, and ratios, were used to help understand the results of the study and make it easier to judge them.

Identification of supply chain was done from inputs to consumer. Identification of supply chain was done on the basis of form utility, place utility, possession utility and time utility [2].

Market Analysis

Marketing Cost

The total marketing cost (TC) incurred along the supply chain was estimated by aggregating the marketing expenses borne by the producer/seller (PC) and those incurred by all intermediaries involved, calculated as the sum of the marketing costs of the *i*th intermediary ($\sum MC_i$) [2].

Marketing Margin

The marketing margin of intermediaries was computed as the difference between their total receipts from sales and the combined expenditure on purchase price and marketing costs [2].

Price Spread

Price spread, also referred to as the marketing margin, represents the difference between the price paid by the consumer and the price received by the producer. It serves as a key indicator of the economic efficiency of a marketing system, with a narrower price spread reflecting higher marketing efficiency and a more effective distribution mechanism [2].

Producer's Price

The net price received by the farmer (PF) was determined by subtracting the marketing costs incurred by the producer (MC) from the gross price paid to the producer (PS) by the commission agent or wholesaler [2].

Producer's Share in Consumer's Rupee

The producer's share in the consumer's rupee (PS) was calculated by expressing the net price received by the farmer (PF) as a percentage of the retail price (RP) per unit of output, obtained by multiplying the ratio of PF to RP by 100 [2].

Marketing Efficiency of the Marketing Channels

In the context of marketing channels, marketing efficiency reflects the effectiveness with which agricultural produce is transferred from producers to consumers at the minimum possible cost, while adequately delivering the services required by consumers. In this study, the marketing efficiency of different channels was estimated using the modified Acharya's method [2], as outlined below.

$$ME = \frac{RP}{MC + MM} - 1$$

Where,
ME = Marketing efficiency
RP = Retailer's price
MC = Total marketing costs
MM = Total marketing margins

Degree of Value Addition

The degree of value addition at each stage of the wheat supply chain was determined by computing the margin for each participant—defined as the difference between selling price and total associated costs—and expressing this margin as a percentage of the aggregate value added along the entire chain [1].

Constraints Encountered By the Various Market Functionaries and Farmers

The Henry Garrett ranking technique (1969) was employed to identify and prioritize the constraints encountered by market functionaries within the wheat supply chain. Under this approach, respondents were requested to rank the identified factors according to their perceived importance, and the assigned ranks were subsequently transformed into corresponding score values for systematic analysis [3].

Results and Discussion

Socio-Economic Characteristics of Sampled Households

Socio-economic characteristics refer to social and economic attributes that define an individual, household or community and ultimately help in understanding living standards, economic conditions and social status of a population.

Distribution of Sampled Households According to Their Size of Land Holding

The distribution of sampled households based on landholding size **revealed** that a majority of the farmers in the study area **fell** into the small farm category (<1 ha), accounting for 53.75 per cent of the total sample. This indicated a predominance of smallholders in wheat cultivation, reflecting the fragmented nature of landholdings in the region. Small farmers tended to cultivate wheat and other crops mainly for subsistence, on the other hand large farmers engage in both commercial cultivation and surplus marketing. Similar studies have been reported in the Shivalik foothills of Haryana, where smallholders accounted for a slightly higher proportion of total farm population, underscoring the fragmented nature of landholdings in such regions (Singh et al. 2025).Large farmers (1–3 ha) **comprised** 46.25 per cent of the sample. The overall sample size **consisted** of 80 households [5].

Farm Category Wise Demographic Profile of Sampled Household in the Study Area

Family systems are very crucial component in any socio-economic study. Family systems, whether nuclear or joint, play a crucial role in individual's lives and society as a whole. Each type had its own unique characteristics, which were shaped by cultural, social and individual factors. Nuclear families offer a high degree of autonomy and independence to their members and this can allow individuals to make decisions that align with their personal goals and values, whereas, joint families offer a built-in support system. With multiple generations living together, family members can provide emotional, financial, and social support to each other. Also, family size is an crucial factor for livelihood diversification. In a large family, some members could remain engaged in traditional farming while others could opt for nonfarm activities. It will also reduce the risk of livelihood failure (Khatun and Roy. 2012).

The average family size of sampled wheat farming households was 5.78 members, with small farms averaging 5.56 members and large farms 6.03 members. The composition of families was nearly balanced in terms of gender, with males constituting about 33.44% and females about 32.03% of the total household population. Joint families accounted for 41.25% of households overall, slightly more common among large farms (43.24%) than small farms (39.53%). These findings are consistent with Menon (2023), which reported almost 42 per cent of households were reported as joint on the sample farm of Kangra. Nuclear families were more prevalent, comprising 58.75% of households [5].The average number of male children per household was 1.17 (20.22%), while female children averaged 0.83 (14.31%).

Age-Wise Distribution of Family Heads of Sampled Households

Age is a important determinant in the adoption of socio-economic changes, and it affects how family heads respond to scientific advancements and new practices. Understanding this characteristic of family heads is essential, as it significantly influences farm management decisions. An insight into the age distribution of family heads showed that 37.50 per cent of households were less than 40 years of age, whereas those above 60 years comprised 17.50 per cent. Similar observations were made by Kumar et al. 2025), where most household heads were in the middle-age bracket, actively managing farm operations. This age structure reflects a relatively experienced farming population, which can influence adoption of new agricultural practices and decision-making capacity [5].

Educational Status

The level of education among family members plays a crucial role in the effective management of farms, the adoption of modern technologies and the efficient marketing of agricultural products. Higher education levels enhance skills and overall awareness within the family, allowing farmers to better understand and implement new innovations and techniques, ultimately improving their overall well-being.

Educational Status of Family Heads of Sampled Households

Modern agriculture is marked by its dynamic nature, along with its associated risks and uncertainties. Family heads assume various roles, including both managerial and hands-on responsibilities on the farm. Their educational background is critical in influencing decisions related to agricultural production and marketing.

The literacy status of family heads revealed a high overall literacy rate of 93.75 per cent. Large farm households exhibited slightly higher literacy (94.59 per cent) compared to small farms (93.02 per cent). Education levels varied with 23.75 per cent having completed matriculation and 22.50 per cent possessing graduation or higher qualifications. Primary and middle schooling accounted for about 20 per cent of sampled heads, while illiteracy was minimal, at 6.25 per cent. The higher education level of head of the family showed that they could play a crucial role in adoption of new innovation and will strengthen the income of family. The results are in conformity with the earlier studied conducted by Mishra and Ghadei (2015).

These findings suggested effective educational outreach and highlight the potential of education in empowering farming communities [5].

Literacy Status of Sampled Households

The literacy levels among household members indicated an overall male literacy rate of 94.06 per cent and a female literacy rate of 91.23 per cent. The improved literacy in Kangra can be attributed to better access to schools, government literacy programs, and growing awareness about the importance of education mainly for women. These findings are consistent with Rashmi (2018), which reported 99.26 per cent literacy rate of males and 92.37 per cent literacy rate of females on the sample farms of Kangra. Higher literacy levels among farmers can enhance the adoption of modern agricultural practices, effective farm management, and informed decision-making, which ultimately contributes to improved farm productivity and socio-economic well-being. Categorization of literacy showed that most males and females had completed education up to matriculation or senior secondary levels. The gender gap in literacy had narrowed compared to previous decades, reflecting progress in female education within the study area. This literacy status contributed to greater awareness, more effective management of farm activities, and enhanced opportunities for diversification [5].

Occupational Pattern of Sampled Households

The occupational pattern of households reflected their primary source of income and livelihood. In hilly regions, limited farming opportunities make people to seek alternative income sources for better livelihood. The results reflected the dependence of households on agriculture as the primary source of income and the limited diversification into other sectors.

The occupational profile of sampled households reflected the predominance of agriculture as the main source of livelihood. The overall workforce engaged in agriculture was 69.75 per cent, with participation slightly higher among large farms (71.72 per cent) than small farms (67.63 per cent). Service sector employment accounted for 15.23 per cent, while 15.03 per cent were involved in business activities. This predominance of agriculture is consistent with Pratyush (2022), where 66.67 per cent of rural sampled household members were depended on farming. The division of labor within agriculture showed that male members slightly more than females, contributed to 51.79 per cent of agricultural work, while females accounted for 48.21 per cent, indicating active participation of women in farming operations. The average number of workers size per household was 3.48. Gender distribution within agricultural labor with males representing 51.79 per cent and females 48.21 per cent, highlighting significant involvement of women in farming activities. This occupational pattern indicates a dependence on agriculture supplemented by engagement in other sectors to diversify household income [5].

Farm Inventory and Investment

Average Investment on Farm Implements, Machinery and Tools of Sampled Households

Investment in farm implements and tools is a critical factor enhancing agricultural productivity by improving operational efficiency and reducing labour costs.. The data revealed an increasing trend in investment with growing farm size. Small farms invested an average of Rs.276, 997.81, whereas large farms invested substantially more, averaging Rs.365, 758.23. Overall, the average investment per farm was Rs. 318,049.50 [5].

Investment in major implements dominated, constituting approximately 95.32 per cent of total investment. Among these, tractor accounted for the largest share at 56.62 per cent overall, with an average investment of Rs.172, 344.32 per farm. This was followed by threshers (28.16%) and power tillers (9.87%). Power sprayers and manual sprayers together comprised the remaining portion of major implements. This distribution highlights the reliance on mechanized equipment to increase farming efficiency and manage larger landholdings effectively [5].

Minor implements accounted 4.68 per cent of total investment. The plough represented the highest share within the minor category at 41.96 per cent, followed by levellers (20.37%) and grass cutters (16.09%). Other tools such as spades, sickles, hoes, axes also contributed smaller but essential shares to the total investment. These findings are consistent with Ruchika (2016), which similarly noted higher investments in heavy machinery like tractors and chaff cutters compared to smaller tools. The spread of investments in minor implements illustrates the continued importance of traditional tools alongside mechanized equipment in farm operations [5].

Overall, the findings demonstrate a positive correlation between farm size and investment in agricultural tools and machinery in the study area. The predominance of tractors and threshers reflects the modernization trend among farmers seeking to increasing productivity through greater mechanization.

Livestock Inventory of sampled Households

Livestock farming is an essential component of agricultural livelihoods, contributing to household income and diversification. The result showed that the average number of animals maintained on an average farm was 1.83 in numbers. Cows constituted the largest proportion of livestock, representing 39.36 per cent of the total, followed by buffaloes, which accounted for 33.29 per cent. Young stock made up 13.23 per cent of the livestock population. Smaller shares were held by goats (7.63%) and poultry (6.49%). The distribution reflects the preference of farmers for large ruminants, which play a significant role in draft

power and dairy production, essential for sustaining farm operations and household nutrition. The greater livestock numbers on larger farms signify their capacity to support diversified farm enterprises. The keeping of cattle and buffaloes reflected the continued use of traditional animals, which helped support both the farmers' income and the environment. This distribution indicated a strong reliance on dairy as a supplementary income source; these findings are consistent with Pratyush (2022) which highlighted the significant role of livestock, particularly dairy cattle, in the livelihoods of rural households in Himachal Pradesh [5].

Land Holdings and Utilization

Land Use Pattern of Selected Growers in Study Area

The results showed that the average operational holding of large farmers 1.83 hectares and 0.73 hectares for small farmers. Out of the total land, the share of cultivated area was found higher for large farmers (86.57%) compared to small farmers (77.01%). Irrigated land accounted for nearly two-thirds of the cultivated area across categories, with large farmers reporting a slightly higher proportion (69.54%) than small farmers (61.19%). The results also showed that orchards occupied only a marginal portion of land 0.07 hectare, while pasture and non-agricultural uses together accounted for less than 15 per cent of holdings. This shows that wheat growers in the region primarily relied on cultivated land, with irrigation support playing a crucial role in crop production [5].

Cropping Pattern

The results indicated that wheat occupied the major share in the rabi season across all farm categories, an overall proportion of 39.04 per cent of the gross cropped area. Among kharif crops, maize emerged as the dominant cereal, covering 25.27 per cent of the total cropped area, followed by paddy accounting for 12.83 per cent [5].

In terms of fruits, kinnow, guava, and sweet orange were also found to be grown, though their share remained quite limited. The results showed that kinnow accounted for 1.46 per cent of the gross cropped area, followed by sweet orange and guava. Fodder crops like chari and berseem were cultivated on a small scale, contributing about 1 to 2 per cent of the cropped area. The gross cropped area was found to be 1.37 ha for small farms and 3.52 ha for large farms, with the overall average at 2.36 ha. The cropping intensity was found to be 195.52 per cent for small farmers and 197.70 per cent for large farmers, with an overall value of 197.13 per cent, indicating multiple cropping practices in the study area. These findings are consistent with Sood (2024), which similarly noted 195.66 per cent cropping intensity on the sample farms of Kangra and Mohan et al. (2025) reported similar intensification in mid-hill districts. The inclusion of orchards like kinnow, guava, and sweet orange, though minor in land allocation, showed diversification efforts to enhance farm income and reduce dependency on cereals alone [5].

Status of Wheat in Terms of Area, Production and Productivity in Different Districts across the State (2022–23)

The district-wise distribution of wheat cultivation in Himachal Pradesh revealed significant regional differences in area, production, and productivity. Kangra emerges as the leading district, with 86,493 hectares under wheat cultivation and a total production of 192,804 MT, contributing substantially to the state's overall wheat output. Wheat in Mandi covers 61,587 hectares with production of 130,058 MT, whereas Una with a smaller area of 35,514 hectares recorded the highest productivity in the state at 2.97 MT/ha, producing 105,473 MT [6].

In contrast, Kinnaur and Lahaul-Spiti remain marginal contributors due to their limited area and climatic constraints, together accounting for less than 200 hectares. Districts such as Hamirpur (1.61 MT/ha) and Kullu (1.99 MT/ha) reflect relatively low productivity levels compared to the state average. On the other hand, Bilaspur (2.61 MT/ha), Shimla (2.59 MT/ha), and Sirmaur (2.27 MT/ha) showed stronger performance in yield terms despite smaller areas under wheat [6].

At overall level, Himachal Pradesh reported 3.20 lakh hectares under wheat cultivation, producing 7.14 lakh MT with an average productivity of 2.23 MT/ha. The data revealed that while Kangra led in scale, districts such as Una and Bilaspur have successfully achieved higher yield levels. This variation highlights the need for targeted measures to uplift productivity in lagging districts like Hamirpur, while sustaining high performance in areas such as Una and Bilaspur [6].

Costs and Returns from Wheat Cultivation of Sampled Farm

Analysing the cost-return structure of wheat production is important for farmers and agricultural professionals as it offers a detailed look at all expenses involved in the production process such as expenses on seed, fertilizers application, human labour, hired labour cost etc. By carefully tracking these expenditures, farmers can manage their finances and make informed decisions regarding resource distribution. Such comprehensive understanding aids in budgeting, forecasting financial needs and ensuring that all costs are assessed and known before planting the crop [6].

In addition to assessment of costs, evaluation of the returns from wheat cultivation is equally important. By estimating potential revenue based on projected yields and current market prices, farmers can forecast their earnings and assess the profitability of their efforts.

This evaluation is important for setting realistic financial targets and developing pricing strategies. Understanding expected returns allows farmers to prepare for market

fluctuations and adjust their production practices to maximize revenue.

A detailed analysis of costs and returns helps in identifying areas for cost savings and efficiency improvements. It provides opportunities to reduce expenses by optimizing resource use and adopting new technologies. In this view, an attempt has been made in this section to analyse the costs and returns of wheat production on sample farms.

Cost of Cultivation of Wheat in the Study Area

The cost structure of wheat cultivation among the sampled households revealed that the total cost of cultivation (Cost C_3) was found to be at ₹71,496.46 per hectare for small farmers, ₹77,510.80 per hectare for large farmers, with an overall average of ₹74,278.09 per hectare. It is evident that large farmers incurred slightly higher expenditure compared to small farmers, which may be attributed to their relatively larger scale of operations and higher investment in machinery and other inputs [6].

Among different cost components, depreciation on implements formed the largest share, accounting for 23.25 per cent in small farms and 28.31 per cent in large farms, with an overall contribution of 25.69 per cent. This showed that wheat cultivation in the area is moderately mechanized. Human labour and machinery use were also important contributors. Hired labour accounted for 10.31 per cent of the total cost, followed by tractor and thresher charges (8.51%) fertilizers (5.42%). Seed costs are a significant part of the material expenses and were calculated at overall Rs.3300.68 per hectare accounting for 4.44 per cent of the total cost. Similar results were reported by Dudve (2023) where cost of seed per hectare was estimated at Rs.3075 for sample farms. Miscellaneous charges, land revenue, and interest on working capital formed a small share of less than 2 per cent. When considering different cost concepts, Cost C_2 (including imputed value of family labour and rental value of land) was found to be at ₹64,996.78 for small farms, ₹70,464.36 for large farms, and at all farm situation was found out to be ₹67,525.54 [6].

Overall, the results highlighted that wheat cultivation in Kangra district involved significant fixed capital requirements along with notable expenses on labour and machinery. The higher costs on large farms suggested greater intensity of input use, though the relative cost distribution remained broadly similar across farm categories [6].

Farm Category Wise Profitability Analysis of Wheat in the Study Area

The profitability of wheat cultivation in the study area across small and large farm categories reflected that the average wheat yield was found to be 37.02 quintals per hectare for small farms and 39.89 quintals per hectare for large farms, with an overall average of 38.35 quintals per hectare. The overall by product returns were Rs.23702.25 per ha, resulting in overall gross returns of Rs.115735.95 per hectare. This finding was consistent with previous studies, such as Dhakal (2022), where the gross returns were Rs.1, 53,717.38 per hectare and Dudve (2023), where gross returns were Rs. 10, 5625.Net farm income ranged from Rs. 39,092.15 per ha in small farms to Rs. 44,207.20 per ha in large farms, averaging Rs. 41,457.86 per ha. Family labour income was calculated at Rs. 53,675.15 per ha and Rs. 58,692.07/ha for small and large farms, respectively, while farm investment income was found at Rs. 61,317.90/ha for small farms and Rs. 67,325.88 per ha for large farms. The output-input ratio was slightly higher in large farms (1.57) compared to small farms (1.55), indicating marginally better resource use efficiency. Break-even yield was 29.79 quintals per ha for small farms and 32.30 quintals per ha for large farms, with corresponding break-even returns of Rs. 50,099.09 per ha and Rs. 56,302.71/ per ha. Overall, the results suggest that large farms earn slightly higher profitability and efficiency in wheat cultivation than small farms [6].

Marketable Surplus and Supply Chain Analysis of Wheat

Production and Utilization of Weat

The results showed that the overall production of wheat was 38.12 q. Out of the total production, 9.73 per cent was utilized at home, 5.51 per cent seed retained and 6.03 per cent was given as kind payments. Since the cultivators of the sampled households retained produce neither less nor more than his actual requirement which equated the marketable surplus is equal to marketed surplus. In absolute terms the marketed surplus was overall 30.01 q (78.73% of total produce) in the study area. These findings are consistent with Thakur (2024), which similarly noted marketed surplus of 80.38 per cent out of total production, for the cultivation of wheat on sample farm of Una [2].

Supply Chain Mapping

Supply Chains of Wheat Crop in Study Area

The supply chains of wheat in study area were identified on the basis of form utility, place utility, time utility and possession utility, ensuring that each component contributes effectively to the overall efficiency and functionality of the system (Jassi, 2011). Form Utility enhances the value of a product through processing, packaging or assembling. Place Utility ensures products are available at locations convenient for consumers. Time Utility guarantees product availability when needed by consumers. Possession Utility facilitates consumer access and ownership of products.

Functionaries/Actors and Their Role in Wheat Supply Chain

Various functionaries play distinct roles and contribute to the overall process in the supply chain analysis of wheat. The primary actors in supply chain include input suppliers, producers, traders and consumers. In addition to these primary or direct actors, there are several indirect actors who

influence the supply chain's efficiency and functioning. These include credit agencies, corporate service providers, governments, non-governmental organizations (NGOs), cooperatives, researchers, and extension agents. The following are the notable functionaries who are frequently involved in the supply chain analysis of wheat [2]:

Input Suppliers

Input suppliers are integral to the agricultural supply chain as they provide farmers with essential agricultural inputs such as seeds, fertilizers, insecticides, and equipment necessary for wheat production. These suppliers ensure that farmers have access to high-quality inputs. In the study area input supply is driven by a combination of private sector actors and government agencies. Private suppliers of inputs include seed dealers, seed companies, and small retail stores that sell small quantities of seed, fertilizer, and plant protection chemicals to farmers at the village level. Government organizations involved in input supply include state agriculture departments.

Sources of Input Supplies

Among various input, 65.33 per cent of small farmers and 69.36 per cent of large farmers procured seeds from government agencies, while 34.67 per cent of small farmers and 30.64 per cent of large farmers relied on the open market. Fertilizers and plant protection chemicals were largely purchased from the open market, accounting for 76.35 to 78.64 per cent and 79.47 to 82.90 per cent of small and large farmers, respectively. A small proportion of seeds was obtained from own sources (23.22% overall). These findings consistent with Mandial (2025) in Himachal Pradesh, who noted farmers preferred easily available and high-quality inputs from open markets for timely application than dependent on government agencies.

The findings indicated that the majority of farmers procured inputs, mainly fertilizers and plant protection chemicals from open markets, while some sourced from government agencies. Inputs purchased from open markets were more expensive. Farmers reported lack of information regarding availability of inputs from government entities and due to these limitations in distribution network, farmers shifted more to open market. This might result in delays or insufficient supplies, particularly during peak demand periods, disrupting cultivation cultivation schedules.

Producers

Producers are individuals or enterprises engaged in farming. They are responsible for cultivating crops; supervise farming operations and ensuring both the quality and quantity of the produce. Producers play a crucial role in selecting wheat varieties; implementing appropriate farming practices and ensure timely harvesting. Producers typically interact with traders, forwarding agents and wholesalers to facilitate the distribution and sale of their produce.

Traders

Traders serve as intermediaries between producers and processor. They facilitate the sale and distribution of wheat by connecting producers with potential buyers. Operating primarily in local markets, they play a role in streamlining the supply chain. Local dealers often procure wheat from multiple growers and collected it for distribution.

Processor

The role of the processor in wheat supply/value chain is essential for adding value to raw material and converting it into processed products. Processing helps transform produce into stable food with an extended storage life, enabling efficient worldwide transportation and distribution.

Wholesalers

Wholesalers procure wheat in bulk from producers, local traders or directly from agricultural markets. They store the produce for some days or a certain period before further distribution. Survey results indicated that local wholesale markets serve as primary centers for wheat aggregation in each area.

Retailers

Retailers represent the final link in the wheat supply/value chain, selling produce directly to consumers. They operate in various locations, including grocery stores, supermarkets, farmers' markets and online platforms.

Consumers

A consumer is an individual who buys goods or services for personal use rather than for resale or further production. Consumers represent the final stage in the supply/value chain.

Marketing Channels

Marketing channel is the pathway through which produce moves from its origin to the final consumer. The presence of multiple intermediaries between producers and consumers results in existence of various structured marketing channels for the same commodity. Local traders, wholesalers and retailers facilitate wheat marketing in study region.

The analysis of supply chains of wheat in the study area indicated that multiple pathways utilized by farmers to reach the final consumer. Three main chains were identified: First chain, where produce was sold directly from producer to consumer, second chain, where produce sold through primary and secondary wholesalers then retailers to consumers, and in third channel, sales via local traders/commission agents to flour mills to retailers and then to consumers. Study revealed that the majority of wheat was routed through intermediaries. This pattern is consistent with findings in Una district by Thakur (2024). These channels facilitate price discovery and timely movement of wheat but also involve varying degrees of marketing costs and margins, impacting the net returns to farmers. These findings also consistent with Kumar (2022),

who observed that functionaries influence the flow and value capture in agricultural marketing chains in Himachal Pradesh [2].

With regard to the marketing pattern of wheat, the results showed that a small number of farmers (1.74%) sold wheat directly to consumers (Channel-I). The majority of wheat was marketed through Channel-II, which involved the movement of wheat from producer → primary wholesaler → secondary wholesaler → retailer → consumer, with 56.86 per cent of total produce passing through this channel. Channel-III, involving producer → local trader/commission agent → flour miller → retailer → consumer, accounted for 41.40 per cent of marketed wheat [2].

Marketing Costs and Margin of Different Functionaries in the Different Marketing Channels of Wheat

Marketing costs and margins of various intermediaries involved in the different marketing channels of wheat were also worked out from the data which is collected by personnel interview method**.** The results revealed that the producer's price varied between channels, ranging from Rs. 2300.93 to Rs. 2490.65. In channel-III, wheat was procured by traders at Rs. 2354.39 per quintal and passed on to processors at Rs. 2521.87 per quintal after incurring marketing costs and margins. The processor stage accounted for a substantial rise in value, as marketing cost at this stage was Rs. 150.00, and the processor's margin was Rs. 494.27. In channel-II, primary wholesalers added marketing cost of Rs. 98.52 and secondary wholesaler added marketing cost of Rs. 50.00, before wheat reached the retailer. In channel-II and channel-III, retailers further contributed by incurring costs of Rs. 90.58 and Rs. 89.36, respectively, and margins of Rs. 120.38 and Rs. 170.00 [2].

The analysis of marketing costs and margins in different wheat marketing channels revealed significant variations in the share of costs and returns in different chains. In Channel I (producer → consumer), the farmer receives the maximum share of the consumer price, as marketing costs are minimum, reflecting direct marketing profits. In contrast, in Channels II and III, where primary and secondary wholesalers, local traders, and processors are involved, the gross marketing margins and costs increase extensively. This trend highlighted the significant role of intermediaries in price formation, with the farmer's share decreasing as the number of intermediaries rises. Thakur (2022) in Una district, Himachal Pradesh, found similar patterns, noted that increased intermediaries lead to higher marketing costs and lower producer shares. Efficient channel management and improved market linkages can help increase farmers' income and reduce post-harvest losses in the region [2].

Price Spread and Marketing Efficiency of Wheat among the Different Marketing Channels

Price spread and marketing efficiency of wheat across different channels was worked out from the primary data which was collected. The results showed that the producer's share in consumer's rupee was highest in channel-I (97.73%), where the farmer directly sold to consumers, and lowest in channel-III (62.88%), where wheat passed through trader, processor, and retailer before reaching consumers. Channel-III had the highest price spread (37.12%) due to heavy marketing costs and margins, followed by channel-II (19.19%). Channel-I, on the other hand, had the least price spread (2.27%), indicating minimal intermediary involvement. In Channel I (Producer → Consumer), there were no functionaries in marketing. The difference between the consumer's price and the producer's net price is entirely accounted for by the marketing cost borne by the producer. So that the gross marketing margin was equal to the marketing cost, and the net marketing margin remains zero. Marketing efficiency was highest in channel-I (42.99%) as reduced intermediation lowered costs and ensured better price realization for producers (Dastagiri *et. al*,2013). However, in channel-III, efficiency was lowest (2.25%), mainly because of high processing costs, packaging expenses, and retailer margins, which widened the price spread. This pattern highlights that larger the number of intermediaries between producers and consumers, higher is the marketing cost and margin, which reduces producer's share and makes the channel less efficient [2].

Channels II and III involve multiple intermediaries such as wholesalers, traders, and processors, which increased marketing costs and reduced the share to producers. Channel III exhibited the lowest marketing efficiency (2.25 %) as farmers received the lowest price of Rs. 2300.93 per quintal, while consumers purchased the processed product at a significantly higher cost. The inefficiency of this channel can be attributed to extensive involvement of market functionaries, high processing costs and additional expenses related to storage, transportation, and distribution. These factors widen price spread, reducing the farmer's share in consumer price while increasing overall cost to consumers. This pattern was consistent with general marketing studies in Himachal Pradesh (Kumar, 2022), showing that as the number of intermediaries rises, producer share declines and marketing margins of intermediaries increase. The findings focused the need for better market linkages, farmer cooperatives, and direct marketing strategies to enhance farmers' returns and overall marketing efficiency in the wheat value chain [2].

It is important to note that reducing the price spread is not only within the control of farmers. However, farmers can reduce price spread by engaging in value addition activities such as processing, grading and by packaging their produce. By establishing farmer cooperatives and adopting modern

storage techniques, also participation in direct marketing channels can help them to secure better prices (Acharya and Pant, 2021). Additionally, investing in agro-processing units and leveraging digital platforms (future marketing) for sales can enhance profitability and reduce dependence on intermediaries.

Degree of Value Addition in Different Channels

Processing Cost and Degree of Value Addition

Processing Cost of Wheat

Wheat processing in the study area was largely confined to flour milling operations. The estimated variable cost amounted to ₹2,619.95 per quintal, comprising expenses on raw materials, energy consumption, labour, packaging, and staff remuneration. In addition, fixed costs of ₹135.68 per quintal were incurred on account of interest and depreciation, bringing the total processing cost to ₹2,755.63 per quintal. These findings are in agreement with observations reported for Himachal Pradesh by Mandial (2025), who identified raw material and labour as the principal cost components in wheat processing. The results underscore the importance of effective cost management in processing activities to enhance profitability and secure improved returns for both producers and processors [1].

Returns from Processing of Wheat

The economic feasibility of wheat processing was assessed through the estimation of gross returns, processing expenses, marketing costs, and net returns on a per-quintal basis. The processing unit was found to be operating at 96% of its installed capacity, reflecting a high level of operational efficiency and effective utilization of available resources.

The total revenues from selling processed wheat were Rs. 3400 per quintal. The cost of marketing, which included shipping, packing, and handling, was Rs. 150 per quintal. The overall cost of processing, which includes both fixed and variable charges, was Rs. 2755.63 per quintal. The processing unit made a good profit because the net return from processing wheat was Rs. 494.37 per quintal. These results show that processing wheat can add value to the raw product, make processors more profitable, and make the whole supply chain work better. This finding was in line with Mandial (2025), which demonstrated that processing after harvest makes more money. Torane (2023) also noted that processing led to greater returns, demonstrating the economic benefit of value addition in agricultural products. Overall, processing is a good way for them to make more money than they would by farming alone [1].

Value Chain Map of Wheat

The value chain is the series of steps and activities that an agricultural product goes through from the time it is made to the time it is eaten. Each step adds value to the commodity. Value chain mapping is a way to show these steps in a methodical way, showing how items move from their source via several phases of handling, processing, and distribution to the final customer. This kind of mapping makes it easier to find the different steps in product development and distribution, as well as the value added at each step of the chain. Figure 1 [1] shows the value chain maps for wheat in the area being studied.

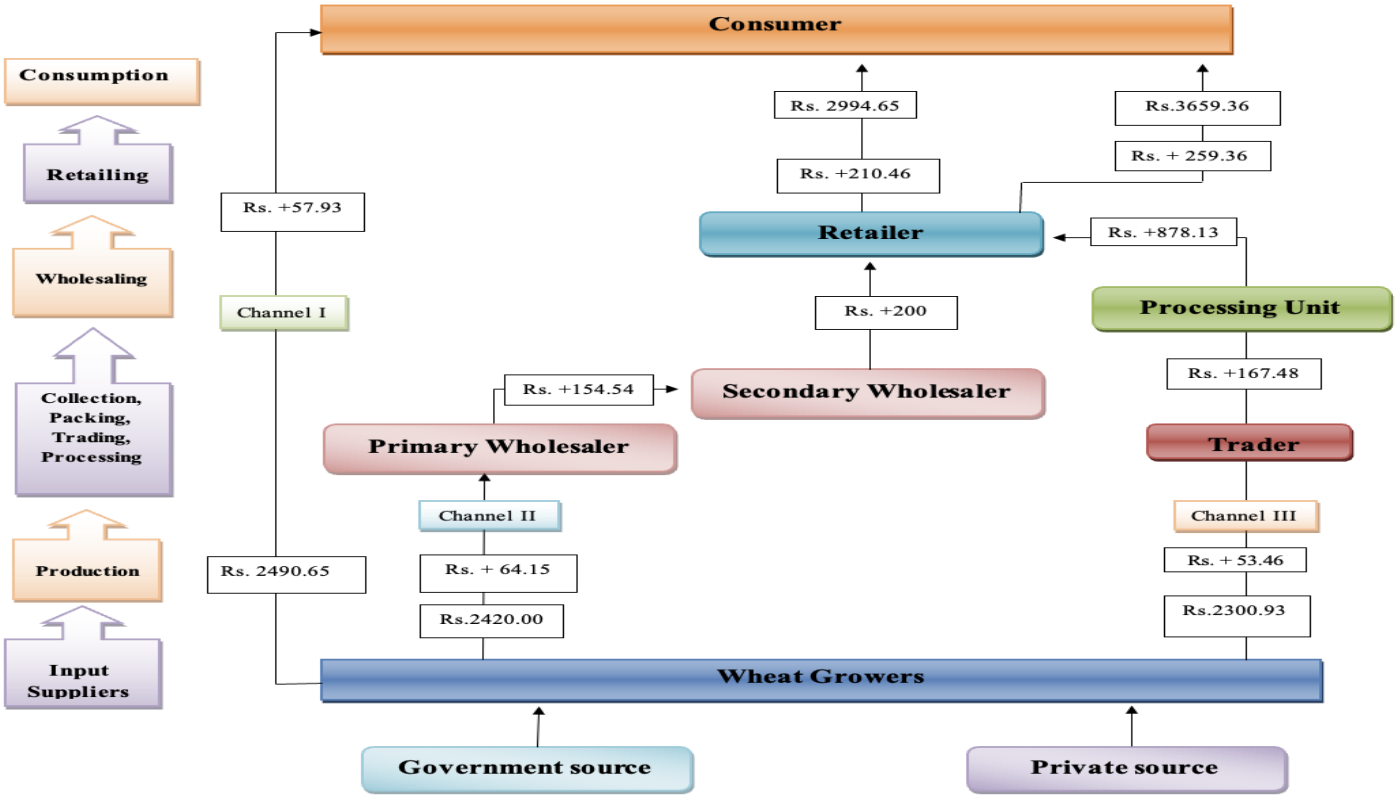

Figure 1: Value Chain Map of Wheat

Degree of Value Addition in Wheat

As wheat passes through successive stages of the supply chain and ownership shifts among different participants, its economic worth increases through a process referred to as value addition. The level of value addition is assessed by the absolute or proportional increase in the product's value across these stages.

We looked at how much value was added to wheat through the marketing channels we had chosen. The results showed that Channel III had the highest level of value addition at the flour miller stage, which was 23.79%. This shows how important processing activities are. Turning raw wheat into flour makes it far more valuable on the market and in terms of consumer demand, which is why the processing channel is the most valuable. To make processed wheat products even more valuable, you can make refined or different types of flour, improve the packaging, use better storage and preservation methods, and use effective marketing and branding strategies that make people want to buy them. Channel II, on the other hand, added the most value at the retail stage (7.58%), mostly because of services like shipping, handling, and selling wheat directly to customers [1].

Constraints Faced By the Farmers

Production Constraints Faced By Farmers

An attempt was made to identify and analyze the various problems encountered by farmers and market intermediaries in wheat production and marketing. The responses were organized and ranked according to Garrett scores highlighted the most critical challenges affecting the efficiency and profitability of wheat supply chains. It is evident from the analysis that among farmers, the low availability of quality seed emerged as the most significant constraint (Rank I), indicating that insufficient access to certify and high-yielding seed varieties limits crop productivity**.** Labour shortage during peak periods was ranked second (Rank II), reflecting the difficulties in timely sowing, harvesting, and other labor-intensive operations. Unpredictable weather conditions were identified as the third major challenge (Rank III), which affects both yield and quality. Issues related to market intermediaries such as middlemen not taking consent while selling (Rank IV), middlemen exploitation (Rank V), and less bargaining power (Rank VI) were also reported, highlighting structural and market-related inefficiencies. Limited access to markets was ranked as the least pressing problem among the surveyed farmers (Rank VIII), though it still constrains the overall marketing effectiveness [3].

Marketing Constraints Faced By the Marketing Functionaries

For market intermediaries, Transportation challenges were ranked second (Rank I), as inadequate infrastructure and logistics increase costs and delay deliveries. Price volatility was ranked as the most critical issue (Rank II), which creates uncertainty in procurement, storage, and sales, impacting their operational planning. The lack of processing units was identified as the third significant problem (Rank III), limiting opportunities for value addition and higher margins. Delayed payments from buyers were considered the least severe constraint (Rank IV), though it affects cash flow and working capital management [3].

The analysis thus indicated that both production and marketing challenges significantly affect wheat productivity, profitability, and the efficiency of the supply chain. Addressing these constraints through improved seed distribution, labour management, better market linkages, and development of infrastructure and processing facilities could enhance the overall performance of the wheat sector

Conclusion and Policy Implications

The research was conducted in the Kangra area of Himachal Pradesh, utilizing a multistage random sampling method to choose a sample of 80 wheat producers. Eight farmers were picked from each of five villages within two randomly determined development blocks of the district. Both primary and secondary data sources were used to reach the goals that were set. We got primary data by doing personal interviews with a carefully planned and tested schedule. The schedule asked about demographic information like household size, age, education, occupation, and livestock holdings, as well as economic information like landholding patterns, farm machinery and implement inventory, cropping patterns, and income levels. We used the right statistical tools, like averages, percentages, and ratios, to systematically organize and analyze the data we collected. This helped us look at the socio-economic profile of the respondents, figure out costs and returns, look at marketing-related issues, and figure out how much value was added at different points in the marketing process. We got secondary data from official government publications, the Statistical Abstracts of Himachal Pradesh, and reports from the Directorate of Agriculture in Himachal Pradesh. The results of the Socio economic analysis revealed that majority of sample households had nuclear families (58.75%). The overall average family size of sampled wheat farming households was 5.78 members, with small farms averaging 5.56 members and large farms 6.03 members. The result revealed that the majority of family heads fall within the prime working age group of 41-60 years, constituting 45 percent of the sample. The result showed that 37.50 percent of households were less than 40 years of age, whereas those above 60 years comprised 17.50 percent. The literacy status of family head of sampled households revealed a high overall literacy rate of 93.75 percent. Large farm households exhibited slightly higher literacy (94.59 percent) compared to small farms (93.02 percent). The literacy levels among household members indicated an overall male literacy rate of 94.06 percent and a female literacy rate of 91.23 percent. Occupational distribution revealed that agriculture (69.75 %) was the most prevalent occupation in the study

area followed by service 15.23 per cent and business 15.03 per cent at overall level. Small farms invested an average of Rs. 2, 76,997.81 per farm on farm implements and machinery, whereas large farms invested substantially more, averaging Rs. 3, 65,758.23. The results revealed an increasing trend in investment with growing farm size. The result showed that the average number of animals maintained on an average farm was 1.83 in numbers. Cows constituted the largest proportion of livestock, representing 39.36 percent of the total, followed by buffaloes (33.29%). At overall farm categories level, 87.21 per cent of land holding was operational holding followed by land under non-agricultural use (10.02 %). The results indicated that wheat occupied the major share in the rabi season across all farm categories. Overall wheat covered 38.59 per cent of the gross cropped area. The cropping intensity was recorded to be 190.32 per cent at overall level, indicating multiple cropping practices in the study area. A significant majority of farmers have small landholdings (below 1 hectare), which limits the potential for large-scale mechanization and often results in lower individual incomes compared to large farms. Farming is the main source of livelihood for most households, with livestock and vegetable cultivation often serving as important supplementary activities, indicating a mixed-farming system to diversify income and sustenance. A large portion of the cultivated area is rain fed in Kangra, making farmers highly dependent on timely rainfall for their wheat crop. Prolonged dry spells can delay sowing and negatively affect yields, highlighting a significant vulnerability to climate change. Farming is a family-based enterprise with an average family size of around 5-6 members. Decisions related to the farm are predominantly made by male heads of the family.

With regard to cost and return from wheat cultivation, the findings showed the total cost of cultivation (Cost C_3) was ₹71,496.46 for small farmers, ₹77,510.80 for large farmers, with an overall average of ₹74,278.09 per hectare. At overall level, cost A_1 was found to be Rs. 43854.31, whereas Cost B_2 amounted to Rs. 59740.48 per hectare. The production of wheat per ha was found to be 38.35 quintals with gross returns of Rs. 115735.95 per ha in all farm situation. Gross returns were highest (Rs. 121718.00/ha) in large category than small category (Rs. 110588.61/ha). Farm Business income, farm labor income, net farm income, farm Investment income for wheat was recorded highest in case of large farm category. Output-input ratio was found out to be 1.56 in overall farm situation. Break-even yield and break-even returns in overall farm situation were found 30.95 quintals per hectare and Rs. 52968.26 per hectare respectively. The results thus highlighted that wheat cultivation in Kangra district involved significant fixed capital requirements along with notable expenses on labour and machinery. The higher costs on large farms suggested greater intensity of input use, though the relative cost distribution remained broadly similar across farm categories. It has therefore, been estimated that wheat cultivation in Kangra district is economically viable, with potential for increased returns through improved input management and mechanization.

Come to the supply chain, wheat supply chain in Kangra, H.P. were identified by analyzing how, form, place, possession and time utilities are created. Form utility is achieved through processing wheat into flour. Place utility is created by transporting wheat from farm to markets, warehouses and ultimately to consumers. Possession utility is established when farmers sell their wheat to wholesalers or retailers, transferring ownership. Time utility emerges when wheat is stored and made available to consumer when they need it, potentially during off-seasons. Three main supply chains were found for wheat. Intermediaries in supply chains were government supplier, open market (private supplier), producer, local trader, processor (flour miller), wholesaler, retailer and consumers. It was observed that producers preferred to buy fertilizers (77.41%) and plant protection chemicals (81.06%) for wheat cultivation from open markets as compared to government agencies whereas seeds (67.19%) were predominantly procured from government suppliers at overall farm situation. Three main marketing channels were found for marketing of wheat. The results showed that channel-III, consisting Producer → Primary Wholesaler → Secondary Wholesaler → Retailer → Consumer was found to be the most preferred channel. Total of 56.86 per cent of wheat were traded through Channel III. The results also concluded that the producer's price of wheat per quintal varied between channels, ranging from Rs. 2300.93 to Rs. 2490.65. In channel III, the consumer purchase price was the highest due to the additional cost of processing. Producer's share in consumer rupee was found to be highest in channel-I (Producer → Consumer). The price spread was determined to be highest in channel-III (Producer →Local trader→ Flour miller → Retailer → Consumer) due to the highest marketing margin (19.84%). Channel-I (Producer → Consumer) was identified as the most efficient marketing channel. The cost of processing and margin of processing unit were found to be high in channel III, making this channel the least efficient marketing route.

The average processing cost, including both variable and fixed expenses, was determined to be Rs. 27,55.63 per quintal, according to the processing cost and returns structure. The total cost of variables per quintal was 2619.95 rupees. A portion of the total processing costs, amounting to Rs. 135.68, were fixed costs. The most efficient marketing channel was determined to be Channel-I (Producer → Consumer), which resulted in an average net return of 494.37 rupees per quintal from the plant. Since channel III had the highest processing costs and processing unit margins, it was determined to be the least efficient marketing route. The results showed that the flour miller's stage in channel III added the most value (23.796%). The processing channel added the most value since turning raw grain into flour increases the market price and consumer demand for the

product. The processing channel is thus the most valuable because of this. At the retailer's stage in channel-II, value addition was 7.58 percent highest since that's when the processes of transporting, managing, and directly selling produce to end users were taking place. Thus, from a policy standpoint, it is recommended that farmers be incentivized to establish direct connections with flour mills or form processing cooperatives/FPOs. This will enable them to engage in value-added activities and earn a larger portion of the rupees spent by consumers.

Opinion of the wheat growers and their marketing functionaries were enlisted regarding their problem and constraints. In this context, low availability of quality seed emerged as the most significant constraint (Rank-I), indicating that insufficient access to certified seeds limits crop productivity in the study area. Labour shortage during peak periods and unpredictable weather conditions were also identified as major constraints. Price volatility, transportation challenges and inadequate infrastructure were major hurdles encountered by the marketing functionaries.

All these findings suggested that the supply chains identified in the study area were extended and multi-layered, involving several functionaries that ultimately reduce the farmer's share in the consumer rupee. While the presence of excessive middlemen increases marketing costs and lowers the producer margin. To ensure fair prices for farmers and improve marketing efficiency, it is essential to reduce unnecessary intermediaries and promote direct sales through local markets and digital platforms. Both farmers and intermediaries face a set of challenges too that affect the efficiency of the agricultural supply chain. While farmers are mainly constrained by production risks, dependency on middlemen, and limited bargaining power, intermediaries encounter transportation challenges, price volatility, and infrastructural hurdles. Addressing these issues requires strengthening institutional support, enhancing infrastructure, and promoting direct linkages between farmers and markets to ensure a more equitable and efficient system in the market.

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