



# Economic analysis of sustainable potato marketing strategies and constraints in Kangra district of Himachal Pradesh

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**Abstract:** Potatoes, a substantial cash crop with the ability to increase farm revenue and promote long-term agricultural development, are the subject of this study, which investigates sustainable marketing tactics, expenses, margins, and limitations in the Kangra area of Himachal Pradesh. Potatoes exhibited a high marketable surplus of 97%, as indicated by the primary data collected from 200 farmers. Nevertheless, the rate at which large farmers sold their potatoes was nearly four times higher than that of small farmers. Post-harvest losses reduced the marketed surplus to 96% of production. Direct marketing to consumers (Channel I) was the most efficient channel, with a marketing efficiency of 9.54. Conversely, Channel IV, which included local traders, wholesalers, and retailers, had a lower efficiency of 3.86 and accounted for 39% of the marketed surplus. Channel I had the largest producer's share in the consumer's rupee, accounting for 93%, while Channel IV had the lowest proportion at 74%. Transportation, storage losses, packing, and grading were the main expenditures. The primary constraints, as reported by 84% of farmers, were high input costs (49%), inadequate transportation (49%), lack of market information (54%), and low pricing (74%). This study provides distinct perspectives on the sustainable marketing challenges and prospects that are exclusive to the Kangra district, addressing a significant void in the existing literature on potato value chains in mountainous areas. The findings offer useful direction for policymakers and stakeholders in formulating focused initiatives to improve the sustainability and profitability of potato cultivation in comparable agro-ecological zones.

**Keywords:** Sustainable marketing, marketing efficiency, constraints, food miles, Himachal Pradesh

## 1. Introduction

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Potato is the primary crop of focus in Himachal Pradesh because of its ability to increase farmers' earnings and support agriculture's sustainable growth [1, 2]. However, certain production and marketing limitations accompany the cultivation of this particular crop, ultimately impeding the efficiency and long-term viability of farming in a hilly region [3]. With rising consumer awareness of sustainable food, the importance of adopting sustainable marketing techniques has increased in order to maintain competitiveness over an extended period of time [4]. Sustainable marketing is the process of incorporating economic, social, and environmental factors into marketing decisions and operations [5]. This includes affordable prices for growers, short supply chains, minimal food waste, and environmentally friendly production methods. Although earlier studies conducted in hilly and mountainous regions have explored different marketing channels, costs, effectiveness, and challenges faced by vegetable smallholder growers [6–9], there is a dearth of literature on sustainable marketing of potatoes in these areas. The study area is the Kangra district of Himachal Pradesh, which has hilly terrain and varies in agro-climatic zones. As a result, it has its own prospects and constraints for potato production and marketing. This research will seek to fill this gap by examining sustainable marketing strategies and challenges for potato farmers in this area. Specifically, the study will focus on the following research questions: The study will concentrate on the marketable surplus and marketing channels of potatoes in Kangra district, the marketing costs, margins, and efficiency of various channels, the obstacles to sustainable potato production and marketing, and the strategies to enhance the sustainability and profitability of potato marketing in Kangra district. This research uses both quantitative data on marketing and qualitative data from the farmer's survey to give a holistic view of the potato value chain in Kangra district. The results of this study can be useful in developing agricultural and business strategies and policies to make potato marketing more profitable and environmentally friendly for producers and consumers [10, 11]. Thus, the study seeks to enhance the profitability and competitiveness of the potato value chain while minimizing its impact on the environment by establishing the constraints that potato growers encounter and analyzing sustainable marketing strategies [4]. The research recommendations provide a positive outlook for producers and consumers to achieve fair pricing, efficient logistics, and minimum food transportation [12]. This is in line with the current trends in sustainable agriculture and food security as discussed in the literature [13, 14]. Therefore, this research adds to the existing literature on sustainable agriculture and marketing of potatoes in mountainous areas [15, 16] and provides useful information for policymakers, farmers, and other stakeholders in the potato value chain. It is useful because it offers a detailed analysis of the situation in Kangra district, which can help design appropriate measures to improve potato marketing sustainability in similar agro-climatic conditions.

## 2. Literature Review

The cultivation of potato topography presents a variety of challenges, as revealed by recent research across diverse regions. Potatoes in the Karnataka region reveal regional disparities in growth and marketing efficiency [2]. Growers from Kenya face challenges related to the environment and seed quality [17], while price uncertainty emerges as a concern for many potato growers [18]. Smallholders in South Africa elaborated on profitability amid efficiency challenges [19]. In Bihar, a non-comparable ranking of limitations depicts pest management and labour availability as crucial issues [20]. These results underscore the varied geographically distinct nature of barriers in potato farming and commercialization, highlighting the need for tailored, context-specific solutions. Potato farming economics reveals a complex interplay of production costs, market dynamics, and regional variations. Research in Gujarat [21] and Himachal Pradesh [6] has identified the most effective channels, indicating that marketing efficiency is a critical factor. Value-added benefits link to Bangladesh's market inefficiencies [13]. Collective endeavours in Himachal Pradesh [7] and Bihar [14] offer potential solutions to logistical challenges. Afghanistan [22] and Uttar Pradesh [23] grapple with price fluctuations and issues in their storage. A global food security concern [2] emphasises the need for sustainable practices. Nepal's studies [24, 25] show streamlined marketing chains, while recent research in Haryana [10] and Kathmandu [11] highlights the ongoing investigation for efficient market channels and quality assurance. These findings underscore the composite nature of potato farming economics across diverse geographies.

## 3. Research Methodology

The Kangra district in Himachal Pradesh conducted the study between 2022 and 2023. The list was prepared from the 15 development blocks and arranged in descending order to select two blocks, *Nagrota Bagwan* and *Bhawarna*. After the selection of blocks, a two-stage stratified random sampling approach was applied to select villages (Stage I) and farmers (Stage II). A sample of 200 potato growers was selected through the proportionate allocation method and using the square root cumulative frequency method for categorising the farmers into small (105) and large (95) based on operational land holdings. In addition to this, a cluster of 20 traders or intermediaries, together with market functionaries, was selected to analyse the constraints of marketing. The personal interview method with potato growers and traders was executed on a systematic schedule to collect the data. The data is composed of socio-economic factors, production and consumption of potatoes, marketable and marketed surplus, different marketing channels, costs, margins, and constraints

encountered. The tabular analysis examined the use and marketing channels. The following are the primary marketing channels identified during the potato marketing study:

The channel I utilise the Producer-Consumer pattern.

Channel II comprises the Producer, Retailer, and Consumer.

Channel III comprises the Producer, Wholesaler, Retailer, and Consumer.

Channel IV consists of a producer, a local trader, a wholesaler, a retailer, and a consumer.

### 3.1 Marketable surplus and marketed surplus

Potato marketed and marketable surplus was calculated as follows:

Marketable surplus:

$$M_S = P - C \quad (1)$$

Where;  $M_S$ =Marketable surplus (q),  $P$ =Total production (q), and  $C$ =Total requirements (family consumption, farm needs, payment to labour, kept for seed, etc.) (q)

Similarly, the farmer's marketable surplus, which refers to the actual quantity sold, was estimated using the following formula:

$$M_T = MS - L_S \quad (2)$$

Where;  $M_T$ =Marketed surplus (q),  $L_S$ =Losses during transit and storage (q)

The Cobb-Douglas production function was employed to analyse and examine the factors that influence the surplus of potatoes available for sale. In order to accurately reflect actual production outcomes, the Cobb-Douglas production function was employed, which is widely recognised as an accurate representation of the relationship between output and inputs [26, 27]. In addition, Yang et al. [28] contend that the application of Cobb's Douglas function to the development of a regression model offers a reliable economic analysis for agricultural economics research and analysis. Consequently, this model was selected to evaluate the efficacy of resource utilisation in potato cultivation.

$$Y = b_0 X_1^{b_1} X_2^{b_2} X_3^{b_3} X_4^{b_4} X_5^{b_5} e^U \quad (3)$$

The function's logarithm is:

$$\text{Log } Y = \text{Log } b_0 + b_1 \text{Log } X_1 + b_2 \text{Log } X_2 + b_3 \text{Log } X_3 + b_4 \text{Log } X_4 + b_5 \text{Log } X_5 + U \quad (4)$$

$Y$ =Surplus that is sold (Marketed surplus (q)),  $X_1$ =Total production (q),  $X_2$ =Losses (q),  $X_3$ = Family size (number),  $X_4$ =Education of head of the family,  $X_5$ =Operational holdings

(ha),  $b_0$ =Constant term,  $b_i$ 's=Regression coefficients (Production elasticities),  $i= 1,2,\dots,5$ ,  $U$ =Random term”The t-test was employed to ascertain the significance of each parameter:

$$t_{(a,n-2)} = \frac{b_i}{SE(b_i)} \quad (5)$$

Where;  $SE(b_i)$ =Standard error of regression coefficient,  $i = 1, 2, \dots, 5$ ,  $n$ =Number of sample observations,  $\alpha$ =Selected level of probability (1 %, 5 % or 10%)

$\bar{R}^2$  is a more effective measure for revealing the variations than  $R^2$ , as the value of  $R^2$  increases as additional variables are incorporated into the model. Consequently, the following calculation was made to determine  $\bar{R}^2$ .

$\bar{R}^2$  is a more effective measure for explaining variations than  $R^2$ , as the value of  $R^2$  increases as more variables are introduced to the model. This was determined by the following method:

$$\bar{R}^2 = 1 - (1 - R^2) \frac{N-1}{N-K} \quad (6)$$

The significance of the adjusted coefficient of multiple determinations ( $\bar{R}^2$ ) was assessed using the F-test:

$$F = \frac{R^2/(k-1)}{(1-\bar{R}^2)/(N-k)} \sim F_{(k-1)(N-k)} df \quad (7)$$

Where;  $N$ =Number of sample observations,  $k$ =Total Number of  $b_i$ 's (including constant  $b_0$ )

The input with the highest marginal value productivity for the potato crop will be identified by comparing the profitability of using a certain input with its factor cost, as well as considering the input-output ratio. The factor costs of the different production factors will be determined by computing the charges per unit and then calculating the ratios of  $MVP_i$  and  $MFC_i$ .

### 3.2 Marketing cost and margins

1. At producer's level: This pertains to the costs that farmers accumulate for the different activities they undertake after harvesting or picking crops.

2. At market level: This encompasses costs disbursed to additional intermediaries (if applicable), auction fees, market tariffs, and other outlays accrued by intermediaries for diverse marketing operations such as packaging, loading, and transportation.
3. Total marketing cost: The total expenses borne by the product/seller, many traders engaged in the buying and selling of crops till they reach the end consumer, and other entities involved in various marketing activities, whether in monetary form or through goods, were computed using the following equation:

$$TC = C_p + \sum_{i=1}^n MC_i \quad (8)$$

Where; TC=Total marketing cost,  $C_p$ =Costs incurred by the producer in marketing,  $MC_i$ =Marketing costs incurred by the  $i^{\text{th}}$  middleman

4. Marketing margin: The middleman's marketing margin refers to the discrepancy between their total payments and receipts, which is equivalent to the selling price. The subsequent marketing margin calculations were formulated:

$$Am_i = Pm_i - (Pp_i + MC_i) \quad (9)$$

Where;  $Am_i$  = Absolute margin of the  $i^{\text{th}}$  middleman,  $Pm_i$  = Selling price of the  $i^{\text{th}}$  middleman,  $Pp_i$  = Purchase price of the  $i^{\text{th}}$  middleman,  $MC_i$  = Marketing costs incurred by  $i^{\text{th}}$  middleman

The net price received by the farmer during the initial sale is referred to as the producer's price ( $G_p$ ), and it was determined using the following calculation:

$$G_p = G_s - G_c \quad (10)$$

Where;  $G_p$ =Net price received by the producer,  $G_s$ =Producer's selling price,  $G_c$ =Cost incurred by the producer in marketing

The proportion of the producer's portion in the consumer's currency was calculated as follows:

$$G_s = \left( \frac{P_f}{P_r} \right) \times 100 \quad (11)$$

Where;  $G_s$ =Producer's share in consumer's rupee,  $P_f$ =Producer's price for his produce,  $P_r$ =Price paid by consumer or sale price of retailer

The charge did not cover the diverse marketing roles of family members. Only the monetary payments made by farmers were considered as costs. Dahal et al. [29] and Kharel et al. [24]

implemented identical methodologies to determine the producer's share and market margin in their respective analyses

### 3.3 Marketing efficiency

The effectiveness of marketing channels ensures that products are delivered from the producer to the consumer at the lowest cost possible, in line with the consumer's required services. The marketing efficacy of various marketing channels was determined using Shepherd's formula [30]:

$$ME = \frac{V}{I} - 1$$

(12)

Where; ME= Marketing efficiency index, V=Value of potato sold/consumer's price in Rs/q, I=Total marketing cost (incurred by all those involved, including margins of the middleman) in Rs/q.

### 3.4 Problems or constraints:

The examination of the numerous responses of farmers who reported a variety of production and marketing issues was conducted to ascertain whether there were substantial disparities in the problems they encountered between small and large categories of farmers. The methodology employed by Kumari *et al.* [20] and Sharma *et al.* [6] to calculate this approach was identical. In order to evaluate the challenges that the researchers encountered, this approach was implemented. The following algorithm was employed to conduct a Chi-square ( $\chi^2$ ) test (Test of Homogeneity) to evaluate the variation in the severity of these issues across various farm categories.

$$\chi^2 = \sum_{i=1}^n \frac{(O_i - E_i)^2}{E_i}$$

(13)

Where;  $O_i$  =Observed frequency of problems confronted by  $i^{\text{th}}$  farmer,  $E_i$ =Expected frequency of problems of  $i^{\text{th}}$  farmer

## 4. Data Analysis

### 4.1 Sustainable production and utilization

The study reported that executing sustainable agricultural practices in the production of potatoes is the first step toward sustainable marketing. The findings revealed that 97% of potato production was a marketable surplus, with some variation between small and large farmers (Table 1). Small farmers used approximately 4% of their produce for household

consumption, seed, and other purposes, compared to 2% for large farmers, emphasizing the importance of potatoes for small farm households' food and nutrition security. However, losses during post-harvest from storage and transportation decreased the marketed surplus to 96%, with large potato growers selling almost four times as much as small growers.

**Table 1. A surplus of potatoes that is both marketable and marketed on the sample farms (q/farm)**

Sr. No.	Particulars	Small	Large	Overall
1	Total production	34.50(100.00)	121.80(100.00)	78.15(100.00)
2	Utilization			
I	Home consumption	1.02(2.96)	1.85(1.52)	1.44(1.84)
ii	Gifts and others	0.39(1.13)	1.03(0.85)	0.71(0.91)
	Subtotal	1.41(4.09)	2.88(2.36)	2.15(2.75)
3	Marketable surplus	33.09(95.91)	118.92(97.64)	76(97.25)
4	Losses	0.35(1.01)	0.97(0.80)	0.66(0.84)
5	Marketed surplus	32.74(94.9)	117.95(96.84)	75.34(96.4)

Source: Author's calculation

Note: The percentage of the total in each category is denoted by the figures in brackets.

#### 4.2 Factors affecting marketed surplus

It is necessary to scrutinize the factors that affecting the marketed surplus of potato growers, as any enhancement in the surplus significantly increases the purchasing power and economic prosperity of farms. To fit a regression equation, a log-linear function was employed for potatoes with the aim of these factors. The outcomes of these factors are depicted in Table 2. The data indicates that the considerable factors influencing the marketed surplus of potatoes growers were total production ( $X_1$ ), losses ( $X_2$ ), and family size ( $X_4$ ). The marketed surplus was significantly correlated with total production and family size, whereas losses displayed a negative impact on relationship. In addition to this, Small farms' marketed surplus was not positively influenced by the education level of the family head. However, the marketed surplus was significantly impacted by the education level on large farms.



The study found a direct correlation between the operational size of small farms and their marketed surplus. It suggests that increasing the family size and operational size of holdings in this category could lead to a rise in the marketed surplus. On an average, it is interesting that the marketed surplus farm did not reveal statistically significant relationships with variables such as the head of the family and operational size of holdings. The labour-intensive nature of growing potatoes makes it difficult to expand production on average or large farms as their size increases. Typically, the characteristics studied explained a large portion of the variation in the marketed surplus, ranging from 97 to 99 percent.

**Table 2. Regression equations estimating the marketed surplus of potatoes**

Sr. No.	Particulars	Regression coefficient	Small	Large	Overall
1	Constant	$b_0$	-0.47 (0.12)	-0.15 (0.03)	-0.23 (0.05)
2	Total production (X1)	$b_1$	1.03* (0.08)	1.05* (0.03)	1.09* (0.02)
3	Losses (X2)	$b_2$	-0.02 (0.03)	-0.01*** (0.01)	-0.03** (0.01)
4	Family size (X3)	$b_3$	0.30** (0.19)	0.01 (0.04)	0.09*** (0.07)
5	Education of the head of the family (X4)	$b_4$	-0.01 (0.03)	0.03* (0.01)	-0.01 (0.02)
6	Operational holding (X5)	$b_5$	0.15** (0.09)	0.01 (0.05)	0.01 (0.05)
7	Adjusted coefficient of multiple determination	$\bar{R}^2$	0.97	0.99	0.99
8	F- value		111.83	1313	1102

Source: Author's calculation

Note: Standard errors are denoted by figures enclosed in brackets.

\* Significant at the 1% significance level

\*\* Significant at the 5% significance level

\*\*\* Significant at the 10% significance level

### 4.3 Marketing channels and sustainability

The allocation of marketed surplus among various marketing agencies is seen in Table 3. The data indicates that local dealers were the main marketing entity for potato marketing in the research area. They controlled a significant proportion of the overall quantity sold, ranging from 34% in large farms to 46.54% in small farms. Retailers controlled over 26% of the entire surplus available for sale. Wholesalers were also essential in the process, managing 12% of the overall surplus that was sold. Significantly, the percentage of surplus produce handled by wholesalers was greater in large farms (13.38%) than in small farms (8.73%). Furthermore, around 24 to 27 percent of the entire surplus of goods available for sale was directly purchased by customers at the village level from both types of farms.

**Table 3. Sample farms utilise sustainable marketing channels.**

Sr. No.	Particulars	Small			Large			Overall		
		No.	q/grower	q/farm	No.	q/grower	q/farm	No.	q/grower	q/farm
1	Channel I	22 (20.95)	42.64 (32.25)	938 (27.28)	19 (20.21)	142.11 (30.07)	2700 (24.09)	41 (20.60)	3600 (24.00)	87.8 (29.08)
2	Channel II	29 (27.62)	20.69 (15.65)	600 (17.45)	26 (27.66)	123.46 (26.13)	3210 (28.64)	55 (27.64)	3900 (26.00)	70.91 (23.48)
3	Channel III	9 (8.57)	33.33 (25.21)	300 (8.73)	17 (18.09)	88.24 (18.67)	1500 (13.38)	26 (13.07)	1800 (12.00)	69.23 (22.93)
4	Channel IV	45 (42.86)	35.56 (26.89)	1600 (46.54)	32 (34.04)	118.75 (25.13)	3800 (33.90)	77 (38.69)	5700 (38.00)	74.03 (24.52)
Total farmers/Total marketed surplus		105 (100.00)	132.22 (100.00)	3438 (100.00)	94 (100.00)	472.56 (100.00)	11210 (100.00)	199 (100.00)	15000 (100.00)	301.97 (100.00)

Source: Author's calculation

Note: The figures in brackets represent the proportion of the total within each category.

#### 4.4 Marketing costs, farmer's share, price spread, and efficiency

The analysis of marketing costs and margins is critical for analyzing the efficiency of the marketing system. Hence, it is necessary to analyze the marketing costs and margins among various marketing channels. In potato marketing, the marketing costs incurred by different agencies, price spread and margins of various channels and marketing efficiency have been

analyzed and shown in Tables 4 to 6. Table 4 displays the different marketing expenses per quintal of potatoes borne by farmers. Upon in-depth analysis, it is noticeable that the overall marketing costs diversified from Rs 180/q (in channel IV) to Rs 230/q (in channel II). Across the various cost items, such as loading, unloading, storage and losses, transportation charges, grading, bag filling, and stitching of bags, the costs incurred in grading constituted a remarkable portion of the total marketing costs among various marketing channels. In addition to this, the cost incurred for storage also accounted for around 27% of the total marketing costs. Table 4 also highlights the overall marketing costs incurred by wholesalers, ranging from Rs 135/q in channel IV to Rs 140/q in channel III. Significantly, commission charges, handling/packing expenses, losses during storage, and market fees were significant factors, each contributing approximately 20 to 26% of the overall marketing expenditures across different marketing channels. Table 4 illustrates the marketing expenses borne by retailers. It reveals that in channels III and IV, the largest cost incurred was Rs 110.05 per unit, while in channel II, the smallest cost was Rs 90 per unit. This is where potato farmers directly sold their products to retailers. Particularly, the main cost components were losses/wastage, loading/unloading, and transportation charges, while market fees and packing charges were also remarkable. Table 4 also reports the constitution of marketing costs incurred by local traders and it was Rs 85/q. Table 5 highlights the price spreads for significant marketing channels. The data illustrates that among the several channels, the proportion of producers' share in the consumer's rupee was largest in channel I (90%), where farmers directly sold their produce to customers. This was followed by channel II (77%), channel III (73.58%), and channel IV (74%) respectively. The total marketing cost incurred by producers was relatively high in channel I (10.76% of consumers' rupees) and lowest in channel IV (7.89%). Local traders incurred a total marketing cost of 3.73% of consumers' rupees, whereas costs of wholesalers ranged from 6.21% in channel I to 5.92% in channel II. Costs of retailers varied from 4.21% to 4.9% of consumers' rupees among various marketing channels. The retailers had the highest margin in various channels across the intermediaries involved. Retailers in channel II, which is a brief channel, obtained a profit margin of approximately 8.56% of consumers' currency. This was followed by channel III with a margin of 3.77% and channel IV with a margin of 2%. The profit margins of wholesalers varied between 1% and 2% when transitioning from channel III to channel IV. Local traders utilized only one channel, earning a margin of 3.73% of consumers' rupees. Among various channels, the price spread was highest in channel IV (Rs 410), followed by channel III (Rs 378), and channel II (Rs 258). The costs related to storage and losses accounted for more than 47% of the total marketing costs incurred by local traders. The efficiency of different marketing channels for potatoes has been analyzed and shown in Table 6. The table illustrates that channel I had the highest

marketing efficiency (9.54) as producers directly sold their products to consumers. Channel II (4.38) and channel IV (3.86) had lower efficiency levels, while channel III (3.79) had the lowest efficiency. The evaluation of marketing channels revealed that farmers in the study area were unable to effectively allocate the most efficient marketing channels for selling their produce. This limitation is a result of the fact that these channels permitted potato growers to sell only a certain amount of their harvest. Among the various marketing channels, channel I stood out as the most efficient due to its greater marketing efficiency index and lack of pricing spread in comparison to the other channels. Channel II was determined to be the most effective in the research area, since it provided producers with greater net prices and a higher marketing efficiency index.

**Table 4. Combined marketing costs among various intermediaries in potato marketing channels**

Sr. No.	Particulars	Marketing channels (Rs/q)			
		Channel I	Channel II	Channel III	Channel IV
Producer costs					
1	Storage and losses	60(30.77)	70(30.43)	60(27.27)	50(27.78)
2	Cost of grading, filling, stitching	70(35.9)	75(32.61)	75(34.09)	70(38.89)
3	Loading and transportation charges	45(23.08)	45(19.57)	45(20.45)	40(22.22)
4	Unloading charges	00(0.00)	20(8.70)	20(9.09)	0(0.00)
5	Others	20(10.26)	20(8.70)	20(9.09)	20(11.11)
	Total producer costs	195(100.00)	230(100.00)	220(100.00)	180(100.00)
Wholesaler costs					
1	Wastage/spoilage	-	-	30(21.43)	30(22.22)
2	Commission	-	-	30(21.43)	30(22.22)
3	Handling/packing	-	-	25(17.86)	20(14.81)
4	Market fee	-	-	35(25.00)	35(25.93)

5	Others	-	-	20(14.29)	20(14.81)
	Total wholesaler costs			140(100.00)	135(100.00)
<hr/>					
Retailer costs					
1	Wastage/spoilage	-	30(33.33)	30.5(27.60)	30(27.27)
2	Commission charges/market fee	-	00(0.00)	20(18.10)	20(18.18)
3	Loading/unloading	-	20(22.22)	20(18.10)	20(18.18)
4	Transportation charges	-	15(16.67)	15(13.57)	15(13.64)
5	Packing cost	-	15(16.67)	15(13.57)	15(13.64)
6	Others	-	10(11.11)	10(9.05)	10(9.09)
	Total retailer costs		90(100.00)	110.5(100.00)	110(100.00)
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Local trader costs					
1	Transportation charges	-	-	-	15(17.65)
2	Storage and losses	-	-	-	40(47.06)
3	Loading/unloading	-	-	-	20(23.53)
4	Others	-	-	-	10(11.76)
5	Total local trader costs	-	-	-	85(100.00)

Source: Author's own calculation

Note: The figures in brackets represent the percentage of each category's total.

**Table 5. The price spread for potatoes across various marketing channels (Rs/ q)**

Sr. No.	Particulars	Channel I	Percent of consumer price	Channel II	Percent of consumer price	Channel III	Percent of consumer price	Channel IV	Percent of consumer price
1	Price received by the farmer	1860	100.00	1880	87.93	1880	83.34	1870	81.99

2	The cost incurred by the farmer	195	10.48	230	10.76	220	09.75	180	07.89
3	Net price received by the farmer	1665	89.52	1650	77.17	1660	73.58	1690	74.09
4	The cost incurred by local trader	0	0	-	-	-	-	85	3.73
5	The sale price of local trader		0					1955	85.71
6	Gross margin of local trader		0					85	3.73
7	Net margin of a local trader		0					185.9	8.15
8	The cost incurred by a wholesaler	0	0	-	-	140	6.21	135	5.92
9	The sale price of wholesaler	0	0	-	-	2075.9	92.02	2140.9	93.86
10	Gross margin of wholesaler		0	-	-	195.9	8.68	185.9	8.15
11	Net margin of wholesaler	0	0	-	-	55.9	2.48	50.9	2.23
12	The cost incurred by the retailer	0	0	75	3.51	95	4.21	95	4.17
13	Gross margin of the retailer	0	0	258	12.07	180	7.98	140	6.14
14	The net margin of the retailer	0	0	183	8.56	85	3.77	45	1.97
15	The sale price of the retailer/consumer purchase price	1860	100.00	2138	100.00	2255.9	100.00	2280.9	100.00
16	Price Spread	-	-	258		375.9		410.9	

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Source: Author's calculation

**Table 6. Marketing efficiency and sustainability of various potato marketing channels**

Sr. No.	Marketing channel	Price paid by consumer (Rs/q)	Marketing cost + Marketing margins (Rs/q)	Marketing efficiency
1	I	1860	195	9.54
2	II	2138	488	4.38
3	III	2255.9	595.9	3.79
4	IV	2280.9	590.9	3.86

Source: Author's calculation

#### 4.5 Constraints in Sustainable Marketing

Farmers in the Kangra district of Himachal Pradesh face numerous challenges in potato production and marketing. Potato growers have a variety of challenges in potato cultivation, including production, marketing, and other related aspects (Table 7). Almost 84% of potato growers reported the high cost of seeds as the most serious production problem. Further notable concern that growers identified was the high wage rates for labour, with about 74% of them indicating this concern. In addition to this, Labour scarcity is also a concern, with 71% of farms indicating they have enough family and hired labour, possibly due to programs like MNRGA. Insect infestations, such as the potato tuber moth, and diseases like late blight affect 71% of farmers. These issues are more pronounced on small farms than on larger ones. Financial difficulties were noted by over 50% of farmers, including challenges in obtaining credit, procedural loan obstacles, low repayment capacity, and poor economic conditions. Marketing challenges are also significant, with 74% of farmers receiving low prices for their produce. Additionally, 49% face inadequate transportation facilities and high costs, while 54% lack market price information. Small farms experience more marketing problems compared to large farms.

**Table 7. Problems and challenges faced by potato farmers on sample farms (Percent multiple response)**

Sr. No.	Particulars	Small	Large	Overall
1	<b>Production problems</b>			

i	Non-availability of seeds of desired quality/quantity	11	14	13
ii	Lack of irrigation facilities	8	7	8
iii	Non-availability of fertilizer	14	9	12
iv	Problems of insects and diseases	71	69	70
v	Non-availability of insecticides/fungicides	14	7	11
vi	Non-availability of labour	72	69	71
vii	Costly seed	85	82	84
viii	Costly labour	73	75	74
ix	Inadequate FYM and vermicompost	19	18	19
<hr/>				
<b>2</b>	<b>Financial problems</b>			
i	Non-availability of credit	50	62	56
ii	High interest rates& cumbersome procedures of banks	36	47	42
iii	Low repayment capacity	71	25	48
iv	Poor economic status	71	31	51
<hr/>				
<b>3</b>	<b>Marketing problems</b>			
i	Non remunerative price for the produce	75	72	74
ii	Inadequate transportation facilities and higher transportation charges	65	32	49
iii	Lack of market intelligence	60	48	54
iv	Delayed payment	21	15	18
<hr/>				
<b>4</b>	<b>Institutional Problems</b>			
i	Inadequate training facilities	55	31	43
ii	Lack of extension facilities	12	5	9



iii	Lake of knowledge package of practices	25	18	22
<b>5 Social problems</b>				
i	Lack of interest of family members in farming	73	54	64
ii	Inadequate land	36	12	24

The calculated value of the Chi-square is 15.60, and the tabulated value of the Chi-square at 20 d.f at a 1% level of probability is 7.43,

Source: Author's calculation

## 5. Conclusion & Discussion

The paper analyses the major issues and prospects of potato production and marketing in Kangra district, which is typical for the overall trends in agricultural sustainability and markets. The high marketable surplus value of 97% suggests a strong potential for commercialization, aligning with the findings of the Karnataka study [2]. However, due to post-harvest losses, the quantity of produce available for sale decreased by 96%, which is in line with the findings made in Bangladesh [13] and Nepal [29]. This underscores the importance of improving post-harvest handling practices and facilities as a key area of intervention. The marketing channel's research revealed significant differences in efficiency and farmers' income. The most efficient direct-to-consumer channel, Channel I, received a marketing efficiency score of 9.54. This score aligns with the findings from studies conducted in Gujarat [21] and Himachal Pradesh [6]. Among the four channels, the consumer's rupee was most heavily directed to the producer in Channel I, with 93 percent, which is consistent with the study done in Bihar [15]. However, this specific channel accounted for only a small percentage of the total revenues, suggesting that there is potential for using direct marketing strategies. The continued prevalence of Channel IV, involving local merchants, wholesalers, and retailers, suggests the existence of market imperfections that require attention. Significant limitations such as expensive inputs, insufficient transportation, and a lack of market information have been identified as important obstacles, especially for small-scale farmers. These issues are similar to those observed in Kenya [17] and Bihar [20]. These problems underscore the need for targeted interventions to support smallholder farmers, who constitute a significant proportion of the farming community. The study also stressed the issues of price instability [18] and efficiency limitations for small-scale farmers [19], pointing to the weaknesses of these producers in the existing market conditions. Cooperative initiatives, as demonstrated in Himachal Pradesh [6] and Bihar [14], play a crucial role in overcoming logistical obstacles and strengthening the negotiating

position of farmers. Implementing collective strategies can be highly advantageous when dealing with storage challenges and pricing volatility, as demonstrated in the cases of Afghanistan [22] and Uttar Pradesh [23]. Nepal [24, 25] emphasized the importance of effective marketing chains, while Haryana [10] and Kathmandu [11] observed the ongoing quest for quality and efficient marketing channels. This demonstrates the potential for regional learning, improvement, and cooperation in potato marketing challenges. The research also concerns the capability of sustainable practices [1; 4] and the need to overcome challenges related to hill agriculture [3]. The Kangra region's climatic conditions and other geographical characteristics necessitate specific solutions for agricultural practices and product marketing. The requirement for integrated strategies for sustainable marketing [5] is apparent, which should encompass economic, environmental, and social dimensions, as pointed out by Bertolini et al. [16] and Kamble et al. [12]. A systems approach is therefore necessary in the development of holistic and fair potato supply chains. The distribution of digital technology and e-commerce platforms [31] can help increase marketing efficiency by increasing market access and reducing the role of middlemen. These innovations have the capability to close research gaps and provide a more direct connection between producers and customers.

In conclusion, this analysis highlights the a lot of opportunities and challenges associated with marketing of potato in the Kangra district, Himachal Pradesh, which are in a harmony with the results of research which was conducted in a variety of global regions. The substantial marketable surplus recommends a promising commercialization potential; however, farmers encounter substantial hurdles in achieving this potential. The outcome focuses the necessity of targeted interventions to increase post-harvest practices, optimize marketing channels, and resolve crucial problems. These initiatives have the capability to enhance the income of farmers, promote marketing efficiency, and contribute to the overall sustainability of the potato value chain in the region.

## **6. Future Study**

In order to investigate the long-term economic longevity of different sustainable practices in the specific context of Kangra district, quantify the environmental and social impacts of different marketing strategies among value chain of potato, and assess consumer willingness to pay for sustainably produced potatoes in local and regional markets, additional research is required. However, future research should examine the potential benefits between potato cultivation and other agricultural or economic activities in the region, as well as the role of emergent technologies in improving the sustainability and traceability of potato marketing. By addressing these areas, future research can provide

valuable insights to inform policy and practice in the pursuit of a more sustainable and equitable potato sector in Himachal Pradesh.

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### Declaration of competing interest

All authors declare that there is no conflict of interest.

### Ethical guidelines

This research did not require ethics approval.

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