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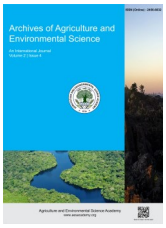

ORIGINAL RESEARCH ARTICLE

Value chain analysis of potato in Bajhang district, Nepal

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ABSTRACT

The study was conducted in the Bajhang district from February to July 2022. Its goals were to find the key actors in the potato value chain, assess their linkage, analyse marketing margins, determine the share of value-addition among each actor, evaluate the production cost, productivity, and profitability of producers, examine the producer's share in consumer rupees, and conduct a SWOT analysis. The data collection process involved the random purposive sampling technique to select a total of 80 potato producers, 5 aggregators, 5 wholesalers, 10 retailers, 50 consumers, and 3 extension service providers. Findings revealed that, on average, potato cultivation covered 0.215 hectares (4.23 Ropani) with a productivity of 13.46 Mt/ha, which is lower than the national average. The production cost of the producer was NRs. 301,756.60/Ha (NRs. 15,356.57/Ropani) with a benefit-cost ratio of 1.37, and the producer's share was 51.68%. The primary value chain actors included input suppliers, producers, aggregators, wholesalers, retailers, and consumers. Marketing margins for producers, aggregators, wholesalers, and retailers were NRs. 359.25/quintal, NRs. 965/quintal, NRs. 945/quintal, and NRs. 1170/quintal, respectively. Value addition by potato producers accounted for 10.45%, while aggregators, wholesalers, and retailers contributed 28.05%, 27.48%, and 34.02%, respectively. The SWOT analysis highlighted opportunities like favourable policies, subsidies, processing options, rising potato demand, and potential production area expansion. To boost the profitability of the potato industry, it is imperative to address challenges such as poor seed quality, diseases-pests, drought, short shelf life, soil degradation, and fertilizer and pesticide availability while strengthening the linkage of value chain actors.

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INTRODUCTION

Potatoes *(Solanum tuberosum)*, belonging to the Solanaceae family, rank sixth in terms of crop cultivation in Nepal, with a total area of 198,788 hectares and a production output of 3,325,231 metric tons (MoALD, 2023). Potatoes are commonly cultivated in Nepal at altitudes ranging from below 100 masl to over 4000 masl (Sapkota *et al*., 2019). The cultivation of potatoes is predominantly focused in the mid-hills, accounting for 41.5 percent of the overall area, while the plains and highlands closely trail behind with 38.5 percent and 20 percent, respectively (Upadhyay and Timilsina, 2020). The majority of farming is subsistence-level, with dispersed and small landholdings of 0.68 ha or less (CBS, 2013). In addition, the potato contributed 5.52 percent to the Agriculture Gross Domestic Product (AGDP) in the fiscal year 2021/22 (MoALD, 2023). In Nepal, per capita consumption rose from 16.44 kg in 1961 to 86 kg in 2020 (FAOStat, 2020).

Potato production exhibits significant potential and a wide range of opportunities in the Sudurpaschim Province, with a production area and production of 16165 hectares and 262,757 metric tons, respectively (MoALD, 2023). Similarly, in Bajhang,

one of the districts of Sudurpaschim Province, potato cultivation has been carried out on a land area of 1600 hectares with a production of 24,580 metric tons and a productivity of 15.36 metric tons per hectare in the fiscal year 2020/21 (MoALD, 2023). Despite the favourable potato production in Bajhang district, there is a dearth of adequate market infrastructure in the region. The primary obstacle to potato production is the lack of access to high-quality and advanced seed varieties. A significant proportion of farmers in this region employ indigenous potato seeds for cultivation, with limited knowledge of alternative potato cultivars that exhibit superior yield and resistance to pests and diseases. The enhancement of the agricultural sector has the potential to elevate the standard of living for farmers in this district

The value chain refers to a series of interconnected activities that involve the supply of inputs, production, conversion, marketing, and eventual delivery of products to consumers (Zamora, 2016). Within the value chain, internal factors like production and marketing interact with external forces such as technological progress, socioeconomic factors, environmental concerns, new industry trends, and regulatory changes (WBSCD, 2011). Assessing the value chain relies on taking into account both internal and external factors, as both are considered crucial (Nassirou Ba, 2016). Instead of focusing on just one area or group of people, the value chain framework tries to solve the big problems that come up at every step of the supply chain (Kassaye *et al.*, 2018). It is possible to lessen the damage that middlemen do to marketing by building strong value chains that connect farmers to markets and doing more activities that add value by using new technology, inputs, scientific processing, and exports (Miller and Jones, 2010). This research will be beneficial to farmers and policymakers because, till now, there has been no research on the value chain analysis of potatoes in Bajhag district. The research findings about production costs, profitability, and value addition by each actor and SWOT analysis will surely provide the foundation for further research in the future.

MATERIALS AND METHODS

Selection of the study site

The study had been carried out in Bajhang district, which covers an area of 3,422 km^2 with a population of about 189,085 (CBS, 2021). It is located between 29°29' and 30°09' north longitude and 80°46' and 81°34' east latitude. The elevation of the district from sea level is 700 m to 7,035 m. Major potato production areas demarcated by PMAMP, Potato Zone, Bajhang were the study sites for the research.

Sample selection

Samples were collected from the potato-growing farmers in the major pocket areas of the whole district. Thus, all respondents were picked using the approach of random purposive selection. A total of 153 samples were collected, encompassing 80 producers, 50 consumers, 10 retailers, 5 wholesalers, 5 aggregators, and 3 extension officers. Efforts were made to enhance the sampling frame's inclusivity by incorporating farmers from diverse categories, considering factors such as wealth, ethnicity, and education levels. The current study made use of both primary and secondary data sources. To acquire primary data, the research employed various methods, including household surveys, focus group discussions, interviews with key informants, and field observations. These techniques were chosen to ensure the acquisition of a comprehensive and varied dataset that could be analysed to yield meaningful insights

Data sources and instruments

The research aims to conduct a comprehensive analysis of the value chain actors and their linkages through a rigorous market assessment. Customized questionnaires were formulated for each value chain actor within the potato value chain. Furthermore, the research employed a purposive sampling method to choose key informants with expertise in potato production and marketing from various sectors and local communities, subsequently conducting interviews to gather pertinent data on these aspects

Data analysis

The research utilized a field survey approach to collect primary data. A semi-structured, open-ended questionnaire schedule was employed as the primary instrument for data collection. The study used secondary data from journals, proceedings, and annual reports from the National Agricultural Research Council (NARC), the National Plant Resources Program (NPRP), the District Agriculture Development Office (DADO), the Department of Agriculture (DoA), the Ministry of Agriculture and Development (MoALD), and other groups that work on development. It involved the collection of data, which was subsequently subjected to coding, tabulation, and analysis. The Statistical Package of Social Science (SPSS) and Microsoft Excel were utilized for the purpose of calculating the cost of production and the benefit-cost ratio.

Economic analysis

This study presents an analysis of various financial metrics, including gross margin, net margin, benefit-cost ratio, producer's share, value share, and price spread, in the context of potato production. Additionally, this research examines the factors that impact gross revenue and investigates the association between cost of production parameters and gross income derived from potato cultivation.

The following parameters were examined during the research:

- Cost of production = Σ cost on all items
- Gross return = (Total quantity marketed (quintal) × Price per unit (NRs.)
- Gross margin = (Gross return − Total variable cost)
- $\frac{B}{C}$ Ratio = $\frac{\text{Gross return}}{\text{Total variable cost}}$
- Marketing margin = (Sale price − purchase price)
- Producer's share = $\frac{\text{Price received by Farmers}}{\text{The price paid by Consumers}} \times 100$
- %Value Added = $\frac{\text{Value-added}}{\text{Total value addition}} \times 100$
- Price spread = (Retail price − farm gate price)

an analysis of the strengths, weaknesses, opportunities, and threats (SWOT) associated with potato production, marketing, and value chain actors. The data for this research was collected through a household and market survey. The study utilized a SWOT analysis to identify the internal and external factors that affect the potato industry. The results of this analysis provide valuable insights into the current state of the potato industry and can inform future decision-making processes.

RESULTS AND DISCUSSION

Socioeconomic and demographic profile of value chain actors

Within the spectrum of value chain actors, the demographic data reveals notable distinctions. Retailers exhibited the highest mean age, recording an average of 49.3 years, followed closely by producers and aggregators, with respective mean ages of 47.46 years and 46.24 years. Conversely, the lowest average age was observed among consumers, with an average age of 35.17 years. Furthermore, among the 10 respondent retailers, only 2 were female, while all 5 aggregators and 5 wholesalers were male. Among the producers, a notable 73.75% (59) were male, while the remaining 26.25% (21) were female. Similarly, within the category of consumers, only 36% (18) were male and a significant 64% (32) of the 50 consumers were female respondents (Table 1). Turning our attention to educational attainment, the maximum education qualification of all the value chain actors was at the 12th-grade level, or high school. The highest mean educational qualification was attributed to wholesalers, who averaged 8.6 years of education, followed by aggregators and consumers, with average education qualifications of 6.5 and 5.82 years, respectively. Among all value chain actors, producers displayed the lowest mean educational attainment, with an average of 4.75 years. In terms of family size, consumers reported the most substantial family sizes, averaging 8.26 members per household. Producers came in second with an average family size of 6.28, closely followed by aggregators (6.21), wholesalers (5.24), and retailers (4.68) (Table 1).

Mapping Potato Value chain: Identifying Key Actors and Their Functions

The potato value chain map was constructed to identify the different value chain actors, the roles they play, and the linkage among them. Figure 1 shows the value chain actors, their relationships, and their functions. The actors identified in the Bajhang district were input suppliers, producers, aggregators or collectors, wholesalers, retailers, and consumers. These actors were engaged in the different functions as depicted in Figure 1. In the study area, wholesalers and retailers played the part of processors. This is different from the finding of Tokha municipality (Shrestha *et al*., 2022), where they were identified as separate actors in the value chain. The major enablers or supporting actors were the Agriculture Knowledge Centre (AKC), Project Implementation Unit (PIU), Potato Zone, District Agriculture Development Office (DADO), NGOs (Sahara Nepal), INGOs, JTAs, Agriculture and Extension officers, Agricultural Development Bank Ltd. (ADBL), and microfinance. Moreover, the value chain actors were linked forward in terms of input and potato supply among the actors, whereas the money flow among the actors was mostly backward. The various arrows in Figure 1, however, show that the flow of information was both unidirectional and bidirectional.

Source of seed potato

The essential input in potato cultivation is seed tubers, and excellent-quality seed potatoes are necessary for higher returns in terms of both quantity and quality (Sakha *et al*., 2007). The sources of seed tubers used by respondents are categorized into six groups, i.e., own stock, neighboring farmers, open market/seed selling center, Project Implementation Unit (PIU), Potato Zone, Agriculture Knowledge Centre (AKC),

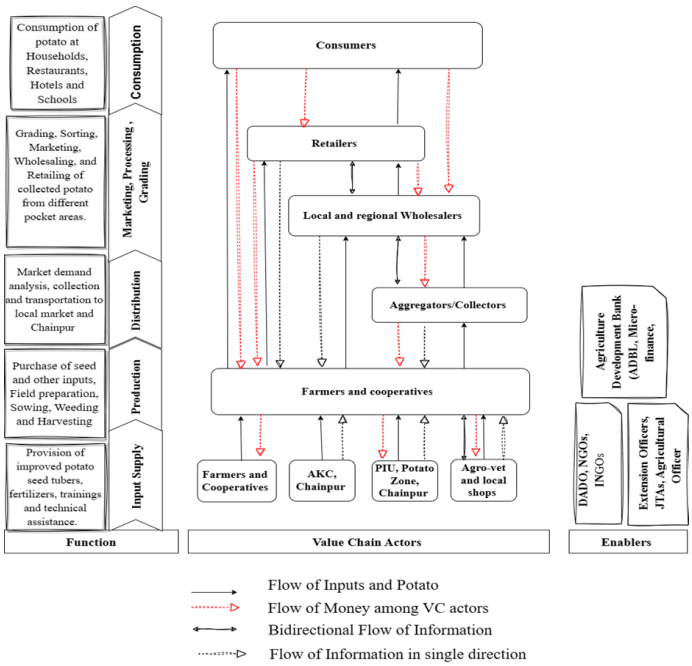

Figure 1. *Value chain map of potato in Bajhang district.*

Table 1. Socioeconomic and demographic profile of different value chain actors.

Value chain Actors	Parameters								
	Age			Gender		Education			Family size
	Max.	Min.	Mean ± SD	Male	Female	Min.	Max.	Mean	Mean± SD
Aggregators	60	30	46.24±12.410	5(100)	0(0)	0	12	6.5	6.21± 3.51
Retailers	72	35	49.30±12.43	8 (80)	2 (20)	0	10	5.45	4.68± 5.03
Wholesalers	55	32	38.20±5.93	5 (100)	0 (0)	5	12	8.6	5.24±4.46
Producers	75	17	47.46±10.52	59(73.75)	21(26.25)	0	10	4.75	6.28±5.76
Consumers	82	18	35.17±14.35	18 (36)	32 (64)	2	12	5.82	8.26±4.02

Note: SD means standard deviation and figure in parenthesis indicate percentage (%); Source: Own field survey (2022)

Bajhang, and NGOs (Sahara Nepal) and INGOs. Out of 80, the majority, i.e., 46 (57.5%) of the respondents, used their own stock seed tuber, followed by 13 (16.25%) from PIU, Potato Zone. Similarly, 7 (8.75%) respondents got seed from neighbors and AKC, 4 (5%) and 3 (3.75%) from the open market and NGO/INGOs, respectively. The outcome is shown in Figure 2, which shows that farmers had been utilizing their own stock seeds for many years and were ignorant of the high-yielding and disease- and pest-resistant potato variety. Farmers in the study region can boost their output by employing high-yielding and disease- and pest-resistant cultivars.

Status of inorganic fertilizer and training among farmers

The research showed that only 24 (30%) out of the 80 respondents had received training in the various aspects of potato growing and storage (Figure 3). It showed that there is a need to strengthen extension and training services for a greater number of potato growers from different government and non-government organizations. Also, farmers did not know how to apply and use inorganic fertilizer because it was not available at the right time and was not widely known. In the study area, the majority of the producers were involved in organic potato farming (95%), i.e., non-users of inorganic fertilizer, whereas only 5% have access to and use inorganic fertilizer. Thus, it has impacted the overall productivity of the study area.

Economic analysis

This section deals with the economic analysis of all value chain actors. Cost of production, marketing cost, gross margin, net margin, benefit-cost ratio, and producer's share were estimated for producers. Similarly, the marketing margin, value share, and percentage of value added by each actor were also estimated.

Production cost of potatoes

The study revealed that the production cost of potatoes, which includes total variable cost and fixed cost, was NRs. 301,756.60/ha, or NRs. 15,356.57/Ropani. Seed tuber cost was the highest, contributing to 22.79% (NRs. 68,774.80/ha) of the total cost of production **(**Table 2**).** The significant loss of stored seeds, which was primarily due to the lack of a cold storage facility, is what led to the increased cost of seeds. The seed tuber cost was the highest cost of production in the findings from Kavrepalanchok district (Bolakhe *et al.*, 2022) and the Terai region of Nepal (Subedi *et al.*, 2019). But in Achham, the cost of labour was highest, followed by the cost of seeds (Sapkota *et al.*, 2019). And in Bajracharya and Sapkota (2017), the cost of FYM was the highest, making up 45.32% of the total cost of production.

The second highest cost of production was land preparation cost

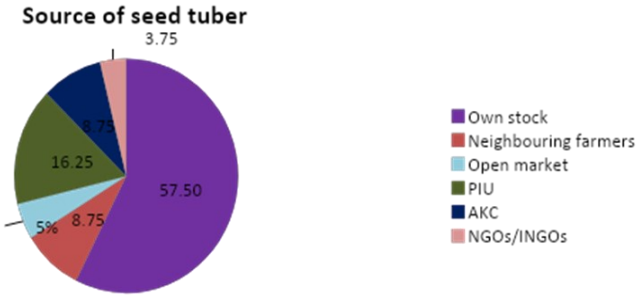

Figure 2. *Major source of potato tubers among farmers of Bajhang district (in percentage).*

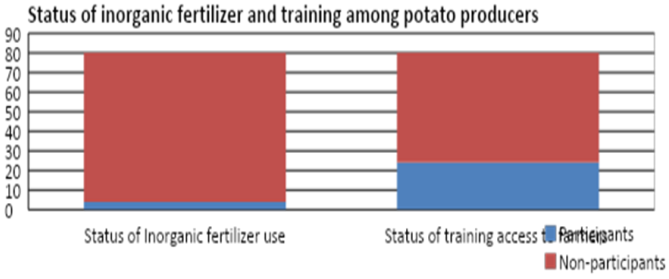

Figure 3. *Status of inorganic fertilizer and training among potato producers of Bajhang district.*

Table 2. Total Production Cost of Potatoes in Bajhang district.

	Cost Item	Cost/Ropani (NRs.)	Cost/Hectar (NRs.)	Cost/kg (NRs.)
Variable cost	Land preparation cost	2,986.67 (19.45%)	58,688.06	4.36
	Seed tuber cost	3,499.99 (22.79%)	68,774.80	5.11
	FYM cost	1,960.11 (12.76%)	38,516.16	2.86
	Inorganic fertilizer cost	55.15 (0.36%)	1,083.69	0.08
	Weeding, Earthing up and Irrigation cost	2,286.87 (14.89%)	44,936.99	3.34
	Pest/Disease control cost	65.31 (0.43%)	1,283.34	0.10
	Harvesting cost	1,921.30 (12.51%)	37,753.54	2.80
	Miscellaneous cost	272.43 (1.77%)	5,353.25	0.40
	Total variable cost	13,047.82 (84.97%)	2,56,389.66	19.05
Fixed cost	Land cost	2,308.75 (15.03%)	45,366.94	3.37
Total production cost		15,356.57 (100%)	3,01,756.60	22.42
Marketing cost	Transportation cost	462.06	9,079.48	0.67
	Post-Harvest loss cost	449.48	8,832.28	0.66
	Total marketing cost	911.55	17,775.22	1.33
Total cost		16,268.12	319,668.56	23.75

Source: Own field survey 2022.

in the Bajhang district, contributing to 19.45% (NRs. 58,688.06/ha) of total production cost. The higher cost associated with land preparation was a result of using bullocks and manual labour due to the difficult land topography and the unavailability of machinery in the study area. Additionally, higher labour costs were due to the unavailability of manpower during peak season, which contributed to the greater land preparation costs. After that, land cost is in the third position (NRs. 45,366.94/ha), followed by weeding, earthing-up, and irrigation (NRs. 44,936.99/ha), FYM cost (NRs. 38,516.16/ha), harvesting cost (NRs. 37753.54/ha), and so on. Further, the cost attributed to inorganic fertilizer, i.e., NRs. 1,083.69/ha, was the least 0.36%, followed by pest and disease control, i.e., NRs. 1,283.34/ha, which contributed to the 0.43% among all production costs. It is because there was less availability and no awareness among farmers about the use of insecticides and pesticides. Marketing cost, which includes transportation and post-harvest loss cost, was NRs 17,775.22/ha. The total cost (sum of total production cost and marketing cost) was found to be NRs. 319,668.56/ha or NRs. 16,268.12/Ropani in Bajhang district.

Return and Profitability of potato producers

From Table 3, among the 80 potato producers, the average area of potato production in the Bajhang district was 0.215 ha (4.23 Ropani) with a productivity of 13.46 MT/ha, which is less than the productivity of Bajhang district (15.36 MT/ha) in the fiscal year 2020/21 (MoALD, 2023). The reason for the low productivity is due to the severe blight infestation and drought compared to previous years. Similarly, the productivity from the findings of Achham (Sapkota *et al.*, 2019), Baglung district (Bajracharya and Sapkota, 2017), and Darchula district (Chauhan *et al.*, 2022) was also found to be lower, i.e., 12.287 MT/Ha, 9.89 MT/Ha, and 13.13 MT/Ha, respectively, than that of the Bajhang district. Moreover, the gross return, which is calculated by multiplying the price per kilogram of potato received by farmers, i.e., the farm gate price, with the total potato production, was NRs. 350,134.90/ha (NRs. 17,818.57/Ropani). Further, the value of the gross margin was found to be NRs. 93,745.04/ha (NRs. 4770.74/Ropani) in the Bajhang district. The variable costs that come up during production were subtracted from the gross return to get the gross margin. The gross margin tells us if the value of the product is enough to cover the variable costs (Gujarati and Porter, 2013). Furthermore, the net profit or net margin of potatoes in Bajhang district was only NRs. 30,466.34/ha (NRs. 1550.45/Ropani) after deducting the total cost that includes the production and marketing costs of farmers. It is the amount that potato producers in the Bajhang district actually earned after all the cost deductions.

The B:C ratio, which had a value of 1.37 after dividing the gross return by the total variable cost, showed profitability for potato producers because it was higher than 1. The finding from Sapkota *et al.* (2019) has a somewhat similar B:C cost ratio of 1.352 for small-scale farms; however, for large-scale farms, the B:C ratio was 1.644. Moreover, the B:C ratio was lower than Bajhang district in Molung rural municipality (0.99) and high in Siddicharan municipality (1.55) of Okhaldhunga district, with an overall B:C ratio of 1.23. The reason for the higher B:C ratio in the municipality was due to farmers' awareness about chemical fertilizers and irrigation facilities (Phulara *et al.*, 2022). However, the findings of Dhital (2017) in Kavre district (2.44), Subedi *et al.* (2019) in the Terai region of Nepal (2.13), and K. Shrestha and Yadav (2018) in the Ilam district (1.7) all have a higher B:C ratio than the Bajhang district. The low B:C ratio compared to other findings from Nepal in Bajhang district is due to the lack of irrigation facilities, minimal use of chemical fertilizers, and the unawareness of people regarding disease-pest control measures.

Producer's share and price spread

Producer's share in consumer rupee is the ratio of the price received by farmers to the retail price paid by consumers.

Producer's Share = (Price received by farmer's / Price paid by consumers) × 100%

= (2600/5030) ×100 % = 51.68%

In the Bajhang district, the farm gate price was NRs. 2600 per quintal, and the retail price paid by consumers was NRs. 5030 per quintal. Therefore, the producer's share in consumer's rupee is only 51.68% which is significantly lower than the producer's share of 72.43% in Tokha municipality, Kathmandu (Shrestha *et al.*, 2022). The finding showcases that the producer's share is not satisfactory because intermediaries are getting almost half of the share from the consumer's pay. This is primarily attributed to producers' limited understanding of market prices and marketing channels, elevated transportation costs resulting from challenging terrain, farmer's compelled to sell at lower seasonal price during surplus production due to inadequate storage facilities for potatoes in Bajhang district. Moreover, the price spread between producers and consumers, calculated by deducting the farm gate price from the retailer price, was NRs. 2430 per quintal, whereas in the Tokha municipality, Kathmandu, it was NRs. 1394.11 per quintal (S. Shrestha *et al.*, 2022).

Table 3. Gross return and B: C ratio calculation of producer

Particular	Mean value
Area of potato production (Hectare)	0.215 (4.23 Ropani)
Potato production (Yield) (Kg/Ha)	13,460.25 Kg (685 Kg/ropani)
Price per Kg (NRs.)	26.0125
Gross Return (A) (NRs./ha)	3,50,134.90 (17,818.57/Ropani)
Variable Cost (I) (NRs./ha)	2,56,389.66
Total cost (II) (NRs./Ha)	3,19,668.56
Gross Margin (A-I) (NRs/Ha)	93,745.04 (4770.74/Ropani)
Net Margin (A-II) (NRs/Ha)	30,466.34 (1550.45/ropani)
B:C Ratio(A/I)	1.37

Table 4. Value Added and Share of each actor in value chain.

S. No	Particular	Producers (Mean± S.D.)	Aggregators (Mean± S.D.)	Wholesalers (Mean± S.D.)	Retailers (Mean± S.D.)	Sum total (Horizontal)
I.	Total Production cost (Variable+ Fixed cost)	2242±137.58	_	_	_	_
II.	Purchase price (P.P.) per quintal (NRs.)	_	3080 ±204.93	3300±220.53	4160±598.88	_
III.	Marketing cost per quintal (NRs.)	133± 38.34	231.8±33.38	275.6±27.14	239.7±78.15	_
IV.	Total cost incurred per quintal (NRs.)	2375±175.92	3311.8±289.05	3575.6±247.67	4439.7±677.03	_
V.	Selling price (S.P.) per quintal (NRs.)	2601.25±485.45	3845±450.54	4245±395.78	5030±336.782	_
VI.	Marketing Margin (Value Added) (NRs.)	359.25	965	945	1170	3439.25
VII.	% Share of Value added	10.45%	28.05%	27.48%	34.02%	100%

Table 5. SWOT analysis of potato at study area.

	Strength	Weakness
Internal Factors	Establishment of PMAMP, Potato zone Increase in the transportation facilities Establishment of Rustic seed storage in the hilly areas Increased exposure of farmers to trainings and improved seed tubers. Organic potato production in most of the areas Local varieties have higher nutritional and medicinal benefits. Greater potential to increase export in the regional market Increased adoption of POP of potato by farmers Potential for enhancing both production area and productivity Involvement of groups and cooperatives in the market	Low seed replacement rate Lack of modern storage and pre-cooling facilities near farm area Low farm gate price and price fluctuation Severe attack from diseases and pests. Lack of awareness about the disease and pest management Unavailability of adequate chemicals and pesticides to control disease and pests Dependence on manual labor and bullocks in most of the areas Deterioration of potato tubers, greening and sprouting during storage Lack of irrigation facilities Lack of processing facilities Poor linkage between value chain actors Poor market information Greater distance from farm to market
	Opportunities	**Threats**
External Factors	Scope for value-added products Scope for establishing potato processing industries More emphasis on the potato commodity from the local bodies More favourable policy from the government due to higher return Increasing technical supports and subsidies to farmers from both state and local government Scope for import substitution	A serious threat of drought Emerging threats of blight, red ant, red wart and cut worm The decreasing trend of farm labor availability is due to migration of youth. Higher production costs Threat of landslides and erosion in many production areas. Threat of snowfall and freezing injury in the hilly areas

The value addition and value share of each actor

The purchase price (P.P.) of aggregators, wholesalers, and retailers was NRs. 3080/quital, NRs. 3300/quital, and NRs. 4160/quital, respectively. The purchase price of retailers was the highest because it included transportation and spoilage costs of farmers' during the off-road journey. To find out the actual cost incurred, marketing cost was calculated, which includes packaging, loading and unloading, sorting, grading, transportation, storage, and other costs, along with the loss in transportation and storage, and then added to the purchase price of each trader and the production cost of the producer. The total cost of producers, aggregators, wholesalers, and retailers was NRs. 2375, NRs. 3311.8, NRs. 3575.6, and NRs. 4439.7 per quintal, respectively. Similarly, the selling price of each value chain actor was NRs. 2601.25, NRs. 3845, NRs. 4245, and NRs. 5030 by producers, aggregators, wholesalers, and retailers, respectively (Table 4). Each actor in the potato value chain adds value to the potato by altering its form through activities like packaging and transportation, thereby creating utility (Tadesse and Bakala, 2018). Value addition refers to the difference between the selling price and the input costs, such as raw materials, at each stage within the value chain (Emana and Nigussie, 2011). In the Bajhang district, value added (marketing margin) was highest for the retailers, i.e., NRs 1170/quintal, followed by aggregators (NRs 965/quintal) and wholesalers (NRs 945/quintal), similar to the finding of marketing margin in the Tokha Municipality, Kathmandu (Shrestha *et al.*, 2022). Potato producers contributed 10.45% of the total value addition, which is similar to the findings of potato producers in Masha district, Ethiopia (Tadesse and Bakala, 2018). Aggregators were responsible for 28.05%, whereas wholesalers and retailers contributed to 27.48% and 34.02%, respectively, in the value addition (Table 4).

Marketing channel and quantity flow in the channel

In the study area, there were six different marketing channels through which the product was reached to end consumers. The six different marketing channels were:

Marketing Channel I: Producers à Consumers
Marketing Channel II: Producers àRetailers à Consumers
Marketing Channel III: Producers àWholesalers à Consumers
Marketing Channel IV: Producers àWholesalersàRetailers à Consumers
Marketing Channel V: Producers àAggregatorsàRetailers à Consumers
Marketing Channel VI: Producers àAggregatorsà Wholesalersà Retailers à Consumers

The estimated sale from the 80 respondent potato producers in the Bajhang district was 950 quintals in 2022. The value chain channel was prepared based on the total quantity flow (volume) of potatoes among each actor. The potato producers used all six channels; however, the quantity flow chart depicted that the quantity flow from the farmer is highest for the wholesalers, which comprise 58.78% of the total volume sold by farmers, followed by 22.57%, 11.42%, and 7.23% to retailers, consumers, and aggregators, respectively. The finding was somewhat similar to the case of Tokha municipality, Kathmandu (Shrestha *et al.*, 2022), where farmers sold about 51.4% of potatoes to wholesalers, followed by 22.47% to aggregators. But, in our study, aggregators carried the fewest potatoes from the farmers. Also, in the finding of Tadesse and Bakala (2018), commission agents were getting more volume of potato, i.e., 43.36%, followed by local traders (35.39%), and the wholesalers received only 5.14% of the potato from the producers. Furthermore, from Figure 4, channel IV (Producer- Wholesaler-Retailer-Consumer) carried the highest potatoes, followed by channel II (Producer-Retailer-Consumer).

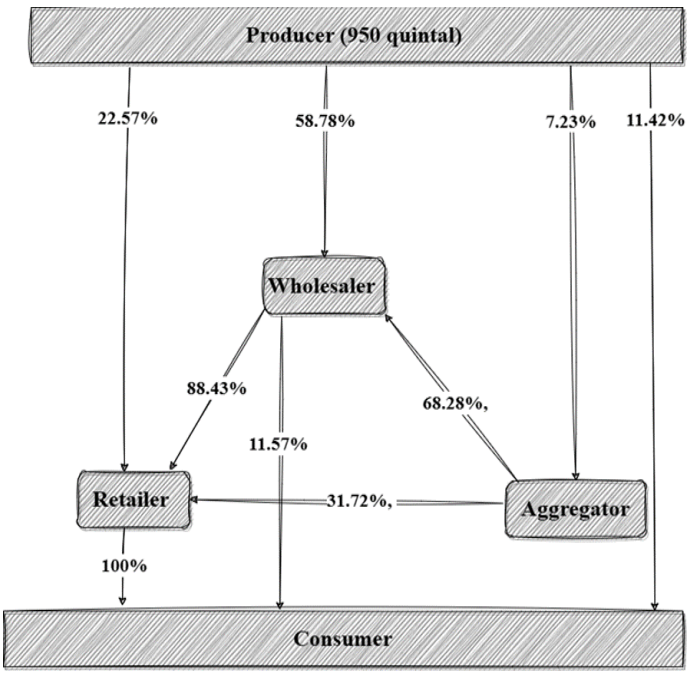

Figure 4. *Potato market channel in Bajhang district.*

Conclusion

With the establishment of the Potato Zone under the purview of the PMAPM (Prime Minister's Agriculture Modernization Project) in the Bajhang district, notable progress has been witnessed in the sphere of potato cultivation. The principal stakeholders within the potato value chain encompass farmers, wholesalers, retailers, aggregators, and enablers. Producers sold a greater percentage of their produced potatoes to wholesalers (58.78%), followed by retailers (22.57%), and directly to consumers (11.42%). Similarly, most quantity flow was from channel IV (producer-wholesaler-retailer-consumer) followed by channel II (producer-retailer-consumer), and the least preferred channel was channel V (producer-aggregator-retailer-consumer). The average potato production area in Bajhang was found to be 0.215 hectares. However, it is noteworthy that a substantial portion of the local farming community predominantly engages in the cultivation of indigenous potato varieties. These local varieties are less economically lucrative and are more susceptible to pests and diseases, consequently resulting in lower productivity at the study site, quantified at 13.46 Mt/ha (6.85 quintal/ropani), which falls below the national productivity standard. In a similar vein, the farmers' contribution to the consumer's financial outlay was 51.68% of the consumer's expenditure. A B:C ratio of 1.37 indicates that the potato industry in the Bajhang district was profitable. Farmers are not getting as many benefits as they should because of problems like rising production costs, poor storage facilities, pest and disease infestations, and a high rate of potato spoilage. Taking these important issues into account makes it clear that farmers and extension service providers need to work together more, and the federal and state governments need to take a strategic and coordinated approach as well.

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Conflict of interest

We wish to emphasize that this article is entirely original, and we can affirm that there are no conflicts of interest to disclose.

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