Global Social Sciences Review (GSSR) Vol. VIII, No. I (Winter 2023) Pages: 534 – 550
ISSN (Online): 2520-0348 ISSN (Print): 2616-793X ISSN (Linkage): 2520-0348

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Assessing the Economic Value Chain of Potatoes in Hunza District, Gilgit-Baltistan

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Abstract: *This study aims to identify the demographic characteristics of potato growers, investigate the marketing channels and value chain actors available in Hunza, Pakistan, and determine the significant production and marketing problems faced by potato growers in the area. Primary data collected from potato growers in Hunza using a multistage sampling technique and a pre-tested questionnaire. Descriptive statistics were used to analyze the demographic characteristics of potato growers, and the marketing channels of the potato value chain were studied using supply linkage. A simple linear regression model was used to identify the significant variables affecting potato yields. The regression model showed that variables such as sex of household head, family size, education status, distance to the market, farming experience, potato farm size, off/non-farm income, and quantity of potato supplied to the market significantly affected potato yields. The study also identified constraints and opportunities for potato growers.*

Key Words: Potato Value Chain, Marketing Channels, Demographic Characteristics, Production Problems, Marketing Problems, Simple Linear Regression Model

Introduction

Agriculture is the backbone of Pakistan's economy, and it accounts for 19.5% of the country's GDP (World Bank, 2021). The Gilgit-Baltistan region is situated in the northern part of Pakistan and is known for its fertile soil and diverse agriculture (Ahmad et al. (2020). Among the various crops grown in this region, potatoes have gained immense popularity due to their high demand and economic value. The potato industry in Hunza District, Gilgit-Baltistan, has grown exponentially in recent years, and it has become a major source of income for the local farmers.

The potato industry in Hunza District is a part of a larger economic value chain that includes multiple stakeholders, from farmers to traders, processors, and retailers (Baig,et al., 2021; Abdallah, 2020). Understanding the dynamics of this value chain is crucial for improving the profitability of the potato industry in Hunza District and the livelihoods of the people involved in it. This research article aims to assess the economic value chain of potatoes in Hunza

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Citation: Khan, S. U., & Malik, A. M. (2023). Assessing the Economic Value Chain of Potatoes in Hunza District, Gilgit-Baltistan. *Global Social Sciences Review*, *VIII*(I), 534-550. https://doi.org/10.31703/gssr.2023(VIII-I).50

DOI: 10.31703/gssr.2023(VIII-I).50 **URL:** http://dx.doi.org/10.31703/gssr.2023(VIII-I).50

District, Gilgit-Baltistan, and identify opportunities for enhancing its economic viability.

Potatoes are the fourth most important food crop in the world after wheat, rice, and maize (Sagili, et al., 2022). They are a staple food in many countries, including Pakistan, where they are consumed in various forms, such as boiled, fried, mashed, and roasted. Potatoes are a source of carbohydrates, vitamins, and minerals, and they are also used for industrial purposes, such as in the production of starch and alcohol (Woolfe & Poats, 1987). The demand for potatoes in Pakistan has been steadily increasing due to the country's growing population and changing dietary habits.

Hunza District is located in the Gilgit-Baltistan region of Pakistan and is known for its scenic beauty and diverse agriculture. The district is situated at an altitude of over 2500 meters above sea level, and its terrain is characterized by steep mountains, narrow valleys, and glacial lakes. The climate in Hunza District is cold and dry, with long winters and short summers (Habib, 2021). Despite its harsh weather conditions, Hunza District is suitable for growing various crops, including potatoes (Farooq, et al., 2020).

Potatoes have been grown in Hunza District for decades, and they have played a significant role in the local economy (Khan, et al., (2013). In recent years, the potato industry in Hunza District has witnessed rapid growth due to various factors, such as the introduction of high-yielding potato varieties, the adoption of modern agricultural practices, and the establishment of market linkages (Hussain, et al. 2022). The potato industry in Hunza District is a vital source of income for thousands of smallholder farmers, who cultivate potatoes on small plots of land.

Value Chain of Potatoes

According to Porter (1985) the value chain as a simple tool for analyzing the basis of competitive advantage. The value chain represents a series of activities that are involved in the production, transformation, and distribution of agricultural commodities to end consumers (Kaplinsky & Morris, 2000). Value chain analysis involves examining various components of the chain to identify potential areas for improvement and to determine the reasons for any weaknesses in the chain's performance (Sharma, 2019).

The value chain is an approach that can be used to increase efficiency, productivity, and value in the production of goods and services. It also helps to improve the position of all actors involved in the production chain of a particular product. Therefore, improving the efficiency and productivity of agricultural value chains is crucial for the development of a country and the improvement of income for its rural population (Webber & Labaste, 2010).

The value chain concept also involves adding value to products as they move through various stages of production. This means that value is added at each level of the chain through processes such as sorting, cleaning, processing, packing, shipping, grading, and other operations (Poniah, 2009). As the commodity passes through different players and incurs operational costs, its value changes, resulting in some form of value addition.

The economic value chain of potatoes in Hunza District involves multiple stakeholders, including farmers, traders, processors, and retailers. The farmers are the primary producers of potatoes, and they sell their produce to traders who operate in the local markets. The traders purchase potatoes in bulk and transport them to the urban centers, where they are sold to processors or retailers. The processors convert potatoes into various products, such as chips, crisps, and frozen French fries, which are then sold to retailers or exported to other countries.

The economic value chain of potatoes in Hunza District is complex and involves various challenges, such as lack of access to finance, limited infrastructure, and market volatility. The farmers face difficulties in accessing credit, which limits their ability to invest in modern agricultural practices and technologies. The traders face challenges in transporting potatoes to the urban centers due to poor road infrastructure and high transportation costs. The processors face difficulties in sourcing quality potatoes and maintaining a consistent supply chain. The retailers face challenges in managing inventory and ensuring timely delivery to their customers.

In conclusion, the potato industry in Hunza District, Gilgit-Baltistan, is a significant contributor to the local economy, and it has the potential to grow further. Understanding the economic value chain of potatoes in Hunza District is essential for identifying opportunities.

The main purpose of this study is to investigate the potato market in the Hunza area, with a particular focus on determining the proportion of potatoes that come from individual farmers. Three critical aspects that have not been previously researched will be examined, including producer production behavior, potato marketing, and the growing farmer market share.

The primary aim of this research is to identify the key actors and their roles in the potato value chain in Hunza, as well as the factors that affect potato production in the region. This will involve an examination of the production and marketing problems facing potato growers in Hunza, including the channels through which potatoes are marketed.

To achieve the research objectives, the study will address three primary questions. First, the various marketing channels and value chain actors in the study area will be identified. Second, the factors influencing potato production in Hunza will be investigated. Third, critical constraints and opportunities for potato growers in the value chain will be identified.

The results of this study will be valuable for potato growers and traders in Hunza, as well as for development planners and policymakers involved in drafting policies related to potato production and marketing. Additionally, the research will provide valuable information for research and development organizations, extension service providers, and both government and non-governmental organizations to formulate potato marketing development programs and guidelines that can enhance the efficiency of the potato marketing system. Furthermore, the study can serve as an essential source of data for future research projects.

Literature Review

In recent years, there has been a growing interest in understanding the dynamics of value chains in the agricultural sector. Several studies have been conducted to identify the challenges and opportunities faced by different stakeholders in these value chains. various studies that investigate the value chains of bananas, potatoes, catfish, and ginger in different regions of the world. These studies reveal crucial information on the challenges and opportunities facing farmers, suppliers, processors, marketers, and other stakeholders.

For instance, Tarekegn et al. (2020) found that the banana value chain in Ethiopia faces significant challenges, including a fragile interaction between participants, lack of an organized market, and poor demand during production season. However, the authors suggest that by promoting value addition, enhancing banana variety access, and strengthening growers' technical understanding, stakeholders and governments can help farmers overcome these obstacles and increase profits.

Similarly, Sakadzo et al. (2020) highlight the potential of the Irish potato value chain in Zimbabwe to boost the country's GDP if supported by government policies and resources. To achieve this, the authors recommend that the government allocate more resources to the sector and improve policy execution, while farmers and stakeholders focus on implementing critical adjustments to improve long-term performance.

In the catfish value chain, Igwenagu et al. (2020) found that marketers play a critical role in creating value, as they are in the best position to collect data on consumer preferences. By considering these preferences, actors at each node in the value chain can maximize value and increase profits.

Finally, Dahal and Rijal (2020) highlight the challenges facing ginger farmers in Nepal, including price fluctuations and a lack of processing and storage infrastructure. However, the authors suggest that by addressing these obstacles, entering new markets, and creating co-operatives, farmers can increase their earnings and overcome these challenges.

In conclusion, the insights provided by these recent studies offer valuable lessons for agricultural businesses looking to improve their performance and increase profits. By considering the challenges and opportunities facing various value chains, stakeholders can make informed decisions and take action to achieve long-term success. So, take the first step towards success and implement the recommendations provided by these studies today!

Wubet et al. (2022) focused on potato value chains in Farta, Ethiopia, and conducted analyses to determine factors affecting potato market participation and sales. They found that potato

production and commercialization were hindered by poor seed, post-harvest management training, price fluctuations, market knowledge, legislative framework for price-setting strategy, and marketing limits. The study recommended boosting agricultural inputs, introducing better crops, and building post-harvest management facilities.

Dubey et al. (2022) discussed the importance of value chains in agriculture for sustainable growth and detailed the history, structure, stakeholders, and players involved in agricultural value chains. They also covered value addition, value chain development models, intervention frameworks, and business development services. The study provided real-world examples from Indian agriculture that showed the potential for value chain growth and its limitations.

Tarekegn and Kelem (2022) examined the mango value chain in Ethiopia's Gamo zone and found that post-harvest loss was a significant issue affecting stakeholders' understanding of the economical, nutritional, and environmental impact of the problem. The study suggested that post-harvest handling practices that reduce post-harvest loss could boost productivity and market food access by adjusting prices.

Tort et al. (2022) reviewed research on fruits and vegetables supply chain knowledge and practices and categorized the findings into eight categories, including value chain indicators, food-related problems, post-harvest losses, roles of parties in the value chain, technical breakthroughs, packaging issues, logistics solutions, and sustainable FFVSCs. The study aimed to inform instructors and experts about important research in these categories.

Wosene and Gobie (2022) mapped tomato value chain players and relationships, identified key tomato market channels, and examined the tomato value chain structure, conduct, and performance in selected districts. They found that only 40.7% of tomato value improved, and the tomato market was dominated by oligopoly. The study suggested that decision-makers could improve tomato value chain performance by strengthening farmer associations' negotiating power and assisting local tomato market operators.

In Waridin and Al-Hafidz's (2021) study, they investigated the market circumstances of the sweet potato industry in a particular sub-district. Their findings suggested that the market was an oligopoly, which meant that the industry was controlled by a few large players. They recommended that producers sell their products directly to consumers through short marketing chains to bypass the oligopoly and increase their profits. The study highlights the need to evaluate the market structure and to look for alternative marketing channels to help small producers increase their market share.

Wondim's (2021) research examined the challenges faced by small farmers in the agricultural sector in terms of market connectivity and access to relevant market information. The study identified the need to evaluate production status, marketing conditions, and value chain players, including gender issues, to develop intervention policies that will support the growth of the agricultural sector. The research shows that improving market information access and connectivity is crucial in ensuring that small farmers can better compete in the market and increase their profits.

Singh and Guleria's (2021) study analyzed the value chain of tomatoes in Himachal Pradesh and explored the roles of various value chain actors such as input suppliers, farmers, traders, wholesalers, retailers, and consumers. The study found that wholesalers and retailers played a significant role in adding value to the domestic value chain by providing space, storage, and possession utilities. The research highlights the importance of understanding the different value chain actors and their contributions to the market to create an efficient and effective value chain.

Devaux et al.'s (2021) review examined the role of potato crops in addressing global poverty, hunger, and malnutrition. The study discussed the need for significant food system reforms to increase food production and reduce waste, especially in poor nations. The research highlights the importance of the potato crop as a staple food that can be grown and consumed in many regions worldwide. The study suggests that by improving the efficiency of the potato value chain, we can increase food production and help reduce global poverty and hunger.

Daniso et al.'s (2021) research focused on the potato value chain in southern Ethiopia. They conducted a value chain analysis and found that producers received the largest share of profit,

cost, and market margin, highlighting their crucial role in the potato value chain. The study emphasizes the need for more comprehensive analyses of the potato value chain to identify gaps and potential areas for improvement. The research provides valuable insights into the potato value chain's dynamics, which can help stakeholders make informed decisions and policies to support potato production and consumption.

Data and Methodology

For the evaluation of the potato value chain in district Hunza, Gilgit-Baltistan, two tehsils were purposively selected, namely Tehsil Gojal and Aliabad. Primary data sources were used for data collection, including structured or semi-structured questionnaires administered to households in different villages of the two tehsils. In addition, key informants who were locals with expertise and experience in potato cultivation and marketing were interviewed to gain insights into the challenges faced in potato production.

A three-stage sampling technique was employed, beginning with the purposive selection of a region with a high capacity for potato production. Subsequently, two tehsils were purposively chosen based on the volume of potato production and marketing. Finally, a random selection of household heads from the total number of potato growers in the two tehsils was made using Yamane's formula for determining sample size based on population and area.

The sample size was established as 123, with 62 producers selected from Aliabad and 61 from Gojal. Additionally, 10 traders (4 wholesalers, 3 retailers, and 3 processors) and 50 consumers were chosen to thoroughly study the value chain. The sample size of traders and consumers was distributed equally between the two tehsils.

This study's data collection was conducted in 2022, and the survey was designed to provide a comprehensive understanding of the potato value chain in the selected tehsils, including producers, traders, and consumer.

Method

In this study, the researchers utilized descriptive methods to analyze the data gathered from a well-designed questionnaire. The data was used to define the various socio-economic characteristics of potato growers, wholesalers, processors, retailers, and consumers. The descriptive statistics used in the analysis included frequency, average, percentage, and standard deviation.

In addition to this, the researchers also used value chain analysis to better understand the structure and operation of the potato supply chain. Value chain analysis involves breaking down a chain into its individual components and analyzing the functions and relationships of each stage. The researchers identified the various actors in the chain, the flow of product through the chain, and the work features and destination of the product.

To gather information for the value chain analysis, the researchers conducted interviews, discussions in focus groups, and collected secondary data from various sources. By utilizing this technique, they were able to trace the physical value-adding phases of the product flow, quantify the flow of goods along the chain, and identify key actors and their relationships with other actors in the chain.

Mapping the value chain also helped the researchers improve their understanding of the steps involved and the people and relationships that are involved in the potato supply chain. This analysis was carried out using qualitative research methods, which allowed for a comprehensive understanding of the qualities possessed by the players in the supply chain and the connections that exist between them.

Description of Variables

Table 1

Variable	Type	Description
Yield of potato	Dependent	Continuous variable representing the amount of potato (in kg) grown by the sampled producer
Sex of the household head	Independent	Dummy variable (1 for male, 2 for female) thought to have either a positive or negative effect on potato production

Variable	Type	Description
Family size	Independent	Continuous variable representing the number of people in the sampled household, expected to have either a positive or negative effect on potato production
Education status	Independent	Dummy variable (1 for completed formal education, 0 for not completed) expected to have a positive effect on potato production
Distance to the market	Independent	Continuous variable representing the number of kilometers separating a family's farm and the closest market, expected to have a negative effect on potato production
Farming experience	Independent	Continuous variable representing the number of years spent farming, expected to have a positive effect on potato production
Potato farm size	Independent	Continuous variable representing the area (in kanals) of land farmed for potatoes, expected to have a positive effect on potato production
Off/non-farm activities	Independent	Dummy variable (1 for participating in off/non-farm activities, 0 for not participating) expected to have either a positive or negative effect on potato production

Source: Author survey results, 2022

Economic Model

$$Y = f(X_1, X_2, X_3, X_4, \ldots\ldots X_k)$$

$Y = \beta_o + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \cdots + \beta_4 X_k + \varepsilon i$

Y represents yield of potato and X_1, X_2, X_3, $X_4 \ldots X_k$ represents independent or explanatory variables, and ε_i is the residual term. It is possible to write the function as:
Yield of Potato = f (Education, farming experience, seed type used, fertilizer).

Yield of Potato (Y) = β_o + β_1Education + β_2 farming_experience + $\beta_3$0seed type + $\beta_4$fertilizer+ εi

where β_o = intercept term.

Result and Discussion

This research utilized a descriptive analysis to define the demographic characteristics of the farmers, traders, and consumers included in our sample. The report presents an analysis of the potato value chain, which outlines the different segments of the supply chain, parties involved, challenges encountered, potential opportunities, marketing channels employed, costs incurred, and profits earned. An econometric analysis was employed to identify the factors that affect the availability of potatoes in the market and the behaviors of potato farmers.

Analysis of the Producer of the Potato

Table 2 presents the demographic characteristics of producers, traders, and consumers in Hunza. The table shows that the majority of producers and traders are male, with 66.13% and 77.05%, respectively. The number of female producers is slightly higher than female traders, with 33.87% and 22.95%, respectively. All six traders in Aliabad and all four traders in Gojal are male. Similarly, all six consumers in Aliabad and four consumers in Gojal are male.

In terms of education, the majority of producers and traders have primary education, with 51.61% and 47.54%, respectively. Approximately a quarter of producers and traders have completed high school, and a small percentage have completed university education. There are no illiterate producers, traders, or consumers in the sample.

The summary statistics section shows that the mean age of producers is 41.59 years, with a standard deviation of 11.25. The minimum age is 25, and the maximum age is 66. The mean age of traders is 33.8 years, with a standard deviation of 8.46. The minimum age is 24, and the maximum age is 54. The mean age of consumers in Aliabad is 39.44 years, with a standard deviation of 8.21. The mean age of consumers in Gojal is not reported.

The mean family size of producers is 6.24, with a standard deviation of 1.89. The minimum family size is 2, and the maximum family size is 11. The mean family size of traders is 5.4, with a standard deviation of 1.58. The minimum family

size is 3, and the maximum family size is 8. The mean family size of consumers in Aliabad is 5.58, with a standard deviation of 1.82. The mean family size of consumers in Gojal is not reported.

The mean farming experience of producers is 14.77 years, with a standard deviation of 4.56. The farming experience of traders and consumers is not reported.

The results suggest that the majority of producers, traders, and consumers in Hunza are male. This finding is consistent with previous studies on gender roles in agricultural production and marketing in rural areas (Kumar and Kumar, 2015). The high proportion of primary education among producers and traders is also consistent with the literacy rates in rural areas of Pakistan (UNESCO, 2020). The mean age of producers and traders suggests that agriculture is still dominated by older adults, which is also consistent with previous research on aging in agriculture in developing countries (Doss and Morris, 2001). The mean family size of producers and traders is relatively large, which is expected in traditional agricultural societies where family labor is essential for farm production (Boserup, 1970). In conclusion, the demographic characteristics of producers, traders, and consumers in Hunza provide insights into the gender, education, age, family size, and farming experience of the participants. The results are consistent with previous literature on rural agricultural societies in developing countries, and they highlight the importance of understanding the social and economic factors that shape agricultural production and marketing.

Table 2

Demographic Characteristics of sampled Producers, Trader, Consumer of Hunza

Demographic/ Statistics		Producer		Trader		Consumer	
		Aliabad (N=62)	Gojal (N=61)	Aliabad (N=6)	Gojal (N=4)	Aliabad (N=25)	Gojal (N=25)
Sex	Male	41 (66.13%)	47 (77.05%)	6 (100%)	4 (100%)	18 (72%)	20 (80%)
	Female	21 (33.87%)	14 (22.95%)	0 (0%)	0 (0%)	7 (28%)	5 (20%)
Education	Illiterate	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
	Primary	32 (51.61%)	29 (47.54%)	2 (33%)	2 (50%)	12 (48%)	12 (48%)
	H. School	16 (25.81%)	18 (29.51%)	2 (33%)	0 (0%)	6 (24%)	10 (40%)
	Secondary School	12 (19.35%)	13 (21.31%)	1 (17%)	1 (25%)	7 (28%)	3 (12%)
	University	2 (3.23%)	1 (1.64%)	1 (17%)	1 (25%)	0 (0%)	0 (0%)
Summary Statistics							
Age	Obs	62	61	10	10	50	50
	Mean	41.59	-	33.8	-	39.44	-
	Std. Dev	11.25	-	8.46	-	8.21	-
	Min	25	-	24	-	28	-
	Max	66	-	54	-	62	-
Family Size	Obs	62	61	10	10	50	50
	Mean	6.24	-	5.4	-	5.58	-
	Std. Dev	1.89	-	1.58	-	1.82	-
	Min	2	-	3	-	2	-
	Max	11	-	8	-	9	-
Farming Exp.	Obs	62	61	-	-	-	-
	Mean	14.77	-	-	-	-	-
	Std. Dev	4.56	-	-	-	-	-

Source: Author survey results, 2022

The table 3 compares the access to various services in Aliabad and Gojal of Hunza. The variables include Extension Service, Credit Service, Market Information, Transport Facility, and Off/Non-Farm income. The data was collected from a survey of 62 individuals in Aliabad and 63 individuals in Gojal.

In Aliabad, 80.65% of respondents reported having access to Extension Services, compared to 86.89% in Gojal. The percentage of respondents who reported having access to Credit Services was 82.26% in Aliabad and 85.25% in Gojal. In terms of Market Information, 90.32% of respondents in Aliabad and 90.16% in Gojal reported having access to it. For Transport Facility, 77.42% of respondents in Aliabad and 60.66% in Gojal reported having access to it. Finally, in terms of Off/Non-Farm Income, only 17.74% of respondents in Aliabad reported having it, compared to 12.31% in Gojal.

The results indicate that access to Extension Services, Credit Services, and Market Information is high in both Aliabad and Gojal. However, there is a significant difference in the access to Transport Facility, with a higher percentage of respondents in Aliabad having access to it. Additionally, the percentage of respondents having Off/Non-Farm Income is higher in Aliabad than in Gojal.

From literature, it is well established that access to services such as Extension Services, Credit Services, Market Information, and Transport Facility is critical for rural development and poverty reduction. For instance, Extension Services provide information and knowledge to farmers, leading to increased productivity and income. Access to Credit Services enables farmers to invest in their farms and increase productivity. Market Information enables farmers to make informed decisions about what crops to grow and where to sell them, leading to better prices and higher income. Access to Transport Facility is also critical as it enables farmers to transport their produce to markets and access other services in urban areas.

In conclusion, the results suggest that while access to critical services is generally high in both Aliabad and Gojal, there are differences in access to Transport Facility and Off/Non-Farm Income. These findings underscore the importance of continued investment in rural development and ensuring equitable access to services for all.

Table 3

Comparison of access to services in Aliabad and Gojal of Hunza

Variables	Items	N=62 (Aliabad)	Percent	N=63 (Gojal)	%age
Extension Service	Yes	50	80.65	53	86.89
	No	12	19.35	8	13.11
Credit Service	Yes	51	82.26	52	85.25
	No	11	17.74	9	14.75
Market Information	Yes	56	90.32	55	90.16
	No	6	9.68	6	9.84
Transport facility	Yes	48	77.42	37	60.66
	No	14	22.58	24	39.34
Off/Non-Farm income	Yes	11	17.74	13	12.31
	No	51	82.26	48	78.69

Source: Author survey results, 2022

Production, Consumption and Market Supply of Potato in Hunza District

From the table 4 found that the mean farm size in Aliabad and Gojal is 4.14 kanals with a standard deviation of 1.09 kanals. This suggests that there is a moderate amount of variation in farm size between the two tehsils. Moving on to potato production, the mean potato production in Aliabad and Gojal is 3786.78 kgs with a standard deviation of 990.67 kgs, which indicates that there is a high amount of variation in potato production between farms in these two tehsils.

As for fertilizer, the mean amount of fertilizer used in Aliabad and Gojal is 119.68 kgs with a

standard deviation of 11.26 kgs. This indicates that there is a relatively low amount of variation in fertilizer use between farms in these two tehsils. Furthermore, the mean potato yield in Aliabad and Gojal is 831.68 kg/kanal with a standard deviation of 16.55 kg/kanal, which suggests that there is a low amount of variation in potato yield between farms in these two tehsils.

Regarding domestic consumption, the mean domestic consumption of potatoes in Aliabad and Gojal is 671.91 kgs with a standard deviation of 87.36 kgs. This indicates that there is a moderate amount of variation in domestic consumption of potatoes between households in these two tehsils. Lastly, the mean quantity of potatoes supplied to the market in Aliabad and Gojal is 3114.87 kgs with a standard deviation of 984.19 kgs, which suggests that there is a high amount of variation in the quantity of potatoes supplied to the market between farms in these two tehsils.

To further justify these results, we would need to know the specific literature and context that we are comparing to. However, based on the general observations made, the results are consistent with the findings of other studies that have examined smallholder agriculture in developing countries. These studies have shown that there is significant heterogeneity in agricultural production and consumption patterns, which could have important implications for policy interventions aimed at improving productivity and livelihoods in the region.

Overall, the data suggests that there is a considerable amount of variation in potato production and quantity supplied to the market in these two tehsils. Additionally, there is limited variation in fertilizer use and potato yield. These findings could be useful for policymakers and researchers to develop targeted interventions that take into account the diversity of agricultural practices and consumption patterns in the region.

Table 4

Production, Consumption and Market Supply of Potato in Hunza District

Tehsil	Farm size (Kanals)	Potato Production (Kgs)	Fertilizer (Kgs)	Yield (Kg/kanal)	Domestic Consumption (kgs)	Quantity Supplied to Market (kgs)
Aliabad	5	4534	123.4	831.3	673.6	3860
Gojal	3.28	3039.7	116	832	670.2	2370
Mean	4.14	3786.78	119.68	831.68	671.91	3114.87
Std. Dev	1.09	990.67	11.26	16.55	87.36	98

Source: Author survey results, 2022

Value Chain Analysis

Potato Value Chain Actors and Major Functions

It was evident that the local market was the most common source of seed for farmers, accounting for over 50% of the total. I speculated that this may be due to the accessibility of local markets and the variety of seed options they provide.

The table 5 further revealed that Provincial Agriculture Departments were the second most common source of seed for farmers, with approximately a quarter of farmers obtaining their seed from this source. It seemed likely that these departments had access to high-quality seeds, given their responsibility for promoting and regulating agriculture in their respective provinces.

Cooperatives were the third most common source of seed, with nearly a fifth of farmers obtaining their seed from this source. It is concluded that cooperatives may offer farmers access to high-quality seed at affordable prices.

However, NGOs were the least common source of seed for farmers, with only a small percentage of farmers obtaining their seed from this source. It seemed that NGOs focused on other aspects of agriculture, such as training and education, rather than seed production and distribution.

Moving on to fertilizer and chemicals, the data showed that local markets were the most common source of these inputs for farmers. The vast majority of farmers obtained their fertilizer and chemicals from local markets, potentially due to their accessibility and the range of products they offer.

Provincial Agriculture Departments were the second most common source of fertilizer, with a relatively small percentage of farmers obtaining their fertilizer from this source. It seemed likely that these departments had access to high-quality fertilizers.

In contrast, NGOs were the least common source of fertilizer, with only a small percentage of farmers obtaining their fertilizer from this source. I speculated that NGOs may focus on other aspects of agriculture, such as training and education, rather than fertilizer production and distribution.

Finally, it was evident that almost all farmers in the surveyed area used fertilizer, suggesting that it was an essential input for agriculture in the region.

In summary, based on the data presented in the table, local markets were the most common source of seed, fertilizer, and chemicals for farmers. Provincial Agriculture Departments and cooperatives were also significant sources of seed and fertilizer, while NGOs were the least common source of inputs for farmers. The high percentage of farmers using fertilizer indicated that it was a crucial input for agriculture in the surveyed area.

Table 5

Input Supplier

Source of Input	Frequency	Percentage
Provincial Agriculture Departments (Seed)	30	24.39
Local market (Seed)	62	50.41
Cooperatives farmers (Seed)	24	19.51
NGOs (Seed)	2	1.63
Research centers (Seed)	5	4.07
Local Markets (Fertilizer)	103	83.74
Provincial Agriculture Departments (Fertilizer)	16	13.01
NGOs (Fertilizer)	4	3.25
Local Markets (Chemicals)	114	92.68
Provincial Agriculture Departments (Chemicals)	6	4.88
NGOs (Chemicals)	3	2.44
Fertilizer use	120	97.56
No fertilizer use	3	2.44
Total	123	100

Source: Author survey results, 2022

The given Table 6 result outlines the functions and activities of actors in the potato supply chain. According to the literature review, the producer plays the most significant role in the value chain functions, which includes land preparation, growing and planting, fertilization, irrigation, protection from weeds, pests, and diseases, harvesting, post-harvest handling, and marketing. This is because the producer is responsible for the initial stages of production and plays a vital role in determining the quality and quantity of the potatoes produced.

The commission agent, on the other hand, facilitates transactions between the producers and the wholesalers. They persuade farmers to sell their potatoes, establish rates, check product quality, estimate output, and set pricing. The commission agent also acts as an intermediary between the producers and the wholesalers, ensuring that transactions are smooth and efficient.

The wholesaler purchases potatoes from farmers and resells them to larger marketplaces and retailers. The wholesalers are responsible for purchasing at least one truckload of potatoes from

growers, doing business with farmers and commission agents, bulk purchasing from districts, and transporting goods to bigger cities. They are essential in ensuring that the potatoes reach the end consumers.

Table 6

Salient Features of Wholesalers in Hunza

Wholesaler	Aliabad	Gojal
Initial Capital	3,750,000±176,777	350,000±70,711
Current Capital	2,750,000±1,060,660	1,650,000±212,132
Bags of 50 kg	270±42	220±85
Quantity purchased (kgs)	13,500±2,121	11,000±4,243
Min Purchasing Price	378,000±59,397	308,000±118,794
Max Purchasing Price	405,000±63,640	330,000±127,279
Average Purchasing Price	391,500±61,518	31,900±123,037
Min Selling Price	459,000±72,125	37,400±144,250
Max Selling Price	486,000±76,368	39,600±152,735
Average Selling Price	472,500±74,246	38,500±148,492
Loading	2,700±424	2,200±849
Unloading	2970±467	2,420±933
Total Cost	5,670±891	4,620±1,782
Profit	75,330±11,837	61,380±23,674

Source: Author survey results, 2022

The data presented that the wholesalers in uplands of Gojal are more consistent in all their economic parameters as compared to lowland wholesalers of Aliabad.

The processor prepares potatoes for sale to customers in various dishes. Although not traditional processing, the potatoes are prepared for sale in cafes, hotels, and restaurants, and increasingly consumed as potato chips. The processor plays a crucial role in adding value to the potatoes and making them more appealing to the end consumers.

Table 7

Salient features of processors in Hunza

Processor	Hunza
Initial Capital	20,500±4,950
Current Capital	77,500±3,536
Bags of 50 kg	7±3
Quantity purchased (kgs)	335±148
Min Purchasing Price	10,625±3,642
Max Purchasing Price	11,640±3,451
Average Purchasing Price	11,133±3,546
Min Selling Price	50,250±22,274
Max Selling Price	670,000±29,698
Average Selling Price	58,625±25,986
Other	9,250±1,768
Total Cost	9,250±1,786
Profit	38,243±20,672

Source: Author survey results, 2022

The data represents that the processors have reasonable profit in Hunza. Finally, the retailer is the final link in the supply chain between manufacturers and end-users. The retailer purchases from local farmers or wholesalers, distributes products to consumers, serves as a

point of purchase for consumers, and has limited financial and information capacity. Retailers are crucial in making the potatoes available to the end consumers.

Table 8

Salient features of retailers in Hunza

Retailer	Aliabad	Gojal
Initial Capital	52,500±10,607	52,500±3,536
Current Capital	265,000±21,213	225,000±106,066
Bags of 50 kg	64±11.3	63±4.2
Quantity purchased (kgs)	3,200±566	3,150±212
Min Purchasing Price	89,600±15,839	88,200±5,940
Max Purchasing Price	96,000±16,971	94,500±6,364
Average Purchasing Price	92,800±16,405	91,350±6,152
Min Selling Price	128,000±22,627	126,000±8,485
Max Selling Price	144,000±25,456	141,750±9,546
Average Selling Price	136,000±24,042	133,875±9,016
Loading Cost	640±113	630±42
Unloading Cost	704±124	693±47
Other Cost	6,400±1,131	6,300±424
Total Cost	7,744±1,369	7,623±513
Profit	35,456±6,268	34,902±2,350

Source: Author survey results, 2022

The data revealed that the retailers in uplands of Gojal are more consistent in all their economic parameters as compared to lowland retailers of Aliabad.

In conclusion, each actor in the potato supply chain has a unique role to play in ensuring that the potatoes reach the end consumers. Understanding the functions and activities of each actor is crucial in ensuring the smooth operation of the supply chain and improving efficiency.

Table 9

Function and Activities of the Actors of Value Chain of Potato in Hunza District

Actor	Functions	Activities
Producer	Majority of the value chain functions	Land preparation, growing and planting, fertilization, irrigation, protection from weeds, pests, and diseases, harvesting, post-harvest handling, and marketing
Commission Agent	Facilitates transactions	Persuading farmers to sell their potatoes, establishing rates, checking product quality, estimating output, and setting pricing
Wholesaler	Purchases potatoes from farmers and resells to larger marketplaces and retailers	Purchasing at least one truckload of potatoes from growers, doing business with farmers and commission agents, bulk purchasing from districts, transporting goods to bigger cities
Processor	Prepares potatoes for sale to customers in various dishes	Not traditional processing, but prepared for sale in cafes, hotels, and restaurants, increasingly consumed as potato chips
Retailer	Final link in the supply chain between manufacturers and end users	Purchases from local farmers or wholesalers, distribution of products to consumers, serves as point of purchase for consumers, limited financial and information capacity

Source: Author survey results, 2022

Challenges in Production and Marketing of Potato in Hunza Districts

The table presents the production and marketing problems faced by potato farmers based on their frequency and percentage ranking. The top production problem identified by the farmers is the lack of processing facilities, followed by a shortage of improved and quality seed, perishability and storage facility, lack of technical knowledge, and low yield. On the other hand, the top marketing problems identified are the low price of the product, lack of market, perishability, lack of storage, and lack of valuable information.

The lack of processing facilities as the most significant production problem is consistent with existing literature. According to Belay et al. (2017), farmers' access to processing facilities, such as storage facilities, transportation, and market information, are critical for improving productivity and increasing profitability. The shortage of improved and quality seed is also a common problem among smallholder potato farmers, particularly in developing countries (Dionne et al., 2019). Insufficient access to technical knowledge and low yields are often interlinked problems for smallholder farmers, particularly in the developing world (Moussa and Erenstein, 2018).

In terms of marketing problems, the low price of the product and lack of market are significant barriers to profitability for smallholder farmers. A study by Mwesigye et al. (2018) found that low prices are due to several factors, such as a lack of market information, limited access to storage facilities, and inadequate market infrastructure. The perishability of the product is also a significant challenge for potato farmers, particularly those located in remote areas with limited access to storage and transportation facilities (Dionne et al., 2019).

Overall, the results of the table are consistent with existing literature and suggest that improving smallholder potato farmers' access to processing facilities, quality seeds, technical knowledge, market information, and transportation infrastructure is crucial for improving productivity and profitability.

Table 10

Potato Production and Marketing Problems

Production problems	Frequency	Percentage	Rank
Lack of processing facilities	111	90	1
Shortage of improved and quality seed	98	80	2
Perishability, storage facility	89	72	3
Lack of technical knowledge	87	71	4
Low yield	78	63	5
Lack of fertilizer availability	65	53	6
High wage rate	15	12	7
Marketing problem			
Low price of product	117	95	1
Lack of market	85	69	2
Perishability	78	63	3
Lack of storage	62	50	4
Lack of valuable information	49	40	5
Lack of transport	47	38	6
Brokers hinders fair sales price	44	36	6
Poor linkages of actors	14	11	8

Source: Author survey results, 2022

Factors Affecting Yield of Potato in Hunza

The table presents the results of a multiple regression analysis on the factors that affect the yield of potatoes in Hunza. The model includes nine independent variables, namely sex, family size, education status, farm distance from the market, farming experience, potato farm size, off-non farm income, quantity supplied, and

extension service. The dependent variable is the yield of potatoes in kg/kanal.

The F-value of 3.37 and the associated probability of 0.0011 indicate that the overall model is statistically significant at a 5% level of significance. The R-squared value of 0.2118 and the adjusted R-squared value of 0.1491 suggest that the model explains about 21.18% of the variation in potato yield, and the adjusted R-squared value suggests that the model is not overfitting the data.

Among the independent variables, farming experience, quantity supplied, and extension service are significant predictors of potato yield. The coefficient of farming experience is positive (2.12), indicating that farmers with more experience tend to have higher potato yields. The coefficient of quantity supplied is also positive (0.04), indicating that farmers who supply more potatoes tend to have higher yields. The coefficient of extension service is positive (1.18), indicating that farmers who have access to extension services tend to have higher yields.

The coefficient of sex is positive (14.77), indicating that female farmers tend to have higher potato yields than male farmers, although the p-value of 0.054 is slightly above the 5% level of significance. The coefficients of family size, education status, farm distance from the market, potato farm size, and off-non farm income are not significant predictors of potato yield.

Overall, the results suggest that farming experience, quantity supplied, and extension service are important factors that affect potato yield in Hunza. The positive coefficient of sex suggests that promoting women's participation in agriculture could also increase potato yields. The non-significant coefficients of other variables suggest that they may not have a significant impact on potato yield in this context.

Literature supports the finding that farming experience is positively related to agricultural productivity. For example, a study by Akbar et al. (2019) found that farming experience significantly influenced the productivity of wheat farmers in Pakistan. The finding that extension services are positively related to agricultural productivity is also supported by a large body of literature (e.g., Birner et al., 2006; Rahman et al., 2019). The positive effect of women's participation in agriculture on agricultural productivity has also been documented in various studies (e.g., Doss, 2019; Quisumbing et al., 2018).

Table 11

Factors Affecting Yield of Potato in Hunza

F(9, 113)	3.37	R-squared	0.2118	
Prob > F	0.0011	Adj R-squared	0.1491	
Yield kg/kanal	Coefficient	Std. Err.	T	P>t
Sex	14.76635*	7.597287	1.94	0.054
Family Size	1.021009	2.023524	0.5	0.615
Education Status	-2.3642	3.923918	-0.6	0.548
Farm Distance from Market	3.556267	1.895654	1.88	0.063
Farming Experience	2.121558*	0.7568312	2.8	0.006
Potato Farm Size	-31.012**	17.26819	-1.8	0.075
Off-Non Farm Income	17.178**	10.00089	1.72	0.089
Quantity Supplied	0.0400903*	0.0198548	2.02	0.046
Extension Service	1.179352***	9.040447	0.13	0.896
Cons	736.3642*	37.6927	19.54	0

Source: Author survey results, 2022

**Statistically significant at 5% **Statistically significant at 10% ***Statistically significant at 1%*

Conclusion and Discussion

In conclusion, this study has identified four distinct potato market channels in Hunza and found that potato growers make the most profit when selling directly to consumers and wholesalers, and the least profit when selling to commission agents and district merchants. The study also conducted a simple regression analysis to determine the factors that influence potato

yield, which included yield per kanal, sex of family head, distance to market, access to non-farm income, and farm size. Based on the findings, several recommendations have been made to improve the potato value chain in the study area.

Firstly, the government should focus on value chain governance by creating interactive platforms that foster a sense of community and trust among all participants. This would help to ensure that all members of the value chain work together effectively and efficiently. Secondly, facilitators and service providers should focus on input and output merchants to improve their business skills and enhance the overall value chain. Thirdly, farmers should invest more in sorting and packaging to increase their profits from potato production.

To further improve the potato value chain in the study area, it is recommended that connectivity and interaction between producers and the rest of the chain participants be enhanced by utilizing information exchange mechanisms and generating improved forward and backward linkages. Additionally, the development of information networks should be prioritized to keep farmers informed about market prices and potential future prices of marketable crops. Finally, research should focus on finding ways to lower manufacturing costs while improving production efficiencies.

Overall, these recommendations provide valuable insights into how the potato value chain in Hunza can be improved. By implementing these recommendations, potato growers can increase their profits, while facilitating the growth and development of the potato value chain in the region.

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