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Measuring the Market Efficiency of Potato Supply Chain in Punjab, Pakistan

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ABSTRACT

Potato is a popular vegetable crop in Pakistan, both for consumers and growers. It is the most extensively consumed staple meal after wheat and rice, and comes in a variety of forms, including cooked, boiled, fries, chips, and snacks. A supply chain is the network of all the individuals, organizations, resources, activities, and technology involved in the creation and sale of a product. Potato supply chain in Pakistan includes farm suppliers, producers, village dealers, commission agents, processors, exporters, and retailers, just like other agricultural products. This specific study was aimed to characterize and map the potato supply chain linkages between actors, processes and activities moreover, to calculate marketing efficiency at different level(s) of supply chain. The findings revealed the difference in potato supply chain among various chain actors. There was a lack of information among supply chain actors, consumers desire is not fulfilled by the supply chain actors. Potato supply chain actors faced problem because of no information sharing system. Farmers should use agricultural management techniques like crop rotation that increase crop productivity. Select a quality seed, and each actor in the supply chain must share information. Supply chain actors upgrade their practices for more profit to farmers and desired quality to consumers.

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Introduction

The agriculture industry contributes 24% of Pakistan's GDP, making it a vital part of the economy (Government of Pakistan, 2022). Potato has become a popular vegetable crop in Pakistan, both for consumers and growers Badar et al. (2020). It is the most extensively consumed staple meal after wheat and rice, and comes in a variety of forms, including cooked, boiled, fries, chips, and snacks (Majeed and Muhammad, 2018). Because to expanding food choices for fast food, Pakistan's per capita consumption of potatoes has increased to 14.4 kg (Government of Pakistan, 2022). It's also the most affordable source of carbs, vitamins, minerals, and proteins. The value of exports of Potato from Pakistan totaled $69 million by the year 2020. Pakistan's commodities exports have fallen by 39% in terms value compared to 2019. Exports of potato decreased by $45 million (cumulative exports of commodity from Pakistan amounted $115 million in 2019). Exports of Potatoes amounted to 0.314% of total exports from Pakistan (cumulative merchandise exports from Pakistan totaled $22 billion in 2020). The share of total exports from Pakistan decreased by 0.171% compared to 2019 (0.485 percent in 2019 and $23 billion in total exports from Pakistan). In 2020, commodity exports accounted for 26% of overall group sales from Pakistan (the value of commodity group exports from Pakistan was $259 million in 2020). In comparison to 2019, the percentage of potato exports in product group sales from Pakistan decreased by 19.3 percent, it was 46 percent in 2019, and product group exports from Pakistan were $249 million (Trend Economy, 2020).

Potato consumption is growing rapidly in emerging nations, which now account for more than half of the world harvest and have become the potato a desirable money crop for millions of farmers due to its ease of production and high energy content. In Pakistan, per capita potato usage was 1.19 kg per month in 2011-12. Around the same time, unlike other main cereals, the potato is not an exportable commodity (Cui et al., 2023). Because only a small portion of its overall production is exported, potato prices are mainly decided by variables such as cost of production, planted area, and yield, rather than the desire of global markets.

As a result, it is a highly recommended food security crop that can assist reduced farmers and susceptible customers in weathering the storm (Anwar et al., 2015). The market infrastructure and accompanying processes do not work efficiently, the market efficiency of perishable items will be decreased. Furthermore, because perishables are an issue in many developing nations, there will be fewer competitors in the market. Because potatoes are perishable and hefty, a strong post-harvest technology and marketing infrastructure is critical to the whole production and consuming process (Miah and Hossain, 2017). One of the most essential and prevalent challenges of Pakistani vegetable marketplaces is an insufficient knowledge about the customer's quality-related requirements.

When it comes to market demand, such as quality, variety, and pricing, each player (cultivators, traders, and consumers) has their own perspective on the final quality of vegetables. Quality is a set of fundamental standards that satisfies the needs of consumers. In agriculture, quality refers to the sum of all aspects of a product, including physical appearance (color, size, texture), as well as internal values such as flavor (taste and scent) and nutritional content (Milesa and City, 2006). Farmers must have access to markets in order to participate. Growers can sell their products immediately at the farm level or physically take them to the market utilizing available transportation(Kyomugisha et al., 2018). Perishable high-value crops are generally related with a

lot of transaction expenses, high transportation costs, and a shortage of cold storage facilities are all factors to consider which make it difficult for smallholders to access markets. Overall, we have followed guidelines outlines in previous research in social sciences for conducting our study (Anser et al., 2020; Gulzar et al., 2022; Hameed et al., 2019; Iqbal et al., 2021; Masood, Feng, Rasheed, Ali, & Gong, 2021; Naeem, Weng, Hameed, & Rasheed, 2020; Pitafi, Rasheed, Kanwal, & Ren, 2020; Zhang, Wu, & Rasheed, 2020).

Literature Review

Lu et al. (2021) constructed an agent-based model based on the instance of Idaho's potato supply chain to better understand the effects of demand on the food supply chain. The findings revealed that not only the amount but also the timing of the demand shock will have diverse effects on various supply chain stakeholders. We provide a twofold addition to the literature. First, the model clarifies why food is consumed.

Badar et al. (2020) examined consumer preferences, for this purpose the study of 250 potato eaters from different groups in society was conducted in Lahore and Faisalabad. A descriptive statistical analysis and factor analysis in SPSS were used to analyze the data. Results found that consumers preferred due to its flavor and health advantages, potatoes are fried and served as fries. Marketing, aesthetics, experience, genetics, and looks were shown to impact buying choices. Such results have the potential to assist Pakistani value stream members, policymakers, and consumers bridge the quality growing gap. These findings can assist value chain actors, lawmakers, and purchasers in Pakistan bridge the perceived quality gap. Pakistani policy makers and institutions should assist them with enhancing their profitability and the satisfaction of potato consumers by providing them with the necessary support services.

Willersinn et al. (2015) analyzed food deficits in quality and quantity in the Swiss potato distribution network field experiments, conducting interviews with wholesalers, processors, and retailers, and consumer surveys along with a 30-day diary research were used to gather qualitative data. For the qualitative evaluation of losses, Swiss trading rule for potatoes for base, economic, legal, and social influences influence the production of fresh potatoes and potato. There have also been damaged because of quality requirements dictated by food safety and customer personal traits. The initial fresh potato crop accounts for approximately 53-55% and the initial processing for approximately 41-46% of the potato value chain deficit among non-organic and organic supply chains different from 2% to 5%. Fresh potato production lost by 15-24% in agricultural production, another 12-24 percent of wholesalers, 1-3 percent of retailers, and 15 percent in private households comparatively; 5-11 percent of the basic producing was a deficit at wholesalers, a more 14-15 percent during processing, 0 percent of retailers, and 2 percent of private domestic. Damages during agricultural producing did not differ significantly (13-25 percent) between fresh and processed potatoes.

It was estimated that fifty percent of total potato losses are due to non-conforming potatoes. Consumer expectations account for 25 to 34 percent of this food security deficit, with storage concerns accounting for the rest. Social variables (such as customer choices, behavior, and socio-demographic characteristics) account for two-thirds to three-quarters of all fresh potato losses and 40-45 percent of all potato production losses. Technological variables were responsible for one-third of all potato processing losses. The bulk of the discarded potatoes in Switzerland (67-90 percent) were utilized as livestock feed (Cui et al., 2023). Only 4-5 percent of processed potato

losses were wasted, related to 30 percent of the raw potato deficit. Fewer quality criteria, it was proposed, would result in lower losses in the basic position of the supply chain, but larger losses later owing to worse storage.
Omar and Hoq (2014) analyzed market efficiency and price structure of potato marketing in terms of marketing cost, margin, growth, and seasonal variations. The study took place in four districts of Bangladesh: Bogra, Jamalpur, Rangpur and Munshigonj. Both primary and secondary data were collected for the study. The marketing efficiency was assessed by using six key performance indicators (Lingyan et al., 2022). Growth rates of real prices, area, yield, and production increased over time due to an increase in demand. There was the highest seasonal variation in potato prices in Bogra and the lowest in Jamalpur. The lowest average price occurred in February and the highest in December. For conducting review of literature for this paper, we have followed pattern outlined in previous research (e.g., Kanwal, Pitafi, Rasheed, Pitafi, & Iqbal, 2022; Khan, Liu, Khan, Liu, & Rasheed, 2020; Luqman, Masood, Shahzad, Imran Rasheed, & Weng, 2020; Rasheed, Malik, et al., 2020; Rasheed, Weng, Umrani, & Moin, 2021).

Data, Variables, and Methodology

The purpose of the research was to examine the potato supply chain in Punjab, Pakistan. The region, kind, and quantity of respondents were used as part of the intended approach to meet the study's objectives. It would be pointless to do it without taking these factors into account. Therefore, it is essential to specify these characteristics in order to make the study more objective and scientific.

The study was conducted in District Okara Punjab, Pakistan. The primary data were collected directly from respondents after constructing well-structured questionnaires. A total of 140 respondents were selected, 40 farmers, 20 wholesalers, 30 retailers and 50 consumers with the help of structured questionnaires. The Secondary data were collected from published articles, websites and surveys (Sarwar et al., 2021). Convenient sampling techniques were used to analyze the data. For designing the method of our study, we have followed the methods followed in previous research (Moin, Omar, Wei, Rasheed, & Hameed, 2021; Nisar, Rasheed, & Qiang, 2018; Sattar, Rasheed, Khan, Tariq, & Iqbal, 2017; Yousaf, Rasheed, Hameed, & Luqman, 2019).

To fairly study the potato supply chain, a sufficient sample was required. 140 respondents were chosen at random for this study (Wei et al., 2021). As a result, the research sample includes a variety of stakeholders such as farmers, wholesalers, commission agents, retailers, and consumers. The respondents were individually interviewed as part of the research's development of questionnaires. A straightforward multi-stage convenient sampling method was used to choose 140 respondents. Data collected were edited, tabulated and analyzed by employing appropriate statistical tools and the share of producer and different market intermediaries in the consumer rupee was calculated. In addition, marketing margins of commission agents, wholesalers and retailers were worked out by employing relevant statistical tools.

The demographic and socio-economic characteristics result of respondents to analyzed using SPSS and descriptive statistics were used to find out the percentage and frequencies**.**
Averages were calculated by using the following formula:

$$AM = EX/N$$

Where,
AM = Arithmetic Mean
X = Values of variables
N = Numbers of observations
Σ = Total sum of variables
Percentages were calculated in simple tables for understanding and comparisons by using Following formula:
P-F/N* 100

Where,
F= frequency of a class
N= total of observations

Marketing Margins analysis

The marketing margin (or farm-retail price spread) is defined as the difference between the prices paid by consumers and prices received by producers for a commodity (Tomek and Robinson, 1990).Marketing margin consists of assembling cost, processing cost, storage cost, transportation cost, wholesaling cost and retailing cost. Increases in marketing margins brought on by higher marketing expenses could not translate into higher profitability for the marketing team. Furthermore, just because farmers earn a relatively modest portion of the sale price does not always indicate that they are being taken advantage of total margins will vary based on how long the marketing chain is and how much the product is processed or stored (Zhao et al., 2021). Understanding the type and distribution of marketing expenditures is crucial to determine if margins are appropriate. The following formulae are used to determine the margins of various actors in the potato supply chain.

Gross Margins Sp-Pp
Where;
Sp= sale price
Pp= purchase price

Net Margin = Gm – Mc

Where;
Gm= Gross margin
Mc Marketing cost

Percent Margin = Ps/Sp*100

Where;
Ps Price spread
Sp=Sale price

Results and Analysis

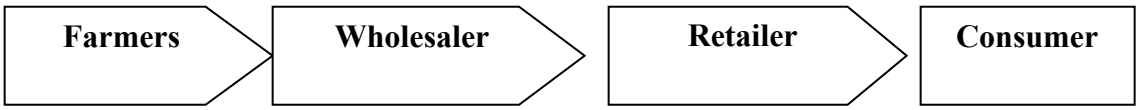
The most crucial phases of social scientific research are data analysis and interpretation. The goal of the research, which is to generalize and forecasts, cannot be achieved without these procedures. Evaluation of the potato supply chain at Punjab's district of Okara was the study's main goal. An effort has been made in this chapter to evaluate and interpret the data to establish conclusions and provide pertinent recommendations in light of the results attained. Input providers, farmers, distributors, retailers, processors, and consumers were the main emphasis of this section's detailed investigation of the different potato supply chain phases. The potato is typically grown by farmers

and sold to wholesalers and merchants, among other market participants.

Supply Chain of Potato

Supply chain consists of various agencies which perform the various markets. Functions in sequence as the Potato moves from the producers to the ultimate consumers.
Following are the intermediaries, involved in supply of potato;
1. Farmers
2. Wholesalers
3. Retailers
4. Consumers

Among these supply chain actors, one may be present in anyone marketing channel and not in another. Most prevailing potato supply chain in district Okara was followed.



Marketing Margins of different Supply Chain Actors.

Pricing spread or marketing margins are regularly used to gauge how effective a marketing approach is. It can be a useful descriptive statistic if used to show how consumer spending is divided across market participants at different levels of the marketing system. The difference between the price consumers pay and the price that is received by producers is the price of a collection of marketing services, which is the outcome of supply and demand for such services. Utilizing marketing margins or price spread, marketing system efficacy is commonly evaluated. It may be a valuable descriptive statistic when used to show how consumer spending is allocated across market actors at various levels of the marketing system. The gap between the price consumers pay and the price that is received by producers is the price of a collection of marketing services, which may be determined by the demand for and supply of such services.

Marketing Margins by Farmers

Table.1 presented results of the analysis of cost and margin of potato farmers. The result indicated that the total variable cost of the potato farmers was Rs.1128/40 kg with the total fixed cost of Rs.73. However, the gross margin of the enterprise stood at Rs.292 with net margin of Rs.219. This indicated that the enterprise was profitable in the study area. The profitability of the business was further confirmed by the percentage marketing which stood at 20.56 percent. This margin could be interpreted to mean that the farmers get an additional 20 percent of the margin along the distribution chain**.** The net profit as percentage of margin indicated that the farmers get 75 percent of the gross margin as pure profit. The net profit a percentage of sales showed the solvency of the business and it could be interpreted to mean that for everyone Rs. sales 15.42 percent were net profit.

Average variable cost (Rs. /40 kg)	=	1128
Average sale price (Rs. /40 kg)	=	1420
Gross margin (Rs. /40 kg)	=	292

Percentage marketing margin (Rs. /40 kg) = 292/1420×100 = 20.56%
Average total cost (Rs. /40 kg) = 1201
Net profit (Rs. /40 kg) = 1420-1201 = 219
Net profit as percentage of margin = 219/292×100 = 75%
Net profit as a percentage of sale price = 219/1420×100 = 15.42%

Item	Avg. Sale Price	Total variable cost	Gross margin	Total Fixed cost	Net margin	% Marketing margin	Avg. Total cost	Net Profit as % of margin	Net Profit as % of Sale price
Potato	1420	1128	292	73	219	20.56	1201	75	15.42

Table 1. Marketing Margins by Farmers (Rs. /40kg)

Marketing Margin by Wholesalers

Potatoes were bought by the wholesaler for an average price of Rs. 1420 per 40 kg, and they were sold to the next stakeholder at an average price of Rs. 1620 per 40 kg. The wholesaler's gross marketing margin per 40 kg was Rs. 200. The average total price was Rs. 54, making the net profit per 40 kg Rs. 146. In the potato supply chain in the Okara area, the wholesaler received 73.0 percent of the whole profit. 9.0 percent of the sale price was the net profit. Transportation and labor costs are included in the overall price (loading and unloading).
Average purchase price (Rs. /40 kg) = 1420
Average sale price (Rs. /40 kg) = 1620
Gross marketing margin (Rs. /40 kg) = 200
Percentage marketing margin (Rs. /40 kg) = 200/1620×100 = 12.34%
Average total cost (Rs. /40 kg) = 54
Net profit (Rs. /40 kg) = 200-54 = 146
Net profit as percentage of margin = 146/200×100 = 73%
Net profit as a percentage of sale price = 146/1620×100 = 9%

Item	Avg. Purchase price	Avg. Sale Price	Gross margin	% Marketing Margin	Avg. Total Cost	Net Profit	Net Profit margin	Net Profit as % of Sale price
Potato	1420	1620	200	12.34	54	146	73	9.0

Table 2. Marketing Margin by wholesalers (Rs. /40kg)

Marketing Margin by Retailers

The retailer paid an average of Rs. 1620 per 40 kg for potatoes that they sold to another shareholder

for an average of Rs. 2000 per 40 kg. For every 40 kg, the retailer's gross marketing margin was Rs. 380. The average total cost per 40 kg was Rs. 65, making the net profit per kg Rs. 315. The store received 83 percent of the entire supply chain margin for potatoes in the Okara area.16 percent of the sale price was the net profit. Transportation and labor costs are included in the overall price (loading and unloading).

Average purchase price (Rs. /40 kg)	=	1620
Average sale price (Rs. /40 kg)	=	2000
Gross marketing margin (Rs. 40 kg)	=	380
Percentage marketing margin (Rs. /40 kg)	=	350/2000×100 = 17.5%
Average total cost (Rs. /40 kg)	=	65
Net profit (Rs. /40 kg)	=	380-65 = 315
Net profit as percentage of margin	=	315/380×100 = 83%
Net profit as percentage of sales	=	315/2000×100 = 16

Table 3. Marketing margin by retailer (Rs. /40kg)

Item	Avg. Purchase Price	Avg. Sale Price	Gross Margin	% Marketing margin	Avg. Total Cost	Net Profit	Net Profit% margin	Net Profit% of
Potato	1620	2000	380	17.5	65	315	83	16

Major Problems of Supply Chain Actors

Problems faced by Farmers

1. Lower prices
2. Temperature extremes
3. Nutrient deficit soil
4. Poor irrigation water
5. Lack of availability of quality seed potatoes

Problems faced by Wholesalers

1. Poor infrastructure and poor transportation
2. Lack of credit
3. Lack of government policies about price determination
4. Market committee regulations
5. Market competition
6. Trust development

Problems faced by Retailers

1. Lack of knowledge about price
2. Poor quality of Potatoes
3. High transport cost
4. Poor transportation
5. Storage problem

6. Poor marketing system

Problems faced by Consumers

1. Poor quality
2. Grading problem
3. High prices
4. Lack of freshness

Suggestions

The study recommends followings suggestions for improvements;

1. Supply chain actors should upgrade their practices for more profit to farmers and desired quality to consumers.
2. The organized retail outlets should work directly with farmers to improve yield by enabling them to obtain quality input supplies, modern farm technology and timely credit at reasonable interest rate.
3. The retail outlet should invest heavily on logistics such as cold storage, warehousing, transport and distribution either directly or through third party logistics.
4. For easy access to disease-free seed potatoes at reasonable rates throughout planting season, the public sector should develop a plan engaging the business sector.
5. Nearly all of the participants in the potato supply chain had to deal with price fluctuation. The demand and supply in the market should be stabilized to prevent price fluctuation.
6. Increases incentives in terms of cheap credit, reduced entry barriers for the private players to invest in the logistics across the chain.

Conclusion and Discussion

The study findings highlight potato has become a popular vegetable crop in Pakistan, both for consumers and growers. It is the most extensively consumed staple meal after wheat and rice, and comes in a variety of forms, including cooked, boiled, fries, chips, and snacks. Because to expanding food choices for fast food, Pakistan's per capita consumption of potatoes has increased. It's also the most affordable source of carbs, vitamins, minerals, and proteins. Increased consumption of potato products has also been aided by the rapid expansion of the processing sector, which has seen numerous new companies enter the market. A supply chain is the network of all the individuals, organizations, resources, activities and technology involved in the creation and sale of a product. Overall, we have followed past research studies to outline this research (Rasheed, Jamad, et al., 2020; Rasheed, Okumus, Weng, Hameed, & Nawaz, 2020; Saleem, Rasheed, Malik, & Okumus, 2021; Yousaf et al., 2014; Zhang, Rasheed, & Luqman, 2019).

Potato supply chain in Pakistan includes farm suppliers, producers, village dealers, commission agents, processors, exporters, and retailers, just like other agricultural products. This specific study was aimed to characterize and map the potato supply chain linkages between actors, processes and activities moreover, to calculate marketing efficiency at different level(s) of supply chain. Main problems related to different supply chain actors were also identified and possible suggestion for the improvement of whole potato supply were addressed in this study. The findings revealed the difference in potato supply chain among various chain actors. There was lack of information

among supply chain actors, consumers desire is not fulfilled by the supply chain actors. Potato supply chain actors faced problem because of no information sharing system.

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