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ANALYZING OPTIMAL MARKETING CHANNELS IN THE VEGETABLE SUPPLY CHAIN: EXPLORING FACTORS INFLUENCING MARKETING CHANNEL SELECTION

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ABSTRACT

Potato is amongst most important vegetables being used in kitchens of ordinary and common men. The income elasticity of demand of potato is relatively high as compared with other vegetables. In Pakistan, the traditional fruit and vegetable markets and considered to be the places of pure competition and farmers are linked to these markets via different marketing channels. This study delves into the analysis of optimal marketing channels within the vegetable supply chain, with a focus on understanding the factors that influence the selection of these channels. The study used cross-sectional primary data gathered from different supply chain actors, including 120 potato growers, 20 retailers, 20 consumers, 16 commission agents, and 16 wholesalers from two districts of Punjab, namely Okara and Chinote. This research employs a two-fold methodology. First, it involves the identification of the optimal marketing channel among five alternatives using a unique ranking technique methodology. Second, it employs regression analysis with binary endogenous treatment to discern the factors affecting the choice of marketing channels. The study sheds light on the intricacies of marketing channel decisions in the vegetable supply chain, offering insights into the preferences and considerations of stakeholders in the Okara and Chinote districts of Punjab, Pakistan. The findings of the study contribute not only to the understanding of optimal channel selection but also to the broader knowledge of the factors that influence these decisions. These insights are valuable for practitioners, policymakers, and researchers aiming to enhance the efficiency and effectiveness of marketing strategies within the agricultural sector, benefiting farming communities and the country as a whole.

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INTRODUCTION

In the dynamic landscape of agricultural economies, the efficiency of marketing channels plays a pivotal role in ensuring the smooth flow of produce from farm to consumer (Castano, 2001). This study employs a dual-method approach. Firstly, it addresses the identification of the optimal marketing channel from a set of five alternatives, providing a nuanced understanding of preferences within the local vegetable supply chain. Secondly, the study utilizes regression analysis with binary endogenous treatment to delve into the multifaceted factors that impact the choice of marketing channels. This research contributes valuable insights to the realm of agricultural marketing by unraveling the complexities of optimal channel selection and providing a comprehensive understanding of the determinants influencing these decisions in the specific context of vegetable supply chains. Such insights are crucial for stakeholders, policymakers, and researchers seeking to enhance the efficacy of marketing practices and strategic planning in the agricultural sector.

Major junk of the total population in Pakistan used to live in villages, and they are dependent on agriculture for their livelihood in one way or another (GOP, 2023b). Horticulture is an important sector in Pakistan's economy and is hugely important in rural areas. In horticulture, Vegetables and crops have substantial significance and position (Naseer et al., 2019b). In the contemporary age of free trade, these crops have huge standings and are relatively important to compete and contribute to agriculture's share in the national economy (Rehman et al., 2015). The profession of vegetable growing has many benefits: earning financial profits for trivial growers, a base for obtaining foreign exchange for the general economy, being as imperative as caring for food and being useful against specific diseases (Thow and Priyadarshi, 2013). Moreover, vegetable crops are important for food guarantee for the masses living in Pakistan and are a source of income support for the rural public. The people of South Asian countries have vegetable dietary habits, and consequently, these poor countries produce and consume significant amounts of vegetables to meet their main food requirements (Jayawardena et al., 2020). Furthermore, in terms of nutrient intake, vegetables offer superior quality and value (Drewnowski and Popkin, 1997).

This state of affairs compels us to think that less developed countries like Pakistan should produce more vegetables efficiently and on a larger scale.

Being a hefty source of starch and fiber, potato is known as a complete food due to its nourishing values. It ranks 5th after sugarcane, rice, wheat, and maize in the world (FAO, 2014). In horticulture, it remained an imperative vegetable for farmers and consumers not only in Pakistan but all over the globe. Globally potato has attained 4th rank due to its production volume and dietary benefits (Mickiewicz et al., 2022). An increase in the area of cultivation from 3000 hectares at the time of independence to 194,000 hectares during 2017-18 shows the growers' interest in this crop (GOP, 2023b). Potato is the most widely produced and consumed vegetable crop due to its nutrient capacity, potential for diverse uses, and easy availability to low-income consumers in the world (Anwar et al., 2015). More than 5000 potato varieties are available in the world, most of which belong to South America (Zaheer and Akhtar, 2016).

Pakistan is exposed to international supply shocks due to net importer of food items. These supply shocks adversely affect local food prices, especially the prices of tomatoes and consequently push even essential food items out of reach of the poor population (Husain, 2018; Rehman et al., 2015). The combined effect of increasing population and high inflation further worsens the situation. Pakistan imports potatoes from India, China, Bangladesh, and Belgium; tomatoes from India and Afghanistan; and Chilies from India and China worth 47,00,000 million rupees annually. This import has increased by about 200 percent for tomatoes and 92 percent for chilies during the last two to three years (Thumaty et al., 2015)

Being a center for vegetable production, Pakistan has better chances to earn foreign exchange by exporting fresh and preserved vegetables to most of the neighboring economies in Asia. Currently, seed is being imported from other countries to grow vegetables because most of the vegetable growers are dependent on imported seed, but it is a fact that vegetable production at commercial levels can be used to reduce import bills and to earn foreign exchange through production of seed to be used by local growers and export of vegetables. Furthermore, many jobs can be created in this regard.

Agricultural Marketing of Pakistan

The traditional agricultural business operates in wholesale markets in Pakistan. These markets are considered places of pure competition despite the existence of monopolies, hoarding, and other malpractices. These markets also take their part in high food prices accompanied by the lowest share of growers in total profit (Naseer et al., 2019a). Vegetables are considered to be the low delta crop, and farmers prefer to grow vegetables due to their short plantation period. In improving the economy of the country, vegetables can play a great role because this sector has not been looked at to earn more returns through exports to other nations (Noonari et al., 2015).

In Pakistan, potatoes and tomatoes are among the important items used in kitchens. For a sustainable vegetable enterprise, the prerequisite is that the production and marketing system is money-spinning and proficient as far as the growers are concerned (Naseer et al., 2019a). In Pakistan, the presence of four to six market intermediaries in the marketing channel, from producers to ultimate consumers, has made the marketing system unique and intricate (Naseer et al., 2019b). Considering the significance of vegetables, the current study is intended to make vegetable production a profitable business, and its efficient distribution may help the growers improve their livelihood.

Despite marketing being an important activity, small growers hesitate and cannot join appropriate marketing channels, especially due to the stress of a free marketing system. Usually, not a considerable number of small growers join prescribed marketing channels and forums. Makhura (2002) found that operational expenses were a major obstacle in South Africa, hindering the farmers from having small holdings to join an appropriate market to sell their produce in Pakistan. The majority of the farmers are small growers and, hence, are not capable of getting a reasonable price for their construction, and these factors result in growers not being able to sustain their living and revenue generation (Naseer et al., 2016). Effective marketing channels and networks are necessary due to the perishable nature of the vegetables. The major challenge in increasing the production of vegetables is increasing the number of vegetable growers visiting the agricultural produce markets and their active engagement in them. An efficient and profitable production and marketing system is a prerequisite for the sustainability of vegetable enterprise. This study aims to improve the marketing network of vegetables and to pinpoint the factors influencing the selection of a marketing channel by vegetable growers in Punjab, Pakistan.

Public wholesale Markets especially the F&V Markets in Pakistan, are the least studied entities regarding the exploitation of growers in the current marketing system. The main objective of the current study is to investigate and analyze the grower's share of consumer rupees in existing potato marketing channels. There is little literature on the selection of a marketing channel in the vegetable marketing system in Punjab, Pakistan. Another aim of this study is to recognize various factors influencing the choice of a specific marketing channel, i.e., public wholesale markets by the growers to earn the highest profits. Before this, as per the researcher's knowledge, no study has been conducted from Pakistan's perspective aimed at determining the choices for the growers regarding a marketing channel to market their produce and to enhance their share in the consumer's rupee. An investigative framework is discussed in the next subsection of the remainder of the paper. Section two deals with the research methodology followed by results and discussion in section three and concluding remakes in section four.

Investigative framework for marketing channel choice

Studies by Henderson and Isaac (2017) and Jordaan et al. (2014) have proved that the choice of a particular Market Channel is affected by several factors. This study has classified those factors into four categories, i.e., farm-specific, grower-specific, geographical, and institutional influences. The investigative framework shown in Figure 1 has carefully identified and analyzed how marketing channels can affect the livelihood of the growers. The grower's choice of a particular Marketing Channel (Public wholesale Market) was designated as the treatment variable, with a list of other independent variables responsible for a grower's profitability. It is an all-inclusive analysis to understand the behavior of the growers in selecting a particular marketing channel and the possibility of altering their attitude to select a marketing channel, keeping in view the profitability to improve their livelihood.

An explanation of the independent variable is presented in Table 1. The age of the vegetable farmers is taken in years. Aged farmers are considered to be less adventurous than the young elite who are also less risk-averse than aged farmers (Knowler and Bradshaw, 2007). Thus for choosing a marketing channel age was considered to be negatively or positively associated with the selection of a market channel. The literacy level of the farmer was

also assigned dummy values, taking the value one if the farmer was literate or zero otherwise. Education enhances working and managing efficiency for effective enactment of better marketing, creating sustainable marketing channels with defined standards. Thus, higher education would increase the probability of joining a market channel. Growers were inquired about the communication networks available to them. The accessibility of market information was represented as a dummy variable, where a farmer with access to market information was assigned the value one or zero otherwise. Farmers with sufficient access to market information were considered to be more optimistic about joining a particular marketing channel.

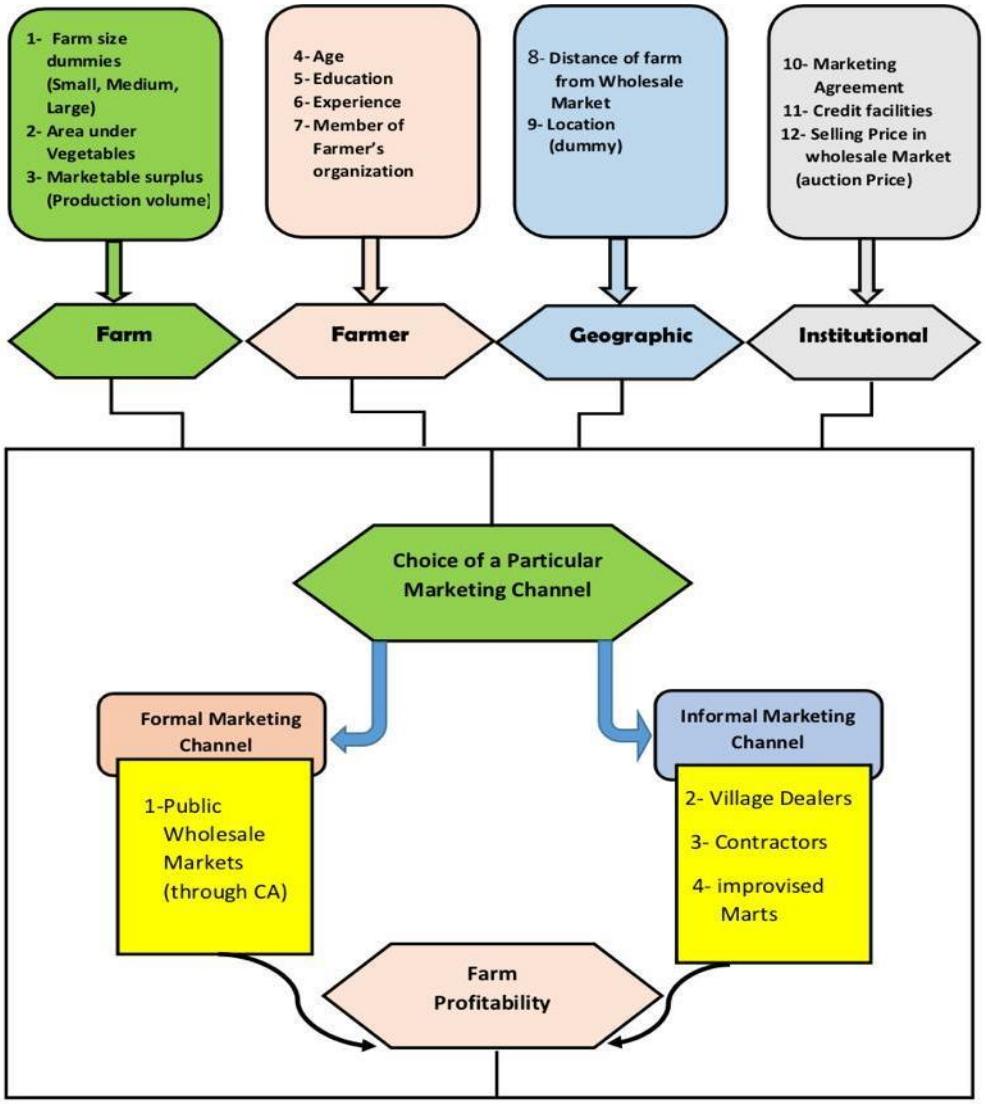

Figure 1. Investigative framework for grower's choice of a particular marketing channel.

The distance from the production area to the market was measured in kilometers. The greater the difference between the production area and the market, the lesser the probability that farmers would join or participate in a particular marketing channel, as they might anticipate lower returns due to the perishable nature of vegetables, increased marketing costs, time wastage, and poor farm-to-market roads, etc. Consequently, this variable was hypothesized to have a negative relationship with market channel choice. The land cultivated under vegetables was measured in acres, with farmland size serving as a proxy for wealth (Feder et al., 1985); therefore, it was hypothesized that this farm size would be directly associated with the choices of market channels. The selling price represented the price the vegetable market channel offered in selected wholesale markets. It was presumed that better prices would motivate farmers to engage in a specific marketing channel. A more favorable price offered to farmers for their produce incentivizes them to participate in a market channel that offers better compensation.

The quantity of vegetable crops produced denoted the amount of each selected vegetable produced in the 2017 season, measured in kilograms. The relationship of marketable surplus was considered to be positively correlated with participation in a specific marketing channel. The greater the quantity of vegetables produced, the higher the likelihood of using a particular market channel. A dummy variable was assigned for membership in the farmer organization, taking the value one if the farmer was a member and zero otherwise. This dummy variable was regarded as a proxy for information access. It was anticipated that members would be more inclined to participate in a sustainable vegetable market channel (Sidibé, 2005). Additionally, a marketing agreement was set as a dummy variable, where the presence of a marketing agreement was represented by the value one or zero otherwise. These contractual agreements provide assurances for market availability, thereby increasing the likelihood of farmers participating in a specific marketing channel. This variable was expected to positively influence the choice of a particular market channel.

Table 1. Description of variables employed in regression analysis and anticipated signs.

Variables		Coding system	Category	Expected sign
X_1	Age	Years	Continuous	-/+
X_2	Education	Years	Continuous	+
X_3	Farming Experience	Years	Continuous	+
X_4	Farm Size (dummies) Small, Medium & Large	Small omitted. 1= for considered, 0 for others	Dummy	+/-
X_5	Distance of farm from the market	Kilometers	Continuous	-
X_6	Membership in farmer's organization	1 for Yes, 0 for No	Dummy	+
X_7	Credit Facilities	1 for Yes, 0 for otherwise	Dummy	+
X_8	Selling Price	Rs./Kg	Continuous	+
X_9	Access to Market information	1 for Yes, 0 for No	Dummy	+
X_{10}	Area under Vegetables	Acres	Continuous	+
X_{11}	Marketing Agreement	1 for Yes, 0 for NO	Dummy	+
X_{12}	Quantity of Marketable surplus	40 Kgs	Continuous	+
X_{13}	Location (Dummies)	1for considered, 0 for others	Dummy	+/-

The decision to participate in either formal (Public Wholesale Marketing Channel) or informal marketing channel or even not participating signifies the individual direction to maximize utility and profit accordingly. Linear regression is used to analyze the farmer's decision to choose a particular marketing channel, keeping profitability in view. It has been identified through field surveys that potato and tomato growers use to sell their produce to the contractors; village dealers (local retailers); commission agents (Arhties) in Fruit and Vegetable Markets; wholesalers (Pharias); Retailers; and improvised marts. The impact of the grower's selection of a particular marketing channel on their profitability was assessed through regression with binary endogenous treatment.

METHODOLOGY

Selection of Study Area

The current study is accomplished in Punjab province, situated in southeast Pakistan located in the semi-arid lowland areas. Punjab is the second largest and the most populous province with productive agricultural lands. Punjab contributes a dominating role in the overall economy of Pakistan by sharing 53% of the total agricultural Gross Domestic Product (GDP) and 56% of the total cultivated area (Badar et al., 2002; GOP, 2023b). Punjab is the largest province in terms of population and second largest in terms of area (GOP, 2023c; Naseer et al., 2016). Punjab contributes the highest share in Agriculture production and GDP accordingly (GOP, 2023b). Likewise, Punjab is the largest producer of potatoes, i.e., more than 90 percent of potatoes are produced in Punjab (Memon, 2017). The total production of potatoes in Pakistan during 2017-18 was 4584 thousand tonnes, of which 4402 thousand tonnes were from Punjab (GOP, 2023d).

This study is carried out in two districts of Punjab, i.e., Okara and Chiniot. Both districts were purposefully chosen to study the production and marketing of potatoes, as in Punjab, these contribute 39% and 38% in the total area and production of potatoes, respectively (GOP, 2023d). Furthermore, the potato is a popular crop in Pakistan, cultivated at about 194,000 hectares in eight different agroecological zones in Pakistan (GOP, 2023d). In Pakistan, potatoes are cultivated in three seasons, i.e., spring crop (Jan-Feb to April-May), summer crop (March-May to August-Oct), and autumn crop (Sept-Oct to Jan-Feb).

Study area profile

Our first district to answer the research question about potato marketing is Okara. It is located alongside the Lower Bari Doab Canal (LBDC), a high ridge land that runs from west to south in Punjab province, Pakistan (Khanam et al., 2023). This district covers an area of 4377 Km^2 and geographically lies between longitudes 73° 27' 33.8256'' E and latitude 30° 48' 30.6000'' N. According to its agroecological settings, this district falls in the mixed cropping zone having agriculture, geography, and distinct climate. The major crops grown in this district are Potato, Sugarcane, Wheat, Rice, Maize, Cotton, and Onion. This district has a hot and cold climate with temperatures ranging from 2-44°C. The average rainfall is 180-200 mm annually (GOP, 2023a).

Our second district to study the production and marketing of potatoes is Chiniot, which is located northwest of the Chenab River. This district covers an area of 2643 Km^2 and geographically lies between 31° 43' 12.00" N latitude and 72° 58' 44.00" E longitude. According to its agroecological settings, this district also falls in a mixed cropping zone with agriculture, geography, and a distinct climate. The major crops grown in this district are wheat, sugarcane, maize, and rice. The district has a hot and mild cold climate with temperatures ranging from 5-46°C. The average rainfall is 336 mm annually (GOP, 2023a).

Calculating Marketing Margins

The marketing margin was considered as the variance of price between growers and retailers. The growers' share in the consumer's rupee was calculated by using simple arithmetic techniques such as the fraction of growers' price to end-consumers price. Explicitly, we can write this as:

$$Ps = Cp - Pp = MM$$
$$Cp - Pp - MM = 0$$
$$Cp - MM = Pp$$
$$\frac{Cp}{Cp} - \frac{MM}{Cp} = \frac{Pp}{Cp}$$
$$PS = 1 - \frac{MM}{Cp} \quad (1)$$

Where

PS = Grower's share
Pp = Grower's price
Cp = end-Consumer price
MM = Marketing margin

The above comparison reveals that a high value of the denominator will reduce the numerator and thus will lead to a lesser grower's share in the final price paid by the consumer and vice versa. It also suggests the welfare distribution amongst the producer and marketing actors. The gross marketing margin was calculated using the relation given below. Total Gross Marketing Margin (TGMM) is the price paid by the end consumer stated in %age (Mendoza, 1995).

$$TGMM = \frac{Consumer\ Price - Producer\ Price}{Consumer\ Price} * 100 \quad (2)$$

Where

$TGMM = Total\ gross\ marketing\ margin.$

Net Marketing Margin (NMM) is defined as the percentage of the final price retained by the intermediary as their net income after subtracting their marketing costs. The equation indicates that an increased marketing margin reduces the producer's share, and conversely, a lower marketing margin enhances the producer's share. Furthermore, it offers insights into the distribution of welfare among production and marketing agents.

$$NMM = \frac{Gross\ Marketing\ Margin - Marketing\ Cost}{Consumer\ Price} * 100 \quad (3)$$

From the above measures, it is likely to see the allocative effectiveness of markets. Greater NMM or profitability of the marketing actors suggests reduced downward and uneven income distribution, this in turn decreases market use by smallholders. A marketing system is said to be an efficient one where the net margin is near to rational profit.

To ascertain the proportional share of each marketing intermediary, a comparable concept was employed with certain modifications. In assessing margins, initially, the Total Gross Marketing Margin (TGMM) was computed, representing the difference between the grower's (farmer's) price and the consumer's price (the price paid by the end-consumer), i.e.,

$TGMM = Consumer\ price - Farmer\ price$

Then, the marketing margin at a given stage 'i' (GMMi) was computed as:

$$GMM_i = \frac{SPi - PPi}{TGMM} * 100 \quad (4)$$

Where

SPi is the selling price at the ith link and

PPi is the purchase price at ith link

The total gross profit margin is also computed as:

$$TGPM = TGMM - TOE \quad (5)$$

where TGPM is the total gross profit margin, TGMM is the total gross marketing margin, and TOE is the total operating expense. Similarly, Gebregziabher (2010) and Negussie and Haji (2011) introduced the concept of a profit margin that subtracts operating expenses from the marketing margin. Then, the profit margin at stage "i" is given as:

$$GPM_i = \frac{GMMi - OEi}{TGPM} * 100 \quad (6)$$

Where.

$GPMi$ = Gross profit margin at ith link

$GMMi$ = Gross marketing margin at ith link

OEi = Operating expense at ith link

$TGPM$ = Total gross profit margin

Measuring the efficiency of a marketing channel

Five performance indicators were used to measure the efficiency of specified marketing channels.

These indicators are:

%age of produce run through the channel (1_1),

(i) Grower's share (1_2),

(ii) Marketing Expenses (1_3),

(iii) Middlemen's' share (1_4),

(iv) Price deviation i.e., differences of maximum and minimum prices of potato/tomato in a month (1_5).

The grower's share was determined by the ratio of the net average price received by the growers to the weighted average price of selected vegetables. It was calculated using the formula provided below, and the channel with the highest grower's share was ranked as (1) for the first position, and so on.

$$\text{Percentage of grower's share} = \frac{PPi}{Pri} * 100 \quad (7)$$

Where:

Ppi = grower's share in the ith channel

Pri = mean price of selected vegetables at the retail level in each channel.

i = Number of marketing channels ($i = 1, 2, - - - - -, n$)

Marketing expenses were estimated, and the marketing channel with lower marketing expenses was assigned the rank of 1, and vice versa. The same methodology was applied to rank the margin of market intermediaries in each channel. For each month, the deviation *(d)* in upper and lower prices during each month in the respective channels was calculated.

Price equalization across all categories of farmers is indicated by d = 0, signifying no price deviation among the farmers' prices. Higher differences imply greater price deviation, and vice versa. The ultimate ranking of all six indicators for each channel was computed using the composite index formula.

$$R = \frac{Ri}{Ni} \quad (8)$$

Where

Ri = Total value of ranks of all indicators for all channels

Ni = Number of indicators.

The Marketing Channel with the least mean value denotes the most efficient marketing channel and vice versa.

Regression Analysis with Binary Endogenous Treatment

The two-step regression analysis with binary endogenous treatment was used to investigate the effect caused by getting one treatment instead of another. In the first step, regression analysis with binary endogenous treatment was carried out to investigate the factors of the marketing channel choice, and in the second step, factors affecting the probability of Potato and Tomato Farmers were estimated conditionally to the different marketing channels. In this, we estimate an average treatment effect and the other parameters of a linear regression model augmented with an endogenous binary treatment variable. We have to specify the treatment variable and the treatment covariates in the treat (s) option. The average treatment effect on the treated (ATET) is estimated using Stata. The current study attempted to address determinants of the choice of a particular marketing channel (marketing through public wholesale markets) conditional to the profitability of potato and tomato growers. So, again, endogeneity is the main problem because implicit heterogeneities may be correlated, affecting both the choice of a particular marketing channel and profitability. And thus, it is likely that the standard regression model may produce biased and inconsistent estimates (Amare, 2012; Vella and Verbeek, 1999). If one of the regressors is endogenous, the regression estimates of the maximum likelihood estimators (MLE) may also be inconsistent, and a two-step consistent estimate was performed instead of MLE (Cameron and Trivedi, 2010). Subsequently, the linear model was considered, wherein at the first instance, a binary variable; $PHMC_i$ as a choice, is used as the treatment variable, and the equation is specified as.

$$PHMC_i = \beta_o + \beta_i X_i + \delta_i L_i + \varepsilon_i \quad (9)$$

Where X_i is the list of independent variables affecting the choice of a particular marketing channel and L_i is the set of instrumental variables that are whether the farmer has an advance agreement with a functionary of a marketing channel and is a member of the farmer's organization in this study. In the second phase, the equation for the profitability of a grower in a selected marketing channel is specified below.

$$Y_i = \alpha_o + \alpha_i X_i + \theta_i E_i + \nu_i \quad (10)$$

Where Y_i is the outcome variable that is profitability, X_i is the set of that independent variable and E_i is the choice of marketing channel of potato and tomato growers.

The current model will be employed to evaluate: First, odds of selling vegetables to public wholesale markets channel compared to selling vegetables to other informal wholesale market channels, and second, selling vegetables to non-wholesale market channels compared to selling vegetables to another wholesale market channel.

RESULTS AND DISCUSSION

Measuring Efficiency of Potato Marketing Channels

Percentage of product run through a channel (I_1)

Agricultural marketing channels refer to a system or routs used to transfer Agricultural Commodities from producers to ultimate consumers. These channels are significant to "Commodities available for sale," i.e., commodities available with growers as surplus produce that enter the process of rotation and trade. The reason behind the trade of these commodities is to gain money in terms of profits, and on the other side, it is done to have access to a variety of other products. The existing vegetable marketing channels for potatoes and the percentage of products running through a marketing channel identified in the study area are depicted in Figure 2.

Furthermore, the ranking of the channel on the basis of the percentage of products run through it is given in Table 2.

Growers' shares in consumer rupee (I_2)

Growers' share in the consumer rupee is represented in Table 3 in different marketing channels. In channels I & IV the growers' share comes out to be maximum due to the shorter path followed by channel II and channels III and was lowest in channel III (the lengthiest path). It is observed that needless marketing layers are developed when there is a market limitation or growers are not organized to act rationally. Moreover, this happens when access to market information is limited and bears heavy costs.

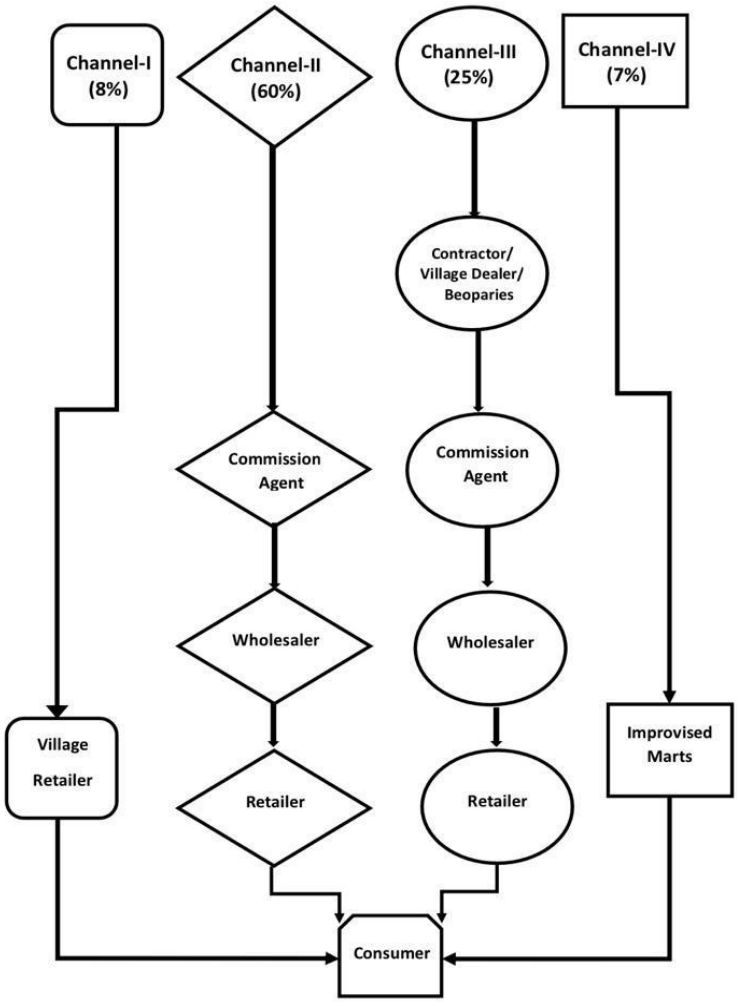

Figure 2. Marketing channel of potato in study area.

Table 2. Potatoes run through different marketing channels in the study.

Channel Name/No.	%age of Product run through	Rank (I_1)
I	8	3
II	60	1
III	25	2
IV	7	4

Marketing margins amongst all intermediaries under different channel settings are given in Table 4. The highest margins are seen on Channel III, and the lowest are noted in Channel I. The presence of the highest number of intermediaries in channel III is the cause of the greatest marketing margins. As a result, the large number of intermediaries in Potato marketing increases marketing expenses and price spread. Although it is impossible to eliminate all the marketing actors from the supply chain, some could be removed through better management to reduce marketing costs and price spread.

Marketing expenses in potato marketing channel (I_3)

Table 5 represents the channel-wise marketing cost, and it was noted that channel III had the greatest marketing expenses (Rs.386/Q) trailed by channels IV, II & I. The Lowest expenses (Rs.181/Quintal) were noted in channel I. High conveyance expenditure, loading and unloading, and compensation in the form of commission charges to commission agents were the primary factors contributing to higher marketing costs. Channel III involved a greater number of marketing actors, which was the primary cause of the elevated marketing expenses.

Middlemen's share (I_4)

The absolute cash margin of growers was obtained after subtracting commission charges from the sale price per bag (100 Kg). The value of the commission paid to the commission agent on total revenue is the cash margin of the commission agent. Similarly, the absolute cash margins for each functionary under different Marketing channels are given in Table 6.

The findings given in Table 7 reveal that the price disparity from grower to commission agent, Pharya, and the retailer was Rs. 44, Rs. 150, and Rs. 200 respectively in channel II and Rs.56, Rs.200, Rs.150 in Channel III. However, the price spread from the producer to the retailer under channels I & IV was observed as Rs.200 and 250 respectively. The consumer prices for potatoes were conveyed as Rs. 1400, Rs. 1450, Rs. 1550, and Rs.1800 per 100 kilograms in Channel I, II, III, and IV respectively. The maximum retail price of Rs. 1800/bag was noted under channel IV, and this may be due to improved packing and grading of the potatoes at improvised marts. The mean price received by the grower was Rs.1214 per 100Kg whereas the mean price offered by the end-consumer was Rs. 1550/bag of 100 kilograms of potato.

Table 3. Producer's share in consumer's rupee (Rs. /100Kg).

Marketing Cost	Channel-I	Channel-II	Channel-III	Channel-IV
Producer's Price	1200	1100	1050	1550
Weighted average Price at Retail level	1400	1450	1550	1800
Producer's share (%age)	86	76	68	86
Rank (I_2)	1	2	3	1

Table 4. Marketing cost and margins (Rs. /100Kg).

Marketing Cost	Channel-I	Channel-II	Channel-III	Channel-IV
Purchase Price	1200	1100	1050	1550
Sale Price	1400	1450	1550	1800
Marketing Margins	200	350	500	250
Marketing Cost	181	296	386	350
Net Margin	19	54	114	100

Table 5. Marketing costs involved in different marketing channels (Rs. /100Kg).

Marketing Cost	Channel-I	Channel-II	Channel-III	Channel-IV
Grading	10	10	-	20
Packing & Packing Material	80	130	130	180
Transportation	-	50	50	50
Loading/Unloading	20	20	20	30
Tool and Taxes	-	50	50	-
Tips and Donations	15	10	50	-
Damage and Spoiling	-	20	30	50
Rents	-	-	-	-
Commission Charges	6	6	6	-
Others	50	-	50	20
Total Costs	181	296	386	350
Rank (I_3)	1	2	4	3

Table 6. Absolute cash margins of different intermediaries (Rs. /100Kg).

Market Intermediaries	Channel-I	Channel-II	Channel-III	Channel-IV	Average
Growers	1200	1056	1050	1550	1214
Contractors/ Distributors	-	-	94	-	94
Commission Agents	-	44	56		50
Wholesalers	-	150	200	-	175
Retailers	200	200	150	250	200
Sale Price of Potatoes	1400	1450	1550	1800	1550

Marketing margins for potato

To calculate the price spread amongst (marketing margins) amongst different intermediaries in different Marketing chains, primary as well as secondary data was used. The use of price for such calculations is always a problem kept in view of the span of the marketing period and price diversification during this period. The researcher faced many difficulties while framing average normal prices. Some of these difficulties are given below:

a) the daily disparity in the value of the commodity in a particular market,
b) price difference due to different grades of the produce,
c) seasonal variation in prices,
d) and the difference of prices in consuming and producing areas.

Such difficulties have been overcome by gathering prices, which may cover a maximum of the above conditions. The potato prices of a quantal were collected, and a quantal is equal to 100 kgs. Similarly, Potato prices were composed every week during the entire harvest season from assembly and wholesale agriculture produce markets as well as from different market actors. The retail price of the potato was obtained simultaneously from retailers as well as shopkeepers in the selected cities. Table 7 represents the normal mean prices for the potato for a quintal quantal for different market actors. Potato growers in Punjab received the maximum price of Rs. 1550/ bag of 100 kilograms when they sold directly to an improvised mart and a minimum of Rs. 1050/ bag of 100 kilograms when they sold it to a contractor without any botheration of marketing. The wholesale price was Rs.1250/Quintal to Rs.1400/Quintal and Rs. 1400 to Rs.1550/Quintal was retail price. Keeping in view of the similar arrangement for wholesalers and retailers, it can be concluded that the highest prices are received by them in channels II & III.

Price deviation (I_5)

A deviation in the price of potatoes for three months was observed for each channel, which is depicted in Table 8. The disparity between the highest and lowest price during a month is called price deviation in the instant study. Average price deviation (d) was calculated by taking the meaning of the price deviations of all the months for three months. Table 8 shows that the minimum price deviation is under channel I followed by channel II and III. However, Channel-IV is characterized by maximum price deviation. One of the reasons for high price deviations might be due to demand and supply situations faced by the growers, and the businessmen/traders took it as a blessing and cashed this chance and charged different prices under different demand settings.

Identification of efficient potato marketing channel

Considering the position of ranks of opted performance indicators in selected channels, performance efficiency of all marketing channels was drawn using composite index formula. The performance indicators in Table 9 depict that channels III and IV are less efficient in the agricultural marketing sectors in potato-producing regions. The reason behind it was the lesser volume of potatoes traded and the huge price differential between maximum and minimum prices in channel IV. Similarly, marketing margins or price spread was high in channel III due to the huge number of market intermediaries involved in this channel. Moreover, the higher cost led to lower efficiency of this channel. Theproducer's reaction to the marketing channels I, direct selling to the retailers, should be the most desirable Marketing Channel. The highest earnings can be obtained by selling directly to the consumers, but farmers used to sell meager quantities of potatoes through this channel, and they cannot store potatoes for a longer period of time in the absence of proper storage facilities and there is apprehension of degeneration and decay. It is established that channel II is the most profitable channel for the growers because the maximum quantity of potatoes is being sold through this channel.

Table 7. The sale price of potatoes at different marketing stages (Rs. /100Kg).

Market Actors	Channel-I	Channel-II	Channel-III	Channel-IV
Growers	1200	1100	1050	1550
Contractors/Distributors	-	-	1200	-
Wholesalers	-	1250	1400	-
Retailers	1400	1450	1550	1800
Price Spread (PS)*	200	350	500	250
Rank (I_4)	1	3	4	2

PS*: Price paid by the consumer and price received by the producer.

Table 8. Deviation between the minimum and maximum price (Rs. /100Kg).

Marketing Cost	Channel-I	Channel-II	Channel-III	Channel-IV
December	120	200	210	415
January	100	120	100	350
February	150	200	190	300
$\sum d$	370	520	500	1015
N^*	3	3	3	3
d^*	123.33	173.33	166.66	338.33
Rank (I_5)	1	3	2	4

N^*: No of months for which deviation in price was observed; d^*: Deviation between the highest and lowest price during each month in the respective channel.

Table 9. Efficiency of different marketing channels.

Marketing Channel	Performance indicator					Composite Index $\left(\frac{Ri}{Ni}\right)$	Final Ranking
	I_1	I_2	I_3	I_4	I_5		
I	3	1	1	1	1	1.4	1
II	1	2	2	3	3	2.2	2
III	2	3	4	4	2	3	4
IV	4	1	3	2	4	2.8	3

Ri: Total value of the ranks of performance indicators; Ni : Total number of performance indicators.

Moreover, marketing expenses and the grower's share in consumer spending are quite reasonable if the potatoes are traded through this channel. Furthermore, if the potatoes are traded through this channel, distant consumers can benefit from their availability in abundance. Middlemen were seen working to manipulate the market against the interest of the growers and the consumers. But if the market imperfections are removed, and growers/sellers are organized, the market intermediaries wouldn't take advantage of anomalous profit.

Factors Affecting the Choice of a Marketing Channel

This analysis has investigated the factors affecting the probability of potato growers selecting a particular marketing channel. The findings of the two-step linear regression with endogenous treatment effects are presented in Table 10. Sahara et al. (2015) and Slamet et al. (2017) recommended the value of the parameter lambda (λ) used to explain the correlation between the outcome equation and the error term of the treatment assignment equation. The estimated result in the table shows that the value of the lambda (λ) is statistically significant, which means that the error term of the outcome equation and the error term of the treatment assignment equation are correlated. That is why the study used the two-step linear regression (two-step consistent estimates) with endogenous treatment effects to avoid any selection bias.

Table 10 represented the estimated results of the factor affecting the probability of selecting a particular marketing channel by the potato farmers. The selection and outcome equations were estimated simultaneously using two-step linear regression with endogenous treatment effects technique. The table is divided into two parts. The 1st part (column three) of the table explains the estimated results of the factor affecting the probability of selecting a particular marketing channel by the potato farmers and 2nd part (column three) of the table explains the factor affecting the profitability of the potato farmers with the assignment of selecting particular marketing channels as treatment variable.

Table 10. Regression analysis regarding the marketing of potatoes with endogenous treatment effect.

Variables	Coding system	Choosing a formal Public Wholesale Market =1, 0 for others	Two Step consistent Estimates (dependent = ln profit
Age	Years	0.0460 (0.0181)	0.4705 (0.0859)
Edu	Years	0.0018* (0.0015)	0.4933* (0.6146)
Farming Experience	Years	0.7286** (0.0573)	0.3129*** (0.0414)
Farm size dummies (Omitted = small, i.e., < 5 Acres)			
Medium	(5 to 10 Acre) = 1, 0 for others	0.0412** (0.0165)	0.0013**(0.0001)
Large	(> 10 Acre) = 1, 0 for others	0.0728*** (0.0089)	0.0621** (0.0080)
Distance of farm from market	Km	-0.3421** (0.1083)	-0.0447552
Member of farmer's organization	Yes =1, 0 for others	0.0003 (0.1160)	0.5425 (0.8029)
Credit facilities	Easily available = 1, 0 for others	0.9196** (0.0473)	-0.0304 (0.1882)
Selling Price	Rs./Kg	0.5250*** (0.0055)	0.124* (0.0012)
Assess to Market information	Yes =1, 0 for others	- 0.3281 (0.1502)	0.8435 (0.760)
Area under Vegetable	Acres	0.6840* (0.0916)	0.3417* (0.0298)
Marketing agreement	1 for Yes, 0 for others	0.9210** (0.0925)	0.3425 (0.230)
Quantity of Marketable produce	40 Kg	0.274* (0.002)	0.673* (0.0396)
Location dummy (Chiniot omitted)			
Okara	1, 0 for others	4.345** (0.132)	
Choosing Public Wholesale Marketing Channel	Yes =1, 0 for others		1.1954** (0.0497)
Constant		24.3100*** (0.607)	0.3425*** (0.0080)
Lambda		0.16229***(0.1319)	

Note: Parenthesis () contains Standard errors; ***, **, and * represent the level of significance at 1, 5, and 10 percent respectively.

The coefficient of choosing a formal public wholesale market in the outcome equation is found to be significant and positive. This implies that the potato farmers who choose formal public wholesale markets earn more profit than those who choose other informal marketing channels. These results are in line with our previous findings in which we have concluded that when farmers use formal public wholesale marketing channels, the returns are highest, i.e., the farmer's share in the consumer's rupee is more than when he chooses to sell through another informal channel. The grower's age, farming experience, larger farm size, better selling price, better credit facilities, and more marketable surplus have a positive and significant impact on choosing formal public wholesale markets to sell their potato.

The study reveals that as the farmer aged and gained more farming experience, a positive impact was seen on selling their produce through formal marketing channels to have better earnings. Moreover, the coefficient of landholding size dummies has a positive and significant impact on both the selection and outcome equation for both medium and large farm sizes, this implies that the probability of choosing a formal channel increase as the farm size increases. Better selling price in a public wholesale market is another factor that influences the potato grower to choose the formal wholesale market and the impact of the coefficient is positive and significant. For a one-rupee increase in the selling price, the probability of choosing the formal marketing channel will increase by 52 percent and in 2nd part of the table, the profitability of the potato growers will increase by 12 percent with the choice of a formal public wholesale marketing channel. Similarly, the more the area is under vegetable production, the more chances there are that the grower will choose a formal marketing channel. The results in both equations in this regard are positive and significant. The results show that with the one-acre increase in area under vegetables, the chances to choose a formal marketing channel increase by 68 percent, and profit is likely to increase by 34 percent.

In Punjab, rather than in Pakistan, few credit facilities are available to the vegetable growers through formal institutions; rather, the vegetable growers depend on commission agents (informal sources of credit) for the credit to fulfill their day-to-day needs and the credit requirements for vegetable farming. In the current study, all the grower respondents were of the view that the commission agents fulfill their credit needs as and when they require it, and thus, they consider that credit is easily available to them from the commission agents working in the public wholesale market. The results shown in the table are in line with the observations that when credit is available to them from the commission agents, the chances of choosing a formal marketing channel increase by 68 percent, and profit is reduced by 3 percent. This is because when they avail the facility of the credit from the commission agents, they are informally bound to sell their produce through the commission agents, and in any price scenario, the commission agent is bound to sell their produce at an appropriate plausible price as the commission agents have to recover their extended credit from this revenue. But at the same time, there is apprehension about losing profit as when the growers avail the facility of the credit from the commission agents; they are informally bound to sell their produce through the commission agents (Public wholesale market) and in the current price scenario there are chances that the grower will profit by paying for an opportunity cost by not selling through a channel where there are higher prices and profit.

Furthermore, the coefficient of the marketing agreement of the potato growers with the contractors or commission agents is positive and significant in the selection equation but is negative and non-significant in the outcome equation. This reveals with a marketing agreement, the grower becomes bound to sell as per his commitment, either formal or informal, and the probability to sell through formal public markets will increase by 92 percent, but at the same time, the profit will decrease by 33 percent (non-significant). The coefficient of distance from farm to market has a negative and significant impact in both equations. This implies that the probability of choosing formal public wholesale decreases by 34 percent when the distance between the farm and the public wholesale market increases by one kilometer. According to the outcome equation, the farmers' profit is decreased by 43 percent. This decrease in profit may be due to selling the produce at a lower and non-competitive rate on another in-formal channel. The coefficient of the location dummy has a positive and significant impact on the selection equation. This implies that the farmers of Okara choose formal marketing channels more often than the farmers in Chiniot District.

CONCLUSIONS AND RECOMMENDATIONS

The result of this study has provided the foundation to ascertain the behavior of growers while marketing their produce. Moreover, the contribution of the current study will provide a launching pad to develop and strengthen the agriculture marketing system in Punjab. This research also indicates the most significant areas for future research. This study has provided valuable insights into the dynamics of marketing channel selection within the vegetable supply chain, with a focus on the factors influencing these decisions in potato crops. Identifying optimal channels and exploring underlying determinants offer a nuanced understanding of the preferences and considerations of stakeholders in the Punjab province of Pakistan. These findings hold significance for practitioners, policymakers, and researchers alike, providing a basis for informed decision-making in the agricultural sector.

The study's outcomes suggest several policy implications for stakeholders involved in agricultural marketing. Policymakers can use the insights gained to formulate strategies that enhance the efficiency of marketing channels, ensuring that they align with the preferences of producers and consumers. Initiatives promoting awareness and access to information about different marketing channels could empower farmers to make informed choices. Additionally, the identification of influential factors highlights the need for targeted interventions, such as capacity-building programs and support mechanisms, to address specific challenges faced by stakeholders in the vegetable supply chain. While the study contributes valuable insights, it is essential to acknowledge its limitations. The research is context-specific to Okara and Chinote districts in Punjab, and generalizing findings to other regions should be approached with caution. The study's reliance on primary data from a specific timeframe may limit the temporal applicability of the results. Furthermore, the scope of factors influencing marketing channel selection may not be exhaustive, and additional variables could be explored in future research. Despite these limitations, the study provides a foundation for further investigations and serves as a starting point for more comprehensive inquiries into the complexities of agricultural marketing channels.

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