Final report PAK-22066 March 2023

Understanding fresh produce supply chain dynamics and price wedges

Evidence from Pakistan

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Abstract

A typical urban agriculture supply chain is dependent on multiple middlemen from the auction yard to the final consumer. The presence of numerous intermediaries adds to the farmgate price and inflates the consumer's overall price. This report aims to document and collect granular level data about transactions from the wholesale auctioneer to the last stage middlemen (retailers) before the product reaches consumers for three staple vegetables - onions, potatoes, and tomatoes. Empirical results indicate that, after controlling for product quality, bulk-breakers retain margins in the range of 20 - 42%, the highest margin for tomatoes. Conversely, retailers retain 14 to 28%, the highest in the case of potatoes. Potential causes for differences in the margins over products could be attributed to types of costs incurred by the entities, vegetables, wastage, and the size of wastage for each vegetable. These findings highlight the need for price-stabilisation policies to consider the role of the bulk-breakers in conjunction with that of retailers. Possible avenues for future research can also explore channels to reduce product wastage in the markets, reduce costs, and improve the functioning of the markets.

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Key Terms

Aarti	A registered commission agent in the government regulated markets (called market committees) who usually acts as an auctioneer.
Pharia	Bidding agents that break the auctioned produce into smaller units to be sold to retailers.
Adda	A station where the *Pharia* wholesales to retailers in the Badami Bagh Market
Mandi	Wholesale market where produce is auctioned by *aarti*s
FPM	Fresh produce market. This term is used interchangeably with 'mandi'
MC	Market Committee - a body that regulates the functioning of FPMs under the Department of Agriculture, Government of Punjab, Pakistan

1. Introduction and Motivation

In previous work[1],we documented the potato supply chain in Punjab, Pakistan. We examined the impact of the pandemic on the price received by farmers and the wholesale agent - the *aarti*. We found that *aarti*s played an important role in the supply chain and were able to manipulate pandemic conditions to retain higher shares of the auction prices.

In this study, we extend the previous analysis to the price wedge between the wholesalers and the final consumer. Specifically, we document the prices of onions, potatoes, and tomatoes in the Lahore Badami Bagh Market[2] at each stage of the urban supply chain as the same lot of commodity exchanges hands between key economic agents.

Figure 1 summarises the urban supply chain. Once produce arrives at the FPM, an *aarti* auctions the whole lot off to a *pharia*/bulk-breaker. The *pharia*[3] makes smaller lots and sells at the wholesale rate to the retailers, who transport the produce to their shops or carts where end-consumers purchase for consumption.

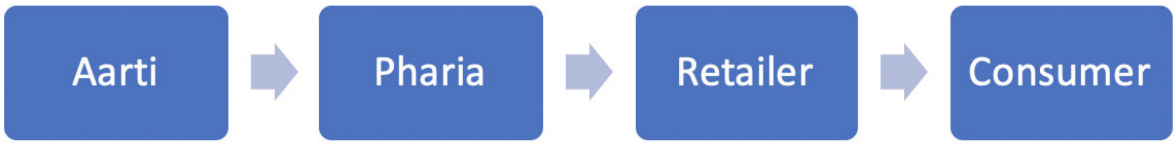

Figure 1: A typical fresh produce urban supply chain

We utilise transaction-level data collected from the Lahore Badami Bagh Market at each stage of this supply chain. We collect data on 751 auctions (between wholesale agents and bulk breakers) and 1,965 unique transactions between bulk breakers and retailers. Finally, we collect the retail price charged by 487 retailers to end customers. Our results show that the market has diverse supply sources and is serving retailers in a large catchment area in and around the city of Lahore. Second, the margins retained by *pharias* and retailers are significant. On average (and not controlling for produce grade or quality), a *pharia* keeps 18.6%, 15%, and 49.5% of margins, respectively, for onions, potatoes, and tomatoes. Meanwhile, the retailer kept 14.9%, 40%, and 30% margins on average for onions, potatoes, and tomatoes, respectively. Moreover, quality influences the margins charged by each entity. For *pharias* there is a negative correlation with quality, signalling that medium-quality products sell for generally lower. However, for retailers there is a positive and significant relationship.

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[1] *IGC PAK-22066 (Impact of COVID-19 on fresh produce supply chains: Evidence from Pakistan)*
[2] *The Lahore Badami Bagh Market is one of the largest fresh produce markets (FPM) of Pakistan by transaction volume. It is also known as the Lahore Fruits and Vegetable Market.*
[3] *Pharias play a central role in that they break the bulk into smaller portions, sort and grade and sell according to quality to the retailers. These agents are also located inside the FPM.*

This report is organised as follows: Section 2 provides a brief background of the setting, and Section 3 explains the data collected. Section 4 presents the results, and Section 5 concludes, highlighting insights for policy.

2. Agents and buyers in the Fresh Produce Market

Fresh produce supply chains in Pakistan involve a chain of agents from the farmer to the final consumer. Fresh produce markets (FPMs) serve as the primary link between producers and consumers of agricultural commodities in the country. FPMs are physical locations where produce from farms located in remote rural areas arrives to be auctioned off to wholesalers. However, what occurs in these markets and how operations are conducted is rarely documented. Anecdotally, middlemen retain a large wedge of the final price of the product; but information on the costs of the middlemen (e.g., due to transport) and their bargaining power with respect to the retailer and farmer are not known. Each market has a Market Committee (MC) that is a regulating arm of the Department of Agriculture, Government of Punjab, Pakistan. The main function of the MC is to regulate prices, monitor agriculture commodities, ensure adequate supply of said commodities, and oversee agriculture markets in their respective jurisdiction. In addition to these main functions, the MC is also responsible for the following:

- Provide infrastructure for the buying and selling of agriculture goods; this can include platforms for conducting auctions and warehouses.
- Inspect and ensure that all parties in the supply chain, such as *aartis* and *pharias,* follow market regulations and fair practices.
- Collect up-to-date data on price trends.
- Register and issue licences to commission agents.

We focus on the Badami Bagh Market, Lahore which was established in 1969; it is one of the largest FPM in the country. Consequently, the mandi is a hub for agriculture-related transactions that involve various commodities including the three staple vegetables we are considering in this report (onion, potato, and tomato). Additionally, by virtue of its nature as a major hub, the mandi is responsible for supplying fresh produce commodities not only to the Lahore area but also to numerous other districts in the country. It is also important to note that the mandi sources fresh produce like fruits and vegetables from different parts of the country as can be seen from figures 5-7 in Appendix 1. During the period of this study (30 May 2022 to 10th March 2023), 343,648 kgs of onions are being transported from the Khyber Pakhtunkhwa province to Lahore, while 541,957 kgs of potatoes are being supplied from Punjab along with 79,835 kgs of tomatoes from Baluchistan. That being said, since the mandi has produce being supplied from almost all parts of the country, the price margins and functioning of the mandi found here are representative of the general situation in Pakistan.

The supply chain starts with the farmer procuring inputs and land (if tenant). Once farmers produce the output, it is sold, either directly or via a middleman, to a commission agent (*aarti)* who auctions it in a wholesale market. The produce is bought in auction by bulk breakers - a wholesaler referred to as the *pharia* - who then sell further to retailers.

Retailers include big supermarkets as well as street vendors from where the consumers buy the produce. We summarise role of each agent in the FPM in the following sections below:

2.1. Auctioneer or the *aarti*:

Fresh produce is auctioned in the Badami Bagh Market seven days a week at specified time of the day.[4] Each auction is conducted by an auctioneer (*aarti)* who is a commission agent registered with the MC authorities for the product. The bidders visit the designated auction sheds and check the produce. One sample bag is cut open for the bidders to check the variety and quality of the produce. Interested bidders then participate in a public open-outcry auction, which is moderated by the *aarti*. The auction time spans for about an hour during which multiple auctions occur simultaneously.[5]

2.2. The bulk-breaker or the *Pharia:*

A *pharia* bids and buys produce sold in the wholesale auction. After securing produce in an auction, the *pharia* arranges to transport their produce to their designated area (*Adda*) in the market rented from the market committee office.[6] Each day, early in the morning (4am), *pharias* open up their lot and divide produce in grades according to quality. Each grade is spread open on carts or on the floor for sale to retailers. A *pharia*'s *Adda* is active till 10 am, after which the market area is cleared for the next scheduled auction.

2.3 The retailer:

Retailers typically start to visit the market around 5am to purchase produce from the *pharias.*[7] They buy the produce and transport them to their shops or vendor carts immediately to start selling to the final consumers. The addresses of retailers that buy from the Badami Bagh market span across Lahore and on its outskirts in Shahdara. Details are provided in section 3.3.2.

2.4 *Aarti* and *Pharia* Network:

*Aarti*s and *pharias* have interconnected relations. One *aarti* deals with multiple different *pharias* each day. On average, an *aarti* deals 23.5 different *pharias* in the sampled 1,965 *aarti-pharia* transactions over the span of 10 months. Meanwhile, one *pharia* transacts with 2.2 *aarti*s in the sampled dataset. Moreover, one *aarti* transacts with the same *pharia* 1.1 times in the collected sample.

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[4] Auction times are fixed and specified. In Badami Bagh, onions are auctioned every day at 11:00 am, potatoes at 2:00 pm, and tomatoes between 3:45 pm to 5:00 pm (during the study time period. Specific timings depend on the time of the year).

[5] A market committee official (sub-inspector) also visits the auction area and records auction data in an auction register. These records are used to produce the market rate list of each vegetable of the day, which is circulated through the Market Committee Office Lahore.

[6] Rates vary from 500 to 1000 PKR per day, depending on the area. Labourers transport the bags from the auction lot to the market area at a rate of PKR 30, 50, and 100 for 20, 60, and 120 kg bags, respectively.

[7] Some retailers place orders with pharia(s) over the phone.

3. Data Sources and Description

In this subsection we describe the primary data used in the analysis. We combine the three sources: auction data, *pharia* price data, and retailer data, primarily to document price margins between the wholesale market and the final consumer. The data also provides a sense of major sources of produce sold at Badami Bagh Market, as well as its catchment areas - localities in and near Lahore that purchase produce from the market.

3.1 Data sources

3.1.1 Auction Data

We collaborated with the Badami Bagh Market Committee Office to collect information on active *aartis* for potatoes, onions and tomatoes. The Market Committee Office maintains a hard-copy record of auctions of all vegetables every day. We were granted access to auctions recorded in January and February of 2022. This record covered a total of 2,509 auctions for potatoes, onions, and tomatoes (736 for onions, 885 for potatoes, and 828 for tomatoes). Additionally, this also allowed us to note down details for the *aarti* that deals in each commodity, along with their market shop numbers and contact details, the daily quantities auctioned off, auction value, and arrival source of each produce. In total, we were able to record details of a total 82 registered *aarti*s (22 for onions, 33 potatoes, 27 tomatoes). A universe of *aartis* was created for each product using this data, out of which 10 *aarti*s were randomly sampled on each day for each product. Out of this random sample list, the top two out of ten *aartis* were selected based on their availability for recording the auction in the mandi by the field team. Thus, two auctions for each vegetable (potato, onion, tomato) were recorded on Mondays, Wednesdays, and Fridays (6 auctions every day), out of which three auctions were traced for each vegetable further in the supply chain. We observe a total of 751 auctions between 30th May 2022 and 10th March 2023.[8]

Our field team observed the daily auction of two of the sampled *aartis* and interviewed the highest bidder, i.e., the *pharia* who made the highest (successful) bid in each auction. From the *pharia,* we collected data on the final auction price, quantity, and source (region) of the produce. We also collected precise information on where the *pharia* will be located in Badami Bagh Market the next morning for parsing the produce according to quality.[9] The last piece of information was relevant to record the next step of the supply chain.

3.1.2 *Pharia* sale data

The next step of the supply chain is brokered by the *pharia* when he sells the produce purchased at the auction within the Badami Bagh Mandi. Before selling further to retailers, the *pharia* divides the produce bought from the previous day's auction into different parts (usually three) according to quality. Quality is determined based on

[8] *Supply chain bottlenecks led to auctions being disrupted on some days.*

[9] *Quality is assigned by the pharia on the basis of the quality assigned by the aarti (at the auction), ranging from Grade 1 to 3 based on physical characteristics.*

physical characteristics of the produce which include weight, size, the degree of rotting, colour etc. The best of the lot is categorised as Grade 1 which is a medium sized vegetable with no rotting. Meanwhile, the worst (the most rotten and/or the smallest in size) is allotted Grade 3.

The Market Committee provided information on the general locations of *pharias,* and we collected more precise locations when interviewing *pharias* after daily auctions. We randomly selected three out of the six *pharias* interviewed the previous day (one for each produce) to observe how they parsed their produce and sold to retailers, record the quality assigned to the produce and the price paid by all the retailers who purchased from the *pharia*, and the retail locations.[10] This process took place early in the morning, between 4 - 5 am until 10 am before the first auctions of the day. In total, we collect follow-up data on half of the *pharias* identified from the auctions on the previous days. Overall, we have follow-up data on 1,965 *pharia*-retailer transactions out of which we were able to confirm 487 retailer-consumer transactions for which there are 108 unique *pharias*.

3.1.3 Retailer Data

Retailers purchasing from *pharias* were asked to give their contact information (address and phone number). They were informed that the field team will contact them within the week to elicit additional information. Data from the retailer was collected in two ways: Phone interviews and mystery shopping. We conducted a total of 487 phone interviews to collect information on the price at which the product was sold to the final consumer, descriptive information on the nature of their shop (permanent, cart) and main costs incurred.

We conducted 130 mystery shopping visits. These were conducted as a check on the self-reported data being collected on the phone.[11] Overall, we find a high correlation - 0.75 - between the self-reported prices reported on the phone and collected via mystery shopping visits - mystery shopping prices are within 1 standard deviation of the prices reported on the phone. Generally, the reported prices in phone calls tend to be lower (by approx. PKR 10 per kg) than the prices offered to mystery shoppers.

[10] *Pharias* were provided with a PKR 1000 incentive for their participation in the survey.
[11] The team that conducted the mystery shopping was different from the team that collected the data in the wholesale market. The retailers therefore did not know that the shopper was affiliated with the researchers. Further note that retailers were responsive to the anonymous calls made by the mystery shopping teams when trying to locate them.

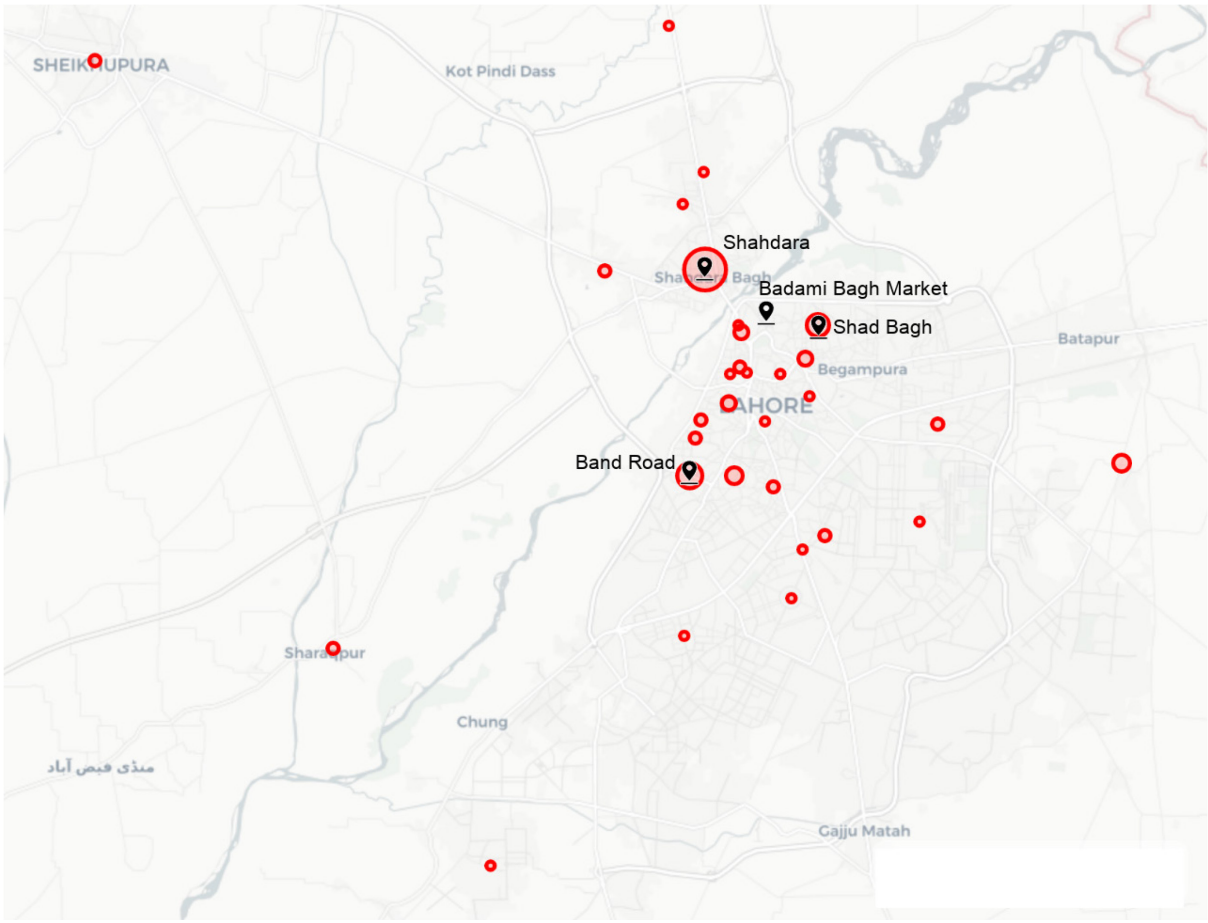
3.2. Description of the data

In this section, we briefly described data collected on auction produce source, prices, retailer location and final retail prices.

3.2.1 Badami Bagh Market supply sources and consumer location

Badami Bagh Market is one of the largest fresh produce markets in the country, with produce coming in from different regions. The provinces of KP and Baluchistan are the two main supply sources of onions, while for potatoes and tomatoes, this is Punjab and Baluchistan. Figures 5-7 in the appendix plot total volume by supply source for the three vegetables.

To understand the areas that the Badami Bagh Market supplies, we track data from sales made by *pharias* to retailers in the study period. Figure 2 highlights the volume of *pharia* sales made to each area i.e., the quantity in total kilograms of potatoes, onions and tomatoes going from Badami Bagh Market to retailers in each area in our sample. The market primarily supplies areas in Lahore, though retailers from neighbouring districts, such as Sheikhupura, also regularly purchase from Badami Bagh as well. The largest volume of fresh produce over the course of our period of data collection is going to Shahdara in Lahore - seen from the largest circle on the upper part of the map: approximately 87,772 kgs or 16% of the total produce sold during the sample period being transported from Badami Bagh to this particular area. The next largest area being catered to by produce from the market is Band Road, for a total of 43,177 kilograms or 8% of produce, and Shad Bagh received 41,066 kgs or 7.4% of the produce. Together, these three areas represent the 3 largest recipients of Badami Bagh's sales and are within 3-8 km of the market. A considerable amount of the total population of Lahore resides in these areas, which means that any measures undertaken by authorities to lower prices and reduce wedges from auction to consumer in Badami Bagh Market's catchment areas could prove to be beneficial for a significant number of people.



***Note**: Each circle represents the location of the area where retailers in our sample were located as well as the location of the FPM. The size of the circle is representative of the amount of produce supplied from the Badami Bagh Market to that particular area. The areas that had the highest levels of produce procured by retailers were Shahdara, Shad Bagh, and Band Road, respectively.*

Figure 2: Volume of *pharia* Sales by Retailer Location

3.2.2 Price margins retained by the *pharia* and retailer:

In total, we collect data on 751 auctions, transaction data on 108 *pharias*, 1,965 *pharia*-retailer transactions, and 487 retailer-consumer prices. In Table 1, we report the average margins by the *pharias* and retailers, and sales. Equations 1, 2, and 3 define *pharia*, retailer, and total margins, respectively.

$$Pharia\ Margin\ = \frac{Pharia\ Price - Auction\ Price}{Auction\ Price} \qquad (1)$$

$$Retailer\ Margin\ = \frac{Consumer\ Price - Pharia\ Price}{Pharia\ Price} \qquad (2)$$

$$Total\ Margin\ = \frac{Consumer\ Price - Auction\ Price}{Auction\ Price} \qquad (3)$$

Average values show that the *pharia* retains a relatively low margin on potato, and a large margin on tomatoes. Conversely, retailer margin on potato is high, followed by tomatoes and then onions. Differences in margins could be attributable to varying harvest dates, quality of produce, difficulty in transport (and hence different transport costs for the

retailer), and elasticity of final consumer demand for each vegetable as well as the perishable nature of each type of produce. Overall margins for the relatively expensive produce - onions - are low, compared to the margins charged for the relatively lower cost vegetables - potatoes and tomatoes. Majority of potatoes and tomatoes in the sample that are sold to retailers are of a good quality.[12]

	Onions	**Potatoes**	**Tomatoes**	**Total**
No. of Auctioneer-*Pharia* Trades (Auctions)	317	254	180	751
No. of Auctioneers (*Aartis*)	22	31	26	72
No. of *Pharias*	228	167	126	494
No. of *Pharia*-Retailer Transactions	782	730	453	1965
No. of Retailers	214	171	102	487
No. of Retailer-Consumer visits (Mystery Shopper visits)	60	36	34	130
Auction-Price (mean and SD)	93.45 (2.81)	34.84 (0.79)	62.97 (3.20)	-
***Pharia*-Price (mean and SD)**	150 (1.93)	40.55 (0.60)	90.1 (2.83)	-
Retail-Price (mean and SD)	205.6 (1.29)	50.2 (0.78)	85.2 (2.53)	-
Average *Pharia* Margin	18.6%	15.0%	49.5%	-
Average Retailer Margin	14.9%	40%	30%	-

Note: *All 487 retailers who were recorded were also contacted telephonically by our team to collect further data regarding transactions and consumer prices. In Rows 7 and 8, we report the average price charged by the aarti (calculated from 751 auction records) and pharia (calculated from 1965 aarti-pharia transactions). In Row 9, the average price charged by 487 retailers for each vegetable is reported. The standard deviation for each price and margin is reported in the brackets. We report the average sales margin retained by the pharia and retailer in Rows 10 and 11.*

Table 1: Descriptive statistics of all recorded transactions

3.3 Types of *Pharias* and retailers

3.3.1 *Pharias*

As stated previously, there were 108 unique *pharias* we were able to track for further analysis. Each *pharia* is responsible for breaking up the auctioned lot into smaller chunks according to the perceived quality of each vegetable. This is an important task in the supply chain since retailer margins i.e. gap between the price at which the retailer buys

[12] *This may potentially explain the greater wedge seen in the data between retailers and consumers in potatoes and tomatoes as well as possible wastage due to their perishable nature.*

the produce and the selling price is dependent on this. As such in our collected data, 50.4% of onions are of a high-quality meaning that they have positive visible characteristics that can be used to charge a relatively higher price as opposed to 49.1% medium quality onions. Similarly, 43.9% of potatoes are of the highest quality while 50.2% are of medium quality.

Furthermore, in our sample we also see that *pharias* have the option of passing on produce to retailers either via a cash payment or on credit terms. It is reported that in our sample of 487 retailers, 79.6% deal in cash while 20.4% procure produce on credit.

3.3.2 Types of Retailers

The majority (82.6%) of retailers we conduct phone interviews or mystery shopping visits with have a permanent physical shop. A retailer selling their produce in the shop is essentially someone who is selling and transacting within the four boundaries of a proper shop. Approximately 30% of these retailers own the shop, while the remaining pay rent. Other than rent, 55% of these retailers report having to pay utility bills and 94% report fees to the Badami Bagh Market authorities to enter the market. Retailers report an additional transport cost of taking the produce to their shop, ranging on average from PKR 500 (tomato retailers) to PKR 900 (onion retailers).

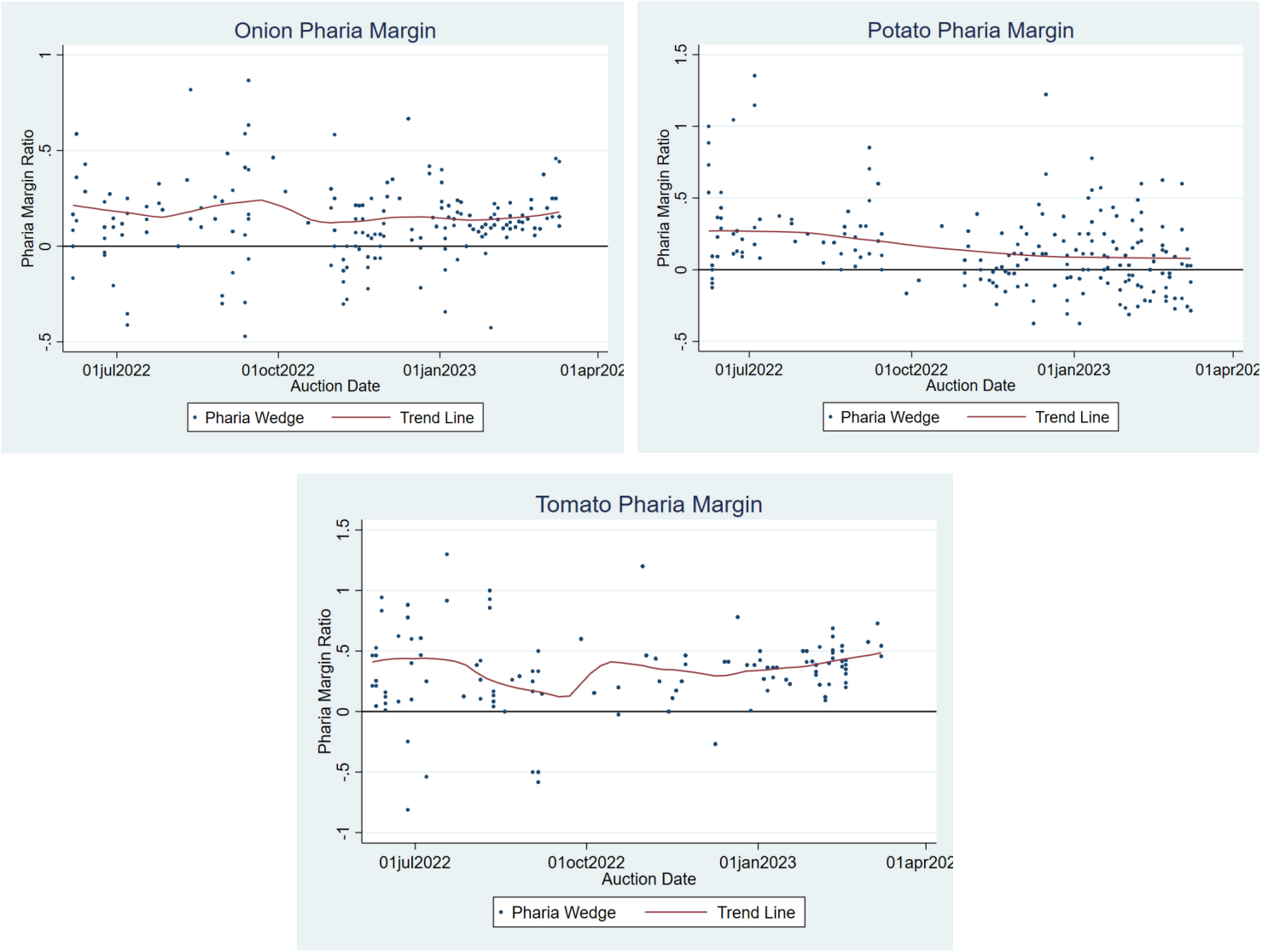
A retailer that sells via a cart may not have a permanent address, but may be more likely to be found in particular areas that are near their places of residence. They most often report entrance fees to the market authorities (90%), followed by utility bills - electricity and phone bills - (21%) to be their main costs in the procurement and sale of the produce.

4. Analysis of Price Margins

The average wedges reported in Section 3.2 conceal considerable temporal variation over lean and harvest seasons. We plot the *pharia* and retailer margins charged by each agent in Figures 3 and 4 below. We use the data from 751 *aarti-pharia* and 1965 *pharia*-retailer observed transactions, and 487 retailer-consumer prices.

Figure 3 below shows the margins that a *pharia* retains for each respective vegetable. This generally indicates that for each vegetable, although the *pharia* on instances sells lower than the auction price, their average margin is still positive overall, with tomatoes exhibiting the highest (almost 50%) overall. While, on average, margins show an upwards trend, for potatoes they are decreasing slightly over the course of the study[13].

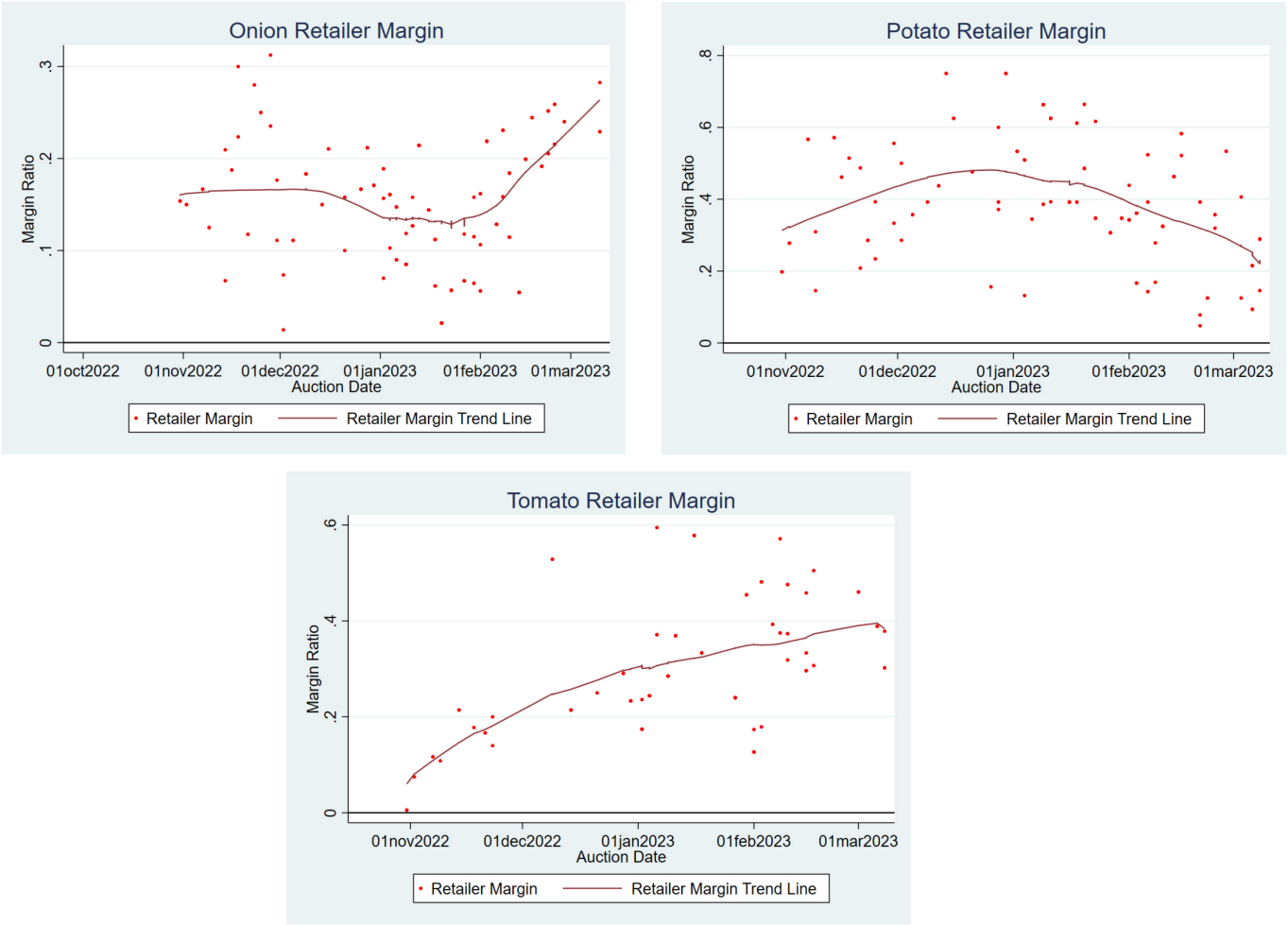
[13] *This may be attributed towards seasonality effects of general potato prices and harvest period which is typically between December-March.*



Note: The y-axis shows the pharia margin ratio i.e. $\frac{pharia\ price - auction\ price}{auction\ price}$*. The x-axis shows the dates for which auctions were recorded. Each dot represents one pharia's margin on each auction date. The lines represent the average pharia margin throughout the period of study (May 2022 – March 2023).*

Figure 3: *Pharia* Margins for Onion, Potato, and Tomato

Figure 4 below shows the margins that retailers of each vegetable keep. As compared to *pharias*, retailers generally keep a higher margin. On average, for onions, the *pharias* retain a margin of 18.6% on top of the auction prices received by the *aarti*, while retailers keep a margin of 14.9% on average over what they pay the *pharia*. For potatoes, the retail margin is high - at almost 40% as opposed to 15.0% margin of the *pharias*. Conversely, for tomatoes, we can see that *pharias* are responsible for keeping a significant margin of 49.5% versus a 30% retailer margin.



Note: The y-axis shows the retailer margin ratio i.e. $\frac{consumer\ price - retailer\ price}{retailer\ price}$. *On the x-axis are the dates of each auction. Each dot represents one pharia's margin on each auction date. The lines represent the average pharia margin throughout the period.*

Figure 4: Retailer Margins for Onion, Potato, and Tomato

However, a higher margin does not indicate higher profits. *Pharias* and retailers incur transportation and loading costs for each day, and other general costs (e.g., rent for shops, utility bills that retailers pay, or wastage of some produce reported by *pharias*, etc). Product wastage, transport, and other costs could potentially lead to variations in margins across different products. Some variation in margins may be due to product quality or the type of vegetable. We control for this in our analysis next.

To understand the margins correlates with quality and type of produce, we run a regression of the margins retained by each agent - *pharias* and retailers - from the time of auction until it reaches the consumers. We test for how margins may be impacted by the quality of the produce - the crop quality as determined by the *pharia* (in *aarti-pharia* transactions); and the type of produce being traded as shown in equation 4 below.

$$Margin_i = \beta_1 MediumQuality_i + \beta_2 LowQuality_i + \beta_3 Onion_i + \beta_4 Potato_i + \beta_5 Tomato_i + \mu_i \quad (4)$$

$Margin_i$ is the *pharia*, retailer, and total margins as calculated in equations 1, 2, and 3 above. $Medium\ Quality_i$ represents vegetables classified as belonging to Grade 2 by the pharia, while $Low\ Quality_i$ represents the worst grade. $Onion_i$ $Potato_i$ $Tomato_i$ represent the type of vegetable i.e. onion, potato, and tomato. μ_i is the error term.

As seen in table 2, quality influences margins for both entities, albeit slightly more for *pharias*. A medium-quality product generally increases the retail margin, while it negatively correlates with the *pharia* margin. Specifically, in the case of *pharia* margins, a medium-quality vegetable decreases the margin by 5.9%. Meanwhile, a low-quality vegetable decreases the *pharia* margin by 27.2%. Moreover, in line with expectations, *pharias* who purchase tomatoes, charge prices that are 42.1% higher, while for onions and potatoes the margin is only 20.3%. Possible reasons that attribute to these differences could be due to product wastage, transport, and other costs.

Meanwhile, the crop quality assigned by the *pharia* does not significantly correlate with the retailer margin if the produce is of low quality, but for a medium quality produce the retailer margin shows a positive relationship. Column 2 highlights that a medium quality produce will potentially increase the retail margin by 2.4%[14]. However, unlike *pharia* margins, retail margins tend to be higher for potatoes as opposed to tomatoes (a more perishable good)[15]. Onions have the lowest margins adding at 13.8%, meanwhile potatoes and tomatoes add as much as 39.3% and 28.1%, respectively.

Conversely, the crop quality does not correlate with the total margin significantly. We see similar results in Column 3 of Table 2, which highlights that, on average, the largest gap between consumer and auction price is for tomatoes of approximately 82.7%. Onions and potatoes display overall margins of 30.6% and 53.1%, respectively.

[14] This could possibly be attributed to consumers preferring a medium sized vegetable that is easy to store and transport with minimum levels of rot.

[15] An underlying reason for this could be differences in cost borne by retailers, but further research is needed to ascertain this.

VARIABLES	(1) *Pharia* Margin	(2) Retailer Margin	(3) Total Margin
Crop Quality (Medium)	-0.0588***	0.0240*	-0.0163
	(0.0118)	(0.0126)	(0.0229)
Crop Quality (Low)	-0.272***	0.0131	0.00232
	(0.0219)	(0.0384)	(0.0696)
Onion	0.203***	0.138***	0.306***
	(0.0103)	(0.0104)	(0.0189)
Potato	0.203***	0.393***	0.531***
	(0.0110)	(0.0117)	(0.0212)
Tomato	0.421***	0.281***	0.827***
	(0.0155)	(0.0175)	(0.0317)
Observations	1,965	487	487
R-squared	0.510	0.856	0.849

*Note: The table displays results from OLS regressions. The dependent variables are pharia, retailer and total margins, respectively. Pharia margin is the ratio of the difference between what the pharia pays (auction price) and what he sells at (pharia price). Retailer margin is the ratio of the difference between what the retailer pays (pharia price) and the price retailer sells at (consumer price). Total margin is the ratio of the difference between consumer price and the auction price. Crop quality is the quality assigned to the produce at the auction). The data for pharia margin comes from 1,965 transactions tracked from the auction to the retailers while the data for retailer and total margins come from 487 transactions tracked from auction to the final consumer. Standard errors are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1*

Table 2: *Pharia*, Retailer, and Total Margins as a function of crop quality and vegetable

5. Conclusion

Onions, potatoes, and tomatoes are staple vegetables that are consumed by numerous households across the country. In this study, we document the margins retained by the middlemen before the product is sold to the final consumer. Transaction level data collected from the auction to the final consumer suggests that both the middlemen in wholesale markets (*pharia*) and the retailers add significant wedges in the final prices charged to the consumer. As a result, there is a notable gap between the auction price in the market and the final price being charged from consumers.

We also find that, as expected, the price of produce is dependent on crop quality, which consequently correlates with *pharia* and retailer margins. For medium or low-quality produce, the *pharia* margins tend to decrease since it will be sold at relatively lower prices to retailers. This could possibly be attributed to consumers preferring to purchase vegetables above a certain quality threshold.

These results open more avenues for future research. Results indicate that intermediaries at the wholesale markets (*pharias*) charge a significant margin on top of the wholesale prices, some of which are passed along to the consumer in the form of higher prices. The margins are product specific, potentially due to product type and differing storage, wastage, and transport costs incurred by the intermediaries. These findings imply that reducing the costs of intermediaries (such as wastages, permit fees, loading, and transportation) at wholesale markets could potentially reduce consumer prices. Similarly,

at the retailer's end, initiatives to reduce transport and wastage costs can lead to cost savings, trickling down to lower prices for consumers.

Future research can test if interventions that improve functionalities of wholesale markets, including proper storage facilities to reduce wastage; as well as initiatives to reduce the per kg costs incurred by retailers, can be meaningful means of stabilising consumer prices.

References

Asad, S.A., Gondal, O.H. and Nabi, I. (2022) *Impact of COVID-19 on fresh produce supply chains: Evidence from Pakistan, www.theigc.org*. Available at: https://www.theigc.org/sites/default/files/2022/10/Asad-et-al.-Final-Report-October-2022.pdf (Accessed: March 14, 2023).

Appendix 1

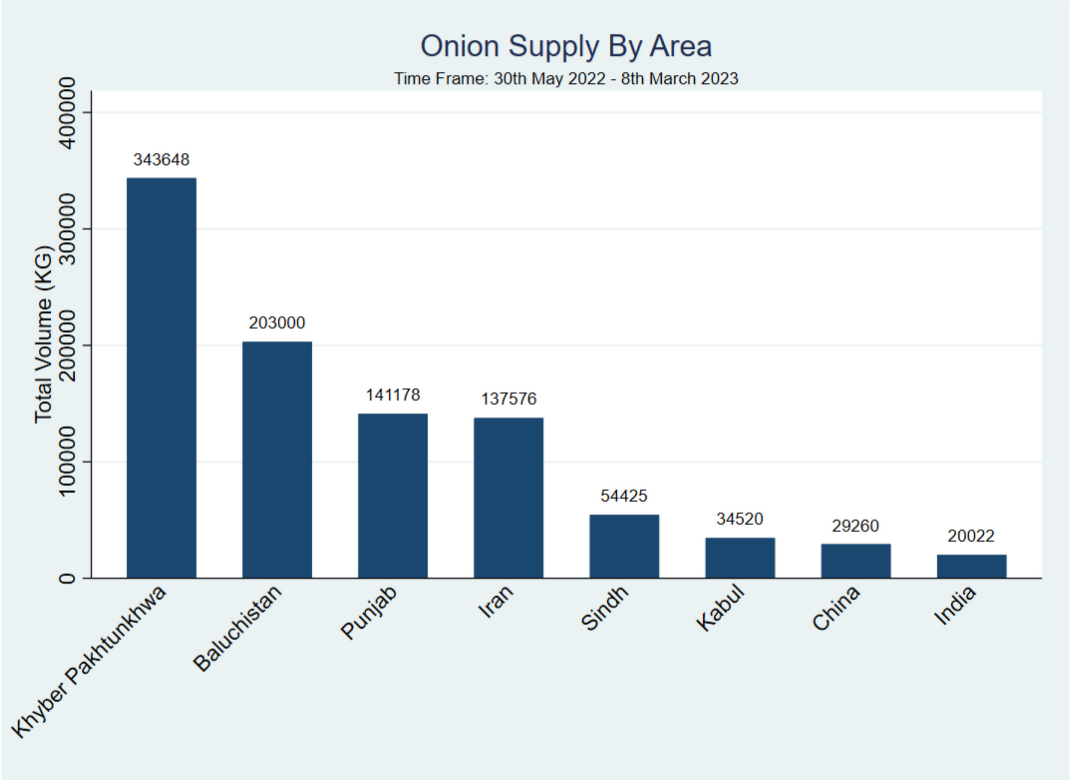


Figure 5: Onion Supply to Badami Bagh Market

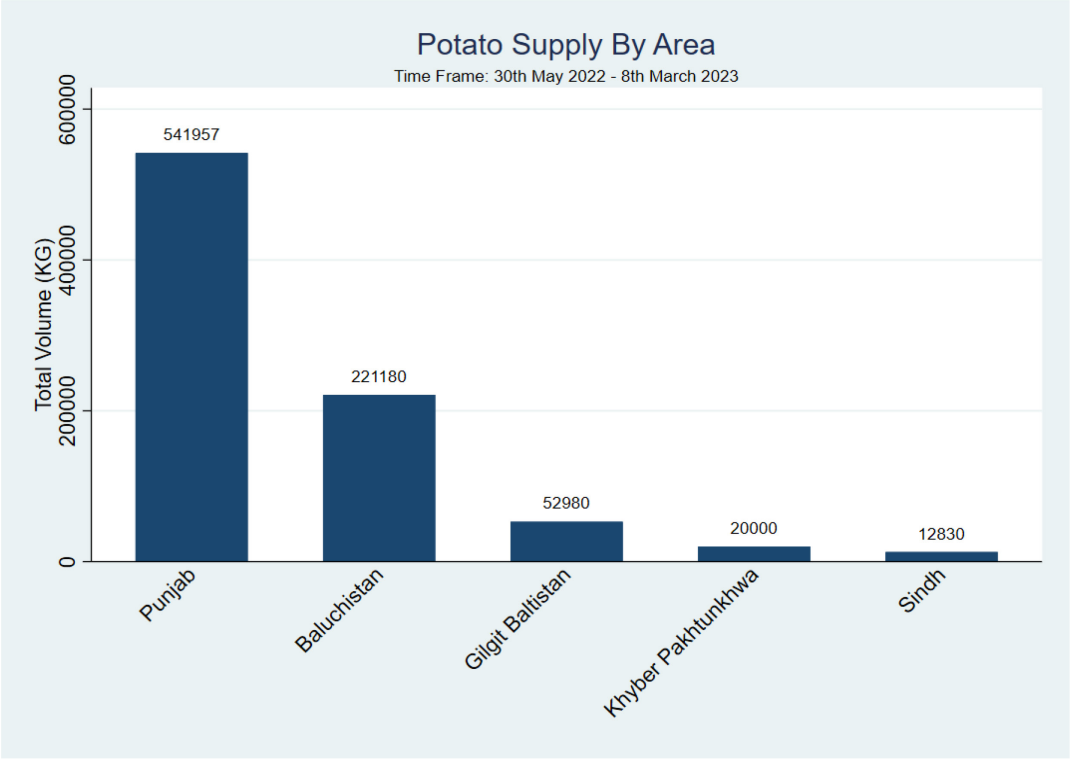


Figure 6: Potato Supply to Badami Bagh Market

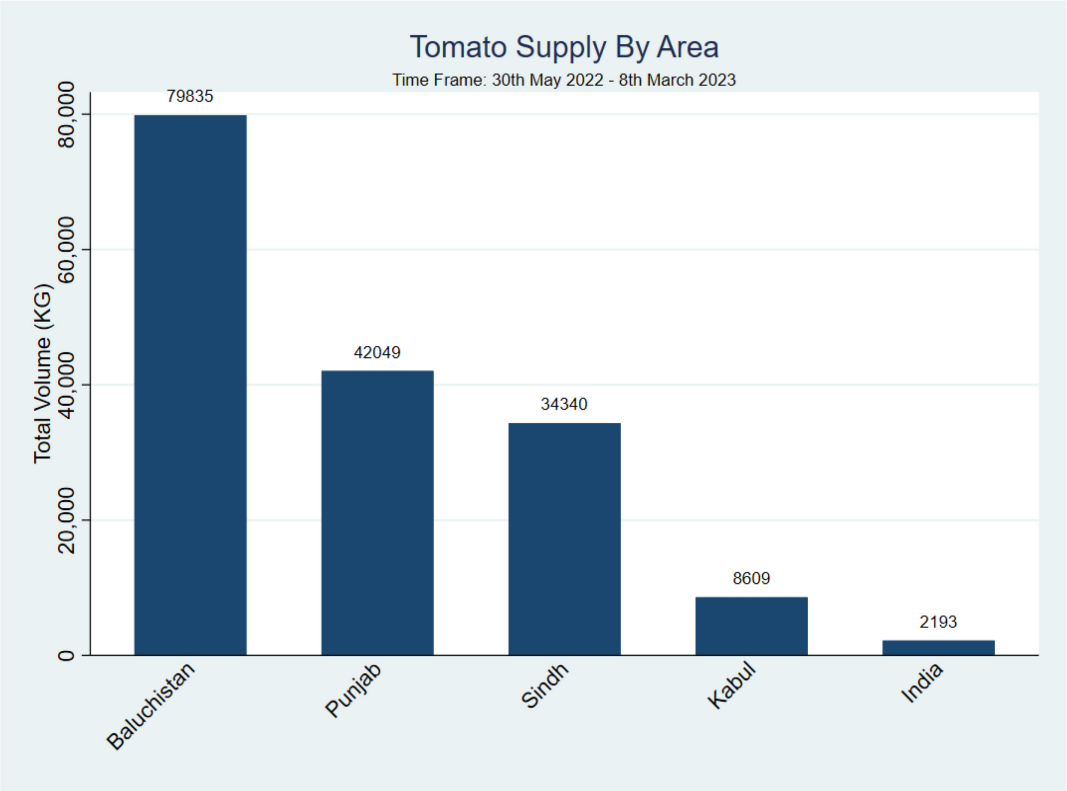


Figure 7: Tomato Supply to Badami Bagh Market

Figure 8: *Aarti* standing on top of his potato produce during an auction

Figure 9: Onion produce ready to be auctioned

Figure 10: Labourer transporting two bags

Figure 11: Onion *pharia* on his *Adda* (station) while parsing his produce into different quality categories. Time: 4am PKT.

Figure 12: Onion *Pharia* with divided categories of produce according to quality.

Figure 13: A sub-inspector recording an onion auction.

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