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## **Behaviour of Market Arrivals and Prices of Selected Vegetable Crops: A Study of Four Metropolitan Markets**

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### **Abstract**

This study has been undertaken with the twin objectives of examining the variability pattern of market arrivals and prices of selected vegetable crops (cabbage, cauliflower, tomato and peas) in metropolitan markets of Delhi, Mumbai, Bangalore and Kolkata and analysing the relationship between market arrivals and prices. The study is based on market arrivals and wholesale prices of different vegetable crops collected from the Azadpur market of Delhi and Agricultural and Processed Food Products Export Development Authority (APEDA), New Delhi, for the period 1990-2001. The study has shown that the extent of variability in the arrivals of cabbage was lower in Bangalore and higher in Mumbai. The prices were relatively stable in Mumbai but were more volatile in Bangalore. There was broadly a similar pattern in the price variability across different months in Kolkata and Delhi markets. For cauliflower, the variability in the market arrivals was more pronounced in Kolkata than the remaining three markets. The price variability was, however, more marked in Delhi. The extent of variability in the market arrivals of tomato across different months was very high in all the four markets. Likewise, while the maximum variability in the prices of peas was noted for Delhi, these were relatively less marked in Bangalore. The results of the study have confirmed the negative relationship between market arrivals and prices in terms of correlation coefficients over the years and across months in all the four metropolitan markets, though there were several instances of positive relationship.

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The authors thank the referee for his constructive suggestions.

## Introduction

In the wake of trade liberalization and globalization, the agriculture sector in India faces an uphill task of meeting global competition, reducing unemployment and enhancing income in the rural areas. This task has to be accomplished in a milieu of stagnant productivity across crops and other agricultural enterprises, declining investments in agriculture, silent neglect of agricultural research and development and above all, increasingly degrading natural resource-base. Diversification of agriculture towards selective high-value crops has been recommended as one of the strategies for meeting these challenge (Joshi *et al.*, 2004).

The decades of 1980s and 90s, witnessed horticulture and livestock-led agricultural diversification in India, though regionally most of it was confined to the southern and western regions. Consequently, marketed surplus-output ratio (expressed as a percentage of gross value of output) in the case of fruits and vegetables went up from 70.0 per cent in 1981-82 to 88.2 per cent in 1999-2000 (Acharya, 2004). Further, the last decade of the century was christened as the Golden Revolution Period in the history of Indian horticulture due to the impressive growth rate of 6.5 per cent per annum and a quantum jump in its share in the agricultural gross domestic product from 18.2 per cent to 29.5 per cent (Singh *et al.*, 2004). Within horticulture, vegetable-growing is considered more important as it generates more income and employment, promotes equity, improves nutrition and protects and conserves the ecology. India has emerged as the second largest producer of vegetables, after China; vegetable production touched the highest level of 93.84 million tonnes in 2000-01. The studies have shown that the demand for vegetables is expected to grow at an average rate of 9.2 per cent per annum, requiring doubling of the vegetable production, from 93.84 million tonnes at present to 185 million tonnes by 2011-12 (Singh *et al.*, 2004). The Government of India has recently launched a plethora of measures to boost production in the horticulture sector. These measures, *inter alia*, include extension of Technology Mission for Integrated Development of Horticulture to the states of Himachal Pradesh, Jammu and Kashmir and Uttaranchal; launching of a National Horticulture Mission to double the horticultural production by 2010, creation of additional cold storage facilities by the National Horticulture Board and allocation of additional budgetary provision for the Hi-Tech Horticulture and Precision Farming (Economic Survey, 2003-04).

The huge geographical area and myriad of agro-climatic niches in the country exert a strong influence on the supply of most of the agricultural commodities. This is particularly true for the vegetable crops because of the shorter growth periods and wide ecological amplitude of these crops

compared to many other crops. The variations in the output of these crops lead to wild fluctuations in their prices, exposing the vegetable growers to more risk as compared to the growers of other crops. In addition, horticultural-based diversification has another set of marketing-related problems. Since most of the vegetable and fruit crops are perishable, and require marketing immediately after harvesting to ensure freshness and quality to the consumers and remunerative prices to the growers. Inadequate market infrastructure and too many intermediaries between the producers and consumers lead to high marketing costs, resulting in lower share of producer in the consumer's rupee. The lack of market intelligence about the potential markets and the pattern of market arrivals and prices in important regional and national markets further add to the woes of the farmers. Therefore, the need for proper marketing intelligence system has been felt and raised from time to time by many scholars (Kalloo and Pandey, 2002; Rai and Pandey, 2004; Singh *et al.*, 2004). The ongoing process of privatization and globalization has further compounded the difficulties of marketing high-value cash crops at reasonable prices. The cheaper imports have also started impacting the market, leading to price crash<sup>1</sup>. The availability of market intelligence on aspects like the potential markets, the quantum of market arrivals and prevailing and expected prices in different regional, national and international markets during different months of the year shall go a long way in mitigating many of these problems. Not only that, it shall help the farmers in adjusting their cropping pattern in a way so that they could sell their produce at a time when the prices are reasonably high in the market.

Against this backdrop, the present study was undertaken to gain insights into the behaviour of market arrivals and wholesale prices of important vegetable crops (cabbage, cauliflower, tomato, and peas) in some selected metropolitan markets of the country<sup>2</sup>. More specifically, the study had two objectives: (i) to examine the pattern of market arrivals and prices of selected vegetable crops in terms of the degree of variability in main metropolitan markets, and (ii) to analyse relationships between market arrivals and prices, both over the years and across months in these markets.

## 2. Data and Methodology

The data on market arrivals and wholesale prices of different vegetable crops were collected from the Azadpur vegetables market of Delhi and Agricultural and Processed Food Products Export Development Authority (APEDA), New Delhi. The data pertained to the period 1990-2001<sup>3</sup> and included monthly information also. The pattern of market arrivals and price behaviour of the selected vegetable crops over the period 1990-2001 was analysed in terms of mean value for each month and the coefficient of

variation. The Karl Pearson correlation coefficient was computed to find the degree of relationship between market arrivals and prices. The prices of the different commodities were predicted for different months using appropriate statistical models.

### **3. Results and Discussion**

#### **3.1. Pattern of Market Arrivals and the Price Behaviour**

The area and production of vegetables have made rapid strides in the country during recent years; the area has increased from 5593 thousand hectares in 1990-91 to 6200 thousand hectares in 2001-02, and the production surged from 58532 to 88620 thousand tonnes. Among different vegetable crops, the area sharing of the selected crops (cabbage, cauliflower, tomato and peas) increased from 15.14 per cent in 1991-92 to 20.91 per cent in 2001-02, while their share in the total production rose from 19.32 per cent to 22.65 per cent. Further, all the three crops, except peas, recorded an increase in yield during the period (Table 1). Across states, West Bengal, Bihar, Orissa, Uttar Pradesh, Maharashtra, Assam and Karnataka are the major vegetable producing states (Table 2). The increase in area and production of vegetable crops cannot be sustained unless remunerative prices are ensured to the farmers. And it is in this context that an understanding of the pattern of market arrivals and price behaviour of vegetable crops both over the years and across months assumes significant importance.

The pattern of market arrivals and price behaviour of the selected vegetable crops over the period 1990-2001 was examined using the mean value and the coefficient of variation for each of the twelve months.

##### **3.1.1. Market Arrivals and Price Variability in Cabbage**

The crop-wise analysis across different markets showed that in the Delhi market (Table 3), the variability in market arrivals of cabbage was maximum (77 to 98%) during the months of June to October and quite low (24%) during December and January. The average volume of cabbage received in Delhi market was lowest (1855.64 tonnes) in the off-season month of July and maximum (3676.2 tonnes) during the peak season month of December. In comparison, in the Mumbai market, the variability in the arrivals of cabbage in terms of coefficient of variation was more pronounced; it ranged from 43.59 per cent in February to 120.86 per cent in August. It was particularly high during the July-November period. The average market arrivals ranged from 2035.56 tonnes in May to 6150.6 tonnes in December. The extent of variability in the arrivals of cabbage was, however, lower in

**Table 1. Changes in area, production and yield of selected vegetables in India: 1990-2001**

Crop	Area ('000 ha)		Production ('000 tonnes)		Yield (tonnes/ha)		Yield growth, %
	1991-92	2001-02	1991-92	2001-02	1991-92	2001-02	1991-92 to 2001-02
Cabbage	177.3	258.1	2771.2	5678.2	15.63	22.00	3.16
Cauliflower	202.8	269.9	2998.1	4890.5	14.78	18.12	1.87
Tomato	289.1	458.1	4243.4	7462.3	14.68	16.29	0.95
Peas	177.7	303.3	1296.0	2038.2	7.29	6.72	-0.74
Sub-Total	846.9 (15.14)	1289.4 (20.91)	11308.7 (19.32)	20069.2 (22.65)	13.35	15.56	1.40
All vegetables	5593.0	6165.0	58532.0	88622.0	10.47	14.38	2.93

*Note:* Figures within the parentheses are percentages of total area and production of all vegetables.

*Source:* National Horticulture Board, 2003 as quoted in Singh *et al.* (2004)

**Table 2. State-wise area, production and productivity of selected vegetables in India, :1991-92 to2001-02**

Crops	Major states	Area ('000 ha)			Production ('000 tonnes)			Productivity (tonnes/ha)		
		1991-92	2001-02	Change, %	1991-92	2001-02	Change, %	1991-92	2001-02	Change, %
Cabbage	West Bengal	26.0	65.9	153.46	260.0	1843.7	609.12	10.0	28.0	180.00
	Orissa	49.0	44.9	-8.37	685.0	1238.9	80.86	14.0	27.6	97.14
	Bihar	36.9	35.1	-4.88	368.8	561.4	52.22	10.0	16.0	60.00
	Assam	25.4	24.1	-5.12	432.0	474.0	9.72	17.0	19.7	15.88
	Maharashtra	8.2	13.4	63.41	204.9	334.7	63.35	25.0	25.0	0.00
	UP	21.4	7.0	-67.29	383.0	209.4	-45.33	17.90	25.0	39.66
	Gujarat	5.0	11.8	136.00	100.0	189.7	89.70	20.0	16.1	-19.50
	Jharkhand	#	6.5	#	#	130.7	#	#	20.0	#
	Haryana	2.8	7.3	160.71	42.5	107.2	152.24	15.2	14.7	-3.29
	<b>Total</b>		<b>177.3</b>	<b>258.1</b>	<b>45.57</b>	<b>2771.2</b>	<b>5678.2</b>	<b>104.90</b>	<b>15.6</b>	<b>22.1</b>
Cauliflower	West Bengal	26.0	58.0	123.08	260.0	1688.0	549.23	10.0	29.1	191.00
	Bihar	66.7	59.2	-11.24	677.1	947.3	39.91	10.2	16.0	56.86
	Orissa	49.0	51.5	5.10	685.0	635.7	-7.20	14.0	12.4	-11.43
	Maharashtra	6.4	11.8	84.38	127.5	294.5	130.98	19.9	25.0	25.63
	Assam	20.5	16.3	-20.49	394.6	239.7	-39.25	19.2	14.7	-23.44
	Jharkhand	#	10.0	#	#	199.1	#	#	20.0	#
	Haryana	2.8	12.4	342.86	42.5	189.9	346.82	15.2	15.3	0.66
	Gujarat	4.0	9.7	142.50	100.0	156.8	56.80	25.0	16.2	-35.20
	MP	6.5	6.0	-7.69	96.0	95.4	-0.62	14.8	16.0	8.11
	<b>Total</b>		<b>202.9</b>	<b>269.9</b>	<b>33.02</b>	<b>2998.1</b>	<b>4890.5</b>	<b>63.12</b>	<b>14.8</b>	<b>18.1</b>

*Contd*

**Table 2. State-wise area, production and productivity of selected vegetables in India, 1991-92 to 2001-02 — Contd**

Crops	Major states	Area ('000 ha)			Production ('000 tonnes)			Productivity (tonnes/ha)		
		1991-92	2001-02	Change, %	1991-92	2001-02	Change, %	1991-92	2001-02	Change, %
Tomato	Maharashtra	26.0	35.6	36.92	649.7	1183.2	82.11	25.0	33.2	32.80
	Karnataka	33.5	40.2	20.00	645.7	1143.6	77.11	19.3	28.4	47.15
	Bihar	52.4	47.0	-10.31	524.4	751.9	43.38	10.0	16.0	60.00
	AP	41.4	74.4	79.71	414.2	744.1	79.65	10.0	10.0	0.00
	Orissa	42.0	56.0	33.33	450.0	669.8	48.84	10.7	12.0	12.15
	West Bengal	15.0	43.7	191.33	150.0	588.1	292.07	10.0	13.5	35.00
	Assam	13.5	13.7	1.48	312.4	318.2	1.86	23.1	23.3	0.87
	Chhatisgarh	#	18.3	#	#	292.5	#	#	16.0	#
	Gujarat	5.0	20.9	318.00	75.1	270.9		15.0	12.9	-14.00
	<b>Total</b>		<b>289.1</b>	<b>458.1</b>	58.46	<b>4243.4</b>	<b>7462.3</b>	<b>260.72</b>	<b>14.7</b>	<b>17.4</b>
Peas <sup>@</sup>	Assam	NA	27.2	NA	NA	163.0	75.86	NA	6.0	NA
	Haryana	NA	8.3	NA	NA	68.5	NA	NA	8.3	NA
	HP	NA	10.3	NA	NA	85.0	NA	NA	8.3	NA
	Orissa	NA	6.8	NA	NA	57.7	NA	NA	8.5	NA
	Punjab	NA	14.4	NA	NA	86.5	NA	NA	6.0	NA
	Rajasthan	NA	14.8	NA	NA	32.5	NA	NA	2.2	NA
	UP (Hills)	NA	12.5	NA	NA	67.7	NA	NA	5.4	NA
	UP (plains)	NA	150.4	NA	NA	1884.7	NA	NA	12.5	NA
	<b>Total</b>		NA	<b>282.5</b>	NA	NA	<b>2706.4</b>	NA	NA	<b>9.6</b>

Notes: # : included in others not given here; @: pertains to 1998-99; NA: not available

Source: Singh *et al.* (2004) and Indian Horticulture Database 2000, National Horticulture Board, New Delhi.

**Table 3. Variability in the market arrivals of cabbage in the selected metropolitan markets of India, 1990-2001**

(tonnes)

Months	Delhi		Mumbai		Bangalore		Kolkata	
	Mean	C.V. (%)	Mean	C.V. (%)	Mean	C.V. (%)	Mean	C.V. (%)
January	3140.82	24.96	4375.8	53.96	2004.7	20.89	6941.36	38.99
February	2361.27	32.34	3770.5	43.59	1926.3	25.24	5455.36	48.71
March	2198.46	34.28	3496.3	50.06	1924.7	20.35	3358.91	47.34
April	2348.73	28.54	2184.1	55.58	1699.5	32.61	1030.3	41.34
May	2797.64	48.44	2035.56	59.64	1720	32.70	703.7	50.43
June	2739.55	85.75	2827.5	65.41	1629.9	35.37	948	29.45
July	1855.64	76.96	3570.88	101.77	1806.9	25.98	2365.27	30.87
August	2546	88.71	3209.38	120.86	1749.2	17.80	2810	27.24
September	2974.27	97.92	4068.44	106.08	1799.3	19.93	3129.46	37.26
October	2154.27	77.81	4046.89	97.13	1717	26.71	2950.46	46.91
November	2472.7	44.14	4146	96.44	1697.5	15.43	3538.18	48.16
December	3676.2	23.62	6150.6	69.92	1927.9	25.20	5226.55	46.46

the Bangalore market, as was evident from a relatively small range of coefficients of variation (15.43 per cent in November to 35.37 per cent in June). The mean cabbage arrivals varied from 1629.9 tonnes in June to 2004.7 tonnes in January. Insofar as Kolkata market was concerned, the variability in arrivals was more pronounced during the months of February to May and October to December. The mean monthly arrivals ranged from 703.7 tonnes in May to 6941.36 tonnes in January.

The extent of monthly price variability in different markets for cabbage has been brought out in Table 4. The price variability, measured in terms of coefficient of variation, in the Delhi market was more pronounced from November (60.28%) to March (45.97%) which happened to be the main season in most of the north Indian states, and was lower during the lean season of August- September (22 to 25%). The pattern was not uniform in the Mumbai market, where price variability was noted high for November and December (67 to 71%) and June and July (42-44%). Nevertheless, the price for cabbage was relatively more stable in the Mumbai than Delhi market. Further, the cabbage prices remained quite volatile, with coefficient of variation ranging from 41.46 per cent in August to 80.08 per cent in October, in the Bangalore market, whereas the variability was high (42.49 to 60.74%) from October to March in the Kolkata market. An almost similar pattern of price behaviour was observed in Kolkata and Delhi markets.

**Table 4. Variability in the wholesale price of cabbage in the selected metropolitan markets of India, 1990-2001**

(Rs/q)

Months	Delhi		Mumbai		Bangalore		Kolkata	
	Mean	C.V. (%)	Mean	C.V. (%)	Mean	C.V. (%)	Mean	C.V. (%)
January	202.00	48.71	249.7	32.82	172.4	45.82	173.64	44.25
February	164.82	54.21	215.4	36.01	128	48.33	168.82	44.72
March	162	45.97	203	37.28	139.6	62.82	203.09	42.49
April	168.64	31.18	276	33.25	150.9	62.05	295.3	31.8
May	213.27	33.17	299.44	29.33	222	65.84	418.9	25.33
June	281.27	29.76	385.88	42.17	305.5	62.74	463.36	29.74
July	556.73	38.7	429	44.43	307.7	54.1	492.82	35.45
August	596.36	22.44	423.5	30.85	248.3	41.46	480.55	34.68
September	612.91	25.24	362.33	29.57	204.8	57.21	478.82	32.94
October	643	37.28	376.89	37.83	198.3	80.08	592	43.46
November	478	60.28	421.44	67.54	248.1	57.71	555.18	47.67
December	271.45	54.55	324	71.27	239.5	50.43	368.73	60.74

**3.1.2. Market Arrivals and Price Variability in Cauliflower**

The variability in the average arrivals of cauliflower in Delhi was maximum (91-101%) during the months of May to August which are off-season months in this part of the country (Table 5). Its value was quite low

**Table 5. Variability in the market arrivals of cauliflower in the selected metropolitan markets of India: 1990-2001**

(tonnes)

Months	Delhi		Mumbai		Bangalore		Kolkata	
	Mean	C.V. (%)	Mean	C.V. (%)	Mean	C.V. (%)	Mean	C.V. (%)
January	3948.73	24.28	3201.5	28.16	872.4	49.64	4962.09	37.54
February	3572.36	23.05	3275.7	40.10	958	46.26	3849	48.72
March	3798.55	23.63	2845.1	43.59	901.9	46.18	2603	52.10
April	2962.1	39.73	1629	56.79	835	47.84	961.5	61.55
May	2408.29	100.61	1054.29	35.99	856.13	37.27	2755	111.14
June	2403	101.88	1358.71	36.81	932.25	33.08	1188	53.81
July	1583.38	94.73	2158.43	40.24	957.13	23.94	394.5	116.69
August	1604.25	90.78	2906	114.73	912	13.63	785	0.00
September	2613.9	44.98	4217.14	85.69	947	19.21	598.33	63.93
October	3904.46	27.01	2786.67	102.65	659.2	27.17	1368.75	38.01
November	4528.91	27.30	3701.56	93.75	747.1	35.10	3045.46	40.01
December	4250.91	27.37	4238.1	98.99	1103.6	49.46	5614.64	30.53

**Table 6. Variability in the wholesale price of cauliflower in the selected metropolitan markets of India: 1990-2001**

(Rs/q)

Months	Delhi		Mumbai		Bangalore		Kolkata	
	Mean	C.V. (%)	Mean	C.V. (%)	Mean	C.V. (%)	Mean	C.V. (%)
January	308.09	64.41	320.3	25.56	718.7	25.19	316.55	33.36
February	222.64	54.22	281.9	30.52	726.4	25.19	288.27	38.29
March	328	53.82	314	24.07	721.9	23.98	-	-
April	583.5	55.04	421.44	14.04	-	-	-	-
May	1268.29	22.62	-	-	-	-	-	-
June	1378.38	40.41	-	-	-	-	-	-
July	2128.75	24.62	-	-	-	-	-	-
August	1692	35.15	-	-	-	-	-	-
September	1254.8	39.4	-	-	-	-	-	-
October	782.64	52.85	506.11	28.48	841.2	25.84	878.36	51.58
November	455.27	61.46	453.44	41.7	912.7	24.62	495.45	59.06
December	276.91	41.82	359.2	49.11	737.2	41.54	607.82	57.16

*Note:* - indicates data not available

during the winter months. The average monthly arrivals ranged from 1583.38 tonnes in July to 4528.91 tonnes in November. The arrivals of cauliflower had higher variability during the months of August to December in Mumbai; the monthly arrivals ranged from 1054.29 tonnes in May to 4238.1 tonnes in December. In Bangalore, the extent of variability was more pronounced during the November-April period and was modest during the July-October period; the average monthly arrivals ranged from 659.2 tonnes in October to 1103.6 tonnes in December. The variability in the market arrivals was higher with values of coefficient of variation fluctuating between 116.69 per cent in July to 30.53 per cent in December in Kolkata.

The monthly price variability (Table 6) in cauliflower remained very high during the main growing season, November to March-April in the Delhi market, with values of coefficient of variation remaining above 50 per cent in all these months, except December. In the lean season, the magnitude of variability was lower during the months of May and July with values of coefficient of variation ranging between 22 and 24 per cent as compared to that in June and August when these were 35 to 40 per cent. In Mumbai, the variability was very high during November and December (41.70 to 49.11%) and low in April (14.04%). In Bangalore, it was high (41.54%) in December and lower in other months for which data were available. Kolkata had high values of coefficient of variation during November and December compared to January and February.

**Table 7. Variability in the market arrivals of tomato in the selected metropolitan markets of India: 1990-2001**

(tonnes)

Months	Delhi		Mumbai		Bangalore		Kolkata	
	Mean	C.V. (%)	Mean	C.V. (%)	Mean	C.V. (%)	Mean	C.V. (%)
January	13519	29.94	6173	34.68	2664	32.84	6633.27	38.29
February	12853	32.12	5668.6	39.03	2715.6	20.29	5499.7	36.08
March	14614.9	22.29	6579.11	47.77	2847.1	24.24	5138.91	46.23
April	10578.6	16.14	5545	44.43	2186.5	20.18	2753.4	58.32
May	5764.18	15.62	4848.8	24.70	2197.6	33.61	1792	90.17
June	7085.91	19.84	3967.3	23.12	2390	41.25	972.27	37.63
July	8995.91	26.37	4256.9	34.03	2936.9	51.44	1415.82	56.96
August	12118.2	29.64	4841.8	32.48	2914.1	42.43	1869	31.79
September	14158.2	30.99	5878.8	33.09	2565.8	36.31	2685.73	52.91
October	12617.3	38.74	5951.2	32.83	2046.2	39.82	3088.82	28.58
November	11382.4	28.85	5019.3	37.83	2065.2	39.74	3174.73	47.31
December	13320.3	24.66	5678.9	60.53	2633.4	44.95	5129.09	40.97

### 3.1.3. Market Arrivals and Price Variability in Tomato

The market arrivals of tomato revealed low variability during the period March–June in Delhi, which subsequently increased in September and October (Table 7). The mean market arrivals ranged between 5764.18 tonnes in May and 14614.9 tonnes in March. In Mumbai, the variability in the market arrivals was highest during December and February–April, while the mean arrivals were highest at 6579.11 tonnes in March. In Bangalore, the arrivals had higher variability towards the later months of the year and the average arrivals varied from 2046.2 tonnes in October to 2936.9 tonnes in July. The magnitude of variability in the market arrivals was very high in Kolkata with values of coefficient of variation varying from 31.79 per cent in August to 90.17 per cent in May. The mean monthly arrivals varied from 972.27 tonnes in June to 6633.27 tonnes in January.

Regarding price variability in tomato (Table 8), it remained quite high during the periods May to June (60%) and October to January (46–58%) in the Delhi market. The variability was lower (17 to 32%) during the months of February and April. On the other hand, in Mumbai, the price variability was more pronounced during the months of October and January with values of coefficient of variation ranging from 48.79 per cent in October and 66.35 per cent in December and was lowest (25.33%) in May. The Bangalore market experienced lower degree of price variability during November and December months. It remained generally high in the remaining months except

**Table 8. Variability in the wholesale price of tomato in the selected metropolitan markets of India: 1990-2001**

(Rs/q)

Months	Delhi		Mumbai		Bangalore		Kolkata	
	Mean	C.V. (%)	Mean	C.V. (%)	Mean	C.V. (%)	Mean	C.V. (%)
January	528.36	46.19	453.3	51.12	350.9	62.31	610.91	38.08
February	514.18	25.76	462.1	37.89	249.2	48.27	412.6	35.97
March	488.36	16.89	376.67	35.35	177.5	45.27	302.91	51.23
April	460.73	22.36	400.8	31.37	221.1	42.94	386.2	37.86
May	324.91	60.43	486.5	25.33	426.2	41.26	675.55	34.22
June	567.09	61.12	774.8	38.48	596.1	55.23	1108.18	34.17
July	1029.82	32.36	853.3	41.79	670.6	50.52	1242.18	33.48
August	838.73	25.23	651.3	36.14	430	43.07	1006.91	31.77
September	652.64	29.35	450.4	28.58	340.2	36.79	835.64	26.86
October	765.36	46.23	515.6	48.79	433.2	52.45	1010.91	31.95
November	951.36	57.9	737.6	56.12	614.1	30.02	1265	46.82
December	701.82	49.4	572	66.35	513.4	33.18	974.18	39.05

September; the highest value was observed in January (62.31%). In the Kolkata market, the variability in the prices was maximum in March (51.23%), followed by November (46.82%), while in all the remaining months it was lower, the values of coefficient of variation remaining below 40 per cent.

#### 3.1.4. Market Arrivals and Price Variability in Peas

The market arrivals of peas in Delhi depicted high variability during the periods April to July and October to December (Table 9). The market arrivals started increasing in November and peaked to 8012.18 tonnes in January; these were lowest (673.13 tonnes) in June, the off-season month. In Mumbai, the arrivals of peas fluctuated widely from March to September and the mean market arrival was highest at 2898.7 tonnes in February. The arrivals were low during the months of May and June. The Bangalore market witnessed very high variability in the arrivals of peas throughout the year and the average market arrivals ranged between low of 89 tonnes in June to high of 527 tonnes in January. In the case of Kolkata, the variability in the arrivals of peas was comparatively higher in November. The mean market arrivals were highest (3341.9 tonnes) in February. The variations in the prices of peas in the Delhi market were comparatively higher in the months of January, February, May and June while in Mumbai, these were higher in January and February compared to November and December (Table 10).

**Table 9. Variability in the market arrivals of peas in the selected metropolitan markets of India 1990-2001**

(tonnes)

Months	Delhi		Mumbai		Bangalore		Kolkata	
	Mean	C.V. (%)	Mean	C.V. (%)	Mean	C.V. (%)	Mean	C.V. (%)
January	8012.18	30.43	2430.2	29.96	527	61.67	3058.7	30.47
February	7489.36	32.49	2898.7	27.91	502.2	66.66	3341.9	26.82
March	5423.36	36.41	1871.6	55.39	176.2	60.12	1074	45.65
April	1733.9	50.29	543.17	55.46	85.44	54.08	140	-
May	901.8	39.84	350.2	50.16	96.25	57.37	-	-
June	673.13	54.67	343.33	52.46	89	60.15	-	-
July	861.25	40.09	624.43	47.44	120.5	53.87	-	-
August	1062.5	25.77	798.43	51.33	204.25	59.66	-	-
September	550.56	25.97	510.4	50.61	211.6	64.87	95	-
October	773.71	49.86	247.75	25.24	112.88	29.97	-	-
November	1820.64	45.04	940.14	47.41	116.7	40.22	387.44	55.81
December	6046.36	47.34	1869.11	36.56	304.9	68.69	1992.73	25.88

**Table 10. Variability in the wholesale price of peas in the selected metropolitan markets of India: 1990-2001**

(Rs/q)

Months	Delhi		Mumbai		Bangalore		Kolkata	
	Mean	C.V. (%)	Mean	C.V. (%)	Mean	C.V. (%)	Mean	C.V. (%)
January	548.91	49.64	684.4	37.9	960.5	37.48	718.9	37.51
February	414.45	49.78	566.8	41.99	846.9	35.67	515.3	23.82
March	423.64	36.62	812.8	31.02	1305.4	22.36	680.56	25.16
April	1136.6	24.27	-	-	2107.22	28.25	-	-
May	1392.4	40.72	-	-	3792.88	48.08	-	-
June	1853.25	49.17	-	-	3636.13	22.5	-	-
July	1943.38	32.99	-	-	2294.88	26.53	-	-
August	1969	19.93	-	-	1376	23.77	-	-
September	2350.78	31.7	-	-	1554.1	17.43	-	-
October	2547.43	23.66	2174	26.65	2389.13	18.23	-	-
November	1503.91	28.82	1093	31.65	2572.2	16.99	1688.89	33.41
December	756.27	35.32	1315.4	42.87	1635.7	28.22	1153.91	34.92

Note: - indicates data not available

The highest variability in prices in the Bangalore market was observed in May (48.08%) and lowest in September and November (17-18%). In Kolkata, the price variability was higher in December and January compared to February and March.

### 3.2. Relationship between Market Arrivals and Prices

The phenomenon of inverse relationship between market arrivals and prices is well known. Nevertheless, factors such as the availability of cold storage facilities, enhanced opportunities for export, value-addition through agro-processing, availability of new poly house technologies, etc. not only weaken this negative relationship but may even turn it positive. The degree of relationship between market arrivals and prices of selected vegetable crops was studied for different years from 1990 to 2001 by computing correlation coefficients. The relationship was also studied for different months over different years. This was necessitated due to the seasonality in vegetables production, the negative relationship may be more pronounced during the peak season and it may be positive for other months. Moreover, given the scope for varying the cropping pattern, the relationship between market arrivals and prices in different months may be more fruitful in that it encourages farmers to adjust their cropping pattern and sell at a time when prices are reasonably high. The results of correlation analysis, given in Table 11, reveal that the negative relationship between market arrivals and prices was not universally true for all the crops and for all years. For example, in the Delhi market, a statistically negative relationship was noticed for most of the years in cauliflower and peas, while in cabbage, statistical significance was evidenced only for three years. For tomato, the correlation coefficients were positive, though statistically non-significant, for most of the years. The month-wise correlation coefficients between arrivals and prices for these crops were positive in a few cases, *albeit* non-significant in most of the cases. A positive and significant correlation coefficient in July (0.86) for cauliflower and in August (0.75) for peas may be attributed to the fact the Delhi market receives off-season supplies of these crops from the hills of Uttaranchal and Himachal Pradesh.

In Mumbai, the negative relationship between arrivals and prices was observed for almost all the years in all the crops, though its significance for most of the years was noticed only in tomato and peas. In cauliflower, the correlation coefficients were positive for as many as ten out of twelve months, in other crops these were positive for about five-six months only. A similar pattern was discernible in Bangalore where the correlation coefficients between arrivals and prices were negative for all crops in most of the years. The statistical significance was, however, noticed only for three-four years. Across months, the relationship was negative for most of the months in cabbage, while for the remaining crops, it was positive for about half of the months. It, however, needs to be mentioned that the correlation coefficients, whether positive or negative, were statistically non-significant practically for most of the months in cabbage. The pattern of relationship between

**Table 11. Relationship between market arrivals and wholesale prices in the selected metropolitan markets of India: 1990-2001 – Correlation Coefficients**

Year/Month	Delhi				Mumbai			
	Cabbage	Cauliflower	Tomato	Peas	Cabbage	Cauliflower	Tomato	Peas
1990	-0.539	-0.865**	-0.459	-0.703	-	-	-	-
1991	-0.748**	-0.797**	-0.215	-0.840**	-0.826**	-0.647	-0.788**	-
1992	-0.580	-0.115	0.189	-0.885**	-0.897**	-0.716	-0.792**	-0.807
1993	-0.736**	-0.739*	-0.554	-0.874*	0.404	-0.552	-0.755**	-
1994	-0.553	-0.889**	0.028	-0.885**	-0.446	-0.579	-0.349	-0.805*
1995	-0.168	-0.840**	-0.383	-0.896**	-0.715**	-0.525	-0.358	-0.844**
1996	-0.808**	-0.801**	0.256	-0.867**	-0.552	-0.663*	-0.698*	-0.796**
1997	-0.326	-0.424	0.167	-0.769**	-0.478	-0.187	-0.496	-0.773**
1998	-0.260	-0.588*	-0.534	-0.882**	-0.202	-0.690*	-0.679*	-0.582
1999	0.495	-0.744**	0.411	-0.854**	-0.375	-0.753**	-0.832**	-0.867**
2001	0.341	-0.233	0.091	-0.860**	0.638*	0.374	0.015	-0.612
January	-0.092	-0.630*	0.047	0.549	-0.159	0.365	0.503	0.140
February	-0.020	-0.314	0.471	0.395	-0.167	-0.142	0.332	-0.137
March	0.207	-0.554	0.013	0.443	-0.479	0.045	0.329	-0.328
April	0.550	-0.052	0.146	-0.138	-0.494	-0.313	0.582	-
May	0.545	0.111	-0.394	-0.221	-0.087	0.041	-0.071	-
June	-0.418	0.227	-0.475	-0.602	-0.322	0.264	-0.057	-0.316
July	0.103	0.860*	-0.092	0.647	0.103	0.492	-0.397	0.192
August	0.418	0.360	0.441	0.755*	0.442	0.438	-0.425	-0.608
September	0.396	0.407	-0.240	-0.073	0.005	0.150	0.502	-
October	0.415	0.365	0.085	-0.221	0.080	0.541	0.137	-
November	-0.329	0.051	-0.338	0.542	0.557	0.469	-0.164	0.804*
December	-0.134	-0.463	-0.091	0.246	0.203	0.134	-0.349	-
Overall	0.673*	0.657*	0.176	0.079	0.385	0.594	0.526	-0.781**

*Contd*

**Table 11. Relationship between market arrivals and wholesale prices in the selected metropolitan markets of India: 1990-2001 – Correlation Coefficients — Contd**

Year/ Month	Bangalore				Kolkata			
	Cabbage	Cauliflower	Tomato	Peas	Cabbage	Cauliflower	Tomato	Peas
1990	-	-	-	-	0.297	-	-0.294	-
1991	-0.617*	-0.417	-0.778**	-0.666	-0.424	-	-0.282	-0.733
1992	-0.542	-0.001	-0.861**	0.664	-0.162	-	-0.697*	-0.820*
1993	-0.523	-0.633*	-0.482	-0.718**	-0.527	-	-0.795**	-
1994	-0.157	0.459	-0.403	-0.502	-0.390	-	-0.397	-0.741
1995	-0.409	-0.776**	-0.157	-0.673*	-0.188	-0.644	-0.261	-0.747
1996	-0.748**	-0.937**	-1.000**	1.000	-0.838**	-0.703	-0.854**	-
1997	-0.811**	-0.458	-0.399	-0.783**	-0.305	-0.207	-0.188	-0.463
1998	-0.450	-0.174	-1.000**	-0.821**	-0.202	-0.534	-0.586*	-
1999	-0.333	-0.676*	0.005	-0.731**	-0.419	-0.807**	-0.554	-0.706
2001	-0.354	-0.228	-1.000**	-0.630	-0.625*	-0.937**	-0.513	-0.638
January	-0.422	-0.194	-0.0182	0.155	0.755**	0.787**	-0.274	-0.370
February	-0.622	-0.299	-0.300	-0.080	0.373	0.519	0.079	-0.366
March	-0.085	-0.025	-0.185	0.581	0.021	-0.079	-0.383	-0.609
April	0.123	-0.372	-0.655*	0.369	-0.234	-	-0.287	-
May	-0.249	-0.317	-0.199	-0.180	0.278	-	0.038	-
June	-0.501	-0.370	-0.010	-0.145	-0.441	-	-0.114	-
July	-0.618	-0.097	-0.543	0.316	-0.714*	-	-0.286	-
August	-0.388	0.566	0.047	-0.112	-0.656*	-	0.205	-
September	-0.507	0.276	0.710	-0.048	-0.798**	-	-0.162	-
October	-0.701	0.143	0.383	0.587	-0.515	-0.388	-0.034	-
November	-0.135	0.174	0.479	0.546	0.241	0.870**	-0.391	-0.657
December	0.017	-0.784	0.415	-0.334	0.270	-0.142	-0.085	0.061
Overall	0.204	0.585	-0.307	0.599	0.128	0.744**	0.256	-0.674*

Note: \* and \*\* denote significance at 0.01 and 0.05 levels of probability, respectively

**Table 12. Predicted prices of important vegetable crops, 2005**

(Rs/q)

Month	Cabbage				Cauliflower			
	Delhi	Mumbai	Bangalore	Kolkata	Delhi	Mumbai	Bangalore	Kolkata
January	310	312	222	292	309	455	979	464
February	260	272	120	327	305	363	1143	383
March	231	265	137	331	430	363	1024	-
April	220	298	171	412	748	472	-	-
May	275	322	248	490	1496	-	-	-
June	192	443	335	574	1824	-	-	-
July	573	590	486	805	3258	-	-	-
August	684	550	419	838	2306	-	-	-
September	799	483	310	788	1367	-	-	-
October	804	486	200	914	1181	741	1237	-
November	655	588	345	960	667	825	1324	1538
December	480	377	287	528	394	577	1102	851
Overall	404	413	283	569	1037	574	-	1185

  

Month	Tomato				Peas			
	Delhi	Mumbai	Bangalore	Kolkata	Delhi	Mumbai	Bangalore	Kolkata
January	746	601	302	1008	1056	1109	1362	1155
February	770	739	325	554	861	1018	1055	675
March	564	400	211	246	677	1261	1772	961
April	590	483	327	396	1874	-	2833	-
May	250	594	601	984	2377	-	5830	-
June	725	950	589	1393	3157	-	4994	-
July	1300	1113	645	1670	2622	-	3027	-
August	1185	992	448	1534	2428	-	1627	-
September	747	425	478	1118	3491	-	1674	-
October	944	549	463	1382	3255	-	2811	-
November	1104	762	698	1557	2552	3179	3416	1957
December	901	633	719	1119	999	1615	1978	1515
Overall	773	578	528	1029	2128	1974	2491	1380

market arrivals and prices was not significantly different in the Kolkata market than that observed in the other three markets. For all the years and all the crops, the correlation coefficients between market arrivals and prices were negative. However, like other markets, the statistical significance of the negative relationship was noted only for a few years. Over different months, the negative relationship was more common unlike remaining three markets. But, here again, the correlation coefficients in most of the cases were statistically non-significant.

Based on the trend analysis of prices over the years, the monthly prices of these crops were predicted for the year 2005 using appropriate regression model. The results are given in Table 12. The prediction showed relatively higher prices for cabbage in the Kolkata and Delhi markets during July to December months. Among the four markets, the prices for cabbage would be relatively lower in Bangalore where farmers would get higher prices in July-August. In Mumbai, the prices would be higher in the months of July, August and November. Further, the analysis has predicted higher prices for tomato in the months of July, August, October and November in Delhi, June to August in Mumbai, May to July and November-December in Bangalore and July to December in Kolkata. The prices of cauliflower are expected to remain relatively high in the months of May to October in Delhi and October and November in Bangalore and Mumbai.. In Kolkata, cauliflower will give highest price to the farmers in November. In the case of peas, the prices would remain high in the months of May to October in Delhi and April to July in Bangalore. In Mumbai and Kolkata, pea prices would be highest in November.

### **Conclusions**

The study has concluded that in cabbage the extent of variability in the arrivals of cabbage was lower in Bangalore and higher in Mumbai. It prices were relatively stable in Mumbai but were more volatile in Bangalore. There was broadly a similar pattern in the price variability across different months in the Kolkata and Delhi markets. In the case of cauliflower, the variability in the market arrivals was more pronounced in the Kolkata than the remaining three markets. The price variability was, however, more marked in the Delhi market with values of coefficient of variation in most of the months staying above 50 per cent. The extent of variability in the market arrivals of tomato across different months was very high in all the four markets. Likewise, while the maximum variability in the prices of peas was noted in Delhi market, these were relatively less marked in Bangalore.

The study has confirmed the negative relationship between market arrivals and prices over the years in all the four metropolitan markets. However, across different months, there have been several instances of positive relationship between arrivals and prices in all the four markets. These positive and significant correlation coefficients could be attributed to the off-season supplies of these vegetables which fetch higher prices. In the Delhi market, statistically significant negative relationship is in evidence in cauliflower and peas for most of the years but for tomato it is positive and

non-significant. In Mumbai, negative and statistically significant relationship has been observed for tomato and peas. A similar pattern has been observed in the Bangalore and Kolkata markets, with a fewer cases of statistical significance.

## Notes

The paper draws from a larger study completed under NATP (Competitive Grant Programme), “Mountain Agriculture in Transition: A Study of Processes, Determinants and Implications Using Micro Evidence from Himachal Pradesh”.

The authors are grateful to Shri Rajiv Kumar for assisting in the collection of data and to the anonymous referee for useful comments on the earlier draft of the paper. The usual caveats, however, apply.

<sup>1</sup> The most recent example has been of the hop cultivation in HP, whose production suffered a big blow due to cheaper imports mainly from China. Similarly, the cheaper imports of garlic from China led to a significant price fall, inflicting huge losses on the local producers.

<sup>2</sup> The share of the selected vegetable crops in the total area (cabbage, cauliflower, tomato and peas) went up from 15.14 per cent to 20.91 per cent while their combined share in production went up from 19.32 to 22.65 per cent in the total vegetable production during the period 1990-91 to 2001-02.

<sup>3</sup> The data for the year 2000 were not available.

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