PAKISTAN

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Introduction

Pakistan is the western-most country of South Asian. With a population of 128 million in 1996 and a total area of 796.1 thousand km^2, population density exceeds 160 people/km^2. During 1970-93, the population doubled from an annual growth rate of more than 3%. Data for 1996 indicate per capita cultivable land availability of about 0.17 ha, and per capita income of about US$495. Agriculture's share in gross domestic product (GDP) decreased from 36% in 1971 to 26% in 1988, and then stayed at that level thereafter. In 1993, 47.5% of the labor force was engaged in farming, down from 58% in 1976. About 70% of the population resides in rural areas (Government of Pakistan 1995). The country is divided into four provinces (Punjab, Sind, Northwest Frontier Province (NWFP), and Baluchistan), and 82 administrative units called districts (Fig. 1).

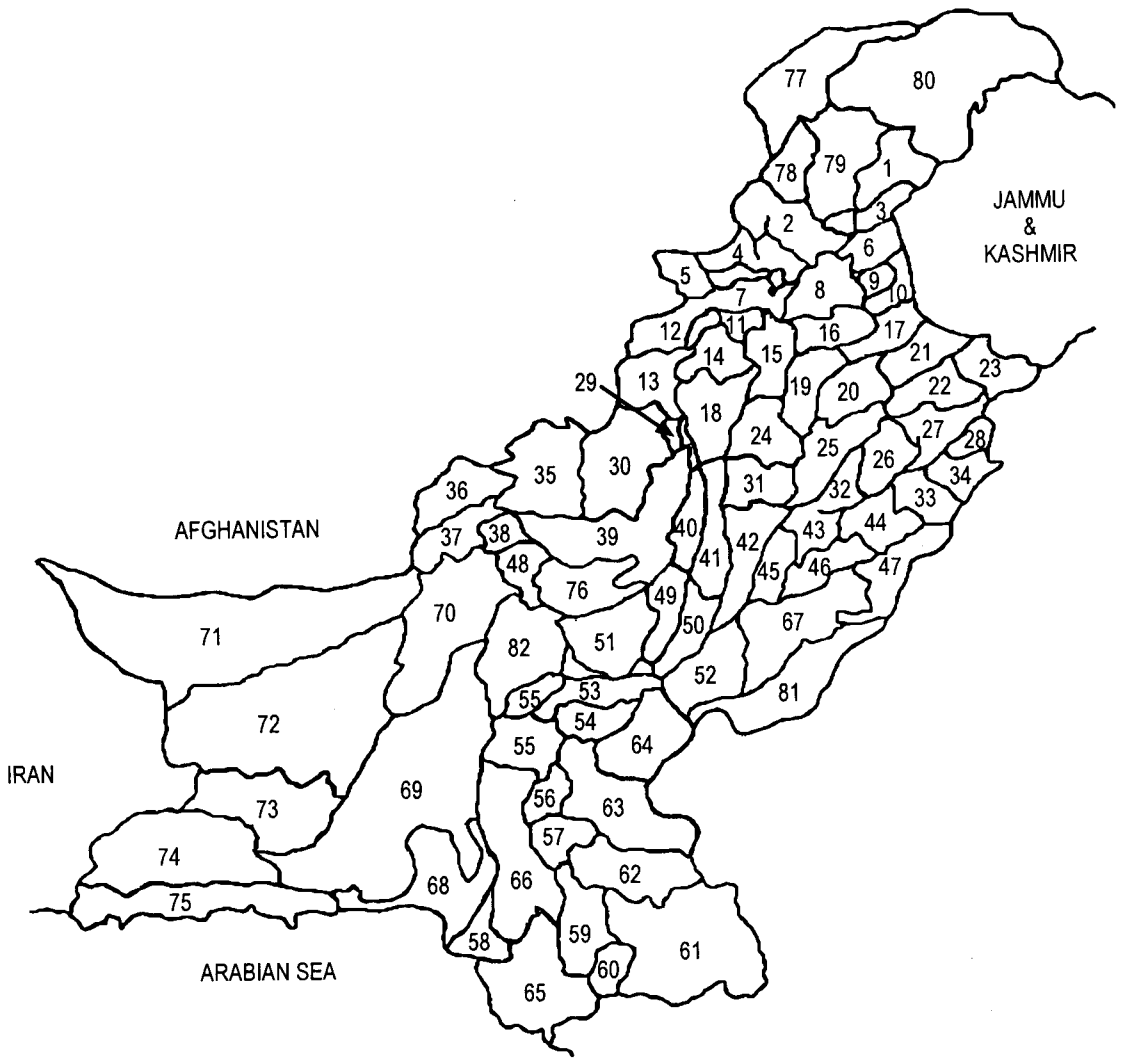
Major crops grown in Pakistan include wheat, cotton, rice, sugarcane, fodder, maize, tobacco, vegetables, and annual fruit. The area under vegetable cultivation during 1994, excluding potato and sweet potato but including onion, garlic, and chili, was 0.381 million ha (about 1.67% of the total cropped area), producing about 4.06 million t of vegetables. The production value of all vegetables is about PKR 22 billion or 21% of the value of all cereal production. In contrast to the modest yields of 2-3 t for most field crops, average vegetable yields are in the neighborhood of 10 t/ha. Per capita availability of vegetables at the farm gate, after excluding exports and potato, is about 89 g/day, less than half the recommended daily vegetable consumption.

In 1991, average per capita food consumption was about 1 kg/day, of which cereals constituted 42%, non-cereal plant food 9%, fruits and vegetables 32%, and livestock products 17% (Government of Pakistan 1993b). Wheat is the staple food, accounting for more than one-third of total consumption.

General Information

Topography

Major coastal areas of the south lie at sea level. Elevations begin to rise gradually through the major plains of the Indus Valley and then meet steeply rising mountains in the north and north-west. The Indus Valley plains contain the country's most fertile land, and most crop production is concentrated there.



BALUCHISTAN
30. ZOHB
35 QILA SAIFULLAH
36. PISHIN
37. QUETTA
38 ZIARAT
39. LORALAI
48. SIBI
51. DERA BUGTI
68. LASBELA
69. KHUZDAR
70 KALAT
71. CHAGI
72. KHARAN
73. PANJGUR
74. TURBAT
75. GWADAR
76 KOHLU
82 KACHHI

NWFP
1 KOHISTAN
2 MOHMAND
3. MANSEHRA
4. KHYBER
5. KURRAM
6. ABBOTT-ABAD
7. KOHAT
11. KARK
12. N. WAZIRISTAN
13 S. WAZIRISTAN
14. BANNU
18. D.I. KHAN
29. FR. DI. KHAN
77. CHITRAL
78. DIR
79 SWAT
80. GIL GIT AGENCY

PUNJAB
8. ATTOCK
9. ISLAM-ABAD
10. R. PINDI
15. MIAN WALI
16. CHAKWAL
17. JEHLUM
19. KHUSHAB
20. SARGODHA
21. GUJRAT
22. GUJRANWALA
23. SIALKOT
24. BHAKAR
25. JHANG
26. FAISALABAD
27. SHEIKHUPURA
28. LAHORE
31. LAYYAH
32. T.T. SINGH
33. OKARA
34. KASUR
40. DE-EX D.G. KHAN
41. D.G. KHAN
42. MUZAFFARGARH
43. KHANEWAL
44. SAHIWAL
45. MULTAN
46. VEHARI
47. B. NAGAR
49. DE-EX RAJAN PUR
50. RAJAN PUR
52. RAHIMYAR KHAN
67. BAHAWALPUR
81. CHOLISTAN

SIND
53. JACCOBABAD
54. SHIKARPUR
55. LARKANA
56. N. FEROZE
57. NAWAB SHAH
58. KARACHI
59. HYDERABAD
60. BADIN
61. THARPARKAR
62. SANGHAR
63. KHAIRPUR
64. SUKKUR
65. THATTA
66. DADU

Fig. 1. District-level map of Pakistan.

Climatic Factors and Vegetable Cultivation

Much of Pakistan is classified as arid to semi-arid with a tropical or subtropical climate. Pakistan experiences four somewhat distinct seasons: winter (December-February), spring (March-April), summer (May-September), and autumn (October-November). During the spring and autumn seasons, daily temperatures do not exceed 10-25°C, while winters are even colder, and temperatures fall to single digit figures with occasional frost. Summers are considerably warmer with day temperatures between 40 and 50°C. In the mountainous areas, subzero temperatures are common during the winter, while summer temperatures are mild, hardly exceeding 25°C. The coastal areas are characterized by a lack of extreme temperature variation. On the basis of climatic conditions, soil types, and physiography, Pakistan can be divided into 10 distinct agroecological zones (PARC 1980).

Pakistan receives virtually year-round supplies of irrigation water from the snow-covered mountain ranges of the north, which permit vegetable and other crop cultivation throughout much of the country. Diversity of climate in the country also ensures vegetable availability throughout the year.

Table 1 shows cultivation times of different vegetables along with their major cultivation areas. Most vegetables are usually grown either in autumn or spring to avoid winter and summer extremes. Deviations occur due to the varied and milder climates of various regions. For example, most summer vegetables can be grown successfully throughout the year in the coastal areas. Likewise, many winter vegetables are suitable for cultivation in the mountain valleys of Baluchistan and the northern areas of Pakistan during the summer. The milder weather of the autumn and spring seasons in the plains is suitable for two potato crops a year from the same land; a third crop can be grown during the summer in the mountain valleys. With this wide range of ecoregional environments, it should be possible to smooth out seasonality in vegetable supplies.

Table 1. Sowing and harvesting time, major cultivating districts, and varieties

Vegetable	Sowing time	Harvesting time	Major cultivating districts	Varieties
Cabbage (0.6)	Year-round	Year round	Not available	Chamcha, Chanun, Snow Drift
Carrot (1.9)	Sept.-Feb.	Nov.-April	Sheikhupura (22.9), Hyderabad (6.6), Lahore (6.7)	Not available
Cauliflower (2.0)	Sept.-Feb.	October-April	Sheikhupura (9.2), Faisalabad (6.7), Bhawalnagar (5.8), Gujranwala (5.0)	Not available
Chili (10.8)	Feb.-March	June-November	Mirpurkhas (55.0), Hyderabad (8.2), Sanghar (6.9), Badin (6.5)	Not available

Contd. Table 1.

Vegetable	Sowing time	Harvesting time	Major cultivating districts	Varieties
Cucurbits[1] (4.6)	Feb., Aug.	April-May, Sept.-Oct.	Not available	Faisalabad-2 long Gourd, Sialkot Round Tinda, Desi-Sialkoti-Cucumber, Marketer-Cucumber
Eggplant (1.6)	March, Aug.	June-Dec.	All over the country	Not available
Garlic (1.8)	Sept.-Oct.	March-April	Sakkar (9.4), Shikarpur (7.8), Nowshera (7.6)	GS1, Pink Garlic
Lady's finger (2.7)	Feb.-March	June-July	Hyderabad (8.4), R.Y. Khan (4.7)	T-13, Uosa Green
Melons (10.0)	Feb.-March	April-May	Not available	Not available
Onion (16.1)	Jan., April	April-July	Hyderabad (13.9), Mirpurkhas (9.0), Swat (5.7), Sanghar (4.9)	Desi Red
Pea (0.8)	Sept.-Oct.	Dec.-April	Not available	H-57, Matore, FC- 3954 Green Feast, UAR-15, Climax P-18
Potato (18.1)	Sept., Feb., May	Dec.-Jan., April-Aug.	Okara (14.6), Sahiwal (12.0), Sialkot (9.5), Kasur (9.5)	Wilja, Patrones Diamant, Ajax, Multa, Spunta, Fb13-9469, Desiree, Cardinal, Ultimus
Radish (1.8)	Year round	Year round	Sheikhupura (8.2), T.T. Singh (5.5), Sahiwal (6.5)	Desi, Shaowmai, Minno, Shmora
Spinach (1.4)	Year round	Year round	Not available	Desi, Cundyari, Kasuri
Tomato (5.5)	Dec.-Jan.	April-June	Swat (11.4), Karachi (6.0), SW agency (5.5), Sheikhupura (5.3)	T-10, Money-maker Roma, Red Top, Marglobe
Turmeric (3.1)	June-July	Nov.-Dec.	Kasur (52.8), Bannu (34.1)	Not available
Total (100) vegetables	-	-	All over the country, especially around cities. Sheikhupura (6.1), Faisalabad (4.3), Gujranwala (3.5), R.Y. Khan (3.4), Bahawalpur (3.0), Hyderabad (3.2), Pishin (2.5), D.I. Khan (4.0), Swat (2.0).	

Source: For sowing and harvesting time, Samad (1993) and Government of Pakistan (n.d); proportion of total vegetable area in major cultivating districts is estimated from unpublished agricultural data, Economic Wing, Ministry of Food, Agriculture, and Livestock, Islamabad, for the 12-month period 1993-94.

[1] The cucurbit family includes different gourd types, pumpkin, and cucumber.

Note: The figures in parenthesis indicate the percentage share of a vegetable in total area.

Major Production Pockets

Vegetable production in Pakistan is well diversified in terms of the range of vegetable species grown. More than 36 species are grown and consumed as summer or winter vegetables. The major vegetable species grown are potatoes, onions, chili, melon, tomato, and cucurbit (Table 1). Most vegetable area is concentrated in specialized districts in the peri-urban areas of big urban centers like Lahore, Karachi, and Peshawar. For example, production of potato is specialized in Okara, Sahiwal, Sialkot, and Kasur around Lahore. Table 1 also shows the varieties of major vegetables grown.

Regional Cropping Patterns

Depending on the major crops grown, cropping patterns vary from region to region. The following discussion is largely based on PARC (1989).

Irrigated Plains of Sindh and Southern Punjab

Wheat, vegetables, pulses, and fodder, such as berseem (*Trifolium alexandrinum*), compete with potatoes in the winter (*rabi*). Year-round crops such as sugarcane and bananas also compete. Rice, cotton, and chili are grown as summer (*kharif*) crops.

Irrigated Plains of Central Punjab

During winter, wheat is the dominant crop. Central Punjab has a mixed cropping pattern involving rice and sugarcane. In the north of central Punjab, rice is the dominant crop during kharif. Potato farmers tend to specialize. These farmers grow the crop at least once a year.

Irrigated Plains of NWFP and Northern Punjab

Potatoes and sugarcane are intercropped in the spring, with potatoes on the ridges and sugarcane in the furrows. Since sugarcane grows slowly during the first few months after planting, there is little competition between the two crops. Wheat is the main winter crop, competing with both spring and autumn potato, as do rape and berseem. Winter vegetables compete with potato, particularly autumn cauliflower and winter sugar beet in Mardan. Tobacco grown in the summer competes with potatoes.

Irrigated Lower Valleys of NWFP (900-1500 m)

Radish, turnips, or coriander are grown in July and August between the two potato crops. This is the only area in Pakistan where potatoes are known to be cultivated at this high altitude, enabling both crops to be harvested at periods of high seasonal prices. Vegetables and wheat are rotated with potato on the same land after every second or third year.

Rain-fed High Valleys and Hillsides (1750-2600 m)

Cropping patterns in this area are as follows:

> *Upper Swat:* Potato 50-95% of the area, maize 0-50%, vegetables (particularly turnips) 0-5%. The area under turnips is increasing fast.

Kaghan Valley: Above 2300 m, potato 95-100%, maize 0-5%. Below 2300 m, maize percentage increases until potatoes disappear below 1900 m.

Dir Kohistan: Thal and above, potatoes 20-30%, maize 75-80%. Between Kalkot and Thal, almost the entire area is under maize, with very few potato fields.

Valleys of Baluchistan (1600-2300 m)

The main competitors to potato include tomatoes, onions, and coriander. Coriander is nearly always intercropped with onion. Potato is sometimes followed by turnip to allow two summer potato crops, though cropping in the summer is not very common. Wheat, or sometimes barley, is grown in the winter. The cropping system can also include one or two years of fallow.

Irrigated High Valleys of Northern Areas and Chitral (2250-3000 m)

The major crops include wheat, barley, maize, broad beans (*Viciafaba*), and fodder crops, such as alfalfa and clover. Fruit trees are particularly important; trees are also grown for timber and fodder. Vegetables cultivation is widespread, but vegetables occupy a small percentage of the cropped area (except in villages specialized for seed potato). Potato is the most important vegetable.

Social Taboos Related to Vegetables

Production and consumption of vegetables can be constrained by social taboos. For example, most wealthy farmers with large holdings consider it unprestigious to specialize in vegetables, and instead cultivate less labor-intensive crops. Among small cultivators, vegetables are a specialty of hard-working Arain families, while most Jats are hesitant to grow vegetables for social reasons. Arains are called an onion-eating caste, but they resent the label. On the demand side, vegetables are avoided during illness and pregnancy, since milk and meat preparations are considered more energetic and more easily digestible than vegetables. Such taboos have weakened considerably in recent years due to the commercialization of agriculture. One can now reasonably assume that production and consumption of vegetables are mainly functions of economic factors rather than social taboos.

Trend Analysis

Production

The trends in area, production, and yield of individual and total vegetables are reported in Table 2. Total vegetable production increased quadratically (both the quadratic and linear terms were positive and significant), mainly because of a strong increase in area (4% per annum), while the overall trend in yield is stagnant, as the yield trend has a negative linear but small positive quadratic term. Only tomato, cauliflower, melon, coriander, and other vegetables experienced positive linear yield increases over the period, while onion yield increased quadratically.

Table 2. Trends in total and individual vegetable area, production, and yield, 1970-93

Vegetable	Trend equations of					
	Production		Area		Yield	
	t	t^2	t	t^2	t	t^2
Cauliflower	0.049	0.003	-	0.001	0.020	-
Chili	0.112	-0.004	0.109	-0.004	-	-
Coriander	0.089	-	0.077	-	0.013	-
Eggplant	0.032	-	0.037	-	-0.004	-
Garlic	0.093	-0.002	0.151	-0.004	-0.057	0.002
Lady's finger	0.138	-0.005	0.106	-0.003	0.031	-0.002
Melon	0.048	-	0.044	-	0.022	-
Onion	0.062	-	0.082	-0.001	-	0.0004
Potato	0.064	-	0.064	-	-	-
Pumpkin	0.358	-0.016	0.291	-0.014	0.067	-0.003
Tomato	0.128	-0.001	0.099	-0.001	0.023	-
Turmeric	0.153	-0.004	0.191	-0.006	-	-
Other vegetables	-0.025	0.003	-0.024	0.002	0.0002	-
All vegetables	0.015	0.001	0.040	-	-0.025	0.001

Source: Estimates based on data reported in Government of Pakistan (1993a, 1994a, and unpublished data from Ministry of Food, Agriculture and Livestock).

Prices

Trends in real price indices (nominal price index divided by consumer price index) of potato, onion, tomato, chili, garlic, and overall vegetables are reported in Table 3. There exist wide annual fluctuations in prices of individual and total vegetables, indicating uncertain vegetable supplies. These fluctuations obscure any systematic trend in price indices for most individual vegetable species. However, a significant (at the 10% level) negative trend is observed in potato prices, while prices of total vegetables show a significant positive trend (the total vegetable prices did not include onion, garlic, turmeric, and potato). This indicates that increases in prices of vegetables exceeded those of other consumer goods and suggests a demand pressure on vegetables and an increasing gap between vegetable demand and supply.

Table 3. Deflated retail price index (1969=100) for selected vegetables, 1969-90

Year	Potato	Onion	Tomato	Chili	Garlic	Vegetables[1]
1969	100	100	100	100	-	100
1974	137	136	88	190	-	114
1975	108	163	95	133	-	115
1976	113	128	111	166	-	149
1977	99	115	114	136	-	135

Contd. Table 3.

Year	Potato	Onion	Tomato	Chili	Garlic	Vegetables[1]
1978	100	156	123	117	-	132
1979	73	103	109	94	-	119
1980	103	147	104	88	100	126
1981	110	89	106	131	151	148
1982	67	156	97	149	91	97
1983	89	115	126	112	79	156
1984	100	75	97	93	79	134
1985	78	124	84	85	116	114
1986	82	141	104	107	117	105
1987	116	145	100	120	119	156
1988	115	81	106	198	62	157
1989	69	82	77	171	80	153
1990	98	175	128	112	186	177
Growth rate (%)	-1.21	0.14	0.30	0.46	0.58	1.25
	(1.82)	(0.14)	(0.68)	(0.55)	(0.18)	(1.79)

[1]Based on nominal retail price indices divided by the food and beverage price index.
Figures in parentheses are the t-values.
Note: To save some space, figures for 1970-73 are skipped.

Risk in Production

Table 4 reports the detrended coefficients of variation (cv) in area, production, and yield of total and individual vegetables. The deviation of yearly production of vegetables from their trend values is high and exceeds considerably that of cereals. Except in onion and lady's finger, the major share of the variation in production comes from area fluctuation, suggesting a large year-to-year variation in the prices of vegetables at the time of sowing and information sharing among farmers. Fluctuations in vegetable production were most pronounced in the case of turmeric, cabbage, chili, and pumpkin. Tomato is the only crop with a lower yield variation than cereals. The relatively low variation in the yield of tomato, eggplant, melons, and cauliflower might be due to the advanced and stable technology used in the cultivation of these crops, or the favorable environments in which these crops are cultivated.

Table 4. Detrended coefficients of variation (%) in area, production, and yield of selected vegetables, 1970-93

Vegetable	Area	Yield	Production
Cabbage	19.3	3.7	21.6
Cauliflower	6.6	2.4	6.2
Chili	17.5	8.1	20.9
Eggplant	7.5	2.3	9.3
Garlic	16.8	13.6	14.0
Lady's finger	3.5	5.3	7.4
Melons	8.0	2.2	7.7
Onion	5.6	10.9	12.9
Potato	8.7	6.8	11.4
Pumpkin	17.2	6.1	18.6
Tomato	4.1	1.9	6.9
Turmeric	25.1	15.7	22.9
All vegetables	9.3	6.1	9.3

Seasonality in Prices

Table 5 reports 10-year monthly average wholesale prices of selected vegetables. The main conclusions that can be drawn from the table are the following: 1) monthly vegetable prices tend to rise gradually in the post-harvest months and reach their highest levels in the pre-harvest period; and 2) the magnitude of price seasonality depends upon perishability, length of harvest period, and storability. For example, relatively stable prices in the case of turmeric and chili follow from their nonperishable nature relative to other vegetables. Tomatoes, being nonstorable and highly perishable, show the highest price variability. Finally, monthly prices remain considerably below the annual price for nearly six months because of overlapping harvests in Sindh and Punjab in the case of garlic and onion, and because of autumn and spring crops in Punjab in the case of potatoes.

Farm Management Practices

The Agricultural Development Bank of Pakistan (1986) provides information on technical and agronomic aspects of both winter and summer vegetables, including planting season and method, varieties, nursery culture, seed rate, land preparation, transplanting, crop culture, harvesting, yield, pests, diseases, income, cost, and net return/gross margin. As well, the Department of Agriculture (DA), Government of Punjab, periodically publishes bulletins in Urdu on most vegetables. The Pakistan Agricultural Research Council (PARC) has published material in both English and Urdu on some of the important vegetables grown in various parts of the country. However, all of these publications provide information on the recommended practices, rather than what actually happens in farmers' fields.

Table 5. Wholesale monthly prices (PKR/40 kg) of vegetables (average for 1983-92)

Months	Dry chili	Turmeric	Onion	Garlic	Potato	Tomato
July	633.5	728.6	76.0	343.2	126.4	240.3
August	594.0	734.0	119.6	470.0	133.1	244.9
September	569.2	779.9	132.5	443.0	123.6	187.4
October	552.2	789.9	137.8	477.0	125.4	282.8
November	568.2	767.9	150.5	532.8	122.4	316.5
December	639.4	781.5	139.0	516.5	76.3	235.6
January	653.3	732.9	111.5	558.0	57.4	175.0
February	674.1	683.8	89.1	595.5	59.8	215.2
March	651.3	676.4	76.9	321.0	62.8	261.4
April	690.7	684.9	79.8	257.8	78.9	247.4
May	740.0	725.5	89.2	292.0	95.7	105.9
June	692.6	768.8	87.7	362.5	107.3	102.0
Annual average	638.2	737.8	105.1	442.3	97.4	217.8
Seasonality (%)	34.0	16.8	98.0	131.0	131.9	210.3

Source: Averages based on data for 1983 to 1992 in Government of Pakistan (1993a).

The University of Agriculture, Faisalabad, has done extensive research on various aspects of vegetable production. However, the entire work is of an experimental nature with emphasis on the effect of a particular input or practice on yield, resistance against pests or diseases, etc. It may, therefore, be concluded that little research has been undertaken to understand farm-level practices, input-output relationships, marketing efficiency, gross and net incomes, etc.

Vegetable Production Systems

Peri-urban Production Systems

Peri-urban vegetable farms are characterized by year-round vegetable cultivation where summer and winter vegetables are rotated in the cropping pattern. In some cases, however, winter vegetables are followed by a summer crop of fodder, maize, sorghum, or millet. Mixed cropping and inter-cropping (e.g., onion with chili, potato with arum or cauliflower, onion with eggplant or chili, sugarcane with onion or chili) are among the popular cropping patterns of peri-urban production systems (Khan, D.A. 1993). Under these systems, vegetable production is concentrated near the consumption centers, i.e., around urban conglomerations. While most production is to supply the closest city, in some cases, surpluses from one peri-urban area are transported to other urban sites. For example, the entire Islamabad-Rawalpindi vegetable market is served by peri-urban production systems in the vicinity of Lahore and Peshawar, and a major proportion of supplies to the Karachi market is shipped from Hyderabad. These systems specialize in the production of all kinds of vegetables, depending on their demand, with emphasis on perishable species, such as cauliflower, spinach, tomatoes, radish, and cucumber. Concentration of these vegetables around cities is a function of proximity and the difficulty of transporting perishable vegetables, and the availability of sewage water and other water for irrigation.

Peri-urban vegetable farming is mainly done on holdings of less than 5 ha. Planting is mostly done by hand, mainly due to the availability of cheap labor, lack of funds for making use of machinery, and the small areas involved. Vegetables, such as eggplant and cauliflower are first sown into nursery beds then transplanted. Others, such as peas, okra, cucurbits, carrots, radish, and spinach, are direct seeded. Most vegetables are planted on ridges containing a single row. Up to now, there is no commercial nursery producing containerized seedlings. Frequent (weekly) irrigation is common in peri-urban systems. Most vegetable growers rely heavily on farmyard manure supplemented by heavy doses of chemical fertilizers, often in the ratio 150:150:75 kg NPK/ha. (National Engineering Services Pakistan (Pvt) Limited and Overseas Project Corporation of Victoria, Limited 1993).

Vegetables in Cropping Systems

Vegetables are also grown in cropping systems dominated by crops such as wheat, cotton, rice, sugarcane, or maize. Vegetables are either intercropped with the main crop or are part of a cropping sequence. Most vegetables grown in such systems are relatively less perishable and can be more easily transported over long distances. Often, the systems are relatively far away from the consumption centers. Vegetables grown in such systems include watermelon, muskmelon, peas, potatoes, wax gourd, chili, garlic, and onions.

Information on farm management practices followed in the above systems, with the exception of potato, is very scanty. Practices followed in potato cultivation are summarized in Table 6.

Kitchen Gardens

Homestead or kitchen gardens are grown all over the country, but more are found in the northern areas. The management practices for various vegetables grown in kitchen gardens in the northern areas of Pakistan are elaborated in Pokhrel (1992).

Economics of Vegetable Production

The history of estimating the economics of production for various crops starts with a field survey carried out by the Ministry of Food and Agriculture in 1977 on the cost of production of major vegetables in the selected districts of Pakistan. On the basis of this exercise, the Ministry published a state of the art report in 1978 and subsequently in 1979 (Government of Pakistan 1978, 1979). After the publication of the Ministry's reports, studies on the economics of vegetable production were undertaken by individual researchers, provincial organizations, commissions, and universities. Based on a small sample of 150 farmers, Ashraf (1989) reported data on total costs per acre of various vegetables without much detail on individual cost items. In 1993-94, Ayub Agricultural Research Institute undertook a cost-of-production study on potato on the basis of a small sample of farms in two Punjab villages.

The Agricultural Prices Commission of Pakistan has also studied the cost of production of potato and onions (Government of Pakistan 1994b,c). Similarly, Ahmad et al. (1993) estimated cost of production and profitability of major crops, including important vegetables. Estimates for major crops were based on various farm-level studies, whereas vegetable estimates were derived from consultation with experts.

Table 6. Farm management practices (per ha) for potato cultivation in Punjab, 1993

Operation/Input	Unit	Farm size	
		Small farms (n=12) (less than 10 ha)	Large farms (n=17) (more than 10 ha)
Land preparation			
Mechanical operation	Hours	30	39.5
Labor	Labor (days)	2.5	-
Seed rate	Bag	30	32
Planting			
Ridge operation	No.	1	1
Labor use with ridger	Labor (days)	2.5	2.5
Fertilizer application			
Farmyard manure (quantity)	Trolley	3.7	2.5
Farmyard manure application	Labor (days)	3.7	2.5
Urea	Bag	7.4	8.6
DAP	Bag	7.4	7.4
Potash	Bag	-	2.5
Super Phosphate	Bag	-	6.2
Transport	PKR	74	124
Fertilizer application	Labor (days)	5	7.4
Plant protection			
Chemical sprays	No.	4	6
Application	Labor (days)	10	6
Irrigation			
Water	Number of irrigations	14	14
Labor	Labor (hours)	35	35
Hoeing and earthing up	Labor (days)	0	0
Weeding (manual)	Labor (days)	0	0

Source: Ayub Agricultural Research Institute (1993a, 1993b, and 1993c) (average of the three sources).

Vegetable cultivation is relatively intensive (Table 7) and more profitable (Table 8) compared to other major arable crops, such as cotton, wheat, rice, and sugarcane.

Table 7. Level of input use per hectare for major vegetables, 1993

Vegetable studied	Regions	Fertilizer (kg)			Pesticide (PKR)	Labor (days)	Reference
		N	P	K			
Chili	Punjab	79.1	56.8	74.1	160	157.7	Ahmad et al. (1993)
Muskmelon	Punjab	82.8	59.3	74.1	800	88.5	Ahmad et al. (1993)
Onion	Punjab	79.1	56.8	80.3	-	173.4	Ahmad et al. (1993)
Onion	Punjab	135.9	56.8	-	683	143.3	Government of Pakistan (1994b)
Potato (Small farms)	Okara Punjab	237.2	178.5	-	1532	108.5	Ayub Agricultural Research Institute (1993b)
Potato (Large farms)	Okara Punjab	265.3	226.1	61.8	2446	104.4	Ayub Agricultural Research Institute (1993b)
Potato	Punjab	158.4	113.7	80.3	800	143.3	Ahmad et al. (1993)
Potato	Pakistan	227.3	113.7	123.6	2872	88.3	Government of Pakistan (1994c)
Tomatoes	Punjab	101.3	150.7	59.3	800	195.4	Ahmad et al. (1993)
Watermelon	Punjab	129.7	59.3	74.1	800	88.5	Ahmad et al. (1993)
Rice (fine) in rice-based system	Punjab	42.0	13.0	-	45	26.0	Ahmad et al. (1993)
Sugarcane in mixed cropping system	Punjab	44.0	23.0	-	250	52.0	Ahmad et al. (1993)
Wheat in cotton-based system	Punjab	42.0	22.0	-	-	9.1	Ahmad et al. (1993)

Table 8. Economics of vegetables and major field crops in PKR/ha, 1993

Vegetable studied	Region	Total cost	Gross returns	Net benefit	Benefit-cost ratio	Reference
Chili	Punjab	22934	39085	16151	1.70	Ahmad et al. (1993)
Muskmelon	Punjab	16291	30875	14584	1.90	Ahmad et al. (1993)
Onion	Punjab	1974	30875	11701	1.61	Ahmad et al. (1993)
Onion	Punjab	28860	55598	267388	1.93	Government of Pakistan (1994b)
Potato (Small farms)	Okara Punjab	34562	N.A.	N.A.	N.A.	Ayub Agricultural Research Institute (1993b)
Potato (Large farms)	Okara Punjab	37769	N.A.	N.A.	N.A.	Ayub Agricultural Research Institute (1993b)

Contd. Table 8.

Vegetable studied	Region	Total cost	Gross returns	Net benefit	Benefit-cost ratio	Reference
Potato	Punjab	42084	69160	27076	1.64	Ahmad et al. (1993)
Potato	Pakistan	27432	58810	31378	2.14	Government of Pakistan (1994c)
Tomatoes	Punjab	21428	44658	23230	2.08	Ahmad et al. (1993)
Watermelon	Punjab	13729	17290	3561	1.26	Ahmad et al. (1993)
Cotton in cotton-based system	Punjab	12699	16006	3307	1.26	Ahmad et al. (1993)
Rice (fine) in rice-based system	Punjab	8993	8954	-39	1.00	Ahmad et al. (1993)
Sugarcane in mixed cropping system	Punjab	22889	22409	-480	0.98	Ahmad et al. (1993)
Wheat in cotton-based system	Punjab	8075	7988	-87	0.99	Ahmad et al. (1993)

Production Constraints

Despite high profitability, availability of irrigation water, and varied climatic conditions, vegetable production in Pakistan remains limited. According to a study by international consultants (Produce Studies Limited 1989) a large number of factors limit Pakistan's production and export potential of fruits and vegetables. The most common among them are poor farm management practices, lack of adequate social and physical infrastructure, such as skill development, extension, transportation, and storage facilities, absence of marketing intelligence; improper storage of seeds, lack of necessary inputs; salinity and water-logging, irregularities in domestic and international markets, lack of grading, and lack of government support.

Guiji and Pretty (1992) identified the following constraints/problems in potato production, which are very much applicable to other crops.

Seeds. i. high cost of imported seed, ii. low quality of local seed, iii. shortage of proper variety seed for an ecoregion, iv. high price of cold storage.

Fertilizer. i. non-availability of fertilizer at the appropriate times, ii. inappropriate dosage of fertilizer, iii. poor quality of fertilizer sacks, iv. high price of fertilizers.

Pest and disease treatment. i. high degree of pest and disease problems, ii. lack of accurate information on pesticides.

Irrigation. i. high cost of irrigation water, ii. uncertainty and fluctuation in the supply of electricity, iii. lack of irrigation, iv. waterlogging.

Labor. i. shortage of labor or high wage rate.

Land. i. land fragmentation, ii. small size of land holdings, iii. high cost of renting land, iv. land disputes.

Credit and loans. i. lack of access to institutional credit and loans.

Marketing. i. low prices in January-February, ii. price fluctuations across the years, iii. trouble in transporting produce to markets, iv. exploitive practices by commission agents (middlemen).

It should, however, be noted that these constraints vary from region to region and hence should be discussed in a regional context. In this respect, a study by PARC on constraints to potato production by ecological zone seems to be highly relevant (Table 9).

Table 9. Constraints to potato production in various ecological zones

Zone	Constraints
1. Irrigated Plains of Sindh and South Punjab	a) Inadequate availability of water b) Inadequate supplies of healthy seed c) Attack of early blight d) Low density of potato production e) Lack of skill
2. Irrigated Plains of Central Punjab	a) Extreme temperatures at planting and maturity stages b) Soil salinity c) Aphids and virus infection d) Attack of late blight and other soil-borne diseases, pests e) Zinc deficiency
3. Irrigated Plains of NWFP and Northern Punjab	a) Virus attack b) Use of unhealthy seed c) Zinc deficiency and inadequate application of fertilizer d) Attack of late blight
4. Irrigated Lower Valleys of NWFP (900-1500 m)	Constraints not studied
5. Rain-fed high valley and hill-side NWFP and Azad Kashmir (1750-2600 m)	a) Uncertain rainfall b) Attack of late blight c) Difficult access to some areas for extension agents
6. Irrigated higher valleys of NWFP (1750-2600 m)	a) Attack of late blight b) Lack of proper rotation, resulting in build-up of diseases c) Attack of cyst nematodes d) Infertile soil and low organic matter content e) Poor access to some areas by road

Contd. Table 9.

Zone	Constraints
7. Irrigated high valleys of northern areas and Chitral (2250-3000 m)	a) Use of virus infested local potato seed b) Poor access to potentially new production areas
8. Irrigated mid-elevation and valleys of Baluchistan (1600-2300 m)	a) Inadequate supply of water b) Strong competition from tomatoes c) Attack of various diseases d) Inefficient marketing system

Source: Pakistan Agricultural Research Council (1989).

Marketing Systems

Marketing Channels

The most common marketing channels for vegetables are depicted in Table 10 and Figure 2. Village sales are important only for the relatively less perishable vegetables, such as onions and pumpkins. After production, vegetables generally pass through three stages (i.e., commission agents, wholesalers, and retailers) before reaching consumers. Commission agents sell for a commission, while wholesalers sell through open auction to retailers in small lots. Vegetables are also sold to preharvest contractors who buy standing fields and harvest and market the produce themselves. Considerable regional variation exists in the proportion sold to different agencies and the ensuing marketing margins for the same vegetable. This variation depends upon the proximity of regulated markets, availability of institutional marketing and credit agencies, status of road links with markets, transportation facilities, and the general attitude of the farmers. It has, for example, been reported that the marketing margins per kilogram of potato did not exceed PKR 0.20 in Mardan, as compared to PKR 0.47 in Okara, PKR 0.98 in Baluchistan, and PKR 1.64 in Swat Valley (Malik 1995).

Table 10. Distribution channels for vegetables (percent of total sales)

Vegetable	Farm to village merchant	Farm to commission agent	Farm to wholesaler
Potatoes	55	-	45
Onions	18	4	78
Tomatoes	31	-	61

Source: Government of Pakistan (1988).

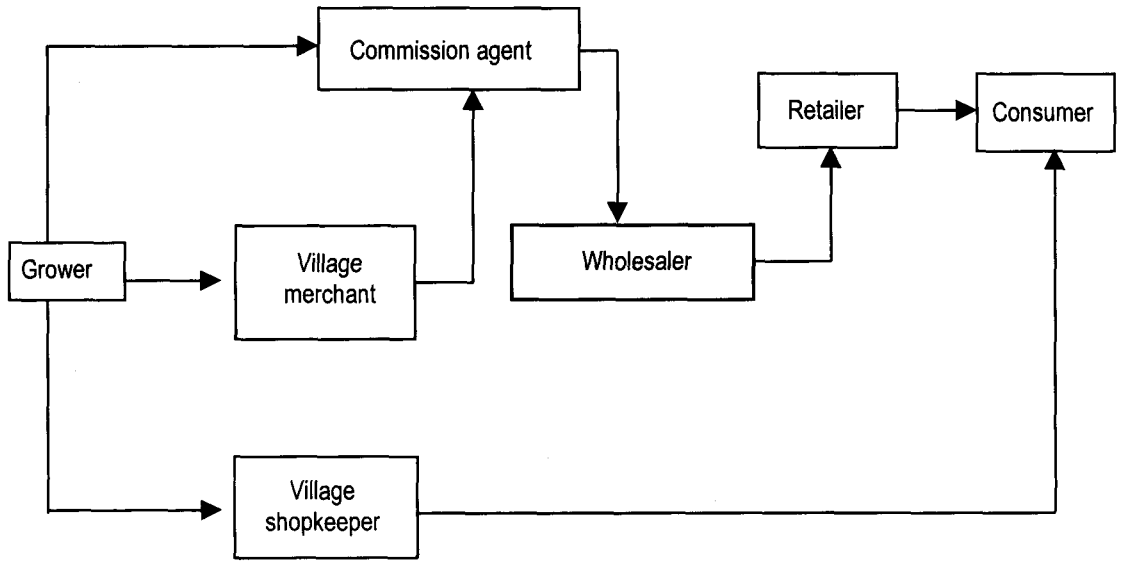


Fig. 2. Market channels for potato.

Efficiency of Marketing

Marketing problems in vegetables are linked to management practices and increased by the lack of on-farm storage, by rudimentary harvesting and packing methods, and by high variability in output from year to year. The segment that links producers to local markets or primary distribution points seems to function relatively efficiently (Malik 1995). At the wholesale marketing level the system is less efficient due to the congested and dilapidated conditions of most vegetable marketplaces, as well as the large number of relatively small transactions that take place before the commodity finally reaches the consumer. Nevertheless, it should be recognized that all these transactions are accomplished with marketing margins that are not excessive when the risk involved and the inadequacy of the facilities are taken into account. Moreover, the wholesale marketing system has shown an ability to handle a high volume of vegetables, despite the poor physical infrastructure and congestion in markets, which impose an absolute limitation on the volume of produce that can be absorbed. That said, there is considerable scope for improvement of the entire marketing system.

Wholesale marketplaces are generally poorly designed. They are too small, have no storage facilities, and are entirely located in the centers of towns and major cities. Congestion, confusion, filth, disorder, and reputed malpractice typify most wholesale marketplaces. Commission agents and wholesalers manage the wholesale markets. Auction "bidding" starts in some markets as early as 4:00 a.m. Few producers are able to enter the marketplace at the early hours of the auction. Prices can vary more than 100% within 2-3 hours. Trading is generally over for the day before 8:00 a.m. This organized confusion and congestion is to the benefit of wholesalers/commission agents who are far better informed as to prices, markets, available storage, etc., than are the small, unorganized, poorly informed producers (Kokab and Smith 1989).

Marketing margins between farm and retail level provide an understanding of the spread between producer and consumer prices. These margins are measured as the difference between the retail price of food and the payment to farmers for an equivalent quantity of farm produce. It represents the total

payments made to marketing agents for providing services, such as assembling, transporting, storing, processing, wholesaling, and retailing. Marketing margins for various vegetables were estimated by United Consultants Group Ltd. (1984), Kokab and Smith (1989), Kokab (1984), Siddique (1980), and Lodhi (1990). The estimates in these studies varied from 36% to 75% (Table 11).

Table 11. Marketing margins for various vegetables (% of consumer price)

	Potato			Onion		Tomato			Peas	Carrot	Brinjal
	Lodhi[1]	UCL[2]	Kokab & Smith[3]	Kokab[4] a	Kokab[4] b	Lodhi	UCL	Siddique[5]	Lodhi	UCL	UCL
Grower	56.0	62.1	63.7	49.1	55.0	57.0	55.5	54.9	25.0	56.9	60.6
Commission Agent	-	8.5	11.3	1.5	1.7	-	7.8	3.4	-	9.0	6.9
Wholesaler (Pharia)	-	11.5	2.1	21.0	14.8	-	10.0	16.4	-	12.8	12.4
Retailer	-	17.9	22.9	28.4	28.5	-	26.7	25.3	-	21.3	20.1
Marketing margin	44.0	37.9	36.3	50.9	45.0	43.0	44.5	45.1	75.0	43.1	39.4

a. Unstored winter onion; b. Stored winter onion; - implies that details are not available.
[1] Lodhi (1990); [2] UCL (1984); [3] Kokab and Smith (1989); [4] Kokab (1984); [5] Siddique (1980).

It is difficult to assess whether the large marketing margins are exploitative. Similar margins are observed in some of the advanced agricultural markets of western countries, although the services provided in western countries are of much superior quality. As services provided by intermediaries in Pakistan are of low quality, charges might appear high. The large margins, however, are the result of the primitive infrastructure, which causes high losses and adds considerably to the handling costs for the intermediaries.

International Trade

Net vegetable international trade to and from Pakistan was worth PKR 49.5 million in 1993, represented by PKR 235.2 million in exports and PKR 185.7 million in imports. The relative share of onion and chili in total export earnings has fluctuated over time. For example, chili contributed 91% during 1991, while onion contributed 53% in export earnings in 1993. The major imports are potato and seed of other vegetable.

Because of the erratic nature of international trade in vegetables in Pakistan, no significant trend was observed in quantities of vegetables exported. The government's sensitivity to the domestic fluctuation of vegetable prices, which causes erratic government intervention in international vegetable trade, is responsible for these results. Producers Study Limited (1989) identified a great potential to expand vegetable exports provided basic changes in the quality of produce, post-harvest handling, and transport infrastructure were made. The maximum quantity of vegetables exported was recorded in 1979. In recent years, vegetable imports have virtually matched exports (Table 12). This is another indication of the increasing gap between domestic demand and production.

Table 12. International trade in vegetables, 1973-93

Year	Total exports (Quantities 000 t)	Total exports (Value million PKR)	Exports net of imports (Quantities 000 t)	Exports net of imports (Value million PKR)
1973	10.6	18.2	10.6	18.2
1974	0.5	4.0	0.5	4.0
1975	14.2	68.4	14.2	68.4
1976	20.9	48.1	20.9	48.1
1977	63.8	136.7	63.8	136.7
1978	66.9	193.3	66.9	193.3
1979	123.7	297.6	123.7	297.6
1980	86.3	170.7	86.3	170.7
1981	39.9	91.0	39.9	91.0
1982	87.0	203.7	87.0	203.7
1983	56.1	191.0	53.1	159.4
1984	40.3	230.7	35.3	186.3
1985	81.0	268.7	75.0	197.2
1986	61.6	259.4	58.6	186.8
1987	77.3	316.1	74.3	234.0
1988	35.9	264.7	27.9	126.6
1989	108.3	343.1	107.4	259.2
1990	16.2	206.7	15.2	106.7
1991	39.8	523.0	35.4	416.8
1992	13.0	165.1	8.2	31.1
1993	37.3	235.2	32.1	49.5

Source: Government of Pakistan (1983a, 1993a and unpublished data from Ministry of Food, Agriculture and Livestock).

Supply and Demand

Availability

Average annual per capita availability of vegetables (excluding potato but including onion, garlic, and chili) derived from domestic production after deducting exports, ranged from 24 kg (65 g/day) in 1980 to 32 kg (89 g/day) in 1993 (Table 13). There was some improvement in vegetable production, although it produced little change in per capita availability, because of high population increase and a low base to start with.

Table 13. Per capita availability of vegetables at the farm level, 1980-1993

Year	Production (000 t)	Trade surplus (000 t)	Net availability (000 t)	Population (million)	Per capita availability	
					kg/annum	g/day
1980	2081.1	86.3	1994.8	83.8	23.8	65.2
1981	2136.1	39.9	2096.2	86.4	24.3	66.4
1982	2610.0	87.0	2523.0	89.1	28.3	77.6
1983	2468.9	53.1	2415.8	91.9	26.3	72.0
1984	2469.4	35.3	2434.1	94.7	25.7	70.4
1985	2624.5	75.0	2549.5	97.7	26.1	71.5
1986	3063.7	58.6	3005.1	100.7	29.8	81.8
1987	3162.2	74.3	3087.9	103.8	29.7	81.5
1988	3318.9	27.9	3291.0	107.0	30.7	84.2
1989	3474.0	107.4	3366.6	110.4	30.5	83.6
1990	3431.8	15.2	3416.6	113.8	30.0	82.3
1991	3688.1	35.4	3652.7	117.3	31.1	85.3
1992	3811.8	8.2	3803.6	120.8	31.5	86.2
1993	4062.7	32.1	4030.6	124.5	32.4	88.7
Growth rate	5.0	-9.7	5.2	3.0	2.2	2.2

Source: Same as in Table 3 for production, and same as in Table 12 for trade surplus. For population, Government of Pakistan (1995). Per capita availability was calculated from the total availability divided by population.

Consumption

Vegetables are consumed both in cooked and raw form. For instance, tomato, coriander, green chili, turnip, carrot, radish, etc., are consumed both in cooked and raw form; while cucumber, watermelon, muskmelon, etc., are consumed only in raw form. Still, some other vegetables, such as potatoes, are consumed in a variety of ways in various parts of Pakistan and are more appreciated when cooked along with other vegetables and meat. Potato chips fried in vegetable oil are commonly served with tea in urban areas. Pakorra is also a famous local snack, the main ingredient of which is potatoes. Presently, different types of potato chips are being introduced in Pakistan, and entrepreneurs are now taking interest in this business. A number of large industrial processors now produce high quality packaged chips.

The Household Income and Expenditure Surveys (HIES) undertaken by the Federal Bureau of Statistics report on monthly per capita consumption and the percentage distribution of monthly household expenditure on consumables, including vegetables, such as potatoes, chili, onions, tomatoes, and other vegetables, by income group and rural-urban area.

According to the survey of 1991, Pakistanis spent about 9.6% of their food expenditures on vegetables, up from 7.2% in 1979. The increase in expenditure share for vegetables was observed across all income groups. Little difference was observed in rural and urban areas with respect to the percentage of food expenditure spent on vegetables. However, the expenditure on vegetables as a percent of food expenditure was found to be a declining function of incomes in both the urban and

rural areas; while the lowest income group allocated 9.9%, the highest income group spent only 7.6% of food expenditures on vegetables.

Average annual per capita vegetable consumption in Pakistan in 1991 was 38.7 kg, up from 23.2 kg in 1979. The increase was observed across all income groups, but a higher percentage increase was found in the middle-income groups. No significant difference in rural and urban areas with respect to vegetable consumption was noticed. However, despite the low share of expenditures on vegetables, high-income groups consumed about 19% more vegetables than did low-income groups in 1991 (Table 14).

Table 14. Annual vegetable consumption (kg/capita) by income group and urban-rural classification in 1979 and 1991

Income group	1979			1991		
	Rural	Urban	Pakistan	Rural	Urban	Pakistan
All groups	22.0 (7.2)	25.7 (7.2)	23.2 (7.2)	38.4 (9.7)	39.3 (9.4)	38.7 (9.6)
1	22.1 (7.3)	23.5 (7.6)	22.4 (7.8)	36.4 (10.1)	36.8 (9.1)	36.5 (9.9)
2	22.8 (7.2)	23.3 (7.6)	22.8 (7.3)	38.0 (11.2)	37.0 (11.1)	37.7 (11.2)
3	21.7 (6.9)	25.4 (7.8)	22.7 (7.3)	37.0 (10.4)	35.3 (11.0)	36.4 (10.6)
4	26.0 (6.6)	24.8 (7.6)	22.3 (7.1)	36.6 (10.3)	37.2 (10.8)	36.8 (10.5)
5	20.6 (6.3)	24.2 (7.3)	22.0 (6.9)	38.3 (9.9)	38.3 (10.2)	38.3 (10.0)
6	23.9 (6.0)	25.9 (6.9)	25.2 (6.6)	37.1 (9.7)	40.1 (9.7)	38.1 (9.7)
7	23.4 (5.7)	27.5 (6.8)	25.8 (6.5)	40.6 (9.0)	41.9 (9.5)	41.1 (9.2)
8	25.0 (5.7)	29.0 (6.2)	27.5 (6.3)	38.3 (8.9)	39.3 (9.3)	38.6 (9.1)
9	26.8 (5.7)	33.4 (6.5)	31.2 (6.0)	38.1 (8.2)	40.2 (8.7)	38.7 (8.4)
10	40.4 (5.9)	32.8 (6.3)	35.4 (6.2)	49.5 (9.3)	43.5 (8.9)	46.6 (9.1)
11	31.8 (4.5)	37.8 (5.5)	36.1 (5.3)	45.2 (8.1)	44.2 (7.1)	44.9 (7.6)

Source: Government of Pakistan (1983b, 1993b); The figures in parentheses are the percentage of total food expenditure spent on vegetables. The monthly per capita income (PKR) groups in the 1979 survey are 1= average of 300 and 301-400, 2=401-500, 3=501-600, 4=601-800, 5=801-1000, 6=1001-1500, 7=1501-2000, 8=2001-2500, 9=2501-3000, 10=3001-3500, 11= above 3500. In the 1990-91 survey, these groups are 1=up to 1000, 2=1001-1500, 3=1501-2000, 4=2001-2500, 5=2501-3000, 6=3001-3500, 7=3501-4000, 8=4001-5000, 9=5001-6000, 10=6001-7000, 11=above 7000.

Micro-level studies have also compared vegetable consumption across different social groups and have quantified the consumption of individual vegetable species. Aslam et al. (1982) estimated consumption of important vegetables for small farmers and non-farmers in four villages of Faisalabad district in Punjab (Table 15). Average total vegetable consumption (including potato) per capita was around 85 g/day. Non-farmer households in the rural communities were consuming less vegetables than farmer households. Khan (1988), on the other hand, reported that non-farmers were spending relatively more of their total food expenditure on vegetables (Table 16). This might be the result of the lower income of non-cultivators, or high vegetable prices that non-cultivators had to pay to buy foods from markets. In another study, Khan, M.J. (1993) reported that farm households in the irrigated areas spent more on vegetable consumption than those in barani (rain-fed) and partially barani areas (Table 16).

Table 15. Consumption of various vegetables (g/capita) in rural areas of Faisalabad

Vegetables	Farmers	Non-farmers	Both
Cauliflower	0.3	-	0.2
Cowpeas	2.7	-	1.7
Eggplant	9.4	7.0	8.5
Ginger	0.1	0.1	0.1
Gourd	25.5	17.3	22.5
Mustard leaves	8.7	15.6	11.2
Onion and garlic	15.3	12.6	14.4
Potato	16.4	13.6	15.4
Radish	2.7	6.4	4.0
Spinach	6.4	8.4	7.1
Total	87.5	81.0	85.1

- implies that the figure was not relevant or it was not available; Source: Aslam et al. (1982).

Table 16. Expenditure on vegetables

Category	Expenditures		Reference
	Percentage of foods expenditure	Percentage of all expenditure	
A.			Aslam et al. (1982)
Farmers	10.7	Not available	
Non-farmers	11.4	Not available	
Both	10.9	Not available	
B.			Khan (1988)
Farm Household			
Barani (rain-fed)	7.21	4.16	
Irrigated	7.28	4.66	
Overall	7.26	4.58	
Non-Farm Household			
Barani (rain-fed)	7.08	4.45	
Irrigated	8.46	5.45	
Overall	8.29	5.38	
C.			Khan, M.J. (1993)
Farm Household			
Barani (rain-fed)	2.74	2.00	
Partial barani	3.70	2.46	
Irrigated	9.38	5.60	
Overall	8.22	5.41	
Non-Farm Household			
Barani (rain-fed)	4.84	3.73	
Partial barani	3.37	2.72	
Irrigated	10.71	6.91	
Overall	16.15	6.91	

Demand Elasticities

Little research has been done on estimating price and income elasticities, especially for individual vegetables. McCarthy (1977) reported an own-price elasticity for vegetables for rural low-income consumers of 0.08, suggesting that the demand for vegetables with respect to price is highly inelastic, i.e., price variations do not affect the demand for vegetables much. Kokab and Smith (1989) found the correlation between income and potato consumption to be insignificant.

Burney and Akmal (1991), basing their analysis on data from the 1985 Household Income and Expenditure Survey, presented more detailed estimates of income and price elasticities of demand for vegetables, including potato, onion, and fresh vegetables, by income group and by urban-rural classification. The results of this study are summarized in Table 17.

Table 17. Income and price elasticities of demand by income group for potato, onion, and all fresh vegetables during 1984-85

Kind of elasticities and vegetable	Income group (PKR)						
	< 1000	1000-1500	1500-2000	2000-3000	3000-5000	5000-15000	All Groups
A. Income Elasticities							
Urban							
Potato	0.28	0.23	0.28	0.16	0.34	0.10	0.25
Onion	0.29	0.26	0.37	0.23	0.45	0.23	0.23
Fresh vegetables	0.38	0.37	0.42	0.39	0.40	0.37	0.39
Rural							
Potato	0.55	0.46	0.29	0.49	0.38	0.89	0.47
Onion	0.62	0.52	0.42	0.51	0.43	1.04	0.54
Fresh vegetables	0.71	0.70	0.44	0.49	0.57	0.59	0.57
B. Price Elasticities							
Urban							
Potato	-0.06	-0.11	-0.13	-0.08	-0.21	-0.05	-0.11
Onion	-0.07	-0.12	-0.17	-0.11	-0.28	-0.11	-0.11
Fresh vegetables	-0.09	-0.19	-0.20	-0.19	-0.25	-0.18	-0.18
Rural							
Potato	-0.11	-0.16	-0.07	-0.21	-0.38	-1.33	-0.16
Onion	-0.12	-0.18	-0.10	-0.21	-0.42	-1.55	-0.18
Fresh vegetables	-0.14	-0.25	-0.11	-0.21	-0.56	-0.85	-0.21

Source: Burney and Akmal (1991).

Generally, income and price elasticities of vegetables are higher in rural areas than in urban areas. While the above results suggest relatively low price elasticities for vegetables, Bouis (1991) estimated a price elasticity of demand for total vegetables which consistently exceeded 1.0, irrespective of income group. Also, income elasticity estimates in Bouis (1991) consistently exceeded those in Burney and Akmal (1991).

Seasonality

Generally, vegetables are consumed in their respective seasons of production as there is no significant carry-over, with the exception of storable vegetables. An indication of seasonal vegetable consumption was obtained from the monthly vegetable arrivals in Faisalabad market, one of the biggest markets in the country (Fig. 3). The lowest availability is in January and February, the coldest months with high frost. The availability suddenly jumps, to its highest level, in March and April. The difference in lowest and highest vegetable arrivals is about 200%. A relatively small dip in vegetable arrivals comes in May-June, the hottest period.

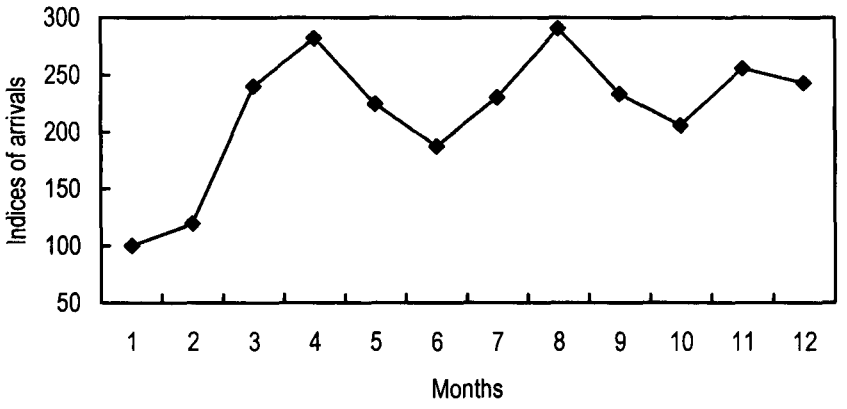


Fig. 3. Seasonality in vegetable arrivals in Faisalabad market (average 1992-94)

Micro-level studies have also indicated seasonal patterns in vegetable consumption for individual vegetables. For example, Kokab and Smith (1989) reported that average per capita consumption of potatoes in the urban areas of Pakistan in winter was more than 1.4 kg/month, while it was only 0.5 kg/month in summer, with an average consumption of 1.1 kg/month. This was mainly because of difference in availability and price of fresh potatoes. Another important factor in depressing demand during summer was the sweet taste of stored potatoes, disliked by consumers.

Consumer Preference

Except for potato, currently no study is available on consumer preferences regarding vegetables. Kokab and Smith (1989) surveyed on factors important in buying potatoes. Freshness of potatoes is considered the most important characteristic by nearly all consumers, particularly because potatoes, when left for a long time in cold storage, develop an unpopular sweet taste. In June 1989, the strong preference for fresh potatoes meant that this produce commanded three or four times the price of the autumn crop, cold-stored potatoes in the Karachi wholesale market.

Price and skin color are two other characteristics considered important by consumers when buying potatoes (Table 18). The relative weight given to price by consumers seems, however, secondary to freshness. Skin color is clearly a major determinant of consumer choice. An interesting finding is the strong preference in northern cities for red-skinned potatoes, while in the south, white-skinned potatoes are preferred; it is difficult to determine any difference in flavor, at least by consumers in general.

Table 18. Factors affecting consumer preferences (% of consumers who consider these factors important) in potato

Cities	% of consumers					
	Freshness	Price	Red skin	Damaged/diseased	Shape	Size
Karachi	100	95	98	78	85	84
Lahore	99	93	81	94	70	72
Multan	99	76	82	77	75	58
Peshawar	99	89	92	90	72	70
Quetta	100	83	83	77	49	46
Rawalpindi	97	95	92	60	78	54
Mean	99	89	87	81	71	63

Source: Kokab and Smith (1989).

Policy Issues

In presenting the analysis of various issues confronting the vegetable industry, the major objective is to facilitate the production of high quality vegetables on a sustained basis. The following are some of the important issues that need the immediate attention of both policy makers and researchers.

Yield Stagnation

Although improved seeds and better cultural practices have been selectively introduced over the last two decades, vegetable yields have tended to stagnate. Some serious efforts will be required to break existing yield ceilings through a pragmatic multidimensional and multidisciplinary approach. The extension system in Pakistan has traditionally been centered around the major crops. There is, therefore, a need to devote more resources to institutional development in the vegetable sector to ensure that inputs and advice are easily available to small farmers. The existing network of Adaptive Research Institutes should undertake verification trials and monitor varieties of various vegetable species with regard to their susceptibility to pests and diseases, and adaptability to soils and climatic conditions. Both quantity and quality should be emphasized in vegetable breeding research. Finally, farm-level diagnostic surveys and studies are needed to identify major constraints to vegetable production.

Availability of Quality Seed

Shortage of quality seed is a major constraint to vegetable production in Pakistan. There is no organized seed production scheme. Most of the cross-pollinated seed varieties, and 100% of the hybrid seed, is imported. Significant quantities of this imported seed are smuggled into the country (NESPAK & OPCT 1993). In recognition of its importance, efforts need to be made at the national level to increase the production and availability of high quality seed. Many northern areas, especially Baluchistan, could be exploited more effectively for this purpose (Samad 1993). However, cost-benefit analyses are needed before starting such an exercise to see if domestic production is cheaper than importing seed, and to identify factors that can help reduce the cost of domestic production.

Inefficient Marketing

The vegetable marketing system in Pakistan is not well developed. The perishable nature of most

vegetables, compounded by rough handling and a lack of storage, processing, packing, and transportation facilities, results in considerable losses. These losses have been estimated to be in the range of 20 to 40% (Kokab and Smith 1989). Appropriate standards and modern technologies needed at various stages of marketing should be introduced to develop an efficient marketing system. Vegetable marketing could be partly improved by encouraging farmers' cooperatives encompassing supply of inputs and credit, harvesting, storing, processing, packaging, and transportation. In view of seasonality in vegetable production, price fluctuation is more of a problem than is level of prices, both for consumers and producers. In this context, there is strong logic for improving marketing intelligence to producers, rather than implementing price intervention schemes. Production technologies that enable crops to tolerate stress, improved marketing infrastructure and crop forecasting methods could be of great help in this regard. Comprehensive studies on these issues could suggest ways and means to smooth out the cyclical gluts and shortages, with their corresponding periods of low and high prices. They would also assist policy makers in their planning.

Export Drive

In addition to widening domestic production opportunities, the option of exporting vegetables on a sustainable basis needs serious consideration. However, international markets are highly competitive and demand high quality and an assured supply of produce. Pakistan has a poor reputation in most export markets (Produce Studies Limited 1989). At the producer, trader, and government levels, a number of measures need to be taken to achieve the necessary quality improvements. Pakistan cannot take the export market for granted. Therefore, grade and quality requirements and preferences of different foreign markets must be studied and arrangements made to meet these standards. For this purpose, the private sector would need to play an active role in developing export markets, while the government's role should be to establish the necessary infrastructure. Without an integrated problem-solving approach at various stages of production, marketing, packaging, grading, and storage, prospects for a breakthrough in vegetable exports from Pakistan will at best remain dim (Produce Studies Limited 1989).

Subsidies and Taxes

At present, producer subsidies are given on agricultural inputs, especially on fertilizer, tube wells, and agricultural machinery. Similarly, services for heavy earth moving equipment are being subsidized by 35 to 70%. Subsidies on deep tillage equipment, reapers, etc., have also been announced. But all of these subsidies are not exclusively for vegetable.

A substantial transfer of resources from the agriculture sector to the non-agriculture sector through direct and indirect taxes, such as land revenue, surcharges, and sales taxes has been reported (Government of Pakistan 1988, 1993c). No comprehensive study is available to evaluate the effect of these taxes and subsidies on vegetable production, consumption, and distribution, including the environmental and health effects of these policies.

Trade Restrictions and Government Regulations

Trade in agriculture, especially in major commodities, is highly regulated. Generally, exportable commodities are procured by the government at low prices from farmers and sold at high prices on the international market. On the other hand, there are no significant restrictions or trade regulations regarding vegetables. However, periodically government does buy surplus to stabilize prices,

especially in potato and onion. But attempts to sell the surplus abroad have failed to create sustained markets.

In the long run, the volume of production and consumption of vegetables is bound to grow because of increased population and prosperity. However, for vegetable producers to enjoy the benefits, modern production and marketing technology must be adopted by farmers, and better marketing intelligence must be provided by government. Vegetables could be an important source of income for farmers, source of food for consumers, and source of foreign exchange for the government.

Research Achievements and Information Gaps

Achievements

Past vegetable research efforts can be divided into breeding and economic research. The goal of the former was to develop high-yielding varieties (HYVs) and that of the latter to suggest institutional adjustments to enhance efficiency in production, distribution, and marketing. As a result of the growing emphasis on breeding research, there are at least 29 research institutes, departments, stations, and substations that are specialized in some aspect of breeding (Hussain 1990). The breeding goals are to achieve resistance to certain pests, diseases, and viruses, reduce the growing period, obtain late or early maturity, and achieve higher yields with plants better suited to climatic conditions. Most vegetables already possess some of these characteristics – each species has more than one variety, and the number can be as large as 12, as is the case for potato (Hussain 1990 and Khan 1993).

As for economic research, many studies have focused on cost of production, marketing channels, and margins, and, in recent years, on production constraints (Ashraf 1989 and Hussain and Hanif 1990), vegetable research (Banaras et al. 1990 and Hussain 1990), production and policy (Assi 1990 and Rana and Rao 1993), and export potential (Produce Studies Limited 1989).

It is not clear, however, if past research has had a significant impact on vegetable production and consumption. For example, despite the emphasis on breeding research, yields of most vegetables remain stagnant. The contribution of economic research also seems unclear. The yield potential of most vegetables remains unexploited. Experimental data in Pakistan have shown that potato and onion yields can reach 40-50 t/ha, yet yields in farmers' fields hardly exceed 10 t/ha (Rana and Rao 1993). Socioeconomic factors contributing to this large yield gap are not very clear.

Information Gaps

The vegetable subsector, despite its importance in nutrition and farm profitability, suffers from information gaps at various stages of production, consumption, and trade. Although data on vegetable area, production, and yields are published annually, doubts about their accuracy are widespread. For example, Hussain and Hanif (1990) have argued that the published official statistics considerably understate potato production, as reported potato yields in independent studies are substantially higher (about 20 t/ha) than official estimates (10 t/ha).

Vegetables are grown in specialized growing areas adjacent to large urban centers. They are also grown in cropping systems dominated by other crops. The relative contribution of each system to total vegetable production is unknown, although it is commonly believed that peri-urban cultivation accounts for most of the total production.

There is a dearth of precise information on farm management practices followed in the production of different vegetables in various regions. Although vegetables have high private profitability as revealed by cost of production studies, their social profitability remains unknown. Given the potentially high rates of return on vegetables relative to field crops, it is not clear why farmers, especially under the assumption of economic rationality, are not shifting to vegetable cultivation to a larger extent. It is not clear whether this should be attributed to inefficiencies of the marketing system, failure of the input delivery system, or to relatively high risks involved in vegetable production. Therefore, there is a need to conduct research which quantifies and prioritizes vegetable production constraints.

There is a need to explain the low adoption rate of modern varieties and technologies by farmers. As far as vegetable consumption is concerned, the Household Income and Expenditure Surveys are the only source of vegetable consumption data. Being minor relative to the consumption of other commodities, individual vegetables are lumped as a group. The income elasticities of demand for vegetables, estimated from these data, reported mixed results. Some show very low, while others very high price elasticities of vegetables. Therefore, more studies are needed in order to have reliable estimates.

Summary, Conclusions, and Suggestions

This study has tried to quantify trends in vegetable production, consumption, and trade and to review the existing literature on various vegetable related issues in Pakistan. Starting with the environment for vegetable production, it is agreed that Pakistan has a good environment for vegetable production. Its diverse climatic conditions, topography, and availability of irrigation water permit year-round cultivation of a wide variety of vegetables. Although certain social taboos against vegetable production and consumption exist, they are only of minor importance. Yearly per capita vegetable availability, mostly from domestic sources, is about 32 kg, or 89 g per day.

Production of various kinds of vegetables has reflected varying trends, and so has trade and per capita consumption. Although total vegetable production (and that of potato) increased significantly over the past two decades, the main contributing factor to these increases came from area increase, while yields remained almost stagnant.

A large part of total vegetable production takes place under traditional management practices. Heavy dependence on farmyard manure, as well on chemical fertilizers, is common. Despite mechanization of some tillage operations, sowing, hoeing, and harvesting remain manual operations. At the same time, most cost of production studies point out that vegetable cultivation is a highly profitable enterprises both in absolute and relative terms (e.g., compared to the field crops). In relative terms, profit rates for vegetables can be 5-10 times those of field crops, depending on the particular vegetable and field crop under consideration. Moreover, since vegetables are short-duration crops, the above figures might understate the relative returns of vegetable cultivation.

Despite potentially high profitability, vegetable production in Pakistan remains limited. A number of factors seem to limit Pakistan's production potential. The most important among them include a lack of physical and social infrastructure, absence of market intelligence, use of improper seed, high infestation of pests and diseases, salinity and water logging, irregularities in domestic and

international markets, and lack of government support. The defective marketing system, in particular, impinges on farm-level profitability, as prices received by farmers are less than half of the prices paid by consumers.

Apart from population growth, family income and consumer prices are the major determinants of aggregate vegetable consumption. After accounting for population growth of 3.0%, income and price trends were responsible for just 2% of the annual growth rate in vegetable availability. Despite the improvement, availability is far below the required minimum level.

Research should try to fill serious information gaps. Specifically, the following issues need immediate investigation.

First, the efficacy and efficiency of the vegetable breeding research system needs to be assessed in order to provide recommendations for improvement. While the former should deal with the question of the current number of research stations, the staff employed, and the available equipment relative to what is needed, the latter should focus on the efficiency of researchers per unit of time. Depending on the findings, the study should suggest how the system should be improved, and what type of research should and should not be carried out.

Second, the data collection system for vegetables in the country needs to be overhauled. Scientific sampling techniques need to be used in generating these data. A field survey of area, production, and yields, along with inputs used in representative districts, seems essential. As part of the survey, questions about constraints could also be included. For an elaborate exploration, these constraints must be divided into production constraints, such as input availability, including seed, labor, fertilizer, manure, insecticides, etc., and post-harvest constraints. Such a study should also generate information on costs and the returns from vegetable cultivation by ecoregion. Technology requirements for alternative vegetable production systems in different ecoregions should be evaluated.

Third, Pakistan's vegetable marketing system suffers from serious inefficiencies. Study is needed into how to reform the system, with clear specifications and justifications for marketing margins of various intermediaries.

Fourth, consumption of vegetables is clearly an unexplored area in Pakistan. To plan the future course of production and trade, estimates of future consumption based on population growth and income and price elasticities would be highly desirable. Detailed consumption statistics by income, locality, vegetable variety, etc., would be worthwhile.

Fifth, in recent years Pakistan has been striving towards diversification and promotion of exports, and has entered the vegetable export market without adequately assessing its prospects. Pakistan faces intense competition in foreign markets, and at times has been out-competed by other producers. A rational strategy for export promotion must be based on relative efficiency and comparative advantage in the production of vegetables. Despite the potentially high private profitability of most vegetables, Pakistani farmers might not possess the comparative advantage in vegetable production needed to enter into foreign trade on a sustainable basis. A study on comparative advantage of vegetables based on domestic resource costs is needed for informed efforts in diversification and export promotion.

Finally, availability of quality vegetable seed is crucial in any program aimed at improving vegetable production. A comprehensive study that focuses on production, availability, constraints, and prospects for quality vegetable-seed production would be a step in the right direction. As a large percentage of seed for certain vegetables is imported, prospects for producing nucleus seed from domestic sources in the various regions of Pakistan should receive special attention in such a study.

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