Research Article

Estimating Household Demand Function for Selected Vegetables in District Peshawar, Khyber Pakhtunkhwa

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Abstract | This research study estimated the household's demand function for selected vegetables (Spinach, Pea, Potato and Cabbage-Cauliflower) in district Peshawar for the year April, 2017. Through proportion allocation technique a total number of 120 households were selected from two villages namely Landi Arbab and Deh Bahadar. Data was analyzed through Double log model for estimation of demand for the selected vegetables. It was found that household head in Landi Arbab includes 87.10% male and 12.90% female whereas in Deh Bahadar, 94.82% household heads were male and 5.18% of the household head were female. Descriptive statistics showed that the average household size was 6. The average education level was 12.92 years and average household's income was Rs. 91,336.66 during the study period. The results showed that on average the quantity demanded of Spinach was 4.1993 Kgs, Pea 4.0767 Kgs, Potato 6.65 Kgs and 4.95 Kgs of Cabbage-Cauliflower. Results showed that Spinach was a compliment of Pea. Results indicated that household size was highly significant and had a positive relation with the quantity demanded. The study showed that household size is highly significant for all the selected vegetables, indicated that as the number of member in household increases the quantity demanded of these vegetables also increases and to meet this gap of excess demand advanced technology should be adopted to increase vegetables production.

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Introduction

Food demand is mostly affected by various factors such as rising population, changes in income as well as prices and nutritional requirements (Maurizio, 2006). The basic information on food consumption patterns of a country is very beneficial to its policy makers in addressing the three main policy issues. Firstly, it helps the policy makers to categorize which of the policy intervention are the most suitable in improving the nutritional status of the people. Secondly, it is helpful in designing different food subsidy strategies which should be practiced by the government. Thirdly, the information on food demand behavior is crucial for performing macro-economic as well as sectoral analyses (Sadoulet and de Janvry, 1995).

Vegetables are a rich source of proteins, vitamins and minerals which are essential for human body. In Pakistan the daily per capita intake is 100 grams which is very low in contrast to the recommended amount of 285 grams. With the increase of population, water scarcity and land degradation the production

of vegetables should be increased to a larger extent to become self-sufficient as well as to increase the exports of vegetables (Mudasir et al., 2012).

In Pakistan there are more than 35 types of vegetables are grown in different environments such as from dry to wet zone, low to high elevation, and rainy areas to irrigated one. During spring and summer season Potato, Tomato, Cucumber, Gourds, Chilies, Okra and Brinjal are grown while in rainy season beans; Gourds, Brinjal, Cucumber and Okra are produced. In the winter season many varieties of vegetables are grown such as Cabbage, Spinach, Cauliflower, Potato, Lettuce, Carrot, Turnip, Onion, Radish, Fenugreek, Pea and Coriander. In order to meet the demand of households for different kinds of vegetables they are traded across local markets of Pakistan (Khokhar, 2014).

The current study provides information about the quantity demanded of the selected vegetables and also whether they are substitutes or compliments of each other. A lot of research work has been done on meat and fruits and other food items but very little work has been done on the vegetables selected under study in district Peshawar. Due to the significance of the consumer behavior in the economic theory, the current research was conducted to find out the quantity demanded of households for selected vegetables in district Peshawar using econometric techniques. In this respect,

The major and specific objective of this research study is to estimate demand function for selected vegetables in the study area.

Materials and Methods

For selection of sample size, multistage sampling technique was used. In the 1st stage, district Peshawar was purposively selected. There were 92 Union Councils in district Peshawar (Provincial Election Authority, Peshawar Khyber Pakhtunkhwa, 2010). In the 2nd stage, two Union Councils namely Landi Arbab and Deh Bahadar were randomly selected through simple random sampling. In the 3rd (final) stage a sample of 120 households were selected from these two villages through proportional allocation sampling technique as follows (Cochran, 1977):

$$n_i = n^* \left(\frac{N_i}{N}\right) \quad \ldots\ldots (1)$$

Where;
n_i= Number of sampled household in the ith village; n = Total sample size (households); Ni=Total number of households in the i^{th} village; N =Total number of households in the study area.

Both primary and secondary data were used in this study. The primary data were collected through an interview schedule. The household's heads were interviewed at their houses. Efforts were made to inform and convince households' heads about the purpose of this study to collect all the relevant and accurate information about the socioeconomic characteristics of households and consumption of selected vegetables. For selection of vegetables a pilot survey was carried out in the study area. During the pilot survey it was revealed that most of the surveyed households were consuming Spinach, Pea, Potato and Cabbage-Cauliflower almost, regularly. The secondary data was collected from different government and official sources e.g. Pakistan Household Final Consumption Expenditure and District Peshawar Census.

Conceptual framework

A demand function relates to the quantity demanded of a good by a consumer with the price of the good. Demand function is derived from the utility function and consumers' budget constraint. Amount of satisfaction a consumer derives from a given bundle of goods. Let a consumer has a utility function U(X) which is a function of n goods:

$$X = (X_1, X_2 \ldots X_n) \ldots\ldots (2)$$

And tries to maximize this utility function subject to the budget constraint:

$$P * X = P_1 X_1 + P_2 X_2 + \ldots + P_n X_n \leq I \quad \ldots\ldots (3)$$
$$\text{Let } u = V(P, I) \quad \ldots \ldots\ldots (4)$$

Equation (4) Define the value of utility attained by solving this problem. V is referred to as indirect utility function.

$$\text{Let } x = X(P,I) = [X_1(P, I), X_2(P, I), \ldots, X_n(P, I)] \quad \ldots (5)$$

Equation (5) Are the n goods that achieve the utility maximum subject to this budget constraint? The function X (P, I) is known as this consumer's market demand function.

Since this function Equation (5) maximizes utility subject to the budget constraint,

$$V(P, I) \equiv U(X(P, I)) \equiv U[X_1(P, I), X_2(P, I), ..., X_n(P, I)] \quad .....(6)$$

In case of two goods say X_1 and X_2, the substitution rate is the slope of the consumer's indifference curve which shows all of the combinations of X_1 and X_2 that the consumer would be equally happy to accept. But consumer also takes in to account the affordability of that combination.

The consumer's utility is maximum at that point where the substitution rate equals the slope of budget line. This point is arrived at when the budget is fully spent on a combination of X_1 and X_2 with no money left over, which makes that combination the optimal one from the consumer's point of view. The slope of the budget line is the ratio between the price of X_1 and the price of X_2. Replacing it with the marginal rate of substitution simplifies the equation so that only one price remains. This makes it possible to find out the demand for the product in terms of its price and the total income available. The demand function would thus formally express the amount of X_1 that a consumer is willing to buy, given his income and the price of X_1. This demand function can then be inserted into the budget equation to derive the demand for X_2. Similarly, instead of two price and goods, the resulting equation could be simplified so that it only includes the price of X_2, the consumer's income and the total quantity of y demanded, given both of those goods (Dhami and Nowaihi, 2016).

Demand function of selected vegetables

The demand function estimated for all selected vegetables were as follows:

$$LnDDSP = \beta_0 + \beta_1 lnSPP + \beta_2 lnPEP + \beta_3 lnPOP + \beta_4 lnCCP + \beta_5 lnHI + \beta_6 HS + e_i \quad ..... (7)$$

$$LnDDPE = \beta_0 + \beta_1 lnSPP + \beta_2 lnPEP + \beta_3 lnPOP + \beta_4 lnCCP + \beta_5 lnHI + \beta_6 HS + e_i \quad ..... (8)$$

$$LnDDPO = \beta_0 + \beta_1 lnSPP + \beta_2 ln\ PEP + \beta_3 lnPOP + \beta_4 lnCCP + \beta_5 lnHI + \beta_6 HS + e_i \quad ..... (9)$$

$$LnDDCC = \beta_0 + \beta_1 lnSPP + \beta_2 lnPEP + \beta_3 lnPOP + \beta_4 lnCCP + \beta_5 lnHI + \beta_6 HS + e_i \quad ..... (10)$$

Where;
DDSP = Quantity demanded of Spinach in kilograms per household; DDPE = Quantity demanded of Pea in kilograms per household; DDPO = Quantity demanded of Potato in kilograms per household; DDCA = Quantity demanded of Cauliflower-Cabbage in kilograms per household; SPP = Price of Spinach in Rs. per '000' kilograms; PEP = Price of Pea in Rs. per '000' kilograms; POP = Price of Potato in Rs. per '000' kilograms; CCP = Price of Cauliflower-Cabbage in Rs. per '000' kilograms; HI = Household Income in Rs. per household; HS = Household Size in number of persons; Ln = Natural log; ei= Random error term.

Limitation of the study

This study was carried out in district Peshawar of Khyber Pakhtunkhwa. The reason behind the selection of district Peshawar for this study was manifold. Firstly, no research work on estimation of demand function of selected vegetables is in knowledge of this researcher that has been conducted in recent past in district Peshawar. Secondly, households of the study area were easily accessible for data collection as this researcher belongs to district Peshawar. Thirdly, district Peshawar is the capital and one of the most important districts of Khyber Pakhtunkhwa.

Results and Discussion

It is the most significant factor which influences the expenditure on food because as the number of households increases their demand for food also increases. Household size has been divided into three major groups. Table 1 shows households' size in both the villages. In Landi Arbab, 37.09% of the households consisted 1-5 members, 61.30% consisted 6-10 members and 1.61% consisted more than 10 members. In Deh Bahadar the majority 53.45% of the households consisted of 6-10 members, 43.10% consisted 1-5 members and 3.45% consisted more than 10 members.

Table 1: *Distribution of the households according to family size.*

Size of Households	Landi Arbab	Deh Bahadar	Total
Up to 5	23	25	48
	37.09%	43.10%	40%
6-10	38	31	69
	61.30%	53.45%	57.5%
Above 10	1	2	3
	1.61%	3.45%	2.5%
Total	62	58	120
	100%	100%	100%

Source: *Survey data, 2017.*

Table 2 represents the quantity demanded of Spinach in each village separately. In Landi Arbab majority of the households i.e. 37.10% consumed 2.6-4.5 kilograms of Spinach monthly followed by 24.19% consumed up to 2.5 kilograms, 22.6% consumed 4.6-6.5 kilograms, 11.30% consumed 6.6-8.5 kilograms and 4.83% consumed 8.6-10.5 kilograms. Majority i.e. 36.20% of the households in Deh Bahadar demanded 2.6-4.5 kilograms of Spinach monthly followed by 32.75% demanded up to 2.5 kilograms, 13.80% demanded 4.6-6.5 kilograms, 13.80% demanded 6.6-8.5 kilograms and 3.45% demanded 8.6-10.5 kilograms.

Table 2: *Distribution of quantity demanded of spinach in kilograms.*

DDSP in Kilograms	Landi Arbab	Deh Bahadar	Total
Up to 2.5	15	19	34
	24.19%	32.75%	28.33%
2.6-4.5	23	21	44
	37.10%	36.20%	36.67%
4.6-6.5	14	8	22
	22.6%	13.80%	18.33%
6.6-8.5	7	8	15
	11.30%	13.80%	12.5%
8.6-10.5	3	2	5
	4.83%	3.45%	4.17%
Total	62	58	120
	100%	100%	100%

Source: *Survey Data, 2017.*

Table 3 shows quantity demanded of Pea by households monthly in both the villages. In Landi Arbab monthly 30.65% of the households demanded 2.6-4.5 kilograms of Pea, 27.42% demanded up to 2.5 kilograms, 27.42% demanded 4.6-6.5 grams, 11.30% demanded 6.6-8.5 kilograms and 3.22% demanded 8.6-10.5 kilograms. In Deh Bahadar, 37.93% of the households demanded 2.6-4.5 kilograms of Pea monthly, 34.48% demanded up to 2.5 kilograms, 18.97% demanded 4.6-6.5, 6.90% demanded 6.6-8.5 kilograms and 1.72% demanded 8.6-10.5 kilograms.

Quantity demanded of Potato by households in each village is shown in Table 4. In Landi Arbab, 43.54% of the households demanded 6.6-8.5 kilograms of Potato monthly, 22.58% demanded 8.6-10.5 kilograms, 17.75% demanded 4.6-6.5, 9.68% demanded 2.6-4.5 and 6.45% demanded up to 2.5 kilograms. In Deh Bahadar, 34.49% of the households demanded 6.6-8.5 kilograms of Potato monthly, 25.87% demanded 2.6-4.5 kilograms, 24.13% demanded 4.6-6.5 kilograms, 12.07% demanded 8.6-10.5 kilograms and 3.44% demanded up to 2.5 kilograms.

Table 3: *Distribution of quantity demanded of pea in kilograms.*

DDPE in Kilograms	Landi Arbab	Deh Bahadar	Total
Up to 2.5	17	20	37
	27.42%	34.48%	30.83%
2.6-4.5	19	22	41
	30.65%	37.93%	34.17%
4.6-6.5	17	11	28
	27.42%	18.97%	23.33%
6.6-8.5	7	4	11
	11.30%	6.90%	9.17%
8.6-10.5	2	1	3
	3.22%	1.72%	2.5%
Total	62	58	120
	100%	100%	100%

Source: *Survey data, 2017.*

Table 4: *Distribution of quantity demanded of potato in kilograms.*

DDPO in Kg	Landi Arbab	Deh Bahadar	Total
Up to 2.5	4	2	6
	6.45%	3.44%	5%
2.6-4.5	6	15	21
	9.68%	25.87%	17.5%
4.6-6.5	11	14	25
	17.75%	24.13%	20.83%
6.6-8.5	27	20	47
	43.54%	34.49%	39.17%
8.6-10.5	14	7	21
	22.58%	12.07%	17.5%
Total	62	58	120
	100%	100%	100%

Source: *Survey data, 2017.*

Table 5 shows the amount of quantity demanded of Cabbage-Cauliflower in Kg by households in both the villages separately. In Landi Arbab most of the households i.e. 35.49% demanded 4.6-6.5 kilograms of Cabbage-Cauliflower monthly, 27.41% demanded 2.6-4.5 kilograms, 17.74% demanded 6.6-8.5 kilograms, 9.68% demanded up to 2.50 kilograms and 9.68% demanded 8.6-10.5 kilograms. In Deh Bahadar majority i.e. 36.21% of the households demanded up to 2.5 kilograms of Cabbage-Cauliflower monthly,

25.87% demanded 6.6-8.5, 15.51% demanded 2.6-4.5 kilograms, 15.51% demanded 4.6-6.5 kilograms and 6.90% demanded 8.6-10.5 kilograms.

Table 5: *Distribution of quantity demanded of cabbage-cauliflower in kilograms.*

DDCC in grams	Landi Arbab	Deh Bahadar	Total
Up to 2.5	6	21	27
	9.68%	36.21%	22.5%
2.6-4.5	17	9	26
	27.41%	15.51%	21.67%
4.6-6.5	22	9	31
	35.49%	15.51%	25.83%
6.6-8.5	11	15	26
	17.74%	25.87%	21.67%
8.6-10.5	6	4	10
	9.68%	6.90%	8.33%
Total	62	58	120
	100%	100%	100%

Source: *Survey data, 2017.*

The Price at which Spinach was demanded by the households in both villages is represented in Table 6. Out of the total households in Landi Arbab, 46.78% of the households demanded. Spinach at the price of up to 35 followed by 32.25% demanded at the price 36-45 and 20.97% demanded at the price of 46-55. In Deh Bahadar, 46.55% of the total households demanded Spinach at the price of up to 35 followed by 41.38% demanded at the price of 36-45 and 12.07% demanded at the price of 46-55.

Table 6: *Distribution of spinach price in rupees.*

SPP in rupees	Landi Arbab	Deh Bahadar	Total
Up to 35	29	27	56
	46.78%	46.55%	46.67%
36-45	20	24	44
	32.25%	41.38%	36.66%
46-55	13	7	20
	20.97%	12.07%	16.67%
Total	62	58	120
	100%	100%	100%

Source: *Survey data, 2017.*

Table 7 represents the price by which Pea was demanded by the households in each village. In Landi Arbab majority 46.78% of the households demanded Pea at the price of up to 55 followed by 37.09% demanded at the price of 56-65, 11.30% demanded at the price of 66-75, and 4.83% demanded at the price of 76-85. In Deh Bahadar, 44.82% of the households demanded Pea at the price of up to 55 followed by 29.31% demanded at the price of 56-65, 13.80% demanded at the price of 66-75 and 12.07% demanded Pea at the price of 76-85.

Table 7: *Distribution of pea price in rupee.*

PEP in rupees	Landi Arbab	Deh Bahadar	Total
Up to 55	29	26	55
	46.78%	44.82%	45.83%
56-65	23	17	40
	37.09%	29.31%	33.33%
66-75	7	8	15
	11.30%	13.80%	12.6%
76-85	3	7	10
	4.83%	12.07%	8.33%
Total	62	58	120
	100%	100%	100%

Source: *Survey data, 2017.*

The amount of quantity demanded of Potatoes at different prices by the households is represented in Table 8 for both villages. In Landi Arbab, 80.65% of the households demanded Potatoes at the price of up to 35 and the remaining 19.35% demanded Potatoes at the price of 36-45. In Deh Bahadar majority i.e. 55.18% of the households demanded Potatoes at the price of upto 35 and 44.82% demanded at the price of 36-45.

Table 8: *Distribution of potato price in rupees.*

POP in rupees	Landi Arbab	Deh Bahadar	Total
Upto 35	50	32	82
	80.65%	55.18%	68.33%
36-45	12	26	38
	19.35%	44.82%	31.67%
Total	62	58	120
	100%	100%	100%

Source: *Survey data, 2017.*

Table 9 represents the prices by which Cabbage-Cauliflower was demanded by the households in each village. The majority i.e. 48.38% of the households in Landi Arbab demanded Cabbage-Cauliflower at the price of up to 35 followed by 33.88% demanded at the price of 36-45 and 17.74% demanded at the price of 46-55. In Deh Bahadar, 36.20% of the households demanded Cabbage-Cauliflower at the price of up to 35 followed by 36.20% demanded at the price of 36-

45 and 27.60% demanded at the price of 46-55.

Table 9: *Distribution of cabbage-cauliflower price in rupees.*

CCP in rupees	Landi Arbab	Deh Bahadar	Total
Up to 35	30	21	51
	48.38%	36.20%	42.5%
36-45	21	21	42
	33.88%	36.20%	35%
46-55	11	16	27
	17.74%	27.60%	22.5%
Total	62	58	120
	100%	100%	100%

Source: *Survey data, 2017.*

Model diagnostic tests

Results of all the diagnostic tests for model are given as under:

Heteroscedasticity: Breusch-Pagan test was used to check heteroscedasticity problem in all the estimated demand models.

Breusch-pagantest result for spinach: Breusch-Pagan test for heteroscadasticity shows that the P-value is greater than 0.05 so we accept the null hypothesis of homoscedasticity.

H_o= Heteroscedasticity was not present

Chi-square (6) = 0.67

Prob > chi-square = 0.4115

Breusch- pagan test result for pea: Breusch-Pagan test for heteroscadasticity shows that the P-value is greater than 0.05 so we accept the null hypothesis of homoscedasticity.

H_o= Heteroscedasticity was not present

Chi-square (6) = 0.19

Prob > chi-square = 0.663

Breusch- pagan test result for potato: Breusch-Pagan test for heteroscadasticity shows that the P-value is greater than 0.05 so we accept the null hypothesis of homoscedasticity.

H_o= Heteroscedasticity was not present

Chi-square (6) = 11.32

Prob > chi-square = 0.078

Breusch- pagan test result for cabbage and cauliflower: Breusch-Pagan test for heteroscadasticity shows that the P-value is greater than 0.05 so we accept the null hypothesis of homoscedasticity.

H_o= Heteroscedasticity was not present

Chi-square (6) = 0.77

Prob > chi-square = 0.3811

Multicollinearity: Table 10, 11, 12 and 13 presents the values of Variance Inflation Factor (VIF) for the explanatory variables and their mean values which are less than 10. Concluding, there is no evidence of multicollinearity in the model.

Table 10: *VIF for log of quantity demanded of spinach.*

Variable	VIF	VIF (Tolerance)
Log of Spinach Price	1.19	0.836
Log of Cabbage-Cauliflower Price	1.10	0.908
Log of Pea Price	1.09	0.914
Log of Potato Price	1.08	0.923
Log of Household Income	1.07	0.931
Household Size	1.04	0.961
Mean VIF	1.09	

Source: *Own estimation.*

Table 11: *VIF for log of quantity demanded of pea.*

Variable	VIF	VIF (Tolerance)
Log of Spinach Price	1.19	0.836
Log of Cabbage-Cauliflower Price	1.10	0.908
Log of Pea Price	1.09	0.914
Log of Potato Price	1.08	0.923
Log of Household Income	1.07	0.931
Household Size	1.04	0.961
Mean VIF	1.09	

Source: *Own estimation.*

Table 12: *VIF for log of quantity demanded of potato.*

Variable	VIF	VIF (Tolerance)
Log of Spinach Price	1.19	0.836
Log of Cabbage-Cauliflower Price	1.10	0.908
Log of Pea Price	1.09	0.914
Log of Potato Price	1.08	0.923
Log of Household Income	1.07	0.931
Household Size	1.04	0.961
Mean VIF	1.09	

Source: *Own estimation.*

The reasonably large sample size i.e. 120 was used in the study which relaxes the normality assumption as recommended by (Gujarati and Porter, 2009).

Table 13: *VIF for log of quantity demanded of cabbage-cauliflower.*

Variable	VIF	VIF (Tolerance)
Log of Spinach Price	1.19	0.836
Log of Cabbage-Cauliflower Price	1.10	0.908
Log of Pea Price	1.09	0.914
Log of Potato Price	1.08	0.923
Log of Household Income	1.07	0.931
Household Size	1.04	0.961
Mean VIF	1.09	

Source: *Own estimation normality of residuals.*

Model specification

Ramsey reset test was used for model specification:

Ramsey reset test for spinach: Ramsey Reset test using powers of the fitted values of Log of quantity demanded of Spinach.

Ho: model has no omitted variables
F (6, 113) = 0.610
Prob > F = 0.6113

As calculated F (0.610) is statistically insignificant (p value = 0.6113), suggests that there is no specification problem in the model.

Ramsey reset test for pea: Ramsey Reset test using powers of the fitted values of Log of quantity demanded of Pea.

Ho: model has no omitted variables
F (6, 113) = 1.04
Prob > F = 0.356

As calculated F (1.04) is statistically insignificant (p value = 0.356), suggests that there is no specification problem in the model.

Ramsey reset test for potato: Ramsey Reset test using powers of the fitted values of Log of quantity demanded of Potato.

Ho: model has no omitted variables
F (6, 113) = 0.80
Prob > F = 0.4989

As calculated F (0.80) is statistically insignificant (p value = 0.4989), suggests that there is no specification problem in the model.

Ramsey reset test for cabbage-cauliflower

Ramsey Reset test using powers of the fitted values of Log of QD of Cabbage-Cauliflower.

Ho: model has no omitted variables
F(6, 113) = 0.33
Prob > F = 0.716

As calculated F (.33) is statistically insignificant (p value = 0.716), suggests that there is no specification problem in the model.

Estimated spinach demand

Demand for Spinach is the function of price of Spinach, Pea, Potato, Cabbage-Cauliflower, household income and household size. The empirical results for the Spinach demand model are in Table 14 which shows that the own price of Spinach is inversely and statistically related to its quantity demanded which indicates that if the price of Spinach increases by 1% then the quantity demanded for Spinach decreases by 0.716%. The coefficient of the study in hand is different from their results but identical in terms of sign to the findings of Huma and Khan (2014); Ilyas and Jan (2013), Haq et al. (2009), Haq et al. (2011) and Mukras et al. (2013). The results reveal that the price of Pea, Potato and Cabbage-Cauliflower are statistically insignificant which indicate that price of these vegetables has no effect on the demand for Spinach. These results are identical to Huma and Khan (2014) and Ilyas and Jan (2013). Household income is statistically highly significant which means 1% increase in income increases the quantity demanded for Spinach by 0.399% which is in accordance with the findings of Haq et al. (2009); Haq et al. (2011) and Mukras et al. (2013). Household size have also highly significant effect on demand for Spinach which shows that if the household size increases by 1 person then there will be 0.105% increase in the quantity demanded for Spinach, the result is similar to Ilyas and Jan (2013) and Mukras et al. (2013). The estimated R-square shows that 37% of the variations in the dependent variable is explained by the explanatory variables included in the model. The p-value of F-Statistics shows that model is overall significant. In cross-sectional data such as household level surveys, empirical observations with low R^2 and good F-statistics are accepted Gujrati (2004).

Most of the results are insignificant and one of the main reasons is that the households in the study area consume vegetables as necessity food item and according to economic theory any commodity taking a small proportion of our income has inelastic demand. This means that the price effect will be negligible on the quantity demanded.

Table 14: *Estimated double log demand model for spinach.*

Log of QD of Spinach	Coefficient	Std. Err.	t-ratio	p-value
Log of Spinach Price	-.716	.273	-2.627	0.010*
Log of Pea Price	-.192	.303	-0.634	0.527
Log of Potato Price	.096	.252	0.382	0.703
Log of Cabbage-Cauliflower Price	-.129	.230	-0.561	0.576
Log of Household Income	.399	.107	3.728	0.000***
Household Size	.105	.016	6.372	0.000***
Constant	-.219	1.897	-.115	0.908

R^2: 0.375; F: 11.306 with p-value: 0.000; Adjusted R-Square: 0.342

Table 15: *Estimated linear demand model for spinach.*

Variables	Coefficient	Standard. Error	t-ratio	p-value
Spinach Price	-.075	.029	-2.594	.011*
Pea Price	-.011	.021	-.536	.539
Potato Price	.030	.033	.885	.378
Cabbage-Cauliflower Price	-.026	.025	-1.034	.304
Household Income	1.657E-005	.000	3.160	.002**
Household Size	.428	.072	5.940	.000***
Constant	4.135	2.071	1.996	.048*

R-Square: 0.349; F: 10.077 with p-value: 0.000; Adjusted R-Square: 0.314.

Estimated pea demand

Table 16 shows that demand for Pea is the function of its own price, price of Spinach, Potato and Cabbage-Cauliflower, household's income and family size. The empirical results for the Pea demand model in log form shows that the own price of Pea is negatively related to its quantity demanded but is statistically insignificant which indicates that if the Pea price increases by 1% then it has no effect on its quantity demanded. Pea is considered as necessity food item in the study area and there is a very little change in the price of vegetables that is why own price effect is found insignificant in the study. The negative cross price signs of Potato and Cabbage-Cauliflower shows that they are substitutes of Pea but p-value show that they have no significant effect on the quantity demanded of Pea. There is very less change in the prices of vegetables so there is no such effect on the quantity demanded of each other. Spinach is compliment of Pea which means that if the price of Spinach increases by 1% then the quantity demanded of Pea decreases by 0.554%, the result is identical with the findings of Emokaro and Dibiah (2014); Huma and Khan (2014), Ilyas and Jan (2013) and Otunaiya and Shittu (2014). Household income is statistically insignificant which means that income has no effect on the quantity demanded of Pea, the result is similar with study of Huma and Khan (2014). Household size is highly significant and positively related to quantity demanded for Pea the table (4.25) shows that if the household size increases by 1 person then the quantity demanded for Pea increases by 0.111%, which is identical with the findings of Ilyas and Jan (2013) and Mukras et al. (2013).

Table 16: *Estimated double-log demand model for pea.*

Log of QD of Pea	Coefficient	Std. Err.	t-ratio	p-value
Log of Pea Price	-.236	.304	-0.777	0.439
Log of Spinach Price	-.554	.273	-2.028	0.045*
Log of Potato Price	.405	.252	1.609	0.110
Log of Cabbage-Cauliflower Price	.094	.230	0.407	0.685
Log of Household Income	.200	.107	1.861	0.065
Household Size	.111	.016	6.764	0.000***
Constant	-.363	1.899	-.191	0.849

R^2: 0.338; F: 9.618 with p-value: 0.000; Adjusted R-Square: 0.303

The estimated R-square shows that 33% of the variations in the model is explained by the explanatory variables included in the model. The p-value of F-Statistics shows that model is overall significant. In cross-sectional data such as household level surveys, empirical observations with low R^2 and good F-statistics are accepted Gujrati (2004).

Table 17: *Estimated linear demand model for pea.*

Variables	Coefficient	Std.Err.	t-ratio	p-value
Pea Price	-.016	.019	-.804	.423
Spinach Price	-.071	.027	-2.634	.010*
Potato Price	.043	.031	1.380	.170
Cabbage-Cauliflower Price	.019	.024	.783	.435
Household Income	8.716E-006	.000	1.768	.080
Household Size	.384	.068	5.667	.000***
Constant	2.760	1.948	1.417	.159

R-Square: 0.296; F: 7.904 with p-value: 0.000; Adjusted R-Square: 0.258

Estimated potato demand

Demand for Potato is the function of price of Potato, Spinach, Pea and Cabbage-Cauliflower, household income and household size as shown in. The

estimated results show that the own price of Potato is statistically insignificant and indirectly related to its quantity demanded which means that if the price of Potato increases by 1% then it has no effect on the quantity demanded for Potato. The result is identical with the study of Ilyas and Jan (2013) in which own price of Potato was insignificant. The results show that Pea, Spinach and Cabbage-Cauliflower are also statistically insignificant which means that the price of these vegetables has no effect on the quantity demanded of Potato. These results are similar to Huma and Khan (2014) and Ilyas and Jan (2013). Most of the results are insignificant and one of the main reason is that the households in the study area consume vegetables as necessity food item and according to economic theory any commodity taking a small proportion of our income have inelastic demand. This means that the price effect will be negligible on the quantity demanded. Household income is statistically significant and is positively related with quantity demanded of Potato which means that 1% change in income increased the quantity demanded for Potato by 0.199% which is similar to the results of Begum et al. (2010) and Mukras et al. (2013).

Table 18: *Estimated double-log demand model for potato.*

Log of QD of Potato	Coefficient	Std. Err.	t-ratio	p-value
Log of Potato Price	-.360	.209	-1.720	0.088
Log of Spinach Price	.359	.227	1.581	0.117
Log of Pea Price	.073	.252	0.290	0.773
Log of Cabbage-Cauliflower Price	.156	.191	0.815	0.417
Log of Household Income	.199	.089	2.228	0.028*
Household Size	.053	.014	3.886	0.000***
Constant	-1.718	1.579	-1.088	0.279

R^2: 0.20; F: 4.631 with p-value: 0.000; Adjusted R-Square: 0.155

Household size is statistically highly significant and positively related with the quantity demanded of Potato indicating that if the household size increases by 1 person then the quantity demanded for Potato increases by 0.053% which is similar with the results of Ilyas and Jan (2013) and Mukras et al. (2013). R^2 is 0.20 which means 20% of the variations in the model is explained by the explanatory variables included in the model. The p-value of F-Statistics shows that model is overall significant. In cross-sectional data such as household level surveys, empirical observations with low R^2 and good F-statistics are accepted Gujrati (2004).

Table 19: *Estimated linear demand model for potato.*

Variables	Coefficient	Std. Err.	t-ratio	p-value
Potato Price	-.069	.036	-1.904	.059*
Spinach Price	.048	.031	1.524	.130
Pea Price	.000	.022	.007	.994
Cabbage-Cauliflower Price	.012	.028	.428	.670
Household Income	1.245E-005	.000	2.187	.031*
Household Size	.297	.078	3.793	.000***
Constant	3.465	2.249	1.541	.126

R-Square: 0.191; F: 4.452 with p-value: 0.000; Adjusted R-Square: 0.148

Estimated cabbage-cauliflower demand

Table 20 shows that demand for Cabbage-Cauliflower is the function of price of Cabbage-Cauliflower, Spinach, Pea and Potato, household income and household size. The empirical results for the Cabbage-Cauliflower demand model in log form shows that the own price of Cabbage-Cauliflower is indirectly related to its quantity demanded but is statistically insignificant which means that if the price of Cabbage-Cauliflower increases by 1% then it has no effect on the quantity demanded for Cabbage-Cauliflower which is identical with the findings of Ilyas and Jan (2013). Pea, Potato and Spinach are also statistically insignificant which means that any increase in the price of these vegetables has no effect on the quantity demanded of Cabbage-Cauliflower, these results are similar with the study of Emokaro and Dibiah (2014), Huma and Khan (2014), Ilyas and Jan (2013) and Otunaiya and Shittu (2014). Household income is statistically insignificant which is in accordance with the study of Huma and Khan (2014). The coefficient of household size 0.555($p_<0.05$) shows positive relation with the quantity demanded of Cabbage-Cauliflower indicating that if the household size increases by 1 person then the demand for Cabbage-Cauliflower increases by 0.153%. These results are found similar with the results of Ilyas and Jan (2013) and Mukras et al. (2013). R^2 is 0.37 which means 37% of the variations in the model is explained by explanatory the variables included in the model. The p-value of F-Statistics shows that model is overall significant. Most of the results are insignificant and one of the main reasons is that the households in the study area consume vegetables as necessity food item and according to economic theory any commodity taking a small proportion of our income has inelastic

demand. This means that the price effect will be negligible on the quantity demanded.

Table 20: *Estimated double-log demand model for cabbage-cauliflower.*

Log of QD of Cabbage-Cauliflower	Coefficient	Std. Err.	t-ratio	p-value
Log of Cabbage-Cauliflower Price	-.429	.307	-1.400	0.164
Log of Spinach Price	-.531	.363	-1.460	0.147
Log of Pea Price	.689	.404	1.705	0.091
Log of Potato Price	.453	.335	1.351	0.179
Log of Household Income	.140	.143	0.980	0.329
Household Size	.153	.022	6.990	0.000***
Constant	-1.992	2.528	-.788	.432

R^2: 0.370; F:11.078 with p-value: 0.000; Adjusted R-Square: 337.

In cross-sectional data such as household level surveys, empirical observations with low R^2 and good F-statistics are accepted Gujrati (2004).

Table 21: *Estimated linear demand model for cabbage-cauliflower.*

Variables	Coefficient	Std. Err.	t-ratio	p-value
Cabbage-Cauliflower Price	-.027	.031	-.888	.756
Spinach Price	-.047	.035	-1.344	.182
Pea Price	.035	.025	1.390	.167
Potato Price	.062	.041	1.530	.129
Household Income	1.129E-005	.000	1.774	.079
Household Size	.555	.087	6.352	.000***
Constant	-.783	2.515	-.311	.756

R-Square: 0.334; F: 9.448 with p-value: 0.000; Adjusted R-Square: 0.299.

Conclusions and Recommendations

It was concluded that income was statistically insignificant for the quantity demanded of Cabbage-Cauliflower. Income was statistically significant for the quantity demanded of Spinach and Potato. Household size was highly significant and had positive relation with the quantity demanded of all the vegetables.

The following recommendations based on findings of the study are forwarded for policy makers.

1. The study showed that household size is highly significant for all the selected vegetables which indicate that as the number of household increases the quantity demanded of these vegetables will also increases and to meet this gap of excess demand advanced technology should be adopted to increase vegetables production.
2. The study revealed that Spinach was compliment of Pea therefore when making price policy the prices of these two vegetables should be made in same range.

Author's Contributions

Noor ul Ain: Collected and interpreted the data and wrote results and discussion.
Malik Muhammad Shafi: Proofread the manuscript technically.
Haidar Ali: Helped in econometric analysis.

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