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Estimation of Household's Meat Consumption Elasticities in Khyber Pakhtunkhwa, Pakistan

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ABSTRACT

The study investigated meat consumption elasticities in Peshawar district of Khyber Pakhtunkhwa. Data was collected from 120 households from Hayatabad and City in Peshawar District, randomly selected through a well-structured interview schedule. Working-Lesser model was employed for estimation of own-price, cross-price and expenditure elasticities. The average price of beef, mutton, poultry and fish was 1150, 1950, 869 and 860, respectively. The Working-Lesser model empirical findings for beef, poultry, and fish show that budget shares are inversely related with total meat expenditure, whereas mutton expenditure share is directly related with total meat expenditure. Mutton is income elastic while beef, poultry and fish are income inelastic. All meat types have elastic own prices, and cross prices reveals that majority of items are substitutes for one another while fish is complement for poultry. Poultry consumption is directly affected by the household size. Consequently, while formulating national policies, these findings need to be considered.

Introduction

The most fundamental need for survival is food. Every human being requires a balanced diet to sustain good health and a minimum quantity of it to survive. Unfortunately, rural populations suffer greatly from lack of access to a healthy food and are largely ignorant of it. Typically, this results in a number of health issues that eventually impact a nation's economic development and prosperity. The way that people consume is evolving throughout time. Food consumption is significantly influenced by a number of factors, including the growing population, household income, food prices, education level, occupation, age, and human tastes and preferences. Another significant element that clearly affects taste and preferences is time (GoP. Report of National Commission on Agriculture, March 1998).

Globally, meat intake varies according to cultural or religious factors. Vegetarians dislike eating meat because of several moral, environmental, religious, and health issues related to its production and consumption (Wikipedia, 2013). Meat provides all of the essential amino acids required for body growth. Meat also contains vitamin B12, which is necessary for metabolism and body growth (Rashed, 1998). The quality and safety characteristics of beef have a significant impact on consumer choices regarding its consumption. Fat content, freshness, staff and butchery cleanliness, quality seal, and cost were all considered important characteristics. The amount of meat that households desire is greatly influenced by the social and economic features of customers (Admassu, 2007).

The amount of meat consumed varies per nation. Meat contributes 20% fat, 40%protein,and 15%energy per day in wealthy nations like the United States. The demand for meat is increasing in developing nations as meat consumption rises with increase in income levels. The dietary pattern characterized by excessive meat consumption takes the place of other food products and cereals (Daniel et al. 2011). The world's per capita meat consumption rose from 41.30 kg in 2009 to 41.90kg in 2010.32.0 kg of meat are consumed annually by persons in developing nations. In contrast, 80.0 kg of beef is consumed per person in industrialized nations. Pork is the most often utilized meat in the world. After beef and mutton, poultry is the second most significant and commonly utilized sort of meat. 70% of rural residents with daily incomes under $1 rely entirely or partially on livestock for their survival (Worldwatch Institute, 2013).

In 2005, the FAO ranked the United States third among 171 countries in terms of per capita meat consumption (279.1 Ibs/person/year), behind Luxembourg #1 (314.6 lbs/person/year) and Hong Kong #2 (295.9 lbs/person/year). The people of the United States consume 41 times more meat than those of Bangladesh, which came in at number 171 (FAO, 2009). In 2009, Americans consumed 37.8 pounds of beef per person, the most of any meat variety. In contrast to chicken, which rose to 32.30 pounds per person in 2009 from 15.80 pounds per person in 1970, beef consumption has dropped 27 percent since 1970 (51.8 pounds per person in 1970),according to USDA figures (USDA, 2011). In 2011-12, Pakistan's annual meat availability per person was 16.76 kg (Planning and Development Division, Islamabad). According to an FAO estimate, Pakistan's per capita meat consumption fell from 14.50 kg annually in 1995 to 12.20 kg in 2007.

Pakistan's inflation was under control throughout this time. Meat consumption has decreased to 1.7% due to rising prices for mutton, beef, and poultry, which is still better than in other nations like Bangladesh, India, Sri Lanka, and Nepal, where annual meat consumption per person is 3.10,5.10,7.10 and 9.70 kg, respectively (FAO,2007).

After beef, chicken is currently the most consumed meat in Pakistan. Chicken consumption has significantly decreased due to the bird flu, but it is suddenly rising (by 45 percent). The percentage of meat consumed that was chicken fell from 49.0% in 2000 to 39.0% in 2007 (Gallup Pakistan Survey, October 2008). The demand for beef is increasing at a rate of 2.80%, 6.10 percent for poultry, and 2.90 percent for mutton due to factors such as population growth, the need for protein and calcium, improved eating patterns, and increased per capita earnings (Sindh Board of Investment, GoP, 2003). Since it is commonly recognized that income (or expenditure) influences the pattern of food expenditure, shifts in dietary intake and expenditures have been the subject of numerous studies throughout the twentieth century. Moreover, initiatives that increase low-income households' purchasing power have a favorable impact on food expenditure (McDowell et al., 1997). Urbanization, increased per capita income, and population growth are the main causes of rapid changes in food consumption patterns. Convenience items with high levels of processing were in great demand from consumers (Goodwin and Brester, 1995). However, as real income

rises and media and advertising become more prevalent in urban areas, the trend is gradually shifting (Chengappa, 2004; Kumar and Mathur, 1996). The cost of prepared meals is strongly correlated with the number of teenagers living in a home (Park et al., 1997). This has had an impact on the nation's consumption and supply of several goods. India's per capita intake of cereals, especially wheat and rice, is drastically declining. Compared to wealthier people, poor people consume fewer animal products. Still, the difference is closing (Kumar et al., 2004). All else being equal, a rise in wealth demonstrates a negative correlation with the consumption of coarse cereals and a positive correlation with the consumption of all cereals, rice, and wheat (Chand and Kumar, 2002). This study is designed to estimate and examine demand elasticities of various meat types in district Peshawar. To suggest policy recommendations based on study findings.

Data and Methodology

The primary goal of this chapter is to raise awareness of the research of the cosmos while providing information on data and data sources. It goes on to explain how the information was described.

Furthermore, it provides details about the conceptual framework, the analysis that needs to be done, and the suggested model that was applied to the study.

Universe of the study

The Peshawar district served as the study's location based on the city's resident's meat consumption. The study was carried out in district Peshawar because various regions have different consumption habits. Pakistan, the fifth most populous country in the world with the ninth largest labor force, is still a developing nation with a yearly increase in population of 1.80% (Government of Pakistan (GoP), 2023). Pakistan has a total area of 881,913 square kilometers (GoP, 2023). As per the 2022 census, the population of Pakistan was at 235.8 million. 241.5 million people were expected to live there in 2023, and 245.2 million in 2024 (GoP, 2024). In every province in Pakistan, there are differences in the amounts of food (meat) consumed both in urban and rural regions. Due to the disparity in income between rural and urban populations, there are variations in the quantity and quality of food consumed as well as changes in food expenditures.

Sampling procedure and sample size

The study area's sample was gathered using the proportionate sampling procedure. The procedure's formula is;(Chaudhary,1996)

ni=n*N_i/N. 1

Where, ni is the ith sample size, n represents the necessary sample size, N_iis the size of ith population and N is the Population size.

In order to determine how meat consumption pattern would change in 2024 in relation to socioeconomic characteristics, household size, and total monthly income, a study was carried out in Peshawar. Data was gathered from 120 Peshawar houses, 60 of which were in Peshawar City and 60 of which were in Hayatabad Peshawar. Since the data was gathered on expenditure of meat consumption. To get the necessary data, an interview with the male owner of the home was conducted.

Data and data sources

Primary data was used in this endeavor in addition to the work of Mwenjeri et al.(2016),Haider et al. (2017), Henga and Houseb (2017), Dey et al. (2018), Adhikari and Prapaspongsa (2019),Ogunmodede and Omonona (2020), Torres's et al. (2021), and Jia et al. (2023).

Analysis

Conceptual framework

Demand is the desire and willingness of a customer to purchase goods and services at a specific price (Sheffrin, 2003). According to the law of demand, demand for a commodity rises when its price decreases.

By calculating a functional equation that links food expenditure to total expenditure and other household factors, the food expenditure share can be parametrically explained. Deaton and Muellbauer (1999) use the so-called Working-Leser specification for this purpose, in which budget shares are linear in the logarithm of total expenditure. In order to incorporate the impact of prices, Deaton and Muellbauer expanded the Working-Leser model developed by Working (1943) and Leser(1963) (Muzayyanah et al., 2015).

$W=\alpha+\beta InX+\varepsilon$. .2

Where w is the share of expenditure for specific meat i.e. beef, mutton, poultry and fish in the total meat expenditure; x is the total household expenditure; a and βare unknown parameters to be estimated, & ε is an independently identically distributed error with a normal distribution of zero mean and standard deviation of sigma. Working-Leser model can be expanded to incorporate the effect of size of household.

$W=\alpha+\beta lnx+\gamma lnn+\varepsilon$. 3

Where n is the size of household and y is an unknown parameter to be estimated.

Elasticity, one of the most significant concepts in economics, was used in this study. The sensitivity of one variable to variations in another variable is called elasticity.

Using the Working-Leser model (3.3), we get the following formula if we represent food expenditure as f,i.e., W=f/x.

$E\_X\ f=1+\beta/\alpha+\beta ln\ x+\gamma Inn$ 4

In reaction to a change in overall expenditure, E_x f provides information about a proportionate change in food expenditure. It fluctuates according to the overall expenditure of household.

In order to estimate demand elasticity and analyze customer demand, several methods have been tried. The Working (1943) and Leser (1963) models are among the earliest ones; they express the expenditure share of a good consumed as a linear function of the logs of the values of all commodities and the log of total expenditure (Toan et al., 2010).

$W\_i=\alpha\_0+\beta\_i\ ln(x)+\sum\gamma\_ij\ ln(p\_j)+\epsilon\_i$ 5

Where W_iis the expenditure share of good i in total expenditure x of S goods; Pj is the price of goodsj; ϵ_iis the error term.

When it came to equations with single models, the double log demand model was once a common model. As an approximation for the data generation process, this model is helpful for both accurately interpreting and evaluating the empirical legality (Altson et al., 2002).

Following is the double log demand equation:

lnQ_i=α_i+η_i1 lnP_1+η_i2 lnP_2+⋯+ηi_N lnP_N+η_i1 lnI 6

Where: I stands for income, while Pj is the commodity's price. As an additional condition on the elasticity of demand for good I, the homogeneity issue is handled as a continuing hypothesis.

n_i^1+n_i^2+⋯n_iN+n_i1=0. 7

The problem with double-log demand models is that they can only meet one restriction homogeneity and cannot meet any others (Altson et al., 2002). The double-log demand model also has the disadvantage of having constant elasticities, meaning that neither price nor income levels affect them (Plourde and Ryan, 1985).

Engel was the first to investigate these patterns as there was a relationship between changes in income levels and changes in food consumption on a particular category. It has been established that the Engel's curve's form and shape are significant factors in demand system modelling. Encouraging more flexibility in Engle curves produces significantly more accurate simulation and forecasting outcomes.

The linear Engle's curve, also known as the Linear Expenditure System (LES), is a much more traditional and maybe the best variation. In 1954, Richard Stone made the initial discovery of LES.

Despite its strong separability assumption, the advantage of using a linear expenditure system was that it was easy to use, offered a spontaneous economic interpretation, and was effective at predicting cross-price elasticity (Dybczak et al., 2010; Astoy, 2019). The following is the functional form:

Y_i=P_i X_i=γipi+βi(m-∑Nj=1ripj) 8

Where:X_iis the ith commodity's quantity, P_ishows the ith commodity's price, Y_iis the amount spent on ith good, m represents total expenditure (income), yi and βi are model parameters, yi is Permanent level of quantity demanded for the ith good, yipj is the basic intake level's expenditure level andβi=Expenditure on good i

The model

The Working-Lesser model was used to analyze the pattern of meat consumption. The original Working-Lesser concept was explained by Working (1943) and Lesser (1963).To determine each food item's relative contribution to overall food expenses along with the log of costs for all food products, the budget's share of every product was determined. As HIES data was not available,so Working Lesser model was used which is partially demand system. The Working Lesser model formula is;

W_i=α_0+α_i logx+∑β_ij logP_j+∑γ_i kHK+ϵ_i 9

Where I,j stand for four different meat types, W_iis the expenditure share of all meat kinds included in the model,α_0is Constant parameter,α_iis Coefficient of parameter, log x is Log of total expenditure on meat, ∑β_ijis the summation of coefficient of parameter of food j, logP_jis log

of price of food j and Σrik is the summation of required parameters that have to be estimated. While HK are Dummy variables and ε; is Error term/Random stochastic variable

Estimation of Expenditure Elasticity

The expenditure elasticity formula can be written as:

e_i=1+(α_i/W_i) 10

wi is referred to as each food item's budget share and αiis the log expenditure coefficient for all types of meat.

Own and Cross Price Elasticity Estimation

The following formula explains own price elasticity (j=i) and cross price elasticity (j≠i):

eij=-□_ij+(β_ij/W_i) -□_ij=1. ……n 11

□ij is known as the Kronecker delta, which is zero otherwise and is unity if i=j.

Results and Discussion

Estimates of Working-Lesser Model for Beef

Table 1 show a negative relationship between the household's total meat expenditures and the beef expenditure share i.e. beef budget share decreases as household's income rises in the study area. The price of beef and its budget share are significantly inversely related ie. Expenditure share decreases or increases with increase or decrease in beef price. Poultry significant and positive price indicates that it can be used as a beef substitute. Mutton and fish have both positive and insignificant price coefficients. According to the significant positive impact of education, the majority of educated head spent more money on beef. 58% of the variance in the dependent variable was explained by independent variables, according to R2.In previous study conducted by (Sana., N, 2014) the coefficient of total meat expenditure in beef Working Lesser-Model was negative i.e.-0.044 and was statistically insignificant which is in stream line with my findings.

Table 1: Estimates of Working-Lesser Model for Beef

Variables	Coefficient	S.E	t-ratio	p-value
Log of total meat expenditure	-0.070374	0.007835	-8.98	0.000
Log of price of beef	-0.142643	0.047123	-3.03	0.003
Log of price of mutton	0.003499	0.005814	0.60	0.548
Log of price of poultry	0.003251	0.000529	6.14	0.000
Log of price of fish	0.008961	0.005809	1.54	0.126
Log of size of household	0.001514	0.001050	1.44	0.152
Household head gender	-0.023474	0.038507	-0.61	0.543

Log of household head age	0.000151	0.000753	0.20	0.841
Education of Household head	0.001360	0.000452	3.01	0.003
Constant	4.569221	1.340268	3.41	0.001

R^2 =0.5838 F=0.0000

Source: Survey data, 2024

Estimates of Working-Lesser Model for Mutton

Table 2 indicate significantly direct relationship between the household's total meat expenditures and the mutton expenditure share ie. mutton expenditure share increases as household's income rises in Peshawar. Coefficient of own price is significant but negative i.e. expenditure share decreases or increases with increase or decrease in mutton price. The significant and positive prices of beef and poultry indicate that they are substitutes of mutton. Fish price is insignificant and positive. The gender and size of household coefficients are both positive and insignificant in both situations. The impact of education and age is significant and negative showing that majority of aged and educated households spent less amount on mutton. 38% of the variance in the dependent variable was explained by independent variables, according to R^2.In previous study conducted by (Yaw Bonsu Osei., A, and Mark., E, 2014) the coefficient of mutton expenditure share in mutton Working-Lesser model was positive i.e. 0.05 which is in stream line with my findings. In previous study conducted by (Sana., N, 2014) the coefficient of total meat expenditure in mutton Working-Lesser model was positive i.e. 0.254 and was statistically significant which is in stream line with my findings.

Table 2:Estimates of Working-Lesser Model for Mutton

Variables	**Coefficient**	**S.E**	**t-ratio**	**p-value**
Log of total meat expenditure	0.148164	0.002487	59.57	0.000
Log of price of mutton	-0.013296	0.005954	-2.23	0.028
Log of price of beef	0.008384	0.002914	2.88	0.005
Log of price of poultry	0.010590	0.000255	41.53	0.000
Log of price of fish	0.003256	0.003315	0.98	0.328
Log of size of household	0.077614	0.211738	0.37	0.715
Gender of the household head	0.0000049	0.000042	0.12	0.908
Log of age of household head	-0.001712	0.000260	-6.57	0.000
Education of household head	0.003582	0.000696	5.14	0.000
Constant	-30.504361	0.681263	-44.78	0.025

R^2 =0.3892 F=0.0000

Source: Survey data, 2024

Estimates of Working-Lesser Model for Poultry

Table 3 indicates significant negative relationship between the household's total meat expenditures and the poultry expenditure share. Own price coefficient is significant and negative showing that poultry expenditure share increases or decreases with decrease or increase in poultry price. Mutton cross price is positive and significant representing that it is poultry substitute. The price coefficient of beef is positive and insignificant. Findings indicate that fish is complement for poultry. Gender has a negative impact on the poultry expenditure share, while size of household, education, and age has a direct impact on poultry expenditure share. In previous study conducted by (Sana., N,2014) the coefficient of total meat expenditure in poultry Working-Lesser model was negative i.e.-0.103 and was statistically significant which is in stream line with my findings. In previous study conducted by (Nikmatul et al., 2023) the coefficient of poultry expenditure share was negative i.e.-0.318 which is in stream line with my findings.

Table 3: Estimates of Working-Lesser Model for Poultry

Variables	**Coefficient**	**S.E**	**t-ratio**	**p-value**
Log of total meat expenditure	-0.342299	0.042595	-8.04	0.000
Log of price of poultry	-0.144748	0.069299	-2.09	0.039
Log of price of beef	0.000025	0.000083	0.31	0.760
Log of price of mutton	0.784838	0.341357	2.30	0.023
Log of price of fish	-0.776750	0.053068	-14.64	0.000
Log of size of household	0.004320	0.000808	5.35	0.000
Household head gender	-0.000085	0.000064	-1.31	0.192
Log of household head age	0.002088	0.005324	0.39	0.696
Education of household head	0.000881	0.001071	0.83	0.410
Constant	13.885911	0.201595	68.88	0.000

R^2 =0.5042 F=0.0000

Source: Survey data, 2024

Estimates of Working-Lesser Model for Fish

Table 4 indicates significant negative relationship between the household's total meat expenditures and the fish expenditure share ie. fish budget share decreases as income of household's rises. Coefficient of own price is significant and negative showing that when fish prices decreases or

increases, the expenditure share of fish also increases or decreases. The positive and significant beef cross price indicates that it can be used as a fish substitute. The findings show that age and education have a positive effect on fish expenditure share while size of household and gender has a negative impact on fish expenditure share. In previous study conducted by (Sana., N,2014)the coefficient of total meat expenditure in fish Working-Lesser model was negative i.e. -0.110 and was statistically significant which is in stream line with my findings. In previous study conducted by (Nikmatul et al., 2023) the coefficient of fish expenditure share was negative i.e. -0.012 which is in line with the findings of this study.

Table 4: Estimates of Working-Lesser Model for Fish

Variables	Coefficient	S.E	t-ratio	p-value
Log of total meat expenditure	-0.683221	0.289571	-2.36	0.020
Log of price of fish	-0.074712	0.005465	-13.67	0.000
Log of price of beef	0.115351	0.016292	7.08	0.000
Log of price of mutton	0.006402	0.010089	0.63	0.527
Log of price of poultry	0.006406	0.007654	0.84	0.404
Log of size of household	-0.006376	0.01819	-0.35	0.727
Household head gender	-0.000409	0.000875	-0.47	0.641
Log of household head age	0.0413193	0.1091925	0.38	0.706
Education of household head	0.0499156	0.0594304	0.84	0.403
Constant	13.09813	15.25714	0.86	0.392

R^2 =0.5801 F=0.0000

Source: Survey data, 2024

Estimation of Meat Elasticity

Expenditure Elasticities

$e_i=1+(\alpha_i/W_i)$ 12

According to table 5, poultry, beef and fish expenditure elasticities are less than one indicating that these are income inelastic. When households income increases, the intake of fish, poultry, and beef also rises, but at a slower rate, suggesting that they are necessities in the research area. As the expenditure elasticity of mutton is greater than one that's why mutton is found as luxury in Peshawar district. In previous study conducted by (Yaw Bonsu Osei, A., and Mark, E., 2014) expenditure elasticity of beef in urban region was 0.9606 and poultry expenditure elasticity in rural region was 0.9967 which is in stream line with my findings. In previous study conducted by Naeem (2014), expenditure elasticity of beef, mutton, poultry and fish was 0.82, 1.59,0.36 and

0.33 which is in line with my findings. In previous study conducted by (H. Zhang et al., 2018) expenditure elasticity of mutton was 1.834 which is in stream line with my findings. In previous study conducted by (Taljaard et al., 2004, Jabarin, 2005, Basarir,2013) expenditure elasticity of poultry was 0.53,0.97 and 0.70 which is in stream line with my findings. In previous study conducted by (Basarir, 2013) expenditure elasticity of beef and fish was 0.80 and 0.97 which is in stream line with my findings.

Table 5: Estimates of Expenditure Elasticity for Meat

Meat Kinds	Estimated Elasticity
Beef	0.91
Mutton	1.13
Poultry	0.32
Fish	0.57

Source: Survey data,2024

Own Price and Cross Price Elasticities

Own price is the term used when a commodity's own price causes a change in the quantity demanded of that commodity, while cross price is the term used when a change in the price of another commodity causes a change in the quantity demanded of that commodity.

eij=- β_ij+(β_ij/W_i) - β ij=1. .n 13

Estimates of Meat Own Price and Cross Price Elasticity

According to table 6, beef, mutton, poultry and fish own price elasticities are -1.181,-1.0118,-1.2838 and -1.0467 respectively. Mutton, poultry and fish are beef substitutes, according to beef cross price parameters. Poultry, fish and beef are mutton substitutes according to mutton cross price parameters. Fish is complement while mutton and beef are poultry substitutes in poultry demand function. Fish cross price parameters indicate that beef, mutton and poultry are substitutes of fish. In previous study conducted by (Linh Vu., H, 2009) coefficients of poultry own price elasticity and fish own price elasticity were negative i.e. -1.05 and -0.99 which is in stream line with my findings. In previous study conducted by (Sana., N, 2014) coefficients of own price elasticities of beef, mutton, poultry and fish were-3.488,-2.004,-3.051 and-1.543 which is in line with my findings.

Table 6: Estimates of Meat Own Price and Cross Price Elasticity

Meat kinds	Estimated Elasticity
Beef	
Beef Own Price (Rs)	-1.181
Cross Price (Rs)	
Mutton Price	0.0044
Poultry Price	0.0041
Fish Price	0.011
Mutton	
Mutton Own Price (Rs)	-1.0118
Cross Price (Rs)	
Beef Price	0.0074
Poultry Price	0.0094
Fish Price	0.0029

Poultry	
Poultry Own Price (Rs)	-1.2838
Cross Price (Rs)	
Beef Price	0.0005
Mutton Price	1.5389
Fish Price	-1.5230
Fish	
Fish Own Price (Rs)	-1.0467
Cross Price(Rs)	
Beef Price	0.0721
Mutton Price	0.0040
Poultry Price	0.0031

Source: Survey data, 2024

Conclusions and Recommendations

According to the research, households in the Peshawar district consume four main kinds of meat. According to the estimated expenditure elasticities, households in the Peshawar district consider mutton to be a luxury whereas beef, poultry, and fish are necessities. These four types of meat are price elastic according to the estimated own price elasticity. Fish, mutton, and poultry are substitutes of beef, according to cross price elasticities. Beef, fish and poultry are mutton substitutes. Beef and mutton are substitutes for poultry while fish is complement for poultry. Cross price parameters of fish indicate that mutton, beef and poultry are fish substitutes. The budget share of the four kinds of meat is also influenced by factors such as gender, age, education, and size of household. Compared to other meat types, the study shows that beef has been used extensively in the study area. Therefore, in order to promote the marketing of meat and meat products and to promote the sustainable production of high-quality meat, the government should create provincial meat policies. The results reveal that the consumption of poultry increases as the number of households increases. Modern methods should be used to enhance backyard poultry in order to fill the demand gap. Opportunities for earning income must be made available in order to increase the purchasing power for higher-quality and more plentiful meat.

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