SUPPLY, DEMAND, AND POLICY ENVIRONMENT FOR PULSES IN PAKISTAN

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ABSTRACT:- The present study was undertaken to verify the various factors influencing the supply of pulses and to develop suitable demand relations. Therefore the paper fills an information gap regarding factors affecting the supply and demand of pulses in Pakistan. The present study focuses on two important pulses grown in the country namely gram (chickpea) and mung (mungbean). Using Nerlove's adjustment lag model as the basic framework supply and demand aspect has been studied at the national level, based on the time series data from 1974-75 to 2010-11. Acreage response results revealed that farm harvest prices, lagged area and good moisture availability at sowing time positively influence the area allocation decision of the farmers. But yield for mung and fertilizers price for both pulses were insignificant factors in influencing the farmers' decision to allocate land. Production of pluses mainly depends on area under the crop. Pulses area under irrigated conditions and sowing season rainfall positively influence the production of gram and mung. Technological factors by the time trend had given positive impact on the yield and production. Demand analysis revealed that own price elasticity of demand was inelastic and less than one for both pulses. This implied the supply and demand gap of pulses in the country. Thus decline in pulses consumption could be attributed to disproportionate increase in pulses price that would affect the poor segment of population in fulfilling the protein demand. Hence there is need to increase production through improving management practices and dissemination of improved technologies.

Key Words: Pulses; Supply; Price Responsive; Demand; Own Price Elasticity; Cross Price Elasticity; Adjustment Lag Model; Pakistan.

INTRODUCTION

Pulses play an important role in the nutritional security of a large number of people across the world. They represent a major source of protein in many developing countries, especially among the poorer section of the population who rely on vegetable sources for their protein and energy requirements (FAO, 2005). It is also the most important source of vegetable protein in Pakistan. They are cultivated on 5% of the total cropped area. Their use ranges from baby food to delicacies of the rich and the poor (PARC, 2012). The area under pulses in the country is around 1395200 ha, out of which major pulses contributed 1298300 ha with

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a production of 701800 t in 2009-2010. Among major pulses, gram is the major winter food legume and mung is the major summer legume, Gram occupies 76% of the total pulses area with 74% contribution to the total production, where as mung occupies 13% of total area devoted to pulses contributing 16% to the total pulses production (Anonymous, 2010).

Due to low production, Pakistan imports large quantities of pulses to meet the ever increasing gap between the domestic production and requirements (Chaudhry et al., 2002). The country's dependence on the import has touched up $ 139.096 million of national exchequer during the fiscal year 2010-11, as the commodity's trade was 53% more during 2010-11. Pakistan imported 628.508 t of pulses during 2010-11 as compared to the import of the commodity of 444.976 t during 2009-10, showing a rise of 183.532 t (41.25%) (Khan, 2012).

The decline in per capita availability of some of the items such as cereals and pulses results in some pressure on their prices. Increase in prices can be attributed to both supply and demand factors (Sher, 2012). Along with this farmer cultivated a crop on his farm keeping in mind its price of previous year profitability and allocated his limited resources for that crop which is stable and less risky however pulses price was highly unstable. Hence instability in price was much influenced by the production instability in all the major pulses (Rani et al., 2012).

Pulses are considered secondary to cereal crops and relegated to marginal soils, as they are perceived to be low yielding and less remunerative crops. As a result of this, the growth rate of production of pulses is low as compared to other cereal crop in Pakistan. The slow growth in pulse production compared to enormous increase in population led to progressive decline in availability of pulses. This has caused great concern among policy makers, administrators and researchers. Supply and demand of a commodity are determined by the policy environment and consumers' prefer-ences. Very little is known how these factors affect the pulses production and consumption. The present study is an attempt to verify the above issues. Therefore the main objective of this study is to fill the information gap related to pulses supply and demand. The specific objectives are to identify various factors influencing the supply of pulses in Pakistan, to develop suitable demand relation in Pakistan and to suggest recommendations for policy makers and researchers.

MATERIALS AND METHOD

Present study was conducted by using annual time series data from 1974-75 to 2010-11. The data was collected from various issues of Agriculture Statistics of Pakistan and Economic Survey of Pakistan and other statistical bulletins.

Structure of the Model

Supply Aspect

The supply aspect of the pulses is examined at the national level and has been explained by two equations (Ali and Abedullah,1998; Savadatti, 2007). The first equation is an area response equation while the second one represents the production of pulses explained by acreage and non-acreage factors. The different variables are tested and finalize depending upon the goodness of fit and stationarity of the data by using Augmented Dickey Fuller (ADF) test.

Acreage Response Function

Using Nerlove's adjustment lag model as the basic framework, the acreage response function for pulses is specified as follows:

$$Y_{1t} = a_{10} + a_{11}X_{1t-1} + a_{12}X_{2t-1} + a_{13}X_{3t} + a_{14}X_{4t} + a_{15}X_{5t} + a_{16}X_{6t} + a_{17}X_{7t} + a_{18}X_{8t-1} + a_{19}X_{9t-1} + a_{110}Y_{1t-1} + U_t$$

Where,

Y_1 = Area under concerned pulse grain in '000' hectares in the year 't'

X_{1t-1} = Lagged relative farm harvest price (FHP) index of concerned pulse grain

$X_{2\,t-1}$ = Lagged yield per hectare of concerned pulse grain

$X_{3\,t}$ = Actual average rainfall (mm) during sowing months of concerned pulse grain

X_{4t} = Percentage of area under irrigation by all crops

X_{5t} = DAP price per 40 kg bag

X_{6t} = Urea price per 40 kg bag

X_{7t} = Price of fuel (light diesel oil per liter)

X_{8t-1} = Weather risk measured by the SD of percentage departure of rainfall during sowing months of concerned pulse grain (mm) measured over the three preceding years or Coefficient of Variation

X_{9t-1} = Yield risk measured by the SD of yield per hectare of concerned pulse grain measured over the three preceding years or Coefficient of Variation

Y_{1t-1} = Lagged area of concerned pulse grain

U_{1t} = Disturbance term

Production Response Function

The various studies (Houck and Gallanghar, 1976; Behrman, 1968) have provided clear evidence that acreage under cultivation is one of the determinations of the actual output and the production would depend on a number of non-acreage factors. The different variable will be tested and finalized depending upon the goodness of fit. The following relation explains the production of pulses.

$$Y_{2t} = a_{20} + a_{21}Y_{1t} + a_{22}X_{10t} + a_{23}X_{11t} + a_{24}X_{12t} + U_{2t}$$

Where,

Y_{2t} = Production of concerned pulse grain in '000' t in the year 't'

Y_{1t} = Area under concerned pulse grain in '000' ha

X_{10t} = Actual average rainfall during growing season of concerned pulse grain

X_{11t} = Percentage of irrigated area to total cropped area under pulse grain

X_{12t} = Weather risk during growing season of concerned pulse grain (mm) measured by percentage departure from normal rainfall

U_{2t} = Disturbance term

Demand Aspect

A number of studies have used time series data for estimating demand function (Schultz, 1938; Stone, 1953; Wold and Jureen, 1953). The estimation of demand function in this study is based on World's market statistics approach to arrive at data on consumption, due to lack of direct data on consumption followed by Savadatti (2006). Thus per capita domestic demand for each of the specific split pulse under question is expressed by the following relation:

$$Y_{3t} = a_{40} + a_{41}X_{13t} + a_{42}X_{14t} + a_{43}X_{15t} + a_{44}X_{16t} + a_{45t}X_{17t} + a_{46}X_{18t} + U_{3t}$$

Where,

Y_{3t} = Per capita domestic consumption of concerned split pulse in kg in the year 't' (domestic production of concerned split pulse - seed purpose-exports + imports of concerned split pulse divided by midyear population)

X_{13t} = Real retail price index or absolute retail price of concerned split pulse

X_{14t} = Real retail price index or absolute retail price of rice

X_{15t} = Real retail price index or absolute retail price of another related pulse for gram

X_{16t} = Real retail price index or absolute retail price of another related pulse for mung

X_{17t} = Real retail price index or absolute retail price of wheat

X_{18t} = Per capita real income

U_{3t} = Disturbance term

RESULTS AND DISCUSSION

Supply Equation

The supply response aims to understand the role of input and output prices, lagged area of the concerned pulses investment on irrigation infrastructure, and technology generation, in the production and area of pulses in Pakistan.

Acreage Response Equations

By using Ordinary Least Squares (OLS) method linear and log-linear forms of the acreage relations for gram and mung for country were estimated (Table 1). A comparative analysis of the several specifications revealed that the OLS estimates of log-linear equations obtained by the adoption of specifications for different pulses have shown better explanatory powers as well as theoretically justifiable parameter coefficient (Table 1). The results indicated that most of the explanatory variables have expected signs and the explanatory power of the equations are satisfactory. High explanatory power is supported by highly significant values of F - statistics, which are significant at 1% both for mung and gram. By applying the ADF test for all the data, all variable is stationary at first difference and highly significant.

Lagged Area under the Crop ($Y_{1,t-1}$)

Coefficient representing lagged area attained positive sign for both pulses. In gram and mung the coefficient sign shows that increase in farm harvest price increases the area of both pulses. The gram and mungbean are significant at 1, 5 and 10% level. Therefore lagged acreage under the crop is an important factor in determining the current acreage

Table 1. Acreage response parameters of major pulses in Pakistan

	Gram		Mung	
Variable	Coefficient	Std. Error	Coefficient	Std. Error
Constant	- 96.360	52.358	215.488	113.437
Lagged area of concerned pulses	0.992***	0.013	1.034***	0.163
Lagged FHP	0.185	0.435	3.404***	1.121
Lagged yield	0.992**	0.008	- 0.002	0.106
Sowing period rainfall	0.910*	0.077	0.140	0.136
Irrigated area by all crops	- 2.055	0.482	- 3.326*	1.175
DAP price	0.994	0.008	0.016	0.025
Urea price	0.983	0.013	- 0.205	0.107
Price of fuel (LOD)	1.420***	0.301	- 0.309	1.531
Weather risk	- 1.039*	0.119	0.162	0.279
Yield risk	- 0.980	0.028	- 0.134	0.179
R-squared	0.96		0.97	
Adjusted R-squared	0.94		0.95	
F-statistic	358793***		51.264***	

,,***, Significant at 10% , 5% and l% level, respectively*

decision of the farmer.

Lagged Farm Harvest Price (FHP) ($X_{1,\ t-1}$)

Results indicated that this coefficient is significant at 1% level of significance for mungbean. Therefore, the price has a significant influence on acreage allocation decision of farmers in growing areas. In case of gram the farm harvest price is insignificant but having the positive relationship with the area as the output price increases the farmers will attract to grow more pulses.

Lagged Yield of Concerned Pulses ($X_{2\ t-1}$)

Yield variable make an entry into the acreage equations for gram. The results indicated that yield had positive influence on the area allocated for the gram by the farmers. The previous year yields of gram were significant at 5% level. In mung it is negative but insignificant throughout Pakistan. Yields of gram and mung are incomparable with the yields of its competing crops regarding acreage especially cereals and oilseeds, which are maintained at a higher level. Hence insignificance of yield coefficient related to mung shows that the area put to crop is not guided by yield factor.

Rainfall during Sowing Months (X_{3t})

Rainfall during sowing months emerged as one of the important factors in determining gram acreage variations for Pakistan. It is positive and insignificant in gram, and for mungbean rainfall during the sowing months is insignificant but has positive relationship with the acreage. These results show that as the rainfall increases during the sowing months area will be increased for the respective crop in the country. Therefore good rainfall conditions during sowing months influence farmers' acreage allocation decisions favorably.

Percentage of Irrigation by all Crops (X_{4t})

This coefficient is negative and significant at 10% level in mungbean. This indicated that the additional irrigational facilities at the national level have led to decline in area under mungbean.

Extension of irrigation has taken away mung areas sown to other more remunerative crop. In gram the coefficient is negative but insignificant. The coefficient for the proportion of irrigated area is insignificant in gram implies that pulses production has not benefitted from the public and private investment on irrigation infrastructure.

Fertilizer Price (DAP, Urea and LOD) (X_{5t},X_{6t} and X_{7t})

In gram the DAP and Urea price is insignificant which indicated that these prices cannot affect the farmers on the allocation of area. Farmers cannot use the fertilizers in their fields because mostly they are cultivated in the marginal land and taken as minor crop. The prices of fuel significantly affect the gram area. The relationship between the fertilizers and the area of mung have the negative effect, which shows that as price of urea and fuel increases farmers reduce the area of mung.

Weather Risk (X_{8t-1}) and Yield Risk (X_{9t-1})

Results revealed that farmers respond reasonably well to variations in yield levels and weather conditions of the pulses.

Production Response Equations

Production responses to acreage and non–acreage factors were analyzed. Equation is estimated by using Ordinary Least Square method in linear as well as log -linear forms (Table 2). More than 92% of variation in production behavior is explained by the explanatory variables in mung and 40% in gram. The values of F-statistics are highly significant for both pulses. Log-linear form is preferred for interpretation because coefficients of the variables mostly have expected signs and significance.

Area under Concerned Pulse Crop (Y_{1t})

The coefficient relating to this variable is positive and significant at 5% level of significance for gram. The results indicate that the area and production having the positive relationship, if area under the gram is increased by 1% that gave change of 0.63% in the production of gram. In mung the results showed that with increase area in mung the production of mung

Table 2. Estimates of production relation for major pulses in Pakistan

	Gram		Mung	
Variable	Coefficient	Std. Error	Coefficient	Std. Error
Constant	- 334.482	218.717	- 16.511	6.409
Area under concerned pulses	0.632**	0.251	0.431***	0.094
Growing season rainfall	2.285	1.862	0.083	0.162
Percent of irrigated area under the pulses	6.343*	4.074	0.993**	0.391
Weather risk	1.979	3.153	- 0.918***	0.312
Time trend	4.915*	2.966	1.325**	0.646
R-squared	0.399		0.920	
Adjusted R-squared	0.302		0.907	
F-statistic	4.116***		71.490***	

,,***, Significant at 10% , 5% and l% level, respectively*

is also increased but not as much as the area increased. Hence increase is positive but less than one and significant at 1% probability level.

Growing Season Rainfall (X_{10t})

Expected positive sign obtained for this coefficient were insignificant both for mung and gram. This indicated that with better moisture conditions during growing seasons, farmers would be able to get more production.

Percent of Area Irrigated Under the Crop (X_{11t})

This coefficient has shown positive sign for gram and mung. The gram pulses area under the irrigation were significant at 10% while that for mung is 5%. This coefficient indicates that the more is the pulse area under the irrigation more will be its production.

Weather Risk (X_{12t})

Coefficient of this variable has expected negative sign in mung all over the Pakistan indicating adverse effect of weather on the production of the mung which is significant at 1% level. This shows that the weather has strong effect on the mung production. But in gram the weather situation were insignificant; thus the weather does not affect the gram production.

Time Trend (T)

Trend variable would capture the effects of technological changes. Its impact was positive under all the situation. The technology has helped marginally in improving the yields/ production but did not give stability in production .

Demand Equation

Pulses are consumed as *daal* cooked separately or, sometime, with other pulses, meat, and egg. *Daal* is a base food eaten with *chapatti* prepared from wheat flour. Sometimes they are used in snacks called *haleem* and *pakora*, and also in sweets. But the use of pulses as a vegetable, in the form of sprouts, is unknown (Ali and Abdullah, 1998). The consumers' relative preference for pulses in the food basket is little known. Therefore to fill this knowledge gap, the own- and cross-price demand was estimated (Table 3). The explanatory variables in the demand equations explain 20% of the variation in demand for gram and around 20% for mung. The F-statistics is significant in all the cases indicating that joint explanatory power is strong but significant at 10% level.

Real Retail Price of Concerned Pulse (X_{13t})

The coefficient of this variable has the expected negative sign. As expected the demand for both pulses are price inelastic because the elasticity is less than one (own price elasticity of demand being around 0.02 and 0.001 in gram and mung, respectively). The low price elasticity of demand broadly indicated the adverse price consequences of the failure to meet the demand. The negative sign of coefficients showed that as the price of concerned pulses increased that decreased the demand of the concerned pulse but the change is not as much as change in the price.

Real Retail Price of Rice (X_{14t})

The coefficient of price of cereals is negative in demand equation for gram and mung indicating their complimentary nature in the consumption basket of the average consumer. This indicated that change in the price of rice also effect the demand of gram and mung but, the cross price elasticity is less than one. The retail price of rice is significant at 5% level in gram and 10% level in mung.

Real Retail Price of Mung for Gram (X_{15t})

The coefficient of the mung price for the gram demand is positive which shows that mung is substitute commodity for the average consumer whenever the price of the mung is high consumer shifts toward the consumption of the gram and vice versa. The cross price elasticity is positive shows the commodities are substitution in nature for the consumer. The significance level of mung price on gram demand is 10%.

Real Retail Price of Gram for Mung (X_{16t})

The coefficient of the gram price for the mung demand is also positive which shows that gram is substitution commodity product for the average consumer and it is significant at 10% level. The results indicated that whenever the gram price is high then the demand for mung increases that shows a positive relationship between the variables.

Real Retail Price of Wheat (X_{17t})

Wheat is also complementary commodity in mungbean for the consumer. Because pulse is a base food eaten with chapatti prepared from wheat flour. But the cross price elasticity is very low in gram as well as for mung.

Per Capita Real Income (X_{18t})

Pulses are inferior commodities, such that their consumption is ex-

Table 3. Estimates of demand equation for major pulses in Pakistan

	Gram		Mung	
Variable	Coefficient	Std. Error	Coefficient	Std. Error
Constant	4.618	0.392	0.396	0.034
Real retail price of concerned pulses	- 0.029	0.034	- 0.001	0.001
Real retail price of rice	- 0.069**	0.048	- 0.006*	0.004
Real retail price of mung	0.017*	0.010	-	-
Real retail price of gram	-	-	0.006	0.010
Real retail price of wheat	0.070	0.119	- 0.002	0.003
Per capita real income	0.006*	0.003	0.005*	0.003
R-squared	0.202		0.202	
Adjusted R-squared	0.073		0.073	
F-statistic	1.571*		1.571*	

,, Significant at 10% and 5% level, respectively*

pected to decline with an increase in income. Contrary to this belief, our estimate gave positive income elasticity for all individual pulses (Table 3). Mung and gram turned out to be a less preferred pulse, as their income elasticity is the lowest. Both pulses are significant at 10% level. Increase in income of the consumer, increases the demand for gram.

CONCLUSION AND RECOMMENDATIONS

The neglect of food legumes by policy-makers caused a serious decline in their availability on the one hand, and created a knowledge gap on the other. From the above observations it is clear that the acreage response results revealed that in farm harvest prices and good weather conditions positively influence the area allocation decision of the farmers. But yield turned out to be an insignificant factor in influencing the farmers' decision to allocate land in mung. Hence, it is clear from the analysis that even though farmers are price responsive and farm harvest prices of pulses are much higher than the farm harvest prices of competing crops like cereals. This should act as an incentive for pulse growers to increase area under pulses, but did not find desired growth in mung area supported from by insignificiant level of yield available.

Production of pulses mainly depends on area under cultivation. Area irrigated under the pulses and growing season rainfall has positive influence on the production of gram and mung. Technological factor represented by time trend turned out to be positive. Demand analysis revealed that coefficient of income variable being positive indicating that as income of the people increases the demand for pulses also increases but this increase in the demand for pulses is slight. The own price elasticity of demand being less than one in gram and mung which indicates that in situations of scarcity, there will be heavy pressure on prices of pulses and hence, sufferers are the poor section of the society.

There is need to enhance production of pulses. Different measures include development of short-duration, pest-resistant and high-yielding pulses varieties and technologies for their production which will greatly benefit consumers and producers. There is a strong need to disseminate the available scientific knowledge to the farmers through an effective system. The irrigation facilities should be expanded for higher yield of the gram and mung. Along with this market structure should also be improved to ensure fair price to the pulses grower for the allocation of better land and resources to the pulses. This would be helpful for increasing the production of the pulses in the country and helpful to meet the demand of the pulses in the country.

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