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Abstract

In the present paper time series data from 1976 to 2010 on the price, area, yield and production of major pulses (gram, masoor, mung and mash) is analyzed to estimate the compound growth rate, instability index and annual fluctuation of area, yield, production and prices. Own price flexibility and cross price flexibility between gram, masoor (winter pulses) and mash and mung (summer pulses) was analyzed to measure the impact of production on cross prices. Growth rate of prices for all these pulses was positive throughout the study period. Price of masoor was highly instable as compared other pulses. High fluctuation in area of mung was found throughout the study period. The analysis of own price flexibility reveals that gram and mung are less risky pulses. Keeping in view the quantity imported due to fulfill the demand supply gap, government should provide incentives to farmers for national food security.

Introduction

Pulses are 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). Normally the area under pulses in the country is around 1395.20 thousand hectares out of which major pulses contributed 1298.30 thousand hectares with a production of 701.80 thousand tones in the year of 2009-2010 which was declining over the year. Among major pulses, gram is the major winter food legume and mung is the major summer legume, Gram occupies 76 Percent of the total pulses area with 74 percent contribution to the total production, whereas mung bean occupies 13 Percent of total area devoted to pulses contributing 16 Percent to the total pulses production. The mash and masoor, each were cultivated on 2 Percent of the total pulses area both were contributed 1.4 Percent to the total pulses production (GOP, 2010).

Due to low production of pulses, Pakistan imports large quantities of pulses to meet the ever increasing gap between the domestic production and requirements. Considerably a large acreage estimated to be over 7 Percent of the total cropped area is occupied by pulses (Chaudhry et al. 2002). The country's dependence on the import of pulses to satisfy the local demand has swallowed up $139.096 million of national exchequer during the fiscal year 2010-11, as the commodity's trade stood at 53 percent up during the period. The country imported 628.508 tons of pulses during the fiscal year 2010-11 as compared to the import of the commodity of 444.976 tons during the fiscal year 2009-10, showing a rise of 183.532 tons or 41.25 percent (Khan, 2012).

Along with this Prices of pulses jumped as compared to other food items such as wheat. This has serious implications for the supply of protein to the poor population who do not have resources to buy expensive livestock-based protein-rich food (Ali et al. 1998). Many attempts have been made to measure the instabilities in prices to identify the risk of selected crops in relation to the other crop but little work done for the pulses. Therefore in this study the changes in prices of major pulses have been analyzed along with the growth of area, Production and yield. In this paper the degree of instabilities in prices has been measured and tried to identify the risky pulses to help the farmers to allocate their limited resources in more profitable pulse, which is less risky.

A considerable body of literature is available on supply response analysis. However the efforts made in analyzing the causes of price flexibility are scanty. The analysis of price flexibility enables us to understand in quantitative form the effect of present production on the harvest prices in the market. The storage facilities are

limited and expansive also which is difficult to manage the small farmers therefore the current market price of these are mainly determined by the current supply. The analysis of price flexibility will help the farmers to understand the extent of seasonality in prices. This will help in designing strategies in major pulses. In this study coefficient of price flexibility of pulse has been estimated to see the influence of current supply of a pulse on its market. Cross price flexibility of substitution is also calculated because cross flexibility co-efficient reveals the impact of supply of one pulse on the price of other substitution pulse in the same production season. There is also measuring the annul fluctuation of the selected pulses to see the trend of the major pulses

Materials and Methods

The pulses which have been selected for this study were gram, masoor, mung and mash. These pulses were the major pulses in the pulses sector in term of area. Major importance to gram (chickpea) improvement was attributed because it contributes 73% to the total pulses area. Masoor (Lentil) is the second major winter season pulse crop after gram in Pakistan. Gram and masoor are the major Rabi (winter) pulses in Pakistan so that they are substitute for each other. Mung and mash are the important kharif (summer) pulses of Pakistan hence that farmers are substituted these pulses with each other. For the analysis wholesale prices of selected pulses have been used. These were the prices on which farmers are selling their crop in the market. Study has been based secondary data. Time series data from 1975-76 to 2009-10 (34 years) was collected from the various issues of Agriculture Statistics of Pakistan, published by ministry of food and agriculture, Islamabad. The period is in these decades government cannot take any measure to increase the production of these pulses and their productivity was decrease year to year.

Analytical Technique

Compound Growth Rate Estimation
Compound growth rates have been computed to see the increase and decrease in the price, area, production and yield of selected crop. Hence for measuring the growth rates of area, production, yield and price. This approach has been used by various authors such as Nandi and Bera (2001), Prajneshu and Chandran (2007) and Rehman et al (2010).

$$Y_t = Y_0 (1 + r)^t \quad \text{--------------- (1)}$$

Where
Y_t = price/area/production/yield of selected pulses in year t

Y_0 = initial (i.e., 1976/77) price/area/production/yield of selected pulses
r = the compound (i.e., over time) rate of growth of Y_t, where stands for the year t.
For growth estimation the annual compound growth rates are largely used. The significance of growth estimates is tested using the t-test.

Instability Estimation
Instability index capture both explained and unexplained variations of the concerned variable and should better reflect the true instability situation. The index is used to measure instability for price, area, production and yield it is defined as follows by Karim, 2007.

$$I = C.V. \ x \ \sqrt{1 - R^2} \quad \text{----------------- (2)}$$

Where I = Instability index
$C.V.$ = Coefficient of variation
R^2 = Adjusted coefficient of determination

Annual Fluctuation Estimation
The changes in price over time essentially mean price fluctuation. The changes can be in either direction. The inter year fluctuation in prices, area, production and yield was estimated by the simplest method year by year. It is estimated following by Javed, 2003.

$$\Delta X_t = [(X_t - X_{t-1}) / X_{t-1}] \ x \ 100 \quad \text{-------------- (3)}$$

Where
X = price/area/production/yield in year t
ΔX_t = Percentage changes of price/area/production/yield in year t over the last period (Year)
X_t = Current year's price/area/production/yield in year t
X_{t-1} = Previous year's price/area/production/yield in year t -1

Price Flexibility and Cross Flexibility Estimation
Price flexibility coefficient implies that price is a function of the quantity of the supply of a particular crop. Estimates of price flexibility help us to know the degree of fluctuations in price caused by the production variations. On the other hand, the cross price flexibility is the percentage change in the price of i pulse in the response to a percentage change in the quantity of crop j while other factors remaining constant. The cross price flexibility of a pulse will be estimated with other pulse, which has substituted relationship between each other (e.g gram and masoor). To measure flexibility and cross price flexibility, the following equation was used by Javed, 2002.

$$P_{it} = f(Q_{it}) \quad \text{--------------------} \quad \text{own price flexibility}$$
$$P_{it} = f(Q_{it}, Q_{jt}) \quad \text{----------------} \quad \text{cross price flexibility}$$

$Ln\ P_{it} = Ln\beta0 + \beta1LnQ_{it} + \beta2LnQ_{jt} + U_t$ ------------ (4)

Where

P_{it} = Price of pulse i in one year

Q_{it} = Production of pulse i in year t

Q_{jt} = Production of pulse j in year t

$U_{t\ =}$ Error term

Results and Discussion

Compound Growth Rates of Selected Pulses

Compound growth rates of price, area, production and yield of major pulses for 34 years (1976-2010) in Pakistan shows in Table 1. It was found that all the growth rates of price, area, yield and production of selected pulses are highly significant because of their t-values except the area of gram and yield of mash.

Table 1: Compound Growth Rates of Price, Area, Yield and Production of Pulses

Pulses	Growth Rates (%)			
	Price	Area	Yield	Production
Gram	9.87 (14.43)***	-0.08 (0.47)	-0.36 (2.55)**	-0.44 (2.42)**
Masoor	11.09 (7.14)***	-3.56 (8.77)***	0.50 (5.10)***	-3.08 (3.71)***
Mung	9.26 (14.29)***	3.21 (15.35)***	1.05 (4.64)***	4.49 (16.28)***
Mash	9.89 (9.47)***	-2.16 (4.99)***	-0.30 (0.44)	-2.53 (5.25)***

Note: *** and ** indicate significant at 1% and 5% level

The growth rate of prices of major pulses is found positive. If comparing the growth rates of prices of major pulses it can be noticed that masoor was at the top by having growth rate 11.09 percent, mash was on the second by having growth rate of 9.89 percent while gram and mung were at the third and fourth position with their growth rate 9.87 and 9.26 percent respectively. In case of gram during the study period the area, production and yield were decreasing over the year by having a growth rate of -0.08, -0.44 and -0.36 percent respectively and it was very low rate among all the pulses. The reason behind this low growth rate was old practice of intercropping gram with wheat has been discontinued; because farmers did not wanted to put their relatively high value wheat crop at risk. Another reason behind the negative growth was the return to farmers is far less compared to the major crops. Hence farmers were shifted their cropping pattern toward major crops.

The results showed that area and production of masoor was highly significant but decreasing over the year by having the growth rate of -3.56 and -3.08 percent respectively. The main reason for decreasing output was desired attention and care, lack of new verities which may promise higher production, diseases attack (Blight, rust, root rot-wilt complex), weeds, cold drought for high lands and drought for low lands. The area as well as its production has been decreased gradually mainly

due to shift of main masoor (lentil) area to other crops, weed and disease problems, and non-availability of certified and quality seed of improved varieties.

It was found that area, yield and production of mung were highly significant at one percent and increasing over the year during the study period. The growth rate for the area, yield and production was 3.21, 1.05 and 4.49 Percent and these were higher among all the pulses. It was also observed that overall situation is better among all the pulses.

It can be noticed that growth rate of area, yield and Production of mash were -2.16, -0.30 and -2.53 respectively. It shows that they were decreasing over the year. The area of mash was decreasing because the return to farmers is far less compared to the major crops. The yield of mash was decreasing due to ineffective weed and pest control. Prices increased more than fivefold from 1971 to 1989, but production did not respond, as this crop has not experienced any technological breakthrough in the last thirty year.

Instability Index of Selected Pulses

Instability index capture both explained and unexplained variations of the concerned variable and should better reflect the true instability situation of the selected pulses which is showed in Table 2. Instability in price of masoor was at the highest level and followed by the mash, gram and mung during the year of 1976-2010.

Table 2: Instability Index of Price, Area, Yield and Production of Pulses

Pulses	Instability Index (I)*			
	Price	Area	Yield	Production
Gram	27.99	8.69	21.21	24.38
Masoor	61.45	16.77	12.54	19.83
Mung	26.98	14.63	12.88	17.73
Mash	36.46	22.88	10.05	22.49

In case of area it was mash at the top level masoor was on the second number while measuring the instability and gram was having low instability in area among all the pulses. While analyzing the yield and production gram was at highest level and mash was at lowest level in yield instability and in the production instability mung is at lowest level during the study period. Price instability was the highest than the area yield and production in case of all the pulses. The instability in the production of these pulses was higher than that of area and yield.

The instability in price was deeply influenced by the production instability in all the selected pulses. The area instability was minimum it means that the instability in the production was due to yield instability.

Annual Fluctuations of Selected Pulses

A farmer cultivated a crop on his farm keeping in mind its price of previous year profitability A farmer will allocated his limited resources for that crop which is stable and less risky. Annul fluctuation of major pulses of price, area, yield and production was showed in the Table 3.

It was noticed that among all the pulses the fluctuation in the price of gram was high. The fluctuation in the price of gram was not a consistent during study period. The fluctuation highly increased in 1981-82 and 1988-89 and the yearly fluctuation was very high during the nineties but in twenties the fluctuation was more consistent. It was high in 1981-82 and highest in 1988-89 and lowest in 1990-91

Table 3: Annual Fluctuations of lagged Price, Area, Yield and Production of Pulses

Pulses	Annual Fluctuation			
	Price	Area	Yield	Production
Gram	-25.62 to 114.73	-25.31 to 19.35	-46.14 to 80.83	-44.77 to 86.47
Masoor	-32.94 to 125.88	-40.70 to 40.77	-26.24 to 22.40	-30.89 to 23.51
Mung	-20.00 to 56.06	-17.60 to 48.86	-9.55 to 16.41	-24.59 to 38.69
Mash	-19.89 to 86.21	-23.00 to 31.62	-34.91 to 19.82	-25.20 to 35.92

There was big uncertainty during the study period that will create problem for the farmers so that the area and production of gram during the study period was not consistent. Area fluctuation was highest during the year 1988-89 and lowest in 1980-8. Production and yield of the gram is high in 2006-07 and highest in 2002-03. It was also observed that among all the study period the fluctuation in production is high during the twenties. The annual fluctuation in the price of mash was consistence during the study period. It was high during the year 1981-82 and highest in 1994-95 and lowest in 2002-03. The area and production was highly fluctuated during the year 1979-80 and lowest in 2004-05. There is too much uncertainty in the area of mash during the study period. That will create problems for the farmers and they can't predict the future trend of the crop.

The yield of the mash was also showed that there was not a specific pattern of increasing and decreasing. The fluctuation was high in 1983-84 but the highest in 1985-86 and it was lowest during the year 1986-87. That shows that there are frequent changes in the consecutive year. The price of masoor was not consistent during the study period like the other pulses. It was noticed that among all the pulses the price of masoor was highest. The fluctuation in the price was extremely high in the 2008-09 and lowest in 1983-84 during the study period. Area of masoor could not have a specific pattern it was highest in 1986-87 and production was highest in 1994-95 and lowest in 2005-06 and Yield of the masoor was highest in the 1983-84. The fluctuation in the price of mung was highest during the 1981-82 and the fluctuation was lowest in 2003-04. It was noticed that the price of mung is lowest among all the pulses. Area was highly fluctuated in 1989-90 and lowest in 2009-10 and yield was also lowest in 2009-10 and highest in 2006-07.

Price and Cross Price Flexibilities of Selected Pulses

When the farmer decided to allocated area for the cultivation of crop, either he speculated its future price or depends upon his past experience. It is the fact that current supply of the crop deeply influences its price. Price of the crop is mainly determined by its supply. In

agriculture the demand for any crop does not play important role in determining the price. The demand for any crop remains inelastic while supply is highly elastic. That is why high variations in the supply of the crop will create variability in its price. The own price flexibility analysis reveals that the relation of price ad production of gram and mung was positive while of masoor and mash it was negative (Table 4).

Table 4: Price and Cross Price Flexibilities of Selected Pulses

Dependent Variable Price	Constant	Quantities Coefficient				
		Gram	Masoor	Mung	Mash	R^2
Gram	0.58	0.98 (1.95)*	-1.38 (-2.90)***	-	-	29.60%
Masoor	1.91	1.03 (2.22)**	-1.77 (-4.04)***	-	-	42.10%
Mung	-1.91	-	-	1.24 (11.78)***	-0.26 (-1.54)*	90.20%
Mash	-1.00	-	-	1.22 (11.56)***	-0.49 (2.85)***	91.20%

Note: ***, ** and * indicate significant at 1%, 5% and 10% level

The price flexibility analysis reveals that the relation of price ad production of gram and mung was positive it may be because these are that major pulses of their respective season also having the high demand. While of masoor and mash it was negative. The supply (Production) of gram increases its current year's price was also increases. A 10 percent increase in the production of gram increase the price of gram the 9.8 percent in the same production season (table 4). Hence price response elasticity in case of gram was elastic closed to unitary elastic. In case of own price elasticity of masoor is highly elastic. A 10 percent increase in the in the production of masoor decrease will cause a decline of 17.7 percent in its price. In case of mung the own price elasticity is highly elastic because due to 10 percent increase in the production in mung that will bring increase in its price by 12.4 percent. Price response elasticity in case of mash is inelastic. A 10 percent increase in the supply of mash will cause a decline of 4.9 percent in its price.

Cross price flexibility of substitution is very important to calculated because cross flexibility co-efficient reveals the impact of supply of one pulse on the price of other substitution pulse in the same production season.

The coefficient shows that the increase in the production of masoor has deep influence on the price of gram. The response of price of Gram with the production (Supply) of the masoor is highly elastic. With an increase of 10 percent in the production of masoor the price of gram will decline by 13.8 percent. The analysis shows that the effect of supply of gram on masoor price is positive and their response is elastic. The price of masoor will increase by 10.3 percent with the increase in production of gram by 10 percent. The substitution effect of supply of mash on the price of mung is low the coefficient shows that with an increase of 10 percent in the supply of mash increase by 10 percent then price of mung decline by 2.6 percent. The supply of mung increases by the 10 percent the price of mash increasing by the 12.2 percent so that the price response is high elastic. Mung and gram are the pulses which show that whenever the production is increases the price of both pulses will be increasing in the study period. Cross price flexibility between gram and masoor was negatively related because whenever the production of gram increase than it was cause an increase in the price of masoor. It means large area under gram means increase in the price of masoor. The results show that Production of mung also having positive relationship with the price of mash because whenever the production of mung increase than it means that mash price also increases. Hence the production of one crop has interrelationship with the price increase/decrease of other competing crop. Technologies achievement for one crop will also affect the price of other crop prevailing in the market. Therefore, policy measures taken may not be only for a single crop in the crop sub sector the effect of any policy should be considered on the other crops too.

Conclusion and Recommendation

This study shows that there was no specific trend in price of all the selected pulses. The growth rates of prices of selected pulses were positive and growth rates of area and production were negative except the mung. Among of all the pulses masoor was having higher instability in price. In case of all the major pulses price fluctuation was higher than that area, production and yield. The reason of these fluctuations is that price is not in the control of farmers. The government should provide incentives for pulses producing farmers. They provide incentive to the gram production instead of

masoor, which are substitution pulses to each other in term of area allocation because it is more instable pulse as compared to the gram. Similarly more incentive should be given for mung instead of mash. If the price of masoor will be lower, the farmers allocate more area for gram. Similar will be the situation in case of mung and mash. If the area instability will reduce, there will be reduction in the productivity instability. If there will be liberty in market modern factor inputs will be available the surplus produce will easily move to deficit areas. It helps the policy makers to stabilize the price. Easy availability of modern factor inputs and sustained supply will reduce area instability largely. Hence procurement and storing selected crops are the effective instruments to control the area instability of the selected pulses. Technological advancement is one of the best methods to control in the area instability of the pulses.

Due to the research efforts of the scientists and breeders if appropriated production technologies and technological advancement is adopted not only in marginal areas but also for different farming systems and cropping patters there will be control in the area instability of the pulses also reducing the per unit cost of the pulses. There will be an urgent need to promote these pulses because these crops perhaps stand among those crops, which although ignored rather neglected for research and development yet have succeeded in having their nutritional value recognized in majority of countries and stressed marginal growing conditions. They have proved their significance in a variety of ways may it be for human or animal consumption along with this government should chalk out effective strategy to improve annual yield of all locally grown pulses and decrease dependence on imported pulses.

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