

## **ANALYZING PRODUCTION POTENTIAL OF SELECTED FOOD AND LEGUME CROPS FOR FOOD SECURITY IN PUNJAB, PAKISTAN**

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**ABSTRACT:-** The present study was designed to assess growth rate in area, yield and production of selected major food commodities and to project these parameters on the basis of estimated growth co-efficient. Time-series data for area, yield and production were collected for wheat, sugarcane, rice, mung and gram since 1980-81. The semi-log trend function was employed to find out the growth rate of selected commodities. The findings of the study showed the positive growth rates of area, production and yield of all selected food grain and legume crops. The estimated co-efficient for all growth models (area, production and yield) of selected commodities were statistically highly significant at 1% level except yield of gram which was significant at 10% level. The estimated annual growth rate of area for wheat, rice and sugarcane was 0.9%, 2.1% and 0.8%, respectively with the production growth of 3.0%, 3.8% and 2.2%, respectively and yield growth of 2.1%, 1.6% and 1.5%, respectively. The results highlighted that the major contribution for expansion in production for rice and sugarcane was area while it was yield for wheat. In this scenario the wheat production can be enhanced by increasing its area than that of rice and sugarcane. The annual growth rate for gram and mung area was estimated about 1.0% and 4.9%, respectively, with the production growth rate of 2.3% and 6.4% while yield growth rate of 2.9% and 1.4%, respectively. Keeping in view the higher growth of gram yield the increase in its area may enhance its production more than that of mung. The proportionate higher increase in the area of wheat and gram may enhance the welfare of producers in particular and provide food security to masses in general.

*Key Words: Wheat; Sugarcane; Rice; Mung; Gram; Growth Rate; Area; Production; Yield; Food Security; Pakistan.*

### **INTRODUCTION**

Pakistan has great potential for producing all types of food commodities as it has a rich and vast natural resource base, covering various ecological and climatic zones. Wheat is the leading food grain of Pakistan and being staple diet of the people, it has strong implications on national food

security. Wheat contributes 12.5% to the value added in agriculture and 2.6% to GDP, respectively (GoP, 2011). According to Rao (2007) the potential wheat production in Pakistan should be over 38 million tons and Pakistan is losing minimum 3 billion US dollar due to wheat production inefficiencies. The study conducted by Sher and Ahmad

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(2008), projected the steady annual growth rate of 1.6% for wheat from 2007 to 2015. According to Hussain et al. (2012), the potential of increase in area under wheat seems exhausted in Punjab as observed during the last two decades. Rehman et al. (2011), investigated the growth trends of area, production and yield of major crops by using component analysis model and comes up with the estimates that production of wheat, rice, sugarcane and cotton has increased at the annual growth rate of 3.27%, 3.00%, 2.48% and 2.91%, respectively. The yield per hectare for these crops has increased annually @ 2.06% for wheat, 1.92% for cotton, 1.09% for rice and 0.81% for sugarcane. The compound growth rate of area under major crops per annum was increased by 1.29%.

Rice is the second staple food in Pakistan and it provides 37% of food calorie intake (FAO, 2012). According to Wang et al. (2012), after green revolution the area, yield and production of rice was increased by 3.68%, 5.24% and 8.91%, respectively, during 1961-1980 due to technological advancement. Later during 1981-1995 the rice production in Pakistan remained modest as the growth in area and yield was stagnant during that period. The introduction and adoption of newly developed high yielding variety after 1995 again boosted production of rice by 3.3% per annum for 1996-2009. Abid et al. (2014) estimated the compound annual growth of major crops (wheat, maize, rice and sugarcane) in Khyber Pukhtunkhwa (KPK) and came up with the findings that area of wheat and rice decreased with increased production and yield in KPK during 1981-2012 whereas maize and sugar-

cane area, production and yield increased during this period. According to Qureshi et al. (1993), the expansion of area under rice is limited due to its water intensive attribute however production and yield of rice remarkably increased after green revolution.

Pulses are considered as the rich source of vegetable protein. Major pulses grown in Punjab are gram, lentil, mung bean and mash beans. Among all pulses gram is the major *rabi* legume crop and mung bean is the major *kharif* legume crop. The combined share of pulses gram and mung bean in the household consumption basket is 1.48% (GoP, 2012). According to Rani et al. (2012), during 1976-2010 the overall area, production and yield of gram in Pakistan was decreasing whereas those of mung increasing. The reduction in gram area, production and yield is due to its reduced profitability than competing crops like wheat. Moreover, the intercropping of gram with wheat has also been discontinued. Akibode and Maredia (2011), analyzed FAO stat data regarding area, production and yield of legume crops worldwide and found that except for chickpeas and lentil, area harvested of all other legumes showed declining trend over 1994-2008 whereas production of all seven focused legumes increased in 2006-08 as compared to 1994-2006. Yield of legumes also increased in 2006-08 as compared to that in 1994-2006, but the yield in developing countries is significantly lower than legumes yield in developed world. According to Ali and Abedullah (1998), the reduced pulses production was attributed by the lack of technological advancement and innovation in pulses, which reduced their profitability, thus pushed them

to the marginal lands which were not suitable for cereal and cash crops.

Food security is one of the major challenges confronting the world today. It is inherently interlinked with other current global challenges of economy and climate change. It is said to exist when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (FAO, 2009). Agricultural production is the foundation of food availability for food security and food access to the masses. Adequate food supply at affordable prices is the cornerstone of food security policy of all nations of the world including Pakistan. Domestic production, commercial imports, and food aid are the main constituents of food availability at the national level. Despite significant improvement in food supply in the aggregate, malnutrition is a widespread phenomenon in Pakistan.

This indicates that despite having sufficient food available at the national level, a large chunk of our population lack access to nutritiously balanced food. Considering food security, the present study was designed to assess growth rate in area, yield and production of selected food commodities and to project the area, production and yield of these food commodities on the basis of estimated growth rate. The specific objectives of the study are: to assess growth rate in area, yield and production of selected food commodities; to project the area, production and yield of these food commodities on the basis of estimated growth rate; and to extend policy options based on the findings of the study.

## MATERIALS AND METHOD

The study is based on time series data, using secondary data from Pakistan Economic Survey, Statistical Bulletins and Agricultural Statistics of Pakistan. Time-series data for area, yield and production was collected for wheat, sugarcane, rice, mung, and gram from 1980-81 to 2010-11. The following semi-log trend function was used to find out the trend and estimate the growth rate since 1980-81.

$$\ln Y = \beta_0 + \beta_1 t + e \dots\dots\dots (1)$$

where,

- Y = Dependent variable (area, yield and production)
- t = Trend over specific period.
- $\beta_1$  = Coefficient of trend
- ln = Natural logarithm
- e = Error term

Compound annual growth rates were computed to estimate the growth trends of area, production and yield of selected crops. Rani et al. (2012) has used this approach to find out the growth estimates of area, production, yield and prices of major pulses. The following regression function has been used to find out the trend and estimate the growth rate of selected crops.

$$Y_t = Y_0 (1 + r)^t \dots\dots\dots (2)$$

where,

- $Y_t$  = Area, production and yield of selected pulses in year t
- $Y_0$  = Initial (i.e., 1980-81) area/production/yield of selected commodities.
- r = The compound (i.e., over time) rate of growth of  $Y_t$ .

For the estimation of projected area, production and yield of selected crops following equation has been used.

$$Y_p = Y_c 1 (1 + \beta_1)^n \dots\dots\dots (3)$$

where,

$Y_c$  = Current year (i.e., 2010-11) area, production and yield of selected commodities

$\beta_1$  = Estimated coefficients of area, production and yield models of selected commodities

$n$  = Number of projected year

Knowing the estimated coefficients the projected value of the area, production and yield for  $n$  year's period of time was calculated.

**RESULTS AND DISCUSSION**

The instantaneous and compound growth rates of the five commodities wheat, rice, sugarcane, gram and mung were calculated by using the semi-log trend function and the above given formulae. On the basis of estimated coefficients of semi-ln trend regression analysis the projected area, production and yield of these commodities in 2020 were calculated.

**Potential and Projected Area, Production and Yield of Selected Food Grains**

Among the food grains wheat, rice and sugarcane were selected depending upon their share in household consumption basket. The share of wheat in total house-hold budget was about 13.85%, rice 4.01% and sugar 6.40% (GoP, 2012). In Pakistan, wheat is used for about 60% of daily diet of common man with average per capita consumption of 125 kg. Almost 75% of total wheat production comes from Punjab.

The estimated coefficients of the regression models for wheat area, production and yield were statistically highly significant and exhibited the per annum growth of 0.9%, 3.0%

and 2.1%, respectively (Table 1). Almost same results of increase in wheat production and yield over time were produced by Ishaq et al. (2004) and Rehman et al. (2011). The regression models of rice area, production and yield were highly statistically significant with the estimated growth of 2.1%, 3.8% and 1.6% per annum, respectively. The study conducted by Wasim (2002), also highlighted that during 1974-85 the rice production was increased due to increased productivity as a result of new technical change. In the second decade from 1985-1995 the increase in rice production was due to the growth in both area and yield of rice. The estimated coefficients of sugarcane growth models (area, production and yield) shows increasing trend of 0.8 %, 2.2 % and 1.5 % per annum, respectively.

On the basis of estimated growth rates the projected area, production and yield of wheat was accounted 7252.9 thousand hectare, 24844.2 thousand tones and 2209 kg ha<sup>-1</sup>, respectively, till 2020. The projected area for rice and sugarcane in 2020 will be 2130 ha and 722.2 thousand ha with an average growth rate of 2.1% and 0.8% per annum, respectively. The projected production of rice and sugarcane in 2020 will be 4733.8 thousand tones and 45590 thousand tones, respectively with the annual growth rate of 3.8% for rice and 2.2% for sugarcane. However, the projected growth rate of yield is highest for wheat (2.1%) followed by rice (1.6%) and sugarcane (1.5%).

**Potential and Projected Area, Production and Yield of Selected Food Legumes**

Among food legumes mung bean

## ANALYZING PRODUCTION POTENTIAL OF SELECTED FOOD

**Table 1. Estimated growth rates of area, production and yield of selected food grains**

	Area	Production	Yield
<b>Wheat</b>			
F statistics	542.336***	476.873***	232.995***
R <sup>2</sup>	0.949	0.943	0.889
Coefficient	0.009	0.030	0.021
Standard error	0.000	0.001	0.001
T statistics	23.288***	21.837***	15.264***
1981	4978.0 (000 ha)	8350.0 (000 t)	1677 (kg <sub>ha</sub> <sup>-1</sup> )
2011	6691.0 (000 ha)	19041.0 (000 t)	2846 (kg <sub>ha</sub> <sup>-1</sup> )
Compound growth rate (%)	0.9	3.0	2.1
2020 (projected)	7252.9 (000 ha)	24844.2 (000 t)	3431 (kg <sub>ha</sub> <sup>-1</sup> )
<b>Rice</b>			
F statistics	523.042***	220.527***	71.276***
R <sup>2</sup>	0.947	0.884	0.711
Coefficient	0.021	0.037	0.016
Standard error	0.001	0.002	0.002
T statistics	22.870***	14.850***	8.443***
1981	1061.9 (000 ha)	1361.7 (000 t)	1282 (kg <sub>ha</sub> <sup>-1</sup> )
2011	1766.8 (000 ha)	3384.0 (000 t)	1915 (kg <sub>ha</sub> <sup>-1</sup> )
Compound growth rate (%)	2.1	3.8	1.6
2020 (projected)	2130.2 (000 ha)	4733.8 (000 t)	2209 (kg <sub>ha</sub> <sup>-1</sup> )
<b>Sugarcane</b>			
F statistics	13.301***	61.931***	130.244***
R <sup>2</sup>	0.314	0.681	0.818
Coefficient	0.008	0.022	0.015
Standard error	0.002	0.003	0.001
T statistics	3.647***	7.870***	11.412***
1981	597.5 (000 ha)	23733 (000 t)	39.70 (kg <sub>ha</sub> <sup>-1</sup> )
2011	672.2 (000 ha)	37481 (000 t)	55.80 (kg <sub>ha</sub> <sup>-1</sup> )
Compound growth rate (%)	0.8	2.2	1.5
2020 (projected)	722.2 (000 ha)	45590 (000 t)	63.8 (kg <sub>ha</sub> <sup>-1</sup> )

\*\*\* Significant at 1% level of probability

and gram were selected due to their vast share of area and production in Punjab. Punjab contributes 76.8% and 91.5% of the total cropped area of mung bean and gram, respectively, in Pakistan. Moreover, it contributes 78.7% and 86.5% of overall mung and gram production of Pakistan during 2011 (GoP, 2011).

The results indicated that the positive growth in the area, production and yield of mung was highly significant at 1% level (Table 2). The projected area, production and yield of mung in 2020 will be 162.3 thousand hectares, 104.9 thousand tones and 644.8 kg ha<sup>-1</sup> per annum with an

average annual compound growth rate of 4.9%, 6.4% and 1.4%, respectively.

The growth rate estimates of gram area, production and yield were significant at 1% and 10%, respectively. The annual compound growth rate of gram area, production and yield were estimated about 1.0%, 2.3% and 2.9%, respectively. The projected area, production and yield of gram in Punjab in 2020 will be 1055 thousand hectares, 526.6 thousand tones and 575.6 kg ha<sup>-1</sup>, respectively. Rani et al. (2012) estimated negative growth of 0.08, 0.04 and 0.36 per annum for area, production and yield

**Table 2. Estimated growth rates of area, production and yield of selected food legumes**

	Area	Production	Yield
<b>Mung</b>			
F statistics	71.493***	171.897***	24.283***
R <sup>2</sup>	0.7**	0.856	0.456
Coefficient	0.048	0.062	0.014
Standard error	0.006	0.005	0.003
T statistics	8.455***	13.110***	4.928
1981	43.7 (000 ha)	31.8 (000 t)	472.0 (kg ha <sup>-1</sup> )
2011	105.5 (000 ha)	60.0 (000 t)	569.30 (kg ha <sup>-1</sup> )
Compound growth rate (%)	4.9	6.4	1.4
2020 (projected)	162.3 (000 ha)	104.9 (000 t)	644.8 (kg ha <sup>-1</sup> )
<b>Gram</b>			
F statistics	53.660***	15.428***	3.038*
R <sup>2</sup>	0.649	0.347	0.095
Coefficient	0.010	0.023	0.029
Standard error	0.00*	0.006	0.017
T statistics	7.325	3.928	1.743*
1981	642.1 (000 ha)	240.1 (000 t)	374.0 (kg ha <sup>-1</sup> )
2011	964.6 (000 ha)	429.1 (000 t)	445.0 (kg ha <sup>-1</sup> )
Compound growth rate (%)	1.0	2.3	2.9
2020 (projected)	1055.0 (000 ha)	526.6 (000 t)	575.6 (kg ha <sup>-1</sup> )

\* and \*\*\* Significant at 10% and 1% level, respectively.

of gram during 1976-2010 whereas area, production and yield of mung showed increasing growth trend of 3.21%, 1.05% and 4.49% per annum, respectively, for the same period.

### Compound Growth Rates of Important Food Crops

The compound growth rates for important food crops showed positive growth of area and production for the five crops under study (Table 3). The estimated annual growth of area, production and yield of wheat was 0.9%, 3.0% and 2.1%, respectively. Rice area, production and yield grew @ 2.1%, 3.8% and 1.6% per annum, respectively. The sugarcane area, production and yield were estimated to grow @ 0.8%, 2.2% and 1.5%, respectively. The annual compound growth rate for gram and mung area was estimated about 1.0% and 4.9%, respectively, with the production growth rate of 2.3% for gram and 6.4% for mung. The growth rate of yield per annum for gram and mung was estimated at 2.9% and 1.4%, respectively.

**Table 3. Annual compound growth rate of important food crops (%)**

Crop	Area	Production	Yield
Wheat	0.9	3.0	2.1
Rice	2.1	3.8	1.6
Sugarcane	0.8	2.2	1.5
Gram	1.0	2.3	2.9
Mung	4.9	6.4	1.4

The estimates of the study clearly concluded that growth of area, production and yield of wheat, rice, sugarcane, mung and gram were positive (Table 3). Likewise keeping in

view the higher growth of gram yield the increase in its area may enhance its production more than that of mung. Therefore, it is concluded that proportionate higher increase in the area of wheat and gram may enhance the welfare of producers in particular and provide food security to masses in general. It is recommended that area allocation of wheat and gram may be enhanced to attain the efficient utilization of land and achieve higher yield. The innovation of new high yielding varieties of wheat, rice, sugarcane, mung and gram can be a viable option to increase the yield of these crops.

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#### AUTHORSHIP AND CONTRIBUTION DECLARATION

S. No	Author Name	Contribution to the paper
1.	Dr. Muhammad Qasim	Conceived the idea, Did analysis wrote results and discussion and conclusion
2.	Ms. Sonila Hassan	Data collection, Write up of introduction and review of literature
3.	Dr. Arshed Bashir	Abstract methodology, technical input at every step
4.	Hafiz Zahid Mahmood	References, Overall management
5.	Mr. Irfan Mehmood	Results and Discussion, Technical input at every step

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