

# Time Series Analysis of Production Potential of Wheat in Pakistan up to the Year 2010-2011

ABDUL SABOOR, FAROOQ TANWIR<sup>†</sup> AND SAMRA INAYAT<sup>‡</sup>

*Departments of Agricultural Economics and <sup>†</sup>Rural Sociology, University of Agriculture-38040, Faisalabad, Pakistan*

*<sup>‡</sup>Department of Economics, Fatima Jinnah Women University, Rawalpindi-Pakistan*

## ABSTRACT

In this study, an attempt has been made to predict the production potential of wheat crop in Pakistan up to the year 2010-11. Production projections were worked out by the application of time series analysis on the secondary data of past 50 years i.e. from 1950-51 to 2000-2001, taking area and yield of wheat into account. It was revealed from the projections that on the basis of last 50 years data of yield and acreage, production will increase from 20628.2 thousand tons in 2001-2002 to 21740.2 thousand tons in 2005-06 and 23753.5 thousand tons in 2010-11. The probability of occurrence of an expected increase in production of wheat appears to be directly related to the expansion in area and rise in average yield per hectare.

**Key Words:** Pakistan; Production potential; Wheat crop

## INTRODUCTION

Planning is fundamentally a process of thinking ahead and anticipating difficulties through rational actions based on experience, prudence and imagination to conduct the course of development so as to realize the pet and professed goals. The long-term supply projections of agricultural commodities prove helpful for formulating government policies with regard to production, consumption, prices, procurement, marketing, storage and domestic and foreign trade. There is no second opinion on the importance of Agriculture for its being key numerator in the sustainable growth and development of the economy of Pakistan. It is a vital sector, providing food to the fast-growing population of the country.

Wheat as staple food grain contributes 12.1% to the total value added in agriculture sector of the economy, 2.9% to Gross Domestic Product (GDP) and 45.6% in terms of cropped area in Pakistan. The significant importance of wheat crop is further judged by the repercussions of its performance on overall growth rate, balance of trade and nutritional standard of the urban masses (Govt. of Pakistan, 2000-2001).

Pakistan is one of the top producers of wheat in the world accounting for about 2% of the global wheat supply. Among the major producers, it has the third highest growth rate in yield and production over the past twenty years. A more than three fold increase in wheat production from 4.3 million tones in 1966-67 to 1990-91 represented a nearly 6% rate of gain per year, considerably ahead of the population growth rate of 3.3% per year during the same period (PARC, 1986). There is an ample scope for increasing wheat productivity. A continuing challenge to wheat production in Pakistan is to exploit the potential of drier rain-fed areas where the pace of change has been stagnant (NARC, 1996). Thus the present study aimed at

assessing the trends in acreage, yield per hectare and production in the country during the last 50 years and estimating the production potential up to 2010-11. It focused myopically on the factors contributing to change in area and per acre yield thereby changing the pattern of wheat production potential in Pakistan.

## MATERIALS AND METHODS

It is not an easy task to forecast the future production potential of agricultural crops because a large number of unpredictable exogenous and institutional factors are involved. Moreover, the data on required variables are usually lacking, incomplete and sometimes obsolete. A good number of approaches can be employed for forecasting such as purely judgmental approaches, structural econometrics models, time series models, etc (Coleman & Thigpen, 1991). For this study we have selected econometric techniques extensively used in some earlier research endeavors (Khutulava, 1991). The second possible technique being followed in this study was to use the relationship between selected variables in the past and to project the future production potential of an agricultural commodity on the basis of past relationship between these variables. The equation was thus fitted with the variables in order to arrive at the final production projections of wheat.

There are two variables, yield per hectare and area under wheat crop that are claimed to be the main sources of variation in production. The data regarding area under wheat, yield per hectare and production were obtained from various government publications and periodicals. The following algebraic expression was used to arrive at the profound figures for yield per hectare and area under cultivation.

$$\ln Y = a + b X$$

To find out yield, log of average yield per hectare was

substituted for 'Ln Y' and for area, log of average area was substituted, whereas 'X' is denoted for the year of observations, and 'a' and 'b' are constants.

The statistical model explains yields in terms of the passage of time and is dubbed as the time series model. Time is considered as a proxy variable for all sorts of changes in management, culture, technology and all other changes associated with the passage of time. The production projections were arrived at by multiplying the projected yield per hectare and projected area under wheat crop. The projected value for production was estimated at 95% confidence interval at n-2 degree of freedom by employing the following formula:

$$Y_f \pm t_{0.05} = S_{YX} \sqrt{1 + \frac{1}{n} + \frac{(X - \bar{X})^2}{\sum X^2}}$$

Where  $Y_f$  = Projected value

$$S_{YX} = \sqrt{\frac{\sum Y^2 - (\sum XY)^2 / \sum X^2}{n - 2}}$$

t = Tabulated value of t at 5% level of significance, at n-2 degrees of freedom

and

n = Number of observations.

To make the time series analysis authentic, some specific axioms have been developed so as to arrive at more precise and realistic projections. The *ceteris paribus* includes absence of exogenous disturbances such as war, social upheavals, law and order and abnormal climatic conditions, unusual developments such as widespread floods, viral attacks, effect of pests and diseases.

## RESULTS AND DISCUSSION

Production projections of wheat crop in Pakistan have been worked out considering in view the variations in the area under cultivation and average yield per hectare on the basis of last 50 years data i.e. from 1950-51 to 2000-01 (Table I). The production estimates for a particular year are mainly a function of average yield per hectare and area under cultivation for the crop concerned. These two variables have been projected to determine production projections of the wheat crop for the years to come (2010-11). The projected results are described here under.

**Area projections.** Area was projected by manipulating linear relationship between area under cultivation of wheat and number of years by employing ARIMMA Model. Area under wheat cultivation is predicted to increase from 8303.6 thousands hectares in 2001-2002 to 9019.5 thousand hectares in 2010-2011 (Table II). This nominal increase in acre age may be due to land reclamation and high prices of the produce. At 5% probability, the maximum area under wheat would increase from 8753.4 thousand hectare to 10279.8 thousand hectares in 2010-11. The increase in minimum and maximum area is due to land reclamation and increasing demand from wheat processing firms. This

difference might be the outcome of shifting trends in the production of other crops, availability of canal water and government policy towards wheat.

**Yield projections.** Based on the past 50 years trends, the average yield per hectare indicated a nominal increasing trend. From 2001-2002 to 2010-11 average yield per hectare would increase from 2445.79 kg to 2560.56 kg, in 2005-06 and 2751.94 kg in 2010-11 (Table II). Thus no significant break-through has been projected in average yield per hectare. The diminishing trend of minimum average per hectare yield of wheat would probably due to the expected drought situation in the decade to come and lack of high yielding varieties if not the traditional farm practices (PARC, 2000)

**Table I. Past production, area and grain yield/ha of wheat crop in Pakistan**

Year	Area ('000" ha)	Yield/ha (kg)	Production ('000" tonnes)
1950-51	4370.3	914	3993.2
1951-52	4106.8	733	3009.6
1952-53	3817.0	630	2405.0
1953-54	4215.2	865	3644.6
1954-55	4261.4	748	3186.4
1955-56	4521.2	745	3370.2
1956-57	4689.2	776	3638.5
1957-58	4608.6	773	3564.3
1958-59	4829.3	809	3906.7
1959-60	4878.5	801	3908.8
1960-61	4639.0	822	3814.2
1961-62	4923.1	818	4026.6
1962-63	5022.3	830	4169.8
1963-64	5019.0	829	4161.7
1964-65	5317.6	863	4590.5
1965-66	5154.9	870	3916.0
1966-67	5343.9	811	4334.4
1967-68	5983.4	1073	6418.4
1968-69	6159.8	1074	6617.5
1969-70	6229.5	1171	7294.2
1970-71	5977.5	1083	6476.3
1971-72	5797.1	1189	6890.4
1972-73	5970.6	1246	7442.3
1973-74	6112.6	1248	7628.9
1974-75	5812.3	1320	7673.5
1975-76	6110.6	1422	8690.7
1976-77	6390.1	1431	9143.9
1977-78	6360.0	1316	8367.2
1978-79	6687.1	1488	9950.0
1979-80	6923.7	1568	10856.5
1980-81	6983.7	1643	11474.6
1981-82	7222.9	1565	11304.2
1982-83	7397.9	1678	12414.4
1983-84	7343.2	1482	10881.9
1984-85	7258.5	1612	11703.0
1985-86	7403.3	1881	13923.0
1986-87	7706.2	1559	12015.9
1987-88	7308.4	1734	12675.1
1988-89	7729.6	1865	14419.2
1989-90	7844.5	1825	14315.5
1990-91	7911.4	1841	14565.0
1991-92	7877.6	1991	15684.2
1992-93	8299.7	1947	16156.5
1993-94	8034.2	1894	15213.0
1994-95	8169.8	2081	17002.4
1995-96	8376.5	2018	16907.4
1996-97	8109.1	2053	16650.5
1997-98	8355.0	2238	18694.0
1998-99	8230.0	2170	17856.0
1999-2000	8463.0	2491	21079.0
2000-2001	8137.0	2278	18535.0

**Table II. Projected area, grain yield and production of wheat crop in Pakistan**

Year	Projected area (000 ha)			Projected yield ( kg/ha )			Projected production (000 t)		
	W.O.C.I.*	W.C.I.**		W.O.C.I.	W.C.I.		W.O.C.I.	W.C.I.	
		Min.	Max.		Min.	Max.		Min.	Max.
2001-02	8303.6	7853.8	8753.4	2445.79	2218.31	2673.27	20628.2	18781.8	22474.7
2002-03	8367.5	7790.7	8944.3	2418.61	2159.97	2677.24	20087.6	18031.6	22143.5
2003-04	8452.7	7759.4	9146.0	2491.27	2171.19	2811.36	21043.9	18471.2	23616.5
2004-05	8533.3	7740.4	9326.1	2512.82	2151.75	2873.90	21150.3	18273.0	24027.7
2005-06	8614.7	7731.2	9498.2	2560.56	2152.48	2968.64	21740.2	18475.7	25004.8
2006-07	8695.8	7728.6	9663.0	2594.9	2144.58	3045.22	22056.1	18461.2	25651.0
2007-08	8776.9	7731.1	9822.7	2636.11	2142.43	3129.80	22528.3	18579.7	26476.9
2008-09	8857.9	7737.5	9978.2	2673.82	2137.99	3209.66	22912.3	18624.8	27198.7
2009-10	8938.7	7747.1	10130.4	2713.34	2135.11	3291.56	23347.0	18714.8	27979.1
2010-11	9019.5	7759.2	10279.8	2751.94	2131.56	3372.32	23753.5	18778.9	28728.0

\*Without confidence interval; \*\*With confidence interval

**Production projections.** The projected results reveal that the production would show an increasing trend in the years to come. On the basis of last 50 years data of yield and acreage, it was projected that production will increase from 20628.2 thousand tons in 2001-2002 to 21740.2 thousand tons in 2005-06 and 23753.5 thousand tons in 2010-11 (Table II). Thus the average growth rate between these two periods would be 0.54% and 0.77%. This increase in production is attributed only to slight increase in cultivation of wheat crop and mild increase in average yield per hectare. The minimum and maximum production probability of wheat at 95% confidence interval was also projected to make the analysis more logical and authentic. The maximum probability of production of wheat is estimated to be 22474.7 thousand tons in 2001-02 to 25004.8 thousand tons in 2005-06 and 28728.0 thousand tons in 2010-11. On the other hand the minimum production possibility of wheat in Pakistan would flow from 18781.8 thousand tons in 2001-02 to 18778.9 thousand tons in 2010-11 (Table II). This reflects a decreasing trend at a negative growth rate which is the outcome of a decrease in minimum average yield per hectare and minimum area under wheat cultivation. In this way the probability of occurrence of an expected future increase in production of wheat appears to be directly related to the expansion in area and rise in average yield per hectare.

## CONCLUSIONS

It appears that total cultivated area has increased due to changes in cropping pattern, higher cropping intensity, increased demand from the industry, better marketing facilities and varying efforts of the government to promote agricultural production. Similarly, the analysis of the past yield trends indicates that there has not been a significant break-through in the average yield per hectare. However, a rising trend in yield during some period was due to the use of improved varieties of wheat, increased water supply through installation of tube wells, increased use of fertilizers, plant protection measures and also due to

increase in stabilized demand for wheat for the industries. But the gloomy picture of some years may be attributed to adverse weather conditions, floods, heavy rains, attack of stem borer, and damage by wild boars etc. Such evidence reveals a little increasing trend in wheat production. There might be scarcity of wheat in the first decade of 21<sup>st</sup> century because of growing rate of population.

## SUGGESTIONS

The following policies may be adopted for wheat yield improvement:

1. The main focus should be on the production and promotion of new high yielding varieties thereby making such varieties available to the farmers through mobilizing the agricultural extension staff.
2. More commercial processing farms should be encouraged to bring the seed, inputs and technical advice to the farm gate, provide production credit and guarantee a price for the crop.
3. Incentive in the shape of support price of wheat is the major contributor to increase the overall production of wheat in Pakistan. The prices should be kept at par with the international prices and the cost of production.

## REFERENCES

- Govt. of Pakistan, 2000-2001. *Economic Survey*, Finance Division, Economic Adviser's Wing, Islamabad
- Coleman, J. and M.E. Thigpen, 1991. World Bank Staff commodity Working Paper 24. Washington D.C.
- Khubulava, N.N., 1991. An econometric model for forecasting agricultural production. Central Economic Research Institute of PSFSR, Moscow, USSR
- NARC, 1996. National Coordinated Wheat Barley of Traffical Programme, National Agricultural Research Council, Islamabad
- PARC, 1986. Wheat research and development in Pakistan, Pakistan Agricultural Research Council/CIMMYT Programme, Islamabad
- PARC, 2000. Factors contributing to higher wheat productivity 1999-2000. Pakistan Agricultural Research Council, Islamabad

(Received 11 March 2003; Accepted 30 April 2003)