

TREND ANALYSIS AND FORECASTING OF WHEAT AND RICE PRICES IN PAKISTAN

Saqib Shakeel Abbasi*, Ayesha Tahir**, Irum Raza* Saleem Abid* and Muhammad Nisar Khan*

ABSTRACT:- Wheat and rice are the basic requirement of every household. This paper analyses the price trends for these crops over the last 30 years and based on statistical models, forecast their prices from 2013 to 2017. Different models have been applied to get the best fit model. These were linear trend model, quadratic trend model, exponential growth model and S-curve model. The minimum values of Mean Absolute Percentage Error (MAPE), Mean Absolute Deviation (MAD) and Mean Squared Deviation (MSD) have been acquired and then the forecasting was made for the best fitted model with minimum error. Five year average prices for the individual crop(s) were also calculated to observe the past trend. The study demonstrates that for wheat and rice (Basmati and IRRI); S-Curve model is recommended for forecasting price. The study presents an insight to national policy makers regarding the essential crops and provides them with a reference range of price in future so that they may be able to effectively deal with the increasing concern of food inflation in Pakistan.

Key Words: Wheat, Rice; Price Forecasting; Agricultural Commodities; Pakistan.

INTRODUCTION

Pakistan is an agricultural country and this sector is major constituent of country's employment sources. Agricultural and derived products are used in different industrial units as raw and/or processed material. Yet, emphasis on agriculture has decreased over time, mostly due to increasing urbanization rate. However, still majority of people living in rural areas of the country are directly or indirectly related to agriculture sector. Ironically, out of total area being used for agriculture purposes, 93 % own less than 12.5 acres, or four hectares, of which 60 % own less than

three acres, or one hectare (Altaf, 2009). The percentage of the land cultivated for agriculture purposes has increased marginally with increase in the support prices of the crops. In Pakistan, the government announces a support price for the major crops to attract the farmers to grow a particular crop more, and also to attract non-farmers to farming. Support price is the minimum amount that must be paid to the farmer for procurement of a certain quantity of the crop. The support price may be accompanied with subsidized seed and fertilizer prices.

Forecasting production and price of commodities is important in

* Social Sciences Research Institute, National Agriculture Research Centre, Islamabad, Pakistan.

** Planning and Development Division, PARC, Islamabad, Pakistan.

Corresponding author: ashfju1@gmail.com

agriculture, as in other fields. The United States Department of Agriculture (USDA, 1999) issues crop supply and demand estimation, which are used both at US and the world level. These estimations are used as standards in the market place due to their nature of objectivity and comprehension. In Pakistan, the production forecast about the major crops such as wheat, cotton and rice is made by the agriculture department. However, no such mechanism is designed for forecasting the prices of agricultural commodities. This, amongst others, is mainly because of the uncertainties in market behavior and the demand and supply shifts.

The most important staple crop in Pakistan is wheat; cultivated at large scale throughout the country. Its consumption constitutes 9% of household consumption. In rural households, wheat is consumed at larger level as compared to the urban household, where it is second most consumed commodity (GoP, 2011). Over the years, many issues, like shortage of water, increases in prices of agricultural input and droughts have affected the yield at large (during last few years, good harvest of wheat crop has been witnessed). Wheat contributes 10.1% to the value addition in agriculture sector, and 2.2% to GDP (GoP, 2012). Wheat is cultivated through a group shaped cropping systems in Pakistan; wheat-cotton, wheat-rice, wheat-sugarcane, wheat-maize, etc. Wheat-cotton and wheat-rice cropping constitutes about 60% of the total areas where 1.50 mha of area is cultivated on rain based irrigation.

During 2014, the government has announced the support price of wheat @ Rs. 1200/40kg. This may

have a significant effect on the future cropping pattern. In last two years, the wheat cultivated area has increased from 8,650 thousand ha in 2011-12, to 8,693 thousand ha in 2012-13. This overall increase in the crop area was mainly attributed to the rise in price of wheat from Rs. 1050 to Rs.1200. Furthermore, due to favorable temperature and timely rains the size of grain had increased.

Rice is an important food and cash crop of Pakistan. It is the second staple food grain crop after wheat. Rice is also a major source of foreign exchange earnings for the country after cotton. Pakistan enjoys fame for growing and also for sending abroad rice with long grains and aroma. Rice is grown under different climatic conditions. Basmati type is grown mainly in the Punjab, cold tolerant varieties of rice are grown in Swat area. Heat tolerant varieties IRRI types are grown towards south side of KPK, Balochistan and Sindh (PARC, 2012). Researchers and academicians have emphasized on forecasting the prices of agricultural commodities. Kasten et al. (1998) viewed that forecasting is an essential part of agricultural economics. USDA for many years, had been routinely providing both quantity and price forecasts of agricultural commodities. These forecasts assist agriculture sector participants in designing informed production, marketing strategies, processing, and retailing decisions.

Taylor et al. (2004), proposed that base forecasts can be used to provide the prices projection along with upcoming prices. Moreover, base forecasts also required to evaluate the prevariation chances. Basis comparison was established in between, practical methods of forecasting basis for

major crops such as wheat, soybeans and corn in Kansas (USA). The support price on few crops is not helpful in creating a suitable market structure. The price of pulses has increased more as compared to wheat. This has serious implications for supply of protein to the poor population who do not have resources to buy expensive livestock based protein rich food. To halt this decline, government has to spend considerable foreign exchange on import of pulses. Increase in prices can be attributed to both supply and demand factors. The per capita availability of some items such as cereals and pulses has been declining, resulting in some pressure on their prices.

Reliable and well-timed forecast provides essential and valuable inputs for proper foresight and informed planning in agriculture which is full of uncertainties (Rani and Raza, 2012). They conducted the price forecasting of pulses grown in Pakistan. Using the double exponential smoothing function (DESF) along with measures of accuracy (MAPE, MAD and MSD) to get the forecasting. Data was collected from 1975 to 2010 on the basis of average annual prices taken from various issues of Agriculture Statistics of Pakistan.

The main objective of the study is to forecast trends regarding prices and accordingly test and future trends of wheat and rice prices were calculated by using appropriate trend analysis model. Trend analysis studies help policy makers in taking policy decision.

MATERIALS AND METHOD

The average annual price data per 40 kg of the crop at whole sale rate of major markets in Pakistan used in

the study is taken from various issues of Agricultural Statistics of Pakistan. Four separate models were used in the study to forecast the prices of selected food commodities from 2012-13 to 2016-17. These were linear trend model, quadratic trend model, exponential growth model and S-curve model. The minimum values of Mean Absolute Percentage Error (MAPE), Mean Absolute Deviation (MAD) and Mean Squared Deviation (MSD) have been acquired and then the forecasting was made for the best fitted model with minimum of error. Five year average of the prices for the individual crop(s) was calculated to observe the trend.

For trend analysis, equation as proposed by Boken (2000) and Rimi et al. (2011) was utilized. The methodology followed is through trend analysis.

$$Y_t = \beta_0 + \beta_1 X + e_x$$

where,

Y_t = Average annual prices of selected food commodities in year t

β_0 = Constant

β_1 = Regression coefficient

X = Time period (years)

e_x = Exponent function

Quadratic Equation

The quadratic trend model which can account for simple curvature in the data is:

$$Y_t = \beta_0 + \beta_1 * X + \beta_2 * X^2 + e_x$$

Exponential Growth Model

The exponential growth trend model accounts for exponential growth or decay. The model is:

$$Y_t = \beta_0 * \beta_1 X * e_x$$

S-curve Model

The S-curve model fits the Pearl-

Reed logistic trend model. This accounts for the case where the series follows an S-shaped curve. The model is:

$$Y_t = 10a / (\beta_0 + \beta_1 \beta_2 X)$$

Accuracy Measures

MAPE, MAD and MSD were used as three measures of accuracy. The smaller values of all these measures indicate a best fitting of the model and the best model further yields the minimum error of forecast (Karim et al., 2010). The best fitted model was used for estimating the prices forecast of crops during 2012-2017.

RESULTS AND DISCUSSION

Diagnostic measures for selection of best forecast model for wheat price in Pakistan showed the S-curve model to be best fitted for forecasting the prices of wheat. The MAPE, MAD and MSD results are minimum for S-curve model which are 8.22, 30.08 and 3941.52, respectively (Table 1).

The price of wheat has shown normal upward trend till 2015 while for 2016 and 2017 the prices have increased more than normal (Figure 1). The five year average trend line of wheat has shown gradual upward movement from 1976 to 1991 and then a rise has started to begin with prices reaching to Rs.400/40kg in

2001-06 from less than Rs.200/40kg in 1991-96. The last few years had made the prices to jump up as the government has been announcing the support prices of wheat each year. Another possible reason for this hike in price can be attributed to the overall food crisis that has caused the jump up in wheat prices after 2008.

The forecast for wheat has shown an increasing trend in prices with an increase of Rs. 200-300 per 40kg per annum. The forecast for 2016-17 has jumped a little higher as it reaches to almost 2676 per mound from 2085 in 2015-16 (Table 2).

Table 2. Five year forecast for Wheat

Year	Forecast (Rs.)	Year	Forecast (Rs.)
2012-2013	1184.95	2015-16	2085.00
2013-2014	1400.18	2016-17	2676.03
2014-2015	1686.49		

Accuracy Check and Forecasting for Rice Basmati

Diagnostic measures for selection of best forecast model for Basmati rice price in Pakistan revealed S-curve model as best fitted for forecasting the prices of wheat. The MAPE, MAD and MSD results are minimum for S-curve model as 8.9, 75.5 and 20713.2, respectively (Table 3). The lowest error term model is S-curve that is further used to forecast the

Table 1. Diagnostic measures for the selection of best forecasting model for wheat price in Pakistan

Forecasting Models	Criteria		
	MAPE	MAD	MSD
Linear trend	79.80	119.3	21270.30
Quadratic trend	35.21	58.84	06069.91
Exponential Growth	11.53	41.29	06677.47
S-Curve	08.22	30.08	03941.52

Table 3. Diagnostic measures for the selection of best forecasting model for Basmati rice price in Pakistan

Forecasting Models	Criteria		
	MAPE	MAD	MSD
Linear trend	39.0	172.3	52147.1
Quadratic trend	18.4	096.3	20207.1
Exponential Growth	09.2	076.2	18357.5
S-Curve	08.9	075.5	20713.2

TREND ANALYSIS AND FORECASTING OF WHEAT AND RICE PRICES

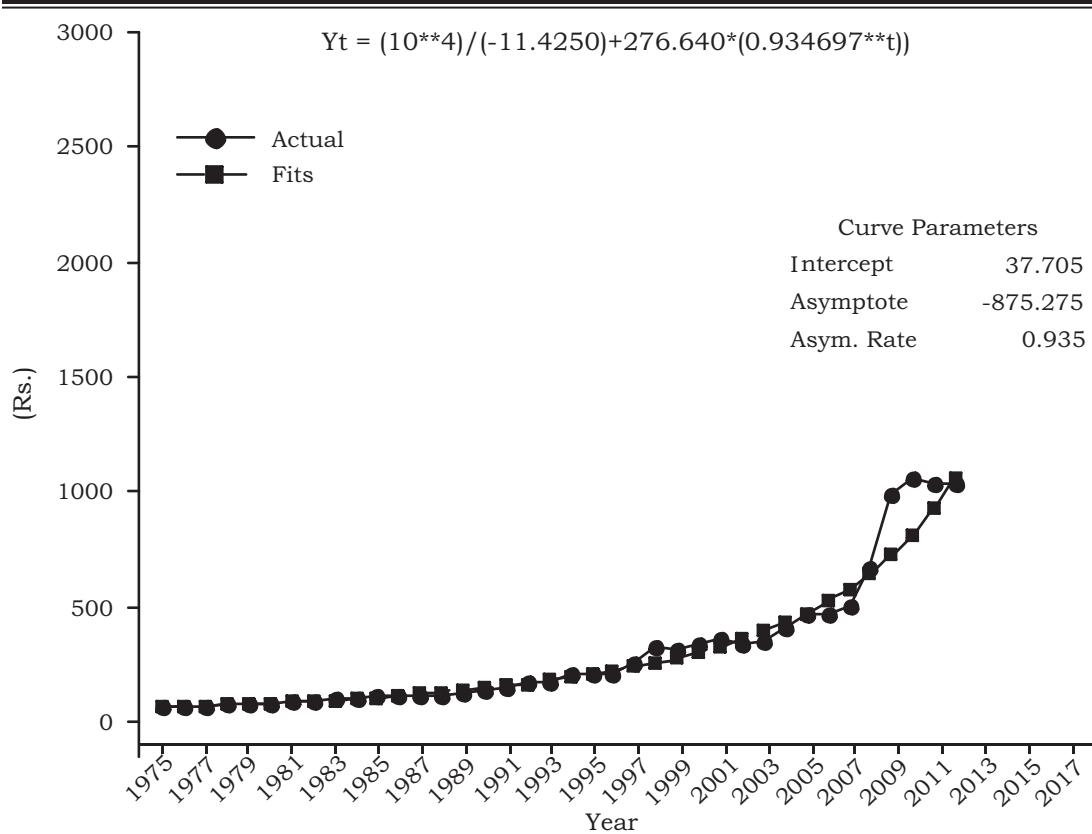


Figure 1. S-Curve model for wheat trend from 1975 to 2015

prices of Basmati rice in Pakistan for the next five years.

The trend analysis shows an upward trend in the prices of Basmati rice for the next five years in Pakistan. The increase in the trend is normal without any high jumps as were noted earlier with wheat. There has been certain ups and down in the prices of Basmati rice in Pakistan since 2000.

The five year average trend line of Basmati rice has shown gradual upward movement from 1976 to 1996 and then a rise has started to begin with prices reaching to 1200/40kg in 2001-06 from less than 500/40kg in 1991-96 (Figure 2, Table 4). The last few years had made the prices to jump up, the local prices as well as the international price for rice is

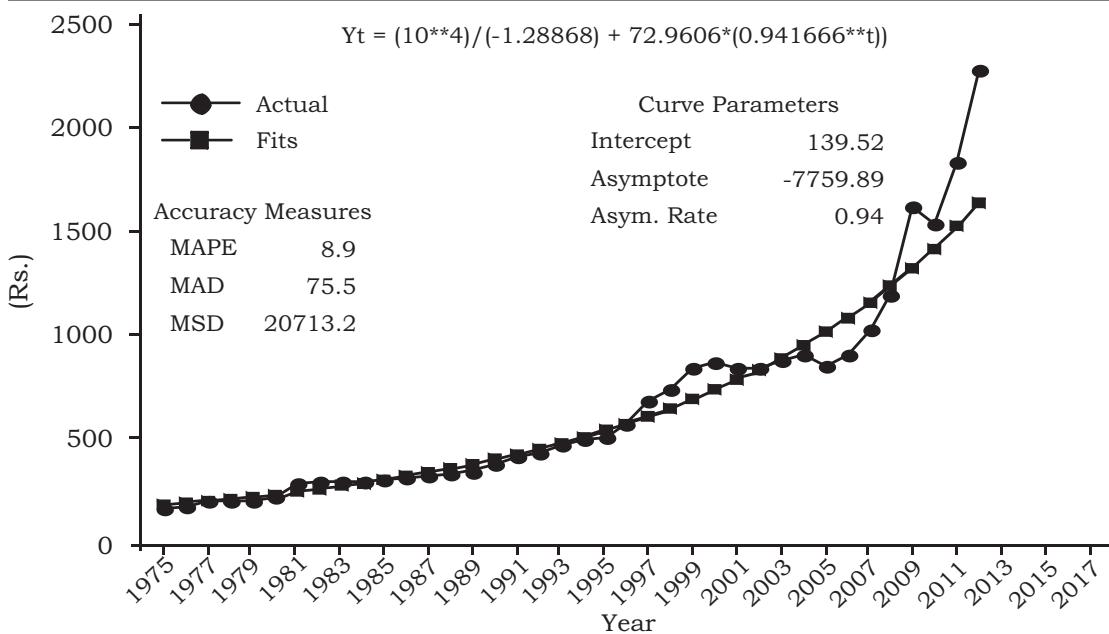
Table 4. Five year forecast for Basmati rice

Year	Forecast (Rs.)	Year	Forecast (Rs.)
2012-2013	1751.02	2015-16	2194.87
2013-2014	1885.85	2016-17	2372.40
2014-2015	2033.28		

increasing. But along with the increase in production of rice the prices have also gone up.

Accuracy Check and Forecasting for Rice IRRI

Again the S-curve model appeared to be best fitted model in the group with low error for IRRI type. The MAPE, MAD and MSD results are minimum for S-curve model as 12.6, 67.9 and 18817, respectively (Table

**Figure 2. S-Curve model for Basmati rice trend from 1975 to 2015**

5). The lowest error term model is S-curve; that is further used to forecast the prices of IRRI rice in Pakistan for the next five years.

The trend analysis shows normal movement of actual prices and the S-curve model fits till 2008, which later showed some dispersion showing the

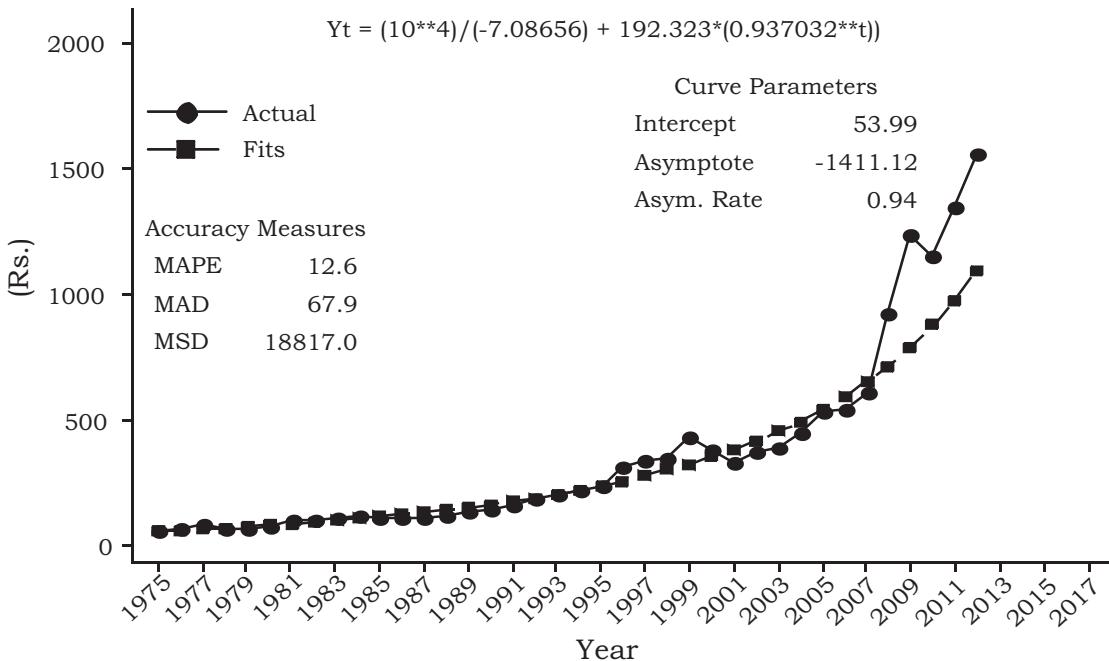
**Figure 3. S-Curve model for IRRI rice trend from 1975 to 2015**

Table 5. Five year forecast for Basmati rice

Forecasting model	Criteria		
	MAPE	MAD	MSD
Linear trend	81.0	171.7	45187.1
Quadratic trend	42.3	093.5	14514.2
Exponential Growth	16.4	075.3	18498.2
S-Curve	12.6	067.9	18817.0

possible reason of food inflation (Figure 3). The world food crisis after 2008 has brought up the prices of major food crops in the country as well as around the world. For the future forecast the line moves smoothly till 2014-15 which afterwards has shown an increasing jump, reaching almost 2151/40kg.

Five year average trend line for IRRI rice remained quite stable from 1976 to 1991, with gradual rise in the average till 2001-2006 time periods. The prices showed a remarkable increase from 2006 to 2010, resulting in the jump from around Rs.500/40kg to more than Rs.1000/40kg (Table 6).

Table 6. Five year forecasted value for Basmati rice

Year	Forecast (Rs.)	Year	Forecast (Rs.)
2012-2013	1229.32	2015-16	1839.43
2013-2014	1393.51	2016-17	2151.50
2014-2015	1592.86		

CONCLUSION AND RECOMMENDATION

The study concludes that for Basmati wheat and IRRI rice price forecasting, S-Curve model is recommended for medium term projections. The study presents an insight to national policy makers regarding the essential crops and provides them with a reference range of price in

future. Policy makers on the basis of the projected price increase can draw policy and strategy to address the factors affecting this increase in price. All the more, the study will prove as a stepping stone for the researchers and economists to carry out further investigation that affects the price forecasting for these essential crops in Pakistan.

LITERATURE CITED

- Altaf, Z. 2009. Food Security in Pluralistic Pakistan. In: M. Kugelman and R.M. Hathaway (eds.). Hunger pains: Pakistan Food Insecurity. Wood-row Wilson International Center for Scholars. Asia Program. Washington, DC. p. 35-45.
- Boken, V.K. 2000. Forecasting spring wheat yield using time series analysis: A case study for the Canadian Prairies. Agron. J. 92(6): 1047-1053.
- GoP. 2011. Economic Survey of Pakistan, Ministry of Finance, Government of Pakistan, Islamabad.
- GoP. 2012. Economic Survey of Pakistan, Ministry of Finance, Government of Pakistan, Islamabad.
- Karim, R., A. Awala and M. Akhter. 2010. Forecasting of wheat production in Bangladesh. Bangladesh J. Agric. Res. 35(1): 17-28.
- Kastens, T.L., R. Jones and T.C. Schroeder. 1998. Futures-based price forecasts for agricultural producers and businesses. J. Agric. Resour. Econ. 23(1): 294-307.
- Pakistan Agricultural Research Council (PARC). 2012. National Coordinated Pulses Programme, (Available at <http://www.parc.gov.pk/1SubDivisions/NARC/CSI/pulses.html>).
- Rani, S. and I. Raza. 2012. Compar-

- ison of trend analysis and double exponential smoothing methods for price estimation of major pulses in a Pakistan. *Pakistan J. Agric. Res.* 25(3): 233-239.
- Rimi, R.H., S.H. Rahman, S. Karmakar and G. Hussain. 2011. Trend analysis of climate change and investigation on its probable impacts on rice production at Satkhira, Bangladesh. *Pakistan J. Meteorol.* 6(11): 37-50.
- Taylor, M., C.D. Kevin and T.L. Kastens. 2004. Incorporating current information into historical-average-based forecasts to improve crop price basis forecasts. Paper presented at the NCR-134 Conference on applied commodity price analysis, Forecasting, and Market Risk Management St. Louis, Missouri, April 19-20. 19 p.
- United States Department of Agriculture (USDA). 1999. In: F.A. Vogel and G.A. Bange (eds.). *Miscellaneous Publication No. 1554*. 17p.

AUTHORSHIP AND CONTRIBUTION DECLARATION

S. No	Author Name	Contribution to the paper
1.	Mr. Saqib Shakeel Abbasi	Conceived the idea, Wrote abstract, Methodology, Conclusion, Data collection, Data entry, Result and Discussion, Introduction, References
2.	Ms. Ayesha Tahir	Technical input, Overall management of the article, References, Abstract
3.	Ms. Irum Raza	Data entry in SPSS and analysis , Result and Discussion
4.	Mr. M. Saleem Abid	Analysis and technical input at every step
5.	Mr. M. Nisar Khan	Result and Discussion

(Received February 2014 and Accepted July 2015)
