



Azerbaijani Journal of Economics and Social Studies

Azərbaycanın İqtisadi və Sosial Araşdırmalar Jurnalı

Sayı/Number 3, 2015

www.azjess.com

TREND ANALYSIS AND FORECASTING OF PRICES FOR WHEAT AND RICE IN PAKISTAN

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Abstract

The major crops under this study are Wheat, Rice (Basmati and IRRI). These two crops are the basis requirements of every household. Price trends during different periods have been analyzed in this study. Different models have been applied to get the best fitted model and further it was used for forecasting purposes for the next five years i.e from 2013-2017. These models 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 also calculated to observe the past trend. The study demonstrates that for Wheat and Rice (basmati & IRRI); S – Curve model was recommended model for forecasting price in next five years. The study presents an insight to national policy makers regarding the essential crops and provides them with a reference range of price in future.

Keywords: Price Forecasting, Wheat, Rice, Agricultural Commodities, Pakistan.

Introduction

Pakistan is agricultural country and this sector is major constituent of country's employment sources. Agricultural and derived products of are immensely used in different industrial units as raw and/or processed material.

Emphasis on the agriculture has decreased over the period of time, mostly due to increasing urbanization rate. However, still majority of people living in rural areas of

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the country, and are related directly or indirectly to agriculture sector. As a matter of fact the daily routine life of urban society has never been linked to the rural people and particularly to agriculture, as it is now. Take an example of recent increase in prices of vegetables and fruits and their impact on the urban population.

Out of total area being used for agriculture purposes, 40 percent of the total farm area has seven percent landowners, while the remaining 60 percent of total crop/agricultural area is used by 93 percent of the farmer community (Liaqat, 2004). 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 the support price for the major crops to attract the farmers to grow a particular crop more, and also to attract non farmer to farming. This is done through providing support price on purchase of particular crop following with subsidized seed and fertilizer prices. However, setting the support price is a crucial step and requires performing price forecasting.

Forecasting of production and price of commodities is important in agriculture; as it is in rest of the fields. The United States Department of Agriculture (USDA) issues crop supply and demand estimation, which are used at both US and the world level. These estimations are used as standards in the marketplace due to their nature of objectivity and comprehension. In Pakistan, the production forecast is made by the agriculture department about the major crops, such as wheat, cotton and rice, etc. However, there is 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 also because of the demand and supply shifts.

The most important staple crop in Pakistan is Wheat, cultivated at large scale throughout country. It contributes to almost 9 percent as a singly consumed household commodity. At the rural household level, wheat is consumed at largest level as compared to the urban household level, where it is on second level (GOP, 2011). Over the years, many issues, like shortage of water, increases in prices of agricultural input, droughts have affected the yield at large, (during last few years, good harvest of wheat crop has been experienced). The Economic Survey of Pakistan's 2012 issue, reports that "wheat contributes around 10.1 percent to the value addition in agriculture sector, and 2.2 percent to Gross Domestic Product" (GDP). Wheat is cultivated through a group shaped cropping systems in Pakistan, such as; wheat-cotton, wheat - rice, wheat - sugarcane, wheat - maize, etc. Wheat-cotton and wheat-rice cropping system together are about 60 percent. 1.50 million ha of area is cultivated on rain based irrigation dependency on wheat.

The government has announced the support price of wheat at Rupees (Rs.) 1200 per 40 kilogram (kg), which created importance on the part of farming society. In last two years, the wheat cultivated area has increased from 8,650 thousand hectare acre (ha) in 2011-12, to 8,693 thousand ha in 2012-13. This overall increase in the crop area is mainly due 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 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 area of Punjab (Zone II). Varieties of rice that are cold tolerant are grown in Swat area (Zone I). Heat tolerant varieties IRRI types are grown towards south side of Khyber Pakhtun Khawa (KPK), Baluchistan and Sindh (Zone III and IV).

Many researchers and academicians have given importance to forecasting the prices of agricultural commodities. In view of Kasten et al (1998a), 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 are anticipated to assist agricultural industry participants in designing informed production, marketing strategies, processing, and retailing decisions.

In a study by Taylor (2004), it was proposed that base forecasts can be used to provide the prices projection along with upcoming prices. Moreover, base forecasts are also required to evaluate the prevarication chances. A lot of studies come up with basis forecasts that are based on simple averages taken historically. In his research, 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 has not been helpful in creating a suitable market structure. The price of pulses has increased much as compared to other food items such as 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. In a failed attempt 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 of 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, 2012).

Saima and Irum (2012) conducted the price forecasting of pulses grown in Pakistan. They used the double exponential smoothing function (DESF) along with Measures of accuracy (MAPE, MAD and MSD) to get the forecasting. Data was collected from the period of 1975 to 2010 on the basis of average annual prices taken from agriculture statistics of Pakistan.

Material and Methods

The price data per 40 kg of the crop at whole sale rate of major markets in Pakistan is used in the study is taken from various issues of Agricultural Statistics of Pakistan. At initial level the district level prices data was collected through different sources, which includes Agricultural statistics of Pakistan, Agriculture Marketing Monthly reviews and Economic Survey of Pakistan. However, analysis revealed that both the district level data and the major markets data were different. At the end, the data from Agriculture Statistics was used as it appeared to be more justifying then the district level prices.

Four separate models were used in the study to forecast the prices of selected food commodities for the year 2012-13 to 2016-17. These models were linear trend model, quadratic trend model, exponential growth model and S – curve model. The

minimum values of MAPE, MAD and 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 = average annual prices of select food commodities
 β_0 = constant,
 β_1 = regression coefficient and
 X = time period (years)

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:

$$Y_t = b_0 * b_1 X * e_x$$

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:

$$Y_t = 10a / (b_0 + b_1 b_2 X)$$

Accuracy Measures

MAPE, MAD and MSD were used as three measures of accuracy. The smaller values of all these measures indicates 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 for the period of 2012-2017.

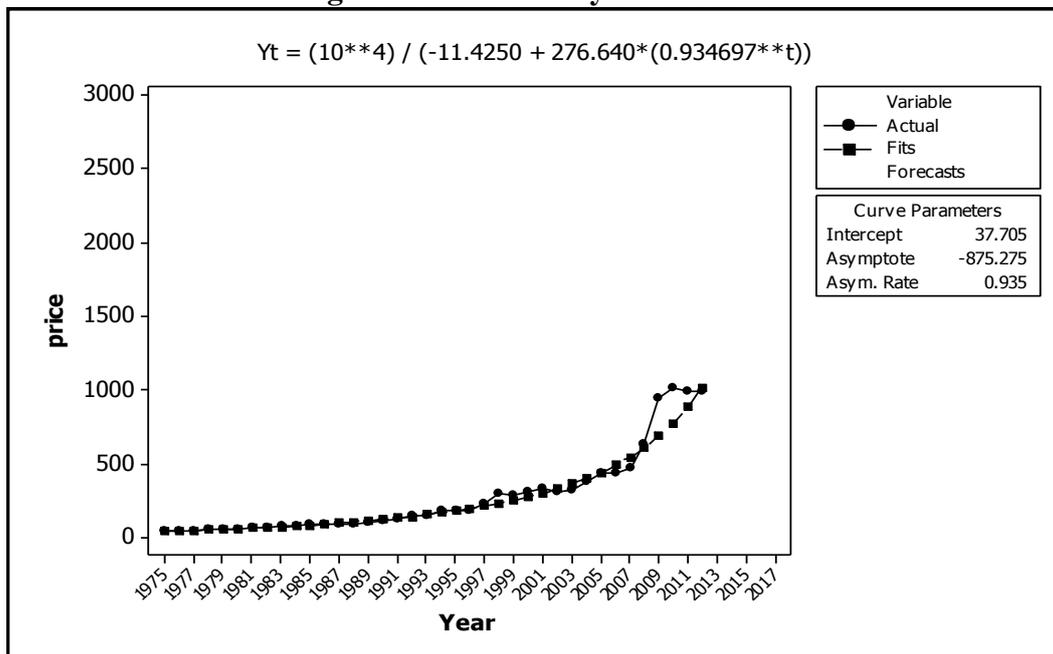
Results and Discussions

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; as shown in table below:

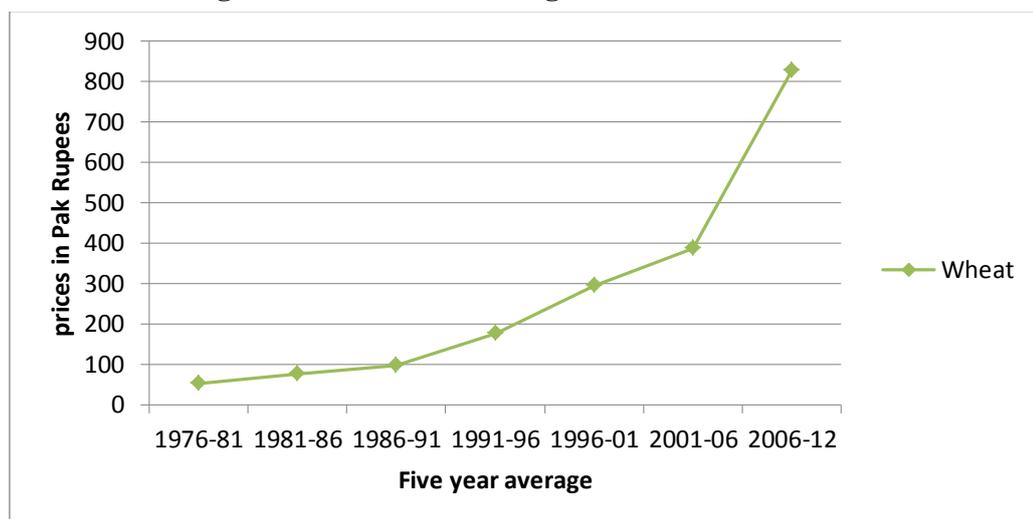
Table 1: Diagnostic measures for the selection of best forecasting model for wheat price in Pakistan.

Forecasting Models	Criteria		
	MAPE	MAD	MSD
Linear trend model	79.8	119.3	21270.3
Quadratic trend model	35.21	58.84	6069.91
Exponential Growth model	11.53	41.29	6677.47
S- curve model	8.22	30.08	3941.52

Wheat price shows an upward trend that is also apparent from Fig 1 below. 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. Trend Analysis of Wheat

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 400/40kg in 2001-06 from less than 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.

Figure 2. Five Year Average Wheat Trend

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 the year 2016-17 has jumped a little higher as it reaches to almost 2676 per moud from 2085 in year 2015-16.

Table 2. Five Year Forecast for Wheat

Years	Forecast in Pak Rupees(Rs)
2012-13	1184.95
2013-14	1400.18
2014-15	1686.49
2015-16	2085.00
2016-17	2676.03

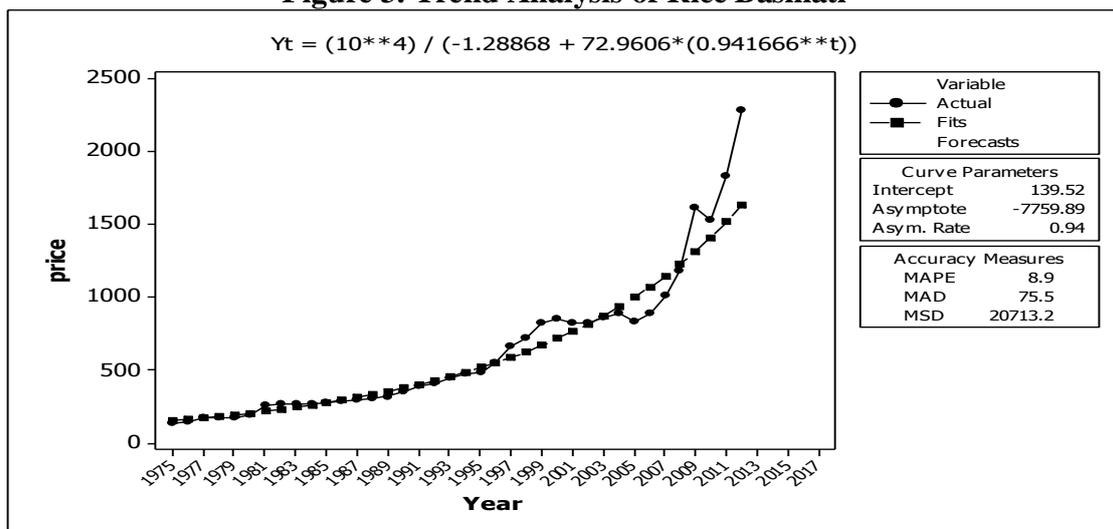
Accuracy Check and Forecasting for Rice Basmati

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 as shown in table 2 below. The lowest error term model is S – curve that is further used to forecast the prices of Rice Basmati in Pakistan for the next five years.

Table 3: Diagnostic measures for the selection of best forecasting model for Rice Basmati price in Pakistan

Forecasting Models	Criteria		
	MAPE	MAD	MSD
Linear trend model	39.0	172.3	52147.1
Quadratic trend model	18.4	96.3	20207.1
Exponential Growth model	9.2	76.2	18357.5
S – Curve model	8.9	75.5	20713.2

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. The graph below illustrates the trend of basmati rice. There has been certain ups and down in the prices of Basmati rice in Pakistan since year 2000 to onwards.

Figure 3. Trend Analysis of Rice Basmati

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. The last few years had made the prices to jump up, the local prices as well as the international price for rice is increasing. But along with the increase in production of rice the prices have also gone up. The trend for last five year average shows a huge spike then before.

Figure 4. Five Year Average Trend Rice Basmati

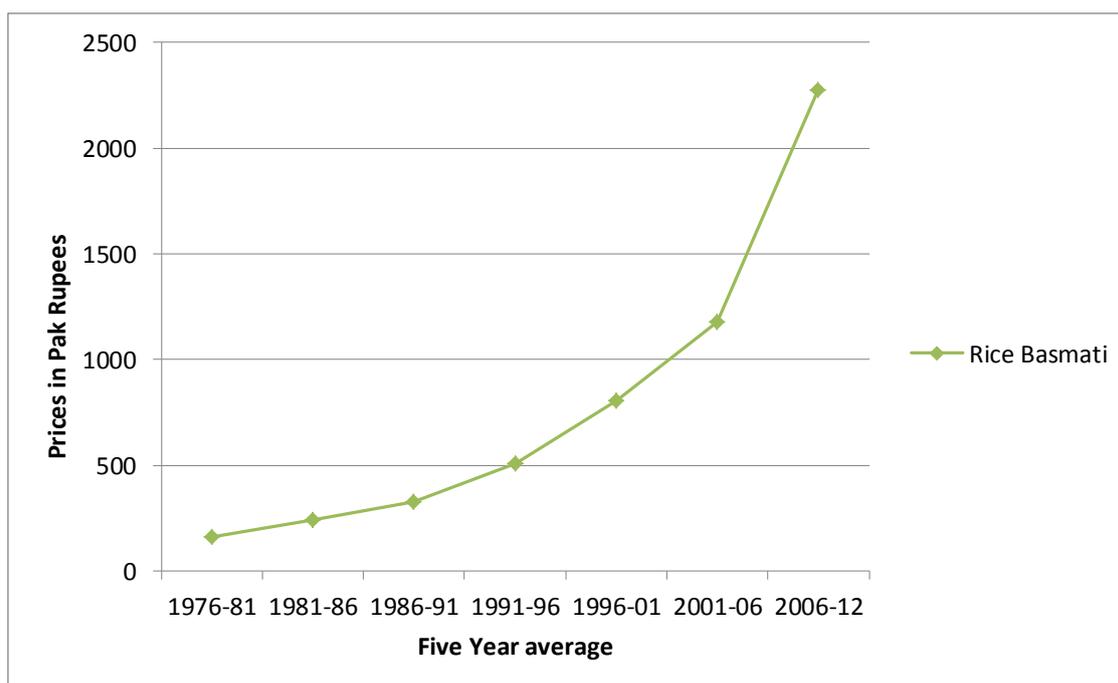


Table 4: Five year forecast for Rice Basmati

Years	Forecast in Pak Rupees
2012-13	1751.02
2013-14	1885.85
2014-15	2033.28
2015-16	2194.87
2016-17	2372.40

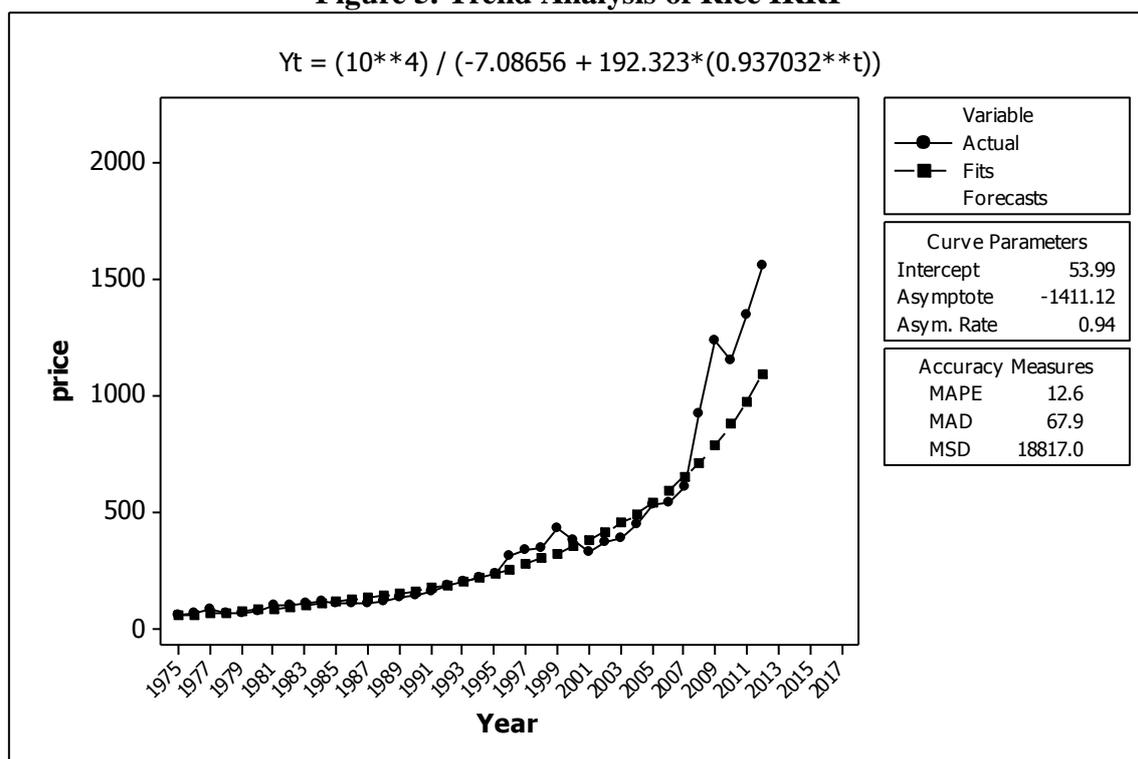
Accuracy Check and Forecasting for Rice IRR

Again the S – curve model appeared to be best fitted model in the group with low error for IRR type. The MAPE, MAD and MSD results are minimum for S – curve model as 12.6, 67.9 and 18817 respectively, as shown in table 3. The lowest error term model is S – curve; that is further used to forecast the prices of Rice IRR in Pakistan for the next five years.

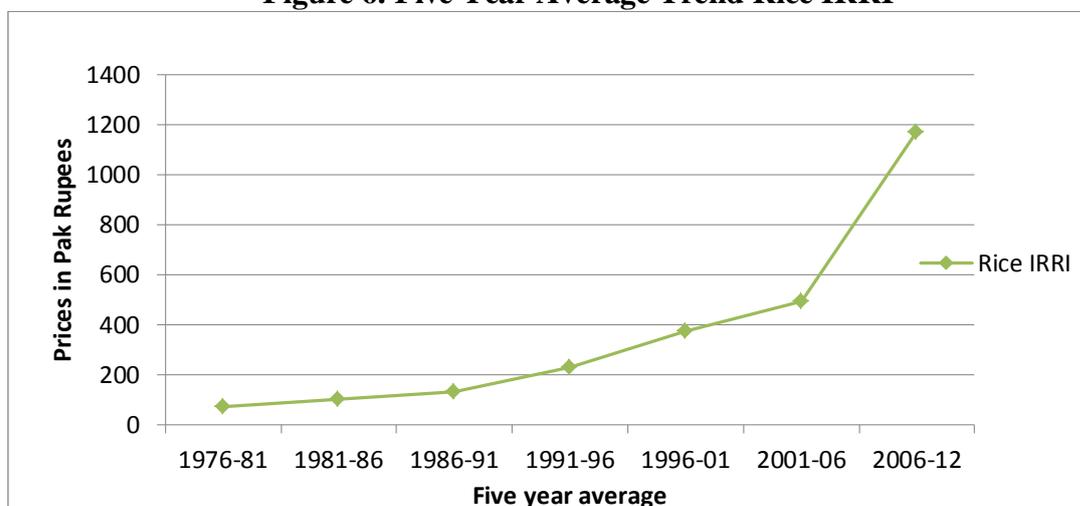
Table 5: Diagnostic measures for the selection of best forecasting model for Rice IRR price in Pakistan

Forecasting Models	Criteria		
	MAPE	MAD	MSD
Linear trend model	81.0	171.7	45187.1
Quadratic trend model	42.3	93.5	14514.2
Exponential Growth model	16.4	75.3	18498.2
S – curve model	12.6	67.9	18817.0

The trend analysis shows normal movement of actual prices and the S-curve model fits till 2008, which afterwards has shown some dispersion showing the possible reason of food inflation. 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 for 40kg.

Figure 5. Trend Analysis of Rice IRR

As the figure 3.1 shows the Five year average trend line for Rice IRR remained quite stable from 1976 to 1991, with gradual rise in the average till 2001-2006 time periods. The prices showed a remarkable increase in the period from 2006 to 2010, resulting in the jump from around 500/40kg to as great as more than 1000/40kg.

Figure 6. Five Year Average Trend Rice IRI**Table 6: Five year forecast for Rice IRI**

Years	Forecast in Pak Rupees
2012-13	1229.32
2013-14	1393.51
2014-15	1592.86
2015-16	1839.43
2016-17	2151.50

Conclusion and Recommendations

The study demonstrates that for Wheat and Rice (Basmati & IRI); S – Curve model is recommended model for forecasting price in next five years. 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.

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