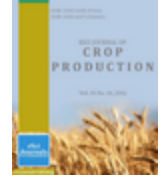




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FORECASTING OF MAIZE AREA AND PRODUCTION IN PAKISTAN

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ABSTRACT

The present study was conducted to check the trend analysis of area and production for Maize in Pakistan. The findings of the study are based on Maize area and production data during the years (1990 to 2011). Four Models of trend analysis were applied. The models were Linear Trend Model, Quadratic Trend Model, Exponential Trend Model and S-curve Model. The most appropriate Model for trend analysis of the present study was Quadratic Trend Model. The data was taken from FAO statistics (2010) and Forecasting of the data was done up to 2017. The forecasted area of Maize in Pakistan would be 1031.07, 1034.23, 1036.94, 1039.19, 1040.98 and 1042.32 ha, and the forecasted production of Maize in Pakistan would be 4554.48, 4881.23, 5223.19, 5580.35, 5952.72 and 6340.29 thousands ton respectively for the years 2012, 2013, 2014, 2015, 2016 and 2017. Forecast values are very close to actual values and have positive increasing trend in Pakistan. Positive increase is due to availability of high yielding varieties, proper use of inputs and in time availability of inputs for Maize in Pakistan.

Keywords: Maize; Area; Production; Quadratic Trend Model; Pakistan.

INTRODUCTION

Agriculture sector of Pakistan has an important role in reducing poverty and ensuring food security, it contributes 21 percent share of the GDP, provide 45 percent employment opportunities to the country's labor force and a source of livelihood for the 60 percent rural population. Maize is one of the major Kharif cereal crops in Pakistan hold area under cultivation 1083 thousand hectares and showing 15.2 percent positive production change during last year (Agri. Statistics, 2010). Production of Maize has increased from 1185 thousand tones during 1990-91 to 4271 thousand tons in 2011-12 (GOP, 2012).

The Production shows an increase of 13.7 percent over the previous year, which is due to corresponding increase in area, favorable weather conditions and more area converted by Hybrid varieties. The average yield productivity of Maize is 3944 kg/ha, which is the highest among all cereals grown in the country. Maize contribute 4.88% of the value added crops which hold 64.6% of all major crops which is the third highest share after wheat

and rice (GOP, 2012). Maize accounts for 4.8% of the total cropped area and 3.5% of the value of agricultural output. The upward trend in yield is mostly due to the adaptation of high yielding varieties and hybrids, which is likely to continue (GOP, 2011). The use of Maize in Pakistan for direct human consumption is declining, but its utilization in the feed and wet milling industry is growing at a much faster pace than anticipated. Currently, sufficient Maize is grown in Pakistan for domestic needs and there is neither a surplus nor deficit in Maize grain supplies. After potato, Maize stands the most profitable stable and dependable crop in Pakistan (Tariq *et al.*, 2010).

Maize (*Zea mays*. L.) enjoys a vital position in the existing cropping systems of Pakistan. It ranks third after wheat and rice in Pakistan for its grain production. Maize is grown in almost all the provinces of the country, but Punjab and KPK are the main areas of production. It is not only consumed by human beings in the form of food grain but it is also used as feed for livestock and poultry besides being a good scavenge crop. It is also gaining importance due to being a commercial crop, where a large number of products are being manufactured out of its grain. Maize grain contains

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about 72% starch, 10% protein, 4.8% oil, 5.8 % fiber, 3.0% sugar and 1.7% ash (Chaudhary, 1993).

The mounting pressure on our economy to feed more people has increased the importance of utilizing the potential rainfed regions of Pakistan to improve food security (Mahmood, *et al.*1991).The increasing demand for healthy food for poor population of Pakistan, there is a dare need to produce pulses crops on larger area. Pakistan Agricultural Research council (PARC) has been focusing on hybrid seed development of important crops at federal level. This study will help to policy makers and scientist to outlook the future area and production under Maize, so that to establish such type of acts to increase the area and production under Maize in Pakistan to fulfill country food requirement.

The main objective of the study was to check past and future trends of Maize area and production in Pakistan by using appropriate trend analysis model. Trend analysis studies help policy makers in taking policy decisions.

MATERIALS AND METHODS

The study was conducted by using time series data of Maize area and production during the years 1990 to 2011 (22 years) of Pakistan. The data was collected from the Food and Agriculture Statistics (FAO 2010). Data was analyzed by using MINITAB software. In this study Linear, The linear trend Model was also used by Finger (2007), Broken *et al.*, (2000) and Rimi *et al.*, (2011), Exponential, Quadratic and S-Curve Models of trend analysis were applied for this study. The best Model was selected on the basis of three accuracy measures. These accuracy measures were Mean Absolute Percentage Error (MAPE), Mean Absolute Deviation (MAD) and

Mean Squared Deviation (MSD). Mean Absolute Percentage Error (MAPE) measures the accuracy of fitted time series values. It expresses accuracy as a percentage. Mean Absolute Deviation (MAD) measures the accuracy of fitted time series values. It expresses accuracy in the same units as the data, which helps conceptualize the amount of error. Mean Squared Deviation (MSD) is always computed using the same denominator, regardless of the model. MSD is a more sensitive measure of an unusually large forecast error than MAD.

Smaller values of all these measures indicate a good fitted Model with minimum forecasting errors (Karim *et al.*, 2010). The best fitted Model for this study was Quadratic Model; and the stationary series of the data was used in the model identification. This Model was also applied by Finger (2007) and applied for forecasting the area and production of Maize in Pakistan for the years 2012 to 2017 respectively.

RESULTS AND DISCUSSION

This section deals with time series data of area and production of Maize in Pakistan, and estimated trends in table and figure form of area and production in Pakistan are presented.

Previous Trends of Area and Production of Maize in Pakistan: The estimated time series parameter of area under Maize of Pakistan during the year 1990 to 2011 has been presented in Figure 1. Figure 1 show that production of Maize has upward trend from the year 1991 to onward but in figure 2, production under this crop has very slow trend not much increased. While from the 2004 to onward production under Maize crop in Pakistan has been continuously increasing.

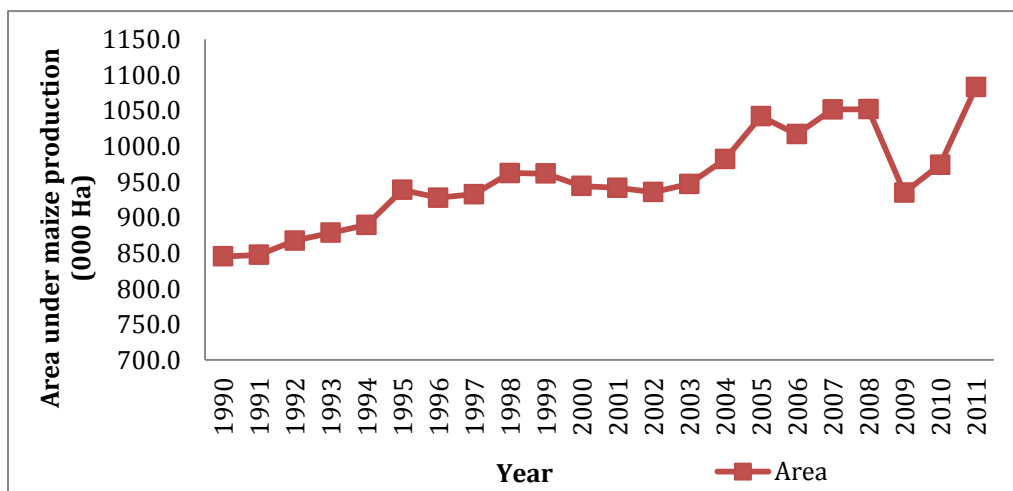


Figure 1: Area (000, Ha) of Maize.

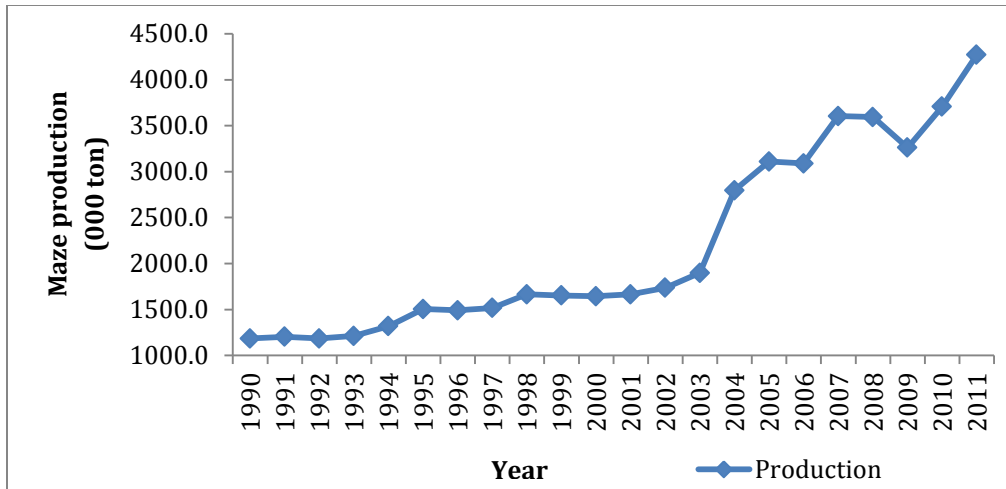


Figure 2: Production (000, ton) of Maize.

These previous trends depict that area of Maize is not much increased as compared to production. The reasons for slower growth of area can be climatic and economic such as cold weather and farmers earned more profit from major crops, so that the area under Maize converted to major crops area. So these become reason for decrease in area of Maize in Pakistan.

Diagnostic Measures for the Selection of Best Forecasting Method for Area and Production in Pakistan: This study applied Quadratic Model for trend analysis of Maize area and production in Pakistan on the basis of smaller values of accuracy measures (Karim *et*

al., 2010). The Quadratic Model shows the small values of all accuracy measures like MAPE, MAD, MSD, so therefore this model is best fitted model and is being selected as a best model for forecasting. Table 1 revealed that all the values of accuracy measures for Maize area in Pakistan are smaller in Quadratic Model. So this Model is best fitted to forecast the future values for Maize area in Pakistan for next Six years. Table 2 revealed that all the values of accuracy measures for Maize Production in Pakistan are smaller in Quadratic Model. So this Model is best fitted to forecast the future values for Maize area in Pakistan for next Six years.

Table 1: Best Fitted Model Selection Criteria for Area.

Measures of Accuracy	Criteria		
	MAPE	MAD	MSD
Linear Trend Model	2.78	26.90	1148.58
Quadratic Trend Model	2.60	25.40	1081.08
Exponential Trend Model	2.81	27.15	1174.03
S-Curve Model	2.86	27.48	1217.29

Table 2: Best Fitted Model Selection Criteria for Production.

Measures of Accuracy	Criteria		
	MAPE	MAD	MSD
Linear Trend Model	16	300	131384
Quadratic Trend Model	8.1	184.1	56937.2
Exponential Trend Model	9.9	216.1	76031.5
S-Curve Model	12	365	431809

Forecasted Maize Area: The area growth rate has positive trend in Pakistan. As figure 3 showed the trend analysis plot for Maize area in Pakistan by using Quadratic Trend Model. The black line shows actual

values, red fitted values and green line is for forecasted values of Maize area at 95% prediction interval. As in Table 3 results showed that if the present growth rates of Maize area remain the same then area of Maize in

Pakistan would be 1031.07, 1034.23, 1036.94, 1039.19, 1040.98 and 1042.32 ha respectively for the years 2012, 2013, 2014, 2015, 2016 and 2017. Forecasted values of area under Maize in Pakistan has slightly increasing trend in coming Six years in Pakistan, But with downward slope as shown in figure 3, it can be due to

ignorance of government and policy makers as a minor crop. Farmers giving more importance to cash and major crops, as they earn more from other crops so they show less intention to this crop. Similarly, Table 3 is also explaining the same type of future trends of Maize area in Pakistan.

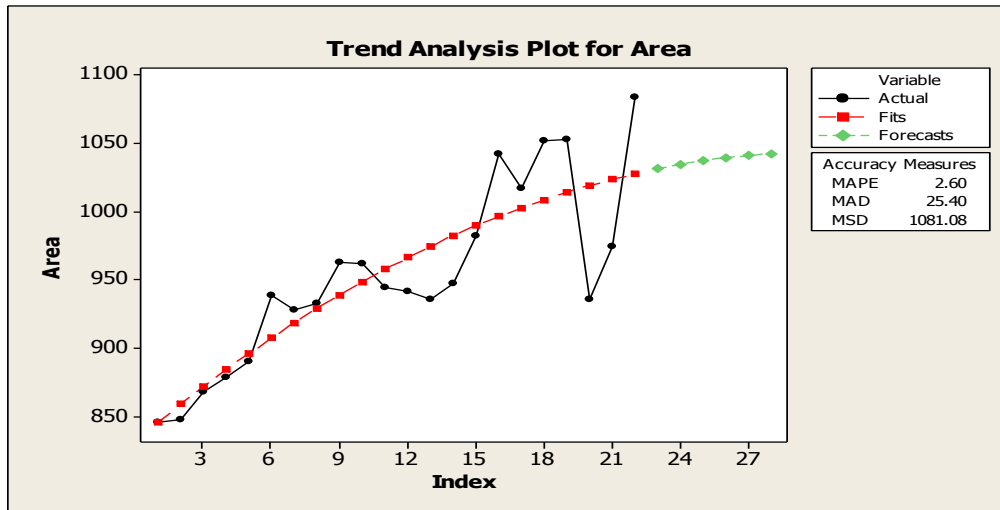


Figure 3: Forecasted Maize Area.

Forecasted Maize Production: The production growth rate is relatively higher than the area growth rate of Maize in Pakistan. As figure 3 showed the trend analysis plot for production of Maize in Pakistan by using Quadratic Trend Model. The black line shows actual values, red fitted values and green line is for forecasted values of Maize production at 95% prediction interval. As in Table 3 results showed that if the present growth rates of Maize remain the same then production of Maize in Pakistan would be 4554.48, 4881.23, 5223.19, 5580.35, 5952.72 and 6340.29 thousands ton

respectively for the years 2012, 2013, 2014, 2015, 2016 and 2017. Forecasted values of production under Maize in Pakistan has positive increasing trend in coming six years in Pakistan. Positive increase in production is due to availability of high yielding varieties, proper use of inputs and in time availability of inputs for Maize in Pakistan. Similarly table 3 is also explaining the future trends of Maize production in Pakistan. These trends show that instead of an incentive for farmers in form of high yielding from Maize and there is also country demand available.

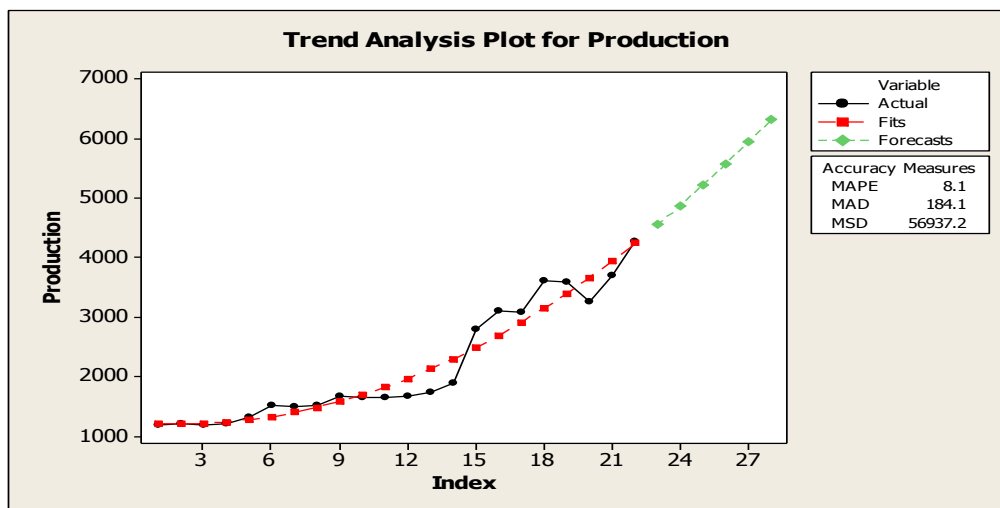


Figure 4: Forecasted Maize Production.

Table 3: Six years 95% forecasted Area and Production.

Forecast Years	Area (000 Hectares)	Production (000, ton)
2012	1031.07	4554.48
2013	1034.23	4881.23
2014	1036.94	5223.19
2015	1039.19	5580.35
2016	1040.98	5952.72
2017	1042.32	6340.29

Table 3 results clearly revealed that there is positive increasing trend for area and production in Pakistan. Instead of supportive positive increase, area has slower growth or not much increased as production.

CONCLUSION AND RECOMMENDATIONS

Quadratic Model provides good technique for predicting the magnitude of any variable. In this study developed Model was Quadratic Trend Model on the basis of best accuracy measures techniques. From the forecast available by using the developed Model, it can be seen that forecasted area and production has increasing trend for the coming six years 2013 to 2017 respectively. But area has slower growth comparative to increase in production of Maize in Pakistan. The Model can be used by researchers for forecasting of Maize yield in Pakistan. However, it should be updated from time to time with inclusion of current data.

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