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Current Situation and Future Outlook of Sorghum 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 Sorghum in Pakistan. The findings of the study are based on sorghum area and production by using the data from 1990 to 2011. Four Models of trend analysis were applied but most appropriate Model for trend analysis of the present study was Quadratic Trend Model. Forecasting was also done up to 2017 for checking the future outlook. Forecast values are very close to actual values and have positive decreasing trend in Pakistan.

Keywords: Sorghum, Area, Production, Quadratic trend model, Pakistan

Introduction

Sorghum (*Sorghum bicolor* L. Moench) is at fifth number among cereal crops with 60 million tons of annual production in the world. In Pakistan, it is grown on the area 0.34 million hectare with annual production of 0.21 million ton and average yield 620 kg ha-1 (Anon, 2006) In addition to being important food, feed and forage crop, sorghum also plays an important role in providing raw material for the making of starch, fiber, dextrose syrup, biofuels, alcohol, and other goods. More than half of the world is growing sorghum in semi arid zones, where it is a staple food for millions of poor and hungry people (Mehmood et al., 2008). In Pakistan, Sorghum known as Jowar is an important kharif season crop which is grown for both the purpose of fodder and

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grains. Sorghum as a fodder is considered as an essential feeds for the livestock, which can help in maintaining good health of cattle's. Sorghum fodder contains more than 50% digestible nutrients with 8% protein, 2.5% fat and 45% nitrogen-free extract. Its dietary value is equivalent to that of corn that is why animals enjoy well due to its deliciousness and juicy character (Wheeler, 1950). Besides grain, sorghum Stover is an important feed in the livestock sector for breeze and dairy animals particularly in the dry seasons when other feed possessions are in short supply. Therefore, twin purpose types that produce both grain and Stover are the favored types (Kelley *et al*., 1993; Kelley and Rao, 1994; Hall 2000).

The production of ample amount of good quality forage is requirement for a well-organized and fruitful livestock industry. At present 2.35 million hectares of land is under fodder crops which accounts for 12% of the total cropped area of Pakistan (Agricultural Statistics of Pakistan, 2005). The area under fodder crops cannot be increased at the cost of food crops. The fodder production in the country is mostly through prehistoric and traditional ways which does not meet fully the fodder necessity both in terms of quantity and quality with the effect that the animals are starving. There are many opportunities for increasing the fodder supply; amongst these mixed sowing of cereals with legumes is a reasonable option. Generally cereals give high tonnage of yield but their protein inside is short as compared to legumes. It is a well recognized truth that livestock feed should contain sufficient protein to preserve their health and according to estimation the minimum protein content of 5-6% is necessary in the preservation ration and 10-14% for prolific purposes (Abdullah and Chaudhry, 1996).

Keeping in view the importance of fodder crops for livestock as well as for food purpose, this study was designed to forecast Sorghum area and production in Pakistan by using the best fitted models.

Materials and Methods

The study was conducted by using the time series data comprising of twenty two years of sorghum area and production from 1990-2011. The data was collected from the various sources like Agriculture Statistics and Economic Surveys of Pakistan, published by Government of Pakistan. Data was analyzed by using MINITAB software. For forecasting purpose, we have applied the deterministic types of time series models which are often called Growth Models also. Such models are linear, logarithmic, quadratic, cubic, exponential, compound, inverse, power, and S-shaped model which are very simple to understand (Pindyck and Ribinfeld, 1991). These models are extensively used to estimate the growth rates of time series data. In this study Linear, Exponential Quadratic and S-Curve trend models were applied. 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). 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 trend model and was applied for forecasting the area and production of Sorghum in Pakistan for the years 2012 to 2017 respectively. An important drawback of making forecasts is that the forecasting error increases as the period of forecast increases. For this reason, short-term forecast is more reliable compared to long run forecast (Karim *et al*., 2010).

Results and Discussion

This section deals with time series data of area and production of sorghum in Pakistan. The estimated trends in the form of tables and graphs regarding area and production are presented in this section.

Looking at the Current Situation

In terms of area, the sorghum area in Pakistan had a long-term upward and downward trend during the period from 1990 to 2011. The sorghum area swiftly falls in 1991 and grew more quickly to the end of 1992. In1990, the sorghum area was 490 thousand ha and after twenty two years in 2011; it was about 457 thousand ha. Similarly, the sorghum production in Pakistan had a long-term upward and downward trend during the period from 1990 to 2011. The sorghum production rapidly falls in 1991 and grew more rapidly to the end of 1992. In1990, the sorghum production was 195 thousand tons and after twenty two years in 2011; it was about 303 thousand tons.

Previous Trends of Area and Production of Sorghum in Pakistan

The estimated time series parameter of area and production under sorghum of Pakistan during the year 1990 to 2011 has been presented in Figure 1. Figure 1 showed that production of sorghum has downward trend from the year 1991 to onwards but production under this crop has very slow increasing trend but from the 2004 onwards production under sorghum crop in Pakistan has been continuously increasing.

These previous trends depict that area of sorghum has not much increased as comparative 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 sorghum converted to major crops area. So this becomes the main reason for decrease in area of sorghum in Pakistan.

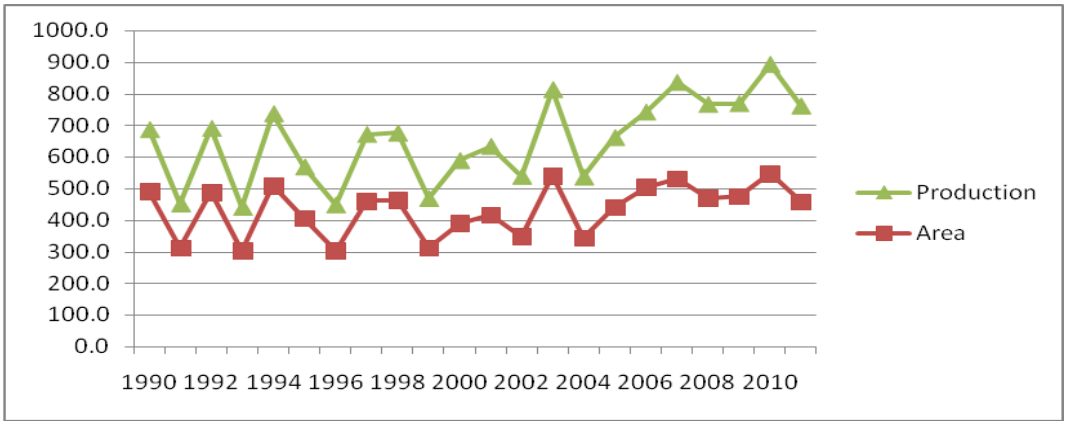

Figure 1: Area (000, Ha) and Production (000, ton) of Sorghum

Diagnostic Measures for the Selection of Best Forecasting Method for Area and Production in Pakistan

This study applied Quadratic Model for trend analysis of sorghum area and production in Pakistan on the basis of smaller values of accuracy measures (Karim *et al.*, 2010).

Table 1 revealed that all the values of accuracy measures for sorghum area in Pakistan are smaller in Quadratic Model. So this Model is best fitted to forecast the future values for sorghum area in Pakistan for next Six years.

Table 1: Best Fitted Model Selection Criteria for Sorghum Area

Measures of Accuracy	Criteria		
	MAPE	MAD	MSD
Linear Trend Model	6.560	22.130	805.722
Quadratic Trend Model	4.395	15.304	519.488
Exponential Trend Model	7.63	26.06	1019.04
S-Curve Model	5.048	16.944	540.050

Table 2 revealed that all the values of accuracy measures for sorghum Production in Pakistan are smaller in Quadratic Model. So this Model is best fitted to forecast the future values for sorghum production in Pakistan for next Six years.

Table 2: Best Fitted Model Selection Criteria for Sorghum Production

Measures of Accuracy	Criteria		
	MAPE	MAD	MSD
Linear Trend Model	7.268	14.910	349.759
Quadratic Trend Model	4.785	9.841	220.908
Exponential Trend Model	7.998	16.617	416.229
S-Curve Model	5.609	11.107	241.082

Forecasted Sorghum Area

The area growth rate has negative trend in Pakistan. As figure 2 explained the trend analysis plot for sorghum 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 sorghum area at 95% prediction interval. Table 3 showed that if the present growth rates of sorghum area remain the same then area of sorghum in Pakistan would be 188.995,168.428,146.918,124.466,101.071 and76.733 thousand ha respectively for the years 2012, 2013, 2014, 2015, 2016 and 2017. Forecasted values of area under sorghum in Pakistan has slightly decreasing trend in coming Six years in Pakistan, But with downward slope as shown in figure 2, 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 sorghum area in Pakistan.

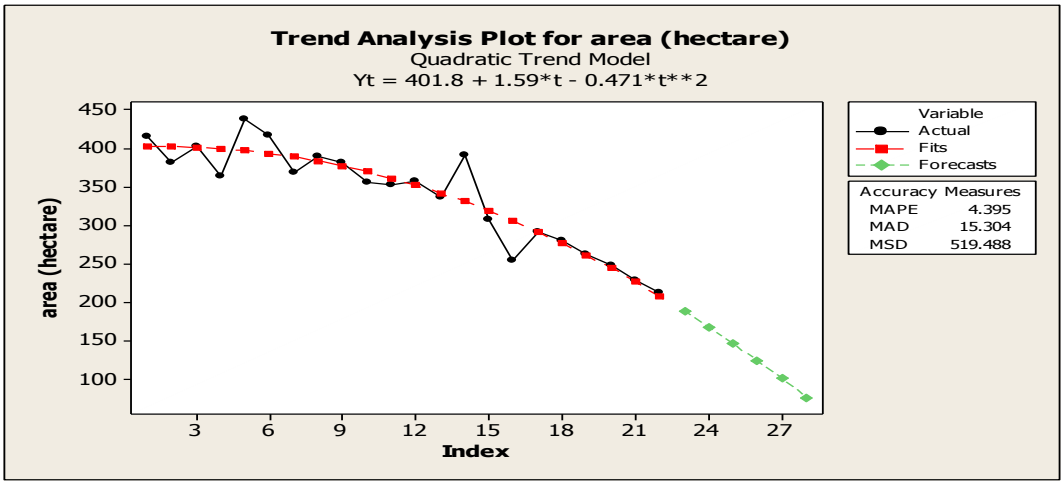

Figure 2: Forecasted Sorghum Area

Forecasted Sorghum Production

The production growth rate is relatively higher than the area growth rate of sorghum in Pakistan. As figure 3 explained the trend analysis plot for production of sorghum in Pakistan by using Quadratic Trend Model. The black line shows actual values, red fitted values and green line is for forecasted values of sorghum production at 95% prediction interval. Table 3 showed that if the present growth rates of sorghum remain the same then production of sorghum in Pakistan would be 117.869, 105.287, 92.072, 78.224, 63.744 and 48.631 thousands ton respectively for the years 2012, 2013, 2014, 2015, 2016 and 2017. Forecasted values of production under sorghum in Pakistan have decreasing trend in coming six years in Pakistan. Decrease in production is due to availability of low yielding varieties, improper use of inputs and non availability of inputs for sorghum in Pakistan.

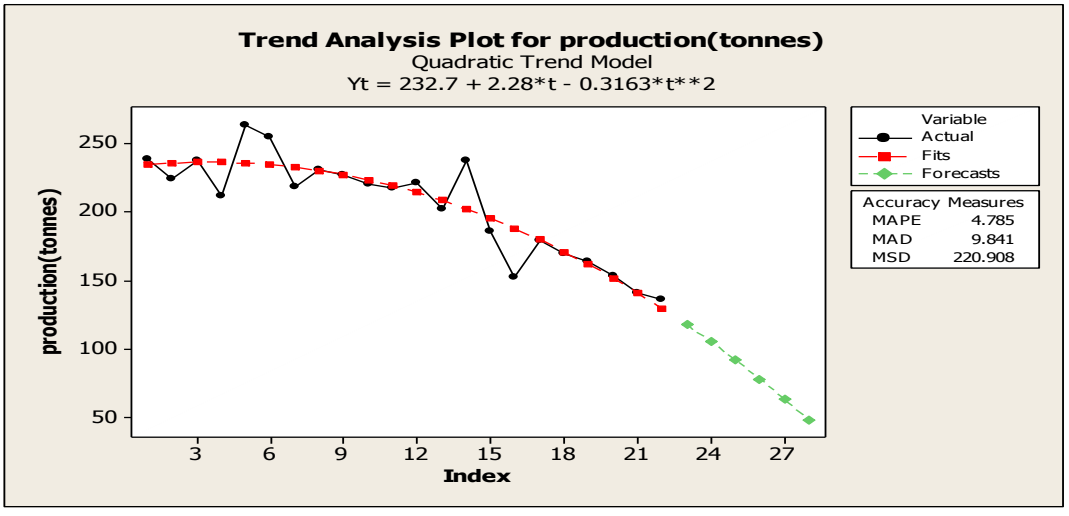

Figure 3: Forecasted Sorghum Production

Table 3: Six years Forecasted Area and Production of Sorghum

Forecast Years	Area (000 Hectares)	Production (000, ton)
2012	188.995	117.869
2013	168.428	105.287
2014	146.918	92.072
2015	124.466	78.224
2016	101.071	63.744
2017	76.733	48.631

Table 3 is explaining the future trends of sorghum area and production in Pakistan. The results clearly revealed that there is decreasing trend for area and production of sorghum in Pakistan. Among various factors responsible for low yield, lack of quality seed of sorghum is of prime importance (Anonymous, 2004).

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. The results showed that from the forecast available by using the developed Model, it can be seen that forecasted area and production has consistent decreasing trends for the coming six years from 2013- 2017 respectively. The decrease in area is more as comparative to decrease in production of sorghum in Pakistan. The Model can be used by researchers for forecasting of sorghum yield as well in Pakistan. However, it should be updated from time to time with inclusion of current data.

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