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Past trends and future prospects of rice area and production in Khyber Pakhtun Khaw

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Abstract

The current study was intended to analyze the trends of area and production for rice in Khyber Pakhtun Khwa by using the past trends and to estimate future area and production for coming ten years. The conclusion of the study is foundation on rice area and yield time series data pertaining the years (1981-82 to 2011-12). Three models of trend analysis were applied but most appropriate model for trend analysis of the current study was quadratic trend model. The model was preferred on the basis of smallest values of accuracy measures (MAPE, MAD and MSD). The forecast values of rice area and production would be 52.86, 51.90, 50.91, 49.89, 48.84, 47.77, 46.66, 45.53, 44.36 & 43.17 thousands ha and 100.15, 96.83, 93.30, 89.58, 85.66, 81.53, 77.21, 72.69, 67.96 & 63.04 kgs per hectare respectively for the years 2012, 2013, 2014, 2015 & 2016, 2017, 2018, 2019, 2020, 2021 & 2022. Predicted values show that there is decreasing trend in production of rice in Khyber Pakhton Khwa, however expected values of area under this crop show decreasing trend. This situation is alarming for poor people of Khyber Pakhtun Khwa, who can't afford costly, based protein, carbohydrates, Fat, Calcium and Iron food.

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Introduction

Rice, Oryza sativa L. (2n = 24) is model specie and a staple food for billions of people across the world (Faridul Islam *et al.,* 2012). It is grown in 112 countries ranging from the Himalayan foothills of Nepal to the desert plains of Australia and from the rain forest of Indonesia to flood plains of Bangladesh (Khakwani *et al.,* 2006). Asia contributes about 90% of global rice consumption and production. Among the many rice cultivating Asian countries, Pakistan is a major exporter and producer of many rice varieties, particularly of scented rice (Rabbani *et al.,* 2008). Fragrant rice constitutes the small and special group of rice and highly priced due to their long grain and aroma. Basmati rice in Pakistan, is popularly known for its aroma (Subudhi 2012).

Pakistan rice is the main cash crop and ranked third after wheat and cotton and is grown as kharif (hot season) (Inamullah *et al.,* 2010). Pakistan rice production during year 2013 is 6200 thousand metric tons and area under cultivation for this year is 2700 0000 hectares (MINFAL 2013). The crop occupies about 10% of the entire crop cultivated area. Of the entire value added in agriculture, it accounts for 6.1 and 1.3% of GDP. It has also been employed as an important source of income and employment for rural masses and as well foreign exchange earning commodity and thus called "Golden Grain of Pakistan" (Galani *et al.,* 2011). Rice is no longer a luxury food but has become the cereal that constitutes a major source of protein for the urban and rural poor that can't afford the protein diet from animal sources (Ogunbayo, 2005).

There are diverse types of rice: Indica rice varieties are popular worldwide for being hard but not sticky on cooking; Koreans and Japanese tend to prefer japonica cooked rice because of its stickiness and moderate elasticity, which is attributable to its lower amylose content; and glutinous rice is generally used in ready-to-eat products such as steamed rice cakes and rice crackers (Hwang *et al.,* 2006). In KPK at high-altitude mountain valleys, temperate japonica rices are grown. In Swat begmi rice is grown in large part. In Sindh, Baluchistan and in the south of KPK, mainly IRRI type long grain heat tolerant tropical rice varieties are grown. The need and importance of rice are increasing day by day due to the increase in human population pressure of the earth. Therefore, improving the productivity of rice would contribute to poverty alleviation, hunger eradication, national food security and economic development (Wyatt *et al.,* 2010). Being a complex trait, grain yield is influenced by various environmental fluctuations and genetic factors (Dewy and Lu, 1959).

Due to the importance of rice crop, it is essential to evaluate scientifically the future production scenario of this crop based on past trends. Forecasting techniques in agriculture comprise forecasting of production, area of crops and sensation of frequency of crop pests and diseases (Ramasubramanianv 2009). Trustworthy and appropriate prediction provides vital and valuable input for proper, foresighted and up-to-date planning in agriculture, which is full of reservations. A forecast of crop production before harvest is requisite for different policy decisions concerning to storage, distribution, pricing, marketing, import-export, etc. (Ranjana 2010). Nazli *et al.,* 2012 presents the projections of future demand and supply for two important cereals (wheat and rice) in all Pakistan for 2010, 2015, 2020, 2025, and 2030. The demand for wheat is expected to be greater than its supply whereas production of rice will be higher than consumer. Our study also highlights the need for further investigations of the impacts of temperature, water availability, CO^2 concentration on physiological processes and mechanisms governing crop growth and production. There is furthermore needed to motivate farmers to grow high-yielding varieties. There is moreover needed to resolve security issues in KPK. It is the responsibility of government to take such a type of policy measures which in the long run increase area under rice in Khyber Pakhtun Khawa. Because there is a challenge need to fulfill poor people highly protein food needs.

The present study was undertaken with following objectives:

i. To check the past trends of rice area and production in Khyber Pakhton Khan
ii. To forecast area and production in the next ten years using the best fitted time series model.

Materials and method

The study was conducted using secondary time series data of rice area and production in KPK from 1981 to 2011. Data were collected from various issues of Agricultural Statistics of Pakistan. Data were analyzed in MINITAB software. Traditionally ARIMA Model technique has been used to forecast area and production of different crops (Munir, 2008; Gujrati, 2003). In this paper trend analysis technique has employed. An advantage of using trend analysis technique over ARIMA is that trends are easily visible in this technique secondly we can forecast future production (Box and Jenkin, 1994; Makridakis, 1998).

Analytic techniques

In this study trend analysis and methods have been employed to estimate rice production in KPK for the period 2012-13 to 2021-22. The models that are used to describe the trend analysis of variables are linear trend model, quadratic trend model and exponential growth trend model these four models were used by Karim *et al.,* (2010).

1. Trend analysis

Trend analysis was used to fit a general trend model to data and offer estimate. Trend analysis consists of linear trend, quadratic trend and growth trend models. The general forms of these models as given in the (MINITAB software 2007) are expressed below:

i. Linear trend model equation

The linear trend model as recommended by Finger (2007), Boken *et al.,* (2000) and Rimi *et al.,* (2011) is described as follows:

$Yt = \beta_o + \beta_1 t + e_t$

Yt is the predicted area and yield, t is the time index β0 is the model intercept and β1 is the annual area and yield modify.

i. Quadratic trend equation

Quadratic model was applied for this study as this model was also applied by Finger (2007), the model equation is:

$Yt = \beta_o + \beta_1 * t + \beta_2 t^2 + e_t$

Yt is the predicted area and yield, t is the time index β0 is the model intercept and β1 is the annual area and yield change.

ii. Exponential trend model equation

The exponential growth trend model financial records for exponential growth and the equation of the model are as follows:

$Yt = \beta_o * \beta_1 t * e_t$

Yt is the forecasted area and yield, t is the time index β0 is the model intercept and β1 is the annual area and yield change.

2. Accuracy measures

Consistency of the forecasting methods was based on three accuracy measures also termed as forecasting errors. These measures contain Mean Absolute Percentage error (MAPE), Mean Absolute Deviation (MAD) and Mean Squared Deviation (MSD). Smaller values of all these measures delegate a good fitting model with minimum forecasting error (Karim *et al.,* 2010). The best model is therefore preferred to forecast rice production in KPK for the year 2012-13 to 2021-22.

Results and discussion

This section deals with time series data of area and production of rice crop in kpk, and estimated trends in table and figure form of rice area and production in kpk are presented. There are different methods to evaluate the trends and forecasting of several commodities, while selection of a method depends upon the best accuracy measures of these models. For this study Quadratic trend model was chosen due to least amount errors.

If we look at past trends

The trends of Rice area and production are described in (figure 1). It shows the rice production in KPK had fluctuation rising and losing moving towards declining trend during the period from 1981 to 2012. The rice production and area was 110.1 '000' tones and 68.9 '000' ha respectively in the year 1981 but with upward downward trend at the end 2011-12 area engaged by rice was 50.1 (000 ha), which is not enough to fulfill the national requirements. In case of production in 2011-12 the yield was 94.7 '000' tones which has been decreased 15.4 tones during this period in Khyber Pakhtun Khwa. These previous trends depict that area and production of rice has decreased. The reasons for decrease in area and production can be climatic and economic such as cold weather and farmers' loss from this crops insufficient water or increased cost for rice, so that the area under rice has been converted to other crops area. So these reasons become for decreasing in area of rice in Khyber Pakhton Khwa which might be the reason of the not wiser decisions of the policy makers. A drastic decline in the area and production of rice was noticed from 1981 to 2011-12. Therefore the growth of rice production is not sufficient enough to meet the ever increasing food requirements of Khyber Pakhtun Khwa.

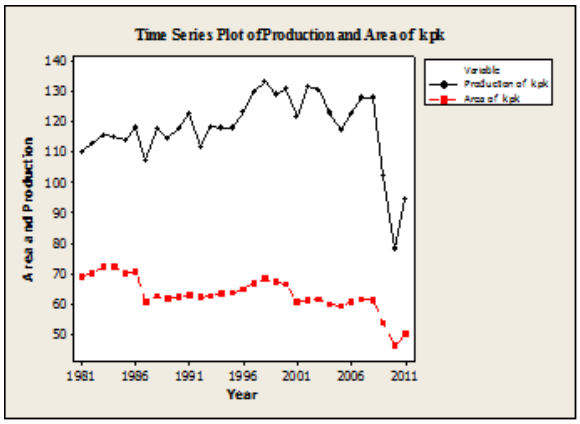

Fig. 1. Time series plot showing trends of rice production and area in KPK.

Source: Agricultural Statistics of Pakistan

Selection of forecasting model for rice area

This study applied quadratic model for trend analysis of rice area and production in Pakistan on the basis of lesser values of accuracy measures (Karim *et al.,* 2010). The results given in table 1 revealed that all the values of accuracy measures are smaller in Quadratic model. Therefore instead of other two models quadratic forecasting technique was adopted to show the future trends of rice production in Pakistan. Linear trend model values of accuracy (MAPE, MAD and MSD) are 5.09, 3.08 and 14.58. Similarly values of accuracy (MAPE, MAD and MSD) for exponential growth trend model are 5.57, 3.24 & 20.25 respectively. Values of accuracy measures (MAPE, MAD and MSD) for quadratic trend model are 5.06, 3.11 & 13.50 respectively which are comparatively lower than the values of linear trend and exponential trend models. These values recommend that quadratic trend model present better fit to data and are appropriate for predicting future area of rice in KPK.

Table 1. Diagnostic measures for the selection of best forecasting method for rice area in KPK

Forecasting models	*Criteria*		
	MAPE	MAD	MSD
Linear trend model	5.0911	3.0829	14.5810
Quadratic trend model	5.0642	3.1148	13.5061
Exponential Growth model	5.5788	3.2431	20.2500

Selection of forecasting model for rice production

Table 2 showed the values of accuracy measures (MAPE, MAD and MSD) for linear trend model are 7.31, 7.98 & 129.24. Similarly values of accuracy measures (MAPE, MAD and MSD) for exponential growth model are 6.49, 6.881 & 114.56. Values of accuracy measures (MAPE, MAD and MSD) for quadratic model are 6.24, 6.86 & 78.10 respectively which are comparatively junior than the values of linear trend and exponential growth models. This exposed that all the values of accuracy measures for rice production in KPK is smaller in quadratic model. That's why, this study applied quadratic model to forecast the future values of rice production in Khyber Pakhtun Khawa.

Table 2. Diagnostic measures for the selection of best forecasting method for rice Production in KPK

Forecasting models	*Criteria*		
	MAPE	MAD	MSD
Linear trend model	7.318	7.989	129.204
Quadratic trend model	6.2435	6.8622	78.1037
Exponential Growth model	6.499	6.881	114.564

Forecasted rice area

After fitted the sufficient model next step was to estimate predicted values for area and production of rice crop in KPK. Objective was to predict the future value subject to minimum errors as a smaller amount as possible (Yaseen *et al.,* 2005). Figure 2 shows the trend analysis plot for area of rice in kpk by using quadratic model. The black, red and green symbols represents the actual, fitted and forecasted values for area at 95% prediction interval in Pakistan. Table 3 results showed that if the present growth rates of rice area remain the same then the area of rice in Pakistan would be 52.86, 51.90, 50.91, 49.89, 48.84, 43.17, 46.66, 45.53, 44.36 and 47.77 thousands ha respectively for the years 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021 and 2022 with continuous decreasing trend. Forecasted values of area reveal that area for rice has continuously decreasing trend in KPK. Reasons for decrease in area for rice Due to poor planning and research by Government and policy makers, the return to farmers is far less compared to major crops and cold weather area of rice has reduced in Khyber Pakhtun Khawa .

Forecasted rice production

The yield growth rate is relatively higher than the area growth rate of rice in Khyber Pakhtun Khawa. As figure 3 showing the trend analysis plot for yield of rice in Pakistan by using quadratic trend model. The black line shows actual values, red fitted values and green line is for forecasted values of rice yield at 95% prediction interval. As in table 4 results showed that if the present growth rates of rice yield remain the same then yield of rice in Khyber Pakhtun Khawa Pakistan would be 96.83, 93.30, 89.58, 85.66, 81.53, 77.21, 72.69, 67.96 and 63 .04 tones per ha respectively for the years 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021 and 2022. Forecasted values of yield under rice in has decreasing trend in coming ten years in Khyber Pakhtun Khawa. Decrease in yield is due to non-availability of sufficient water and not appropriate use of inputs and non availability of inputs for rice in Khyber Pakhtun Khawa. Likewise table 4 is also amplification the future trends of rice production in Khyber Pakhtun Khawa. These trends show that as a substitute of a motivation for farmers in form of high yielding from Mungbean and there is also country demand available, still there is a decrease in area of rice in Khyber Pakhtun Khawa Pakistan. The need is that to take such type of policy measures which ultimately increase the area under rice in Khyber Pakhtun Khawa. Because there is challenge need to fulfill poor people highly protein food needs.

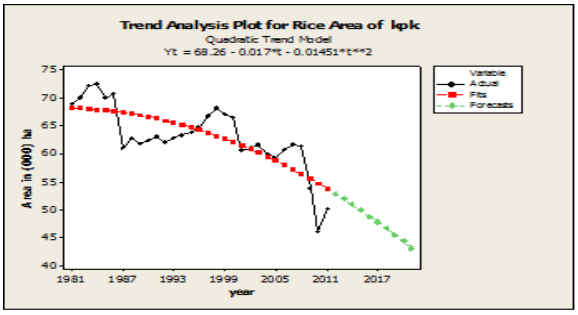

Fig. 2. Trend analysis of rice area with quadratic trend model.

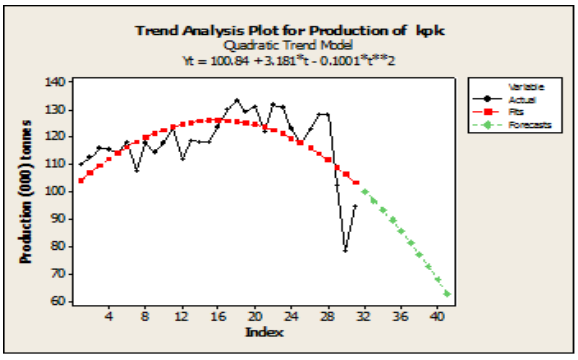

Fig. 3. Trend analysis of rice production with quadratic trend model.

Table 4. Forecasted rice area and production.

Forecast Years	*Area (000 Hectares)*	*Production (Kg/ Hectare)*
2012-13	52.86	100.15
2013-14	51.90	96.83
2014-15	50.91	93.30
2015-16	49.89	89.58
2016-17	48.84	85.66
2017-18	47.77	81.53
2018-19	46.66	77.21
2019-20	45.53	72.69
2020-21	44.36	67.96
2021-22	43.17	63.04

Conclusion and recommendations

The study results exposed that quadratic model was suitable for evaluation of rice area and yield in Khyber Pakhton Khawa. The values of the accuracy measures were slighter in quadratic method in compare to other trend analysis methods, on behalf of these smaller values quadratic method applied on this study analysis. The results showed that if the present growth rates of rice area remain the same then the area of rice in kpk would be 52.86, 51.90, 50.91, 49.89, 48.84, 47.77, 46.66, 45.53, 44.36 and 43.17 thousands ha respectively for the years 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021 & 2022. The results showed that if the present growth rates of rice yield remain the same then yield of rice in KPK would be 100.15, 96.83, 93.30, 89.58, 85.66, 81.53, 77.21, 72.69, 67.96 & 63.04 kgs per ha respectively for the years 2012, 2013, 2014, 2015 & 2016, 2017, 2018, 2019, 2020, 2021 & 2022..The ten years forecasted area under rice trends to decreasing in the coming years in KPK , which is alarming situation for poor Pakistani consumers of rice. While forecasted yield of rice for coming ten years tend to low in KPK. As there is an decrease in yield and also there is a province requirement so the need is to decrease the area under rice in kpk, to fulfill poor people supply of protein, carbohydrates, Fat, Calcium and Iron that do not have enough resources to buy expensive diet based protein food. Therefore there is urgent need to take such type of policy measures which ultimately increased the area under rice in kpk.

References

Agrawal R. 2010. Indian Statistics Research Institute, library avenue, New Delhi-110012.

Dewey RD, Lu KH. 1959. A correlation and path coefficient analysis of components of crested wheat grass seed production. Argon.Journal **51,** 515-518.

Finger R. 2007. Evidence of Slowing Yield Growth-The example of Swiss Cereal Yield.Agri-food and Agri-environmental Economics Group, ETH Zürich, Switzerland.

Box GEP, Jenkins GM. 1994. Time Series Analysis: Forecasting and Control, 3rd Edition. Prentice Hall.

Galani S, Naz F, Soomro F, Jamil I, Hassan Z U, Azhar A and Ashraf A. 2011. Seed storage protein polymorphism in ten elite rice (*Oryza sativa* L.) genotypes of Sindh African Journal of Biotechnology **10(7),** 1106-1111.

Gujarati ND. 2003. Semi-log Models: Log-lin and Lin-log Models. Basic Econometrics, 4th Int'l. Ed.

Hwang HJ, Kim KS, Choi HC. 2006.Comparison of the Physicochemical Properties and Ultrastructure of Japonica and Indica Rice Grains. Journal of Agriculture and Food Chemistry **54,** 13.

Inamullah IA, Ahmad H, Sajid-ul-Ghafoor, Afridi SG, Muhammad I, Illyas M. 2010. Seed Storage Protein Profile of Rice Varieties Commonly Grown in Pakistan. Asian Journal of Agricultural Sciences **2(4),** 120-123.

Islam ASMF, Ali MR, Gregorio GB, Islam MR. 2012. Genetic diversity analysis of stress tolerant rice (Oryza sativa L.). African Journal of Biotechnology **11,** 15123-9.

Karim MR, Awal MA, Akter M. 2010. Forecasting of wheat production in Bangladesh. Bangladesh Journal of Agricultural Research **35(1),** 17-28.

Khakwani AZ, Zubair M, Mansoor M, Naveed K, Shah IH, Wahab A, Ilyas M, Ahmad I. 2006. Agronomic and morphological parameter of rice crop as affected by date of transplanting. Journal of .Agronomy **5(2),** 248-250.

Khan M, Mustafa K, Shah M, Khan N, Khan JZ. 2008. Forecasting Mango Production in Pakistan an Econometric Model Approach Sarhad J. Agric **24,** 2.

Mahmood K, Munir M, Rafique S. 1991. Rainfed Farming Systems and Socio-economic Aspects in Kalat Division (Highland Balochistan). Pakistan. Journal of Agriculture. Society.Sciences **5,** 15-20.

MINFAL. 2013. United States Department of Agriculturehttp://www.usda.gov. MINITAB version 15.1. 2006, Statistical data analysis software.

Naeem, Amanullah M, Hussain N. 2010. Study of correlation among yield related traits and pathcoefficient analysis in rice (Oryza sativa L.) African Journal of Biotechnology **9(46),** 7853-7856.

Nazli H, Haider SH, Tariq A. 2012. Supply and demand for cereals in Pakistan, 2010-2030.IFPRI discussion paper No.01222.

Ogunbayo SA, Ojo DK, Guei RG, Oyelakin OO, Sanni KA. 2005. Phylogenetic diversity and relationships among 40 rice accessions using morphological and RAPDs techniques. African Journal of Biotechnology **4 (11),** 1234-124.

Rabbani MA, Pervaiz ZH, Masood MS. 2008. Genetic diversity analysis of traditional and improved cultivars of Pakistani rice (Oryza sativa L.) using RAPD markers. Electronic.Journal of Biotechnology **11,** 1-10.

Ramasubramanianv. 2009, Indian Statistics Research Institute, library avenue, New Delhi-110012.

Makridakis S, Wheelwright SC, Hyndman RJ. 1998. Forecasting: Methods and Applications. Wiley.

Salim M, Akram M, Akhter ME, Ashraf M. 2003. In: Saleem MT (ed), Rice, A production: Handbook: Pakistan Agric. Res. Council, Islamabad, 68.

Subudhi HN, Samantaray S, Swain D, Singh NO. 2012. Collection and agro-morphological characterization of aromatic short grain rice in eastern India African Journal of Agricultural Research **7(36),** 5060-5068.

Takaiwa F, Ogawa M, Okita TW. 1999. Rice Glutelins. In: Seed Proteins. Ed. by Shewry PR, Casey R.Kluwer Academic Publishers.Norwell MA, USA; 1999.

Yaseen M, Zakriya M, Shahzad ID, Khan MI, Javed M A. 2005. Modeling and Forecasting the Sugarcane Yield of Pakistan. International.Journal.Of Agriulture & Biology **7**,180-183. Biotechnology **11(85),** 15123-15129.