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# DOUBLE EXPONENTIAL FORECASTING MODEL FOR DATES PRODUCTION IN PAKISTAN

Saleem Abid*, Anum Fatima*, Sobia Naheed*, Asrar Sarwar** and Muhammad Nisar Khan*

**ABSTRACT:- This study was carried out to examine prospect trends of dates area and production in Pakistan by using time series data from 1980-81 to 2012-13 (32 years).Three accuracy measures were used for the selection of best fitted model. These accuracy measures are mean absolute percentage error (MAPE), mean absolute deviation (MAD) and mean squared deviation (MSD). Double exponential trend was located to be best fitted model among other five models (linear trend, quadratic trend , exponential growth , s-curve and moving average) for estimating predicted values of area and production of dates for upcoming seven years. The estimated values of area and production represent increasing trend were 2.2, 93.8, 95.5, 97.2, 98.0, 100.6 and 102.3 '000' hectares and 548.5, 556.0, 563.5, 571.0, 578.5, 585.9 and 593.4 '000' tonnes from 2013-14 to 2019-20, respectively .**

*Key Words: Phoenix dactylifera; Time Series Data; Forecasting Errors; Double Exponential Model; Area; Production; Pakistan.*

## INTRODUCTION

In many parts of world date palm (*Phoenix dactylifera* L.) or "Khajoor" in Urdu language has been considered as very old crop (Kwaasi, 2003). Date is a very tasty, nutritious, delicious and most important food in many countries. Nutritional values of dates are very high and it is rich in vitamin A, B, C, E, K. phosphorous, iron, calcium, potassium, magnesium, sodium and zinc are essential minerals which are found in dates (Al-Rawahi et al., 2005).

In preparation of many food items dates are also used as an important ingredient like sweet, snacks, roasting products, institutional feeding and health foods (Yahaya et al., 2015). In rural Bangladesh natural date palm contributes a lot to the living wage of the people and used in sugar manufacturing and for additional points resembling rug making, fencing, animal nourish, garden umbrella etc. (Chowdhury et al., 2008).

Mostly production of dates is intense in the Muslim world. In world agricultural industry date production is almost about 5.4 mt mostly produces in the sub-tropical desert, semi-arid and dry areas with the help of very careful and rigorous climatic conditions. Pakistan is one of the top producers of dates and 90% of total dates production consumed locally and exports 10% of dates produces in the country. Every year Pakistan produces almost 650,000 t dates and

* *Social Sciences Research Institute, National Agricultural Research Centre, Islamabad, Pakistan.*
** *World Vegetable Center, Pakistan*
.Corresponding author: *sobianarc@gmail.com*

is 4th leading producer of dates in the world. During 2007-08 Pakistan sell to other countries 88,451t dehydrated dates and 4,687t fresh dates and received 36.033 million US Dollar (EPB, 2008-09). Turbat, Panjgur, Gwadar, Khairpur, and D.I.Khan are major dates producing areas in Pakistan. In Pakistan there are almost 300 varieties of dates. Some of them are Aseel, Karbalai, Fasli, Muzawati, Hillawi, Begum Jhangi, Dashtiari, Sabzo, Jaan Swore, Kehraba, Rabai and Dhakki. Aseel of Sindh, Dhakki of Dera Ismail Khan and Begum Jhangi of Balochistan (PHDEB, 2008). Share of Sindh in production of dates is on rise with 55% of the total production. Ata et al. (2014) investigate that date palm was the third major source of income for farmers and extensive usage of commercial and household products made by date palm improve the livelihood of farmers of Pakistan.

In Pakistan dates are very essential cash fruit crops. In 2012-13 area cultivated under dates crop were 89600 ha by an yearly production of 524600t (Table 1). Turbat, Panjgur, Gwadar, Khairpur, and D.I.Khan are major dates producing areas in Pakistan (GoP, 2013).

**Table 1. Area and production of dates in Pakistan**

| Year | Area (ha) | Production (000t) |
|---|---|---|
| 2007-08 | 90.1 | 557.5 |
| 2008-09 | 90.7 | 566.5 |
| 2009-10 | 90.6 | 531.2 |
| 2010-11 | 90.1 | 522.2 |
| 2011-12 | 93.1 | 557.3 |
| 2012-13 | 89.6 | 524.6 |

*Source: GoP, 2013*

Today dates production is a business and also has high economic significance in the world. It's true that Pakistan is one of the foremost producers of dates but unfortunately date business is incapable to process realistic production for export because of deprived management practices and lack of modern techniques. By improving the management practices, adapting modern techniques and get better a group in date stuffing, stock up, and marketing progress towards the bright future of Pakistan is possible (Ismail et al., 2006).

Forecast the future trends of area and production of dates in Pakistan on the basis of past trends by using suitable forecasting model will help the policy makers for taking their future decisions to improve date area and production. There are many forecasting models which were used earlier for projecting the different crops. Linear trend model, quadratic trend model, exponential growth model, moving average model and double exponential smoothing model were used to forecast the area and production of maize crop in Khyber Pakhtunkhwa for five years. Abid et al. (2014); El-Juhany (2010) studied the degradation of date palm trees and date production in Arab countries. Farah (2012) used ARIMA modeling technique to forecast the date exports of Pakistan and concluded upward trend for future dates exports.

The main objective of this study was to forecast the future trends of area and production of dates in Pakistan on the basis of past trends by using suitable forecasting model. This study will help the policy makers for improving their future policies.

## MATERIALS AND METHOD

Time series data for area and production of dates fruit in Pakistan were collected from various issues of Agricultural Statistics of Pakistan from 1980-81 to 2012-13 (32 years). The collected data were analyzed in statistical software Minitab Version 16.

### Forecasting Models

This study was carried out in 2014 at National Agricultural Research Centre, Islamabad for forecasting of dates area and production for next seven years. Six forecasting models namely Linear trend model, Quadratic trend model, Exponential growth model, S-Curve model, Moving average model and Double exponential smoothing model were used to find the best fitted model for area and production of dates in Pakistan. The general forms of Double exponential smoothing model as given in the Minitab software 2013 are described below:

### *Double Exponential Smoothing Model*

The algebraic form of the linear exponential smoothing model can be expressed as follows:

Let S' denotes the singly smoothed series obtained by applying simple exponential smoothing to series Y (Abid, F. et al., 2014). Then, the value of S' at period t is given by:

$$S'(t) = \alpha Y(t) + (1-\alpha)S'(t-1)$$

Let S'' denote the doubly smoothed series obtained by applying simple exponential smoothing

$$S''(t) = \alpha S'(t) + (1-\alpha)S''(t-1)$$

Finally, the forecast $\acute{Y}(t+1)$ is given by:

$$\acute{Y}(t+1) = a(t) + b(t)$$

where,

$a(t) = 2S'(t) - S''(t)$ the estimated level at period t.

$b(t) = (a/(1-\alpha))(S'(t) - S''(t))$ the estimated trend at period t

### *Accuracy Measures*

Reliability of the forecasting methods was based on three accuracy measures also termed as forecasting errors. These measures include Mean Absolute Percentage Error (MAPE), Mean Absolute Deviation (MAD) and Mean Squared Deviation (MSD). The best fitted model was selected on the basis of these three accuracy measures or forecasting errors. The model which has the smaller values of the error term indicates the best fitted model for forecasting (Karim et al., 2010). Difference between the actual and fitted value with respect to time series data is known as forecasting error or measure of accuracy.

MAPE is relative measures which express the error in terms of percentage and calculated as follows:

$$MAPE = \frac{\Sigma |e_t| \div Z_t}{n} \times (100)$$

MAD analyzes the average of the unknown errors and expresses accuracy in terms of same units as the data. It is a more sensitive measure of accuracy. It is more concerned about the average distance between each data value and the mean. It is defined as follows;

$$MAD = \frac{\Sigma |e_t|}{n}$$

MSD is another measures used to understand the forecasting performance of model. It gives more weightage to large errors than small errors as errors are squared before being summed.

$$MSD = \frac{\Sigma |e_t|^2}{n}$$

where,

$e_t$ = $x_t$-$y_t$
$x_t$ = Actual value
$y_t$ = Fitted value
n = Number of observation

## RESULTS AND DISCUSSION

### Choosing Suitable Model for Forecasting of Dates Area and Production

The results revealed that the values of three accuracy measures (MAPE, MAD, and MSD) for Linear trend model, Quadratic trend model, Exponential growth model, S-Curve model and Moving average model are greater than the values of correctness procedures for Double exponential trend model (Table 2). So that, Double exponential model is most appropriate model for predicting the future trend of dates area on the basis of smaller values of forecasting errors. Rani and Raza (2012) also use Double exponential smoothing model for price estimation of major pulses in Pakistan. Similarly, Habib et al. (2013) and Tahir and Habib (2013) made use of Quadratic trend model for forecasting of mungbean, maize and sorghum area and production in Pakistan, respectively on the starting point of lowest forecast errors.

After choosing the best fitted model, the expected values of area and production of dates in Pakistan were calculated. Results indicated that if the current growth rate of dates area remain the same then the area of dates from 2014 to 2020 would be 92.148 ha, 93.875 ha, 95.525 ha, 97.214 ha, 98.03 ha, 100.592 ha and 102.281 ha, respectively (Table 3). Similarly from 2014 to 2020 the production of dates in Pakistan would be

**Table 2. Diagnostic measures for choosing suitable model for dates fruit area and production in Pakistan**

| | Criteria for selection of best fitted model | | | | | |
|---|---|---|---|---|---|---|
| | MAPE | | MAD | | MSD | |
| Forecasting Model | Area (000 ha) | Production (000 t ) | Area (000 ha) | Production (000 t) | Area (000 ha) | Production (000 t) |
| Linear trend | 9.11 | 18.07 | 5.34 | 77.27 | 48.55 | 7630.51 |
| Quadratic trend | 8.73 | 15.62 | 4.53 | 58.56 | 37.31 | 5086.91 |
| Exponential growth | 11.72 | 18.30 | 7.61 | 85.20 | 99.40 | 10326.30 |
| S-curve | 7.63 | 15.93 | 4.25 | 61.28 | 33.94 | 5530.33 |
| Double exponential smoothing | 4.39 | 8.52 | 2.82 | 40.38 | 33.04 | 5437.8 |
| Moving average | 5.78 | 9.72 | 3.59 | 46.32 | 47.93 | 6210.26 |

**Table 3. Forecasts and their 95% prediction intervals of area and production of dates fruit in Pakistan.**

| Forecast Years | Area (000 ha) | | | Production (000 t) | | |
|---|---|---|---|---|---|---|
| | Lower limit | Forecast | Upper limit | Lower limit | Forecast | Upper limit |
| 2013-14 | 85.2433 | 92.2 | 99.052 | 449.587 | 548.5 | 647.460 |
| 2014-15 | 84.3609 | 93.8 | 103.312 | 442.011 | 556.0 | 670.001 |
| 2015-16 | 83.2980 | 95.5 | 107.753 | 432.892 | 563.5 | 694.085 |
| 2016-17 | 82.1532 | 97.2 | 112.275 | 422.747 | 571.0 | 719.195 |
| 2017-18 | 80.9653 | 98.0 | 116.841 | 411.902 | 578.0 | 745.005 |
| 2018-19 | 79.7521 | 100.6 | 121.4321 | 400.564 | 585.9 | 771.309 |
| 2019-20 | 78.5229 | 102.3 | 126.039 | 388.869 | 593.4 | 797.969 |

*Source: Author's own calculation*

548.523, 556.006, 563.489, 570.971, 578.454, 585.936 and 593.419 '000' t, correspondingly. Lower and upper limits show that forecast for area and production of dates lies between these two limits, means that not below than lower limit and not more than upper limit.

Graphically trend analysis for dates area and production showed that area of dates has continuous upward trend with minor increasing and decreasing trend (Figure 1), whereas, the production has many fluctuations during the years (Figure 2). These fluctuations may be due to insufficient management practices or it may be because of some natural changes or due to economic conditions.

The study concludes that due to smaller forecasting errors, Double

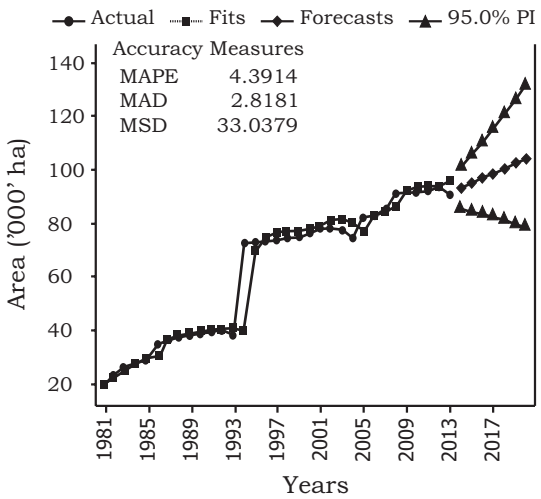


**Figure 1. Trend analysis for dates area**

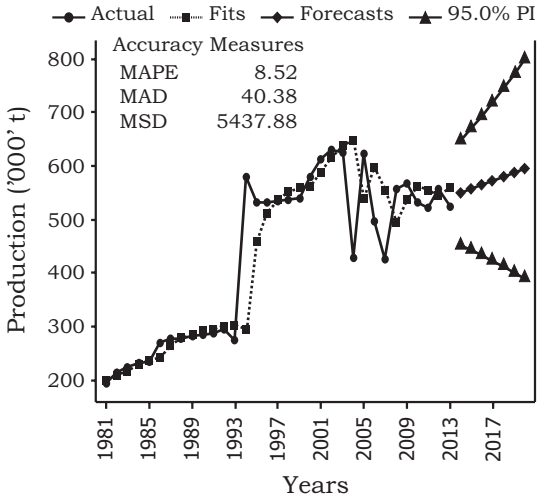


**Figure 2. Trend analysis for dates production**

exponential model is most appropriate and good method for prediction of area and production of dates in Pakistan. These results gave an idea about the forecast of area and production of dates for coming seven years which are calculated via the expanded model, it can be clearly seen that predicted area and production has constant increasing trends during 2013- 2017, respectively. These trends indicated that there is extensive increase in area and production of dates so keeping in view the economic significance of dates, it is important for strategy creators and government to get steps for enhancing date industry in Pakistan. So that date industry of Pakistan will also be able to enhance the process of export. It would be definitely in the favor of economy of Pakistan.

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## AUTHORSHIP AND CONTRIBUTION DECLARATION

| S.No | Author Name | Contribution to the paper |
|---|---|---|
| 1. | Mr. Saleem Abid | Conceived the idea, Overall management of the article, Data Analysis, Results, Methodology |
| 2. | Ms. Anum Fatima | Data collection, Methodology, Results and Discussion, Introduction |
| 3. | Ms. Sobia Naheed | Review of Literature |
| 4. | Mr. Asrar Sarwar | References |
| 5. | Mr. Muhammad Nisar Khan | Data collection |

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