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Trends And Variability Of Major Fruits Production In Khyber Pakhtunkhwa, Pakistan

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ABSTRACT

The present study investigates major fruit production trends and analyzes variability in Khyber Pakhtunkhwa. The study based on secondary data covers a period of about 34 years i.e. starting from 1980-81 to 2013-14, whereas, the trend models and Cuddy Della Vella Index techniques have been employed to fit the best trend model and variability analysis[1] respectively for major fruits production i.e. Apple, Citrus, Peach, Pear, Plum. Among the studied trend models regarding major fruit production, the power trend model, Cubic trend model, Exponential trend model, Cubic trend model, and Cubic trend model respectively were found adequate for forecasting based on the forecast evaluation criteria (MAD, MSE, and MAPE). Moreover, the variability analysis for each major fruit crop production was 2.46%, 0.27%, 24.07%, 2.20%, and 0.84% respectively.

Keywords: *Parameter estimates, Accuracy Measures, Variability, Cuddy-Della Valle Index, Fruit.*

Introduction:

The agriculture sector plays a significant role in the economy of a country. Agriculture occupies a central position in Pakistan and contributes nearly 20.9% to the GDP. About 43.5% of the labor force is engaged in agriculture (Pakistan Economic Survey, 2014-2015). One of the main components of agriculture is horticulture. The horticulture industry play pivotal role in the development of economy of every country and particularly, in Pakistan it greatly contribute in the social as well as economic development by improving the income status of individuals and add nutritional values in the context of their good health. Among the other associated benefits, orchards having pleasant effect on the environment and by maintaining ecological balance. The horticultural sector mainly includes fruits and vegetables, contributing 11% to the total value addition of the agriculture sector of Pakistan. Major horticulture crops of our country are mainly grown on the area of about 0.812 million hectares, which is approximately 5% of the total cultivable land of the country. Also, the current income status of exports of horticultural sector is recorded to be 400 million USD which significantly contributes and laid down foundation towards the growth of economy. The horticulture crops are very labor intensive in nature and the country like Pakistan where there is lake of resources including capital scarcity

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and labor abundant, the production of the horticultural products should be encouraged to improve the economy and also to alleviate poverty. Pakistan is sacred with variety of suitable climatic situations to produce different types of horticultural products by the help of which demands of national and international markets can easily be fulfilled (Pakistan Horticultural Development and Export Board, 2011).

Especially, Khyber Pakhtunkhwa is gifted with the natural ecology and its land is favorable to grow different fine varieties of fruits and vegetables. It has vast mountainous area naturally suitable for growing precious quality of dry fruits like pine-nuts, wall-nuts and almond etc. Besides that it produces sweet and delicious oranges, persimmons, peaches, plums, apples, pears and pomegranate due to its favorable climatic situation. Like-wise in plain areas guava, citrus, strawberry, loquat, apricot, dates, melons and plums are abundantly produced. The production of apples, peaches, plums, pomegranate, dates, grapes, and persimmon have strong market demand in the domestic markets. In the citrus fruits, kinnow variety "mandarin" is the large producing fruit in Khyber Pakhtunkhwa and having great source of revenue earning. Moreover, in some Northern areas of Khyber Pakhtunkhwa there are significantly great potential for different types of fruits. Pakistan is the fifth largest producer of dates. Though the production of mangoes is in millions of tons annually, but the exported potential of the same is very low. In Khyber Pakhtunkhwa, the Northern areas having potential for the promotion of peaches, apples, guava, strawberry, citrus, persimmon, apricot and plums etc. Also, there is a great room for the growth and development of some altered fruits like strawberries, cherries, litchi etc. in different regions of our country. (Crop Reporting Service Khyber Pakhtunkhwa, 2013). According to Sen (1967) observed the variability phenomena of different fruit crops in India. He employed variability measures and concluded that the agricultural production was significantly increased due to improved usage of purchased inputs and also caused expansion in the cultivation related to the marginal land and resources. Similarly, Rao (1975) compared the variability in yield and area of different fruit crops of India. He concluded that variability in productivity was much greater than the variability in the corresponding area due to shifting growth components based upon increasing area related to growth. Moreover, Hazell (1982 and 1989) conducted a study related to food crops of India. He concluded that due to the vast scope and adoption of modern prevailing technology, the variability in the production of world cereal, as well as Indian food grain, was found to be increased. In literature different studies have also been employed regarding the trend model by Boken et al. (2000), Finger (2007), Rimi et al. (2011), Sorva et. al. (1990), Pere (2000), and Rao et al. (1980).

Material and Method:

The present study is conducted by using time series data with effect from 1980-81 to 2013-14 i.e. time series data of 34 years, to forecast production for onward ten years regarding major fruits including Apple, Citrus, Peach, Plum and Pear in Khyber Pakhtunkhwa, Pakistan. The time series data were collected from secondary sources of various issues of Fruits, Vegetables and Condiments Statistics, Crop Reporting Service of Khyber Pakhtunkhwa and were analyzed in Statistical Package SPSS version 22.

Trend analysis technique provide clear picture of trend so that we can easily forecast the future related production of different crops (Box and Jenkin, 1994; Makridakis, 1998). In literature, several forecasting models have been developed so far to forecast the future values. The study has been carried out by using forecasting models including Linear trend model, Quadratic trend model, Cubic trend model, Power trend model, S-curve model, Logarithmic trend model, Exponential trend model, Compound growth model, Growth curve, Inverse curve, Logistic Curve to find out the best-fitted model for the production of major fruit crops of Khyber Pakhtunkhwa. Trend models are described below in brief.

Trend models

i. **Linear Trend Model:** The linear trend model is used for forecasting trends in the production of major fruit crops. The linear trend model was also used in literature by Boken et al. (2000), Finger (2007), and Rimi et al. (2011) which can be described as follows:

$$Y_t = \beta_0 + \beta_1 t + e_t ----(1.1)$$

Where, Y_t represents the production predicted at time t, t represents the time index, β_0 is the intercept of the model β_1 is the annual change in production and e_t is the error term of the model.

ii. **Quadratic Trend Model:** Quadratic trend model is used to check the trend patterns which was also been applied by Finger (2007). The model equation presented in Equation-(1.2);

$$Y_t = \beta_0 + \beta_1 t + \beta_2 t^2 + e_t ------(1.2)$$

Where, Y_t represents production predicted at period t, t is the time index β_0 is the intercept, β_1 and β_2 represents the annual change in production, e_t is the error term of the respective model.

iii. **Exponential Trend Model:** The exponential trend model permits a relationship in which the series increases (decreases) at an increasing (decreasing) rate. The exponential trend model was used in literature by Sorva et. al. (1990) and Pere (2000) is described as follows;

$$Y_t = \beta_0 * \beta_1^t + e_t ------(1.3)$$

Here, Y_t represents predicted production; t is the time index, β_0 is the intercept of the model, β_1 is the respective annual change in production and e_t is the error term of the model.

iv. **Cubic Trend Model:** Cubic Model was used in literature by Rao et al. (1980) and Wiktor and Travis (1985). It can be defined by the equation

$$Y_t = \beta_0 + \beta_1 * t + \beta_2 * t^2 + \beta_3 * t^3 + e_t ----(1.4)$$

Here, Y_t represents predicted production; t is the time index, β_0 is the intercept of the model, β_1, β_2 and β_3 is the respective annual change in production and e_t is the error term of the model.

v. **Power Trend Model (PTM):** Power trend model was used by Rao et al. (1980). The PTM can be written in Equation-(1.5);

$$Y_t = \beta_0 * t^{\beta_1} + e_t ------(1.5)$$

Where, Y_t represents production predicted at period t, t is the time index β_0 is the intercept, β_1 represents the annual change in production, e_t is the error term of the respective model.

vi. **Logarithmic Trend Model:** Logarithmic trend model was used in literature by Rao et al. (1980) and Sagar (1980). The equation for the logarithmic trend model can be represented as;

$$Y_t = \beta_0 + \beta_1 * \ln(t) + e_t ----(1.6)$$

Here, Y_t represents the production predicted at time t, t represents the time index, β_0 is the intercept of the model,β_1 is the annual change in production and e_t is the error term of the model.

vii. **Inverse Trend Model:** The Inverse growth model was used in literature by Rao et al. (1980) and Sagar (1980). The equation for Inverse trend model is represented by;

$$Y_t = \beta_0 + \frac{\beta_1}{t} + e_t ----(1.7)$$

As, Y_t represents the production predicted at time t, t represents time index, β_0 is the intercept of the model, β_1 is the annual change in production and e_t is the error term of the model.

viii. **Compound Trend Model:** Compound trend model was used in literature by Wiktor and Travis (1985). The equation for the compound trend model can be written as follows;

$$Y_t = \beta_0 * {\beta_1}^t + e_t ------(1.8)$$

Here, Y_t represents the production predicted at time t, t represents the time index, β_0 is the intercept of the model, β_1 is the annual change in production and e_t is the error term of the model.

Instability Analysis:- Instability is one of the most important decision parameter in developing fields, specially, in the field of agriculture sector. The wide fluctuation in the crops output not only brings about sharp fluctuation but also results in wide variation in farmer's income as well. To examine the extent of variability in the production of major fruit crops of Khyber Pakhtunkhwa, the Cuddy-Della Valle Index is used (Cuddy and Della Valle, 1978).

The instability in the production of major fruit crops is measured in relative terms by using the Cuddy- Della Valle index (I), symbolically written as:

$$I = CV * \sqrt{1 - AdR^2} ------(1.9)$$

Whereas,

I = Instability index (in percent)

CV = Coefficient of variation (in percent), and

AdR = Coefficient of determination from time trend regression adjusted by the corresponding number of degrees of freedom.

Results and Discussion

1.1-Trend Analysis for Apple Production: The trend analysis technique is employed to check the best-fitted trend model for Apple fruit production in Khyber Pakhtunkhwa Province of Pakistan by using the SPSS Package. Among the trend models including linear trend model, Quadratic trend model, cubic trend model, compound trend model, exponential trend model, power trend model, S-Curve model, inverse trend model, growth trend model, logarithmic trend model, logistic trend model, etc., the best-fitted model based on Accuracy measures the power trend curve is found to be best-fitted curve presented in Table-1.1 and Figure-1.1.

Table:1.1:-Results of Trend Model for Apple production

Equation	Accuracy Measures				Parameter Estimates			
	R^2	MAE	MSE	MAPE	Constant	b1	b2	b3
Linear	0.54	13039	230000000	15	64494.925	1677.734		
Logarithmic	0.659	10622	75658210	19	38030.658	21427.172		
Inverse	0.452	15087	89941270	34	103912.48	-83032.483		
Quadratic	0.701	10732	150000000	11	42540.802	5336.754	-104.543	

Cubic	0.718	9288	9083421	10	51645.171	2424.216	100.51	-3.906
Compound	0.551	1778	867000000	11	63738.666	1.02		
Power	0.730	5863	77971520	5	45004.794	0.269		
S	0.553	12165	202000000	13	11.549	-1.097		
Growth	0.551	7981	8571120	11	11.063	0.02		
Exponential	0.551	7724	8473220	11	63738.666	0.02		
Logistic	0.551	7862	820000000	12	0.0000157	0.98		

The parameter estimate of all selected models presented in Table-1.1 is found to be significant, having $p \leq 0.05$. Also, power trend model is found to be the best suitable one among the studied trend models, on the basis of forecast evaluation criteria.

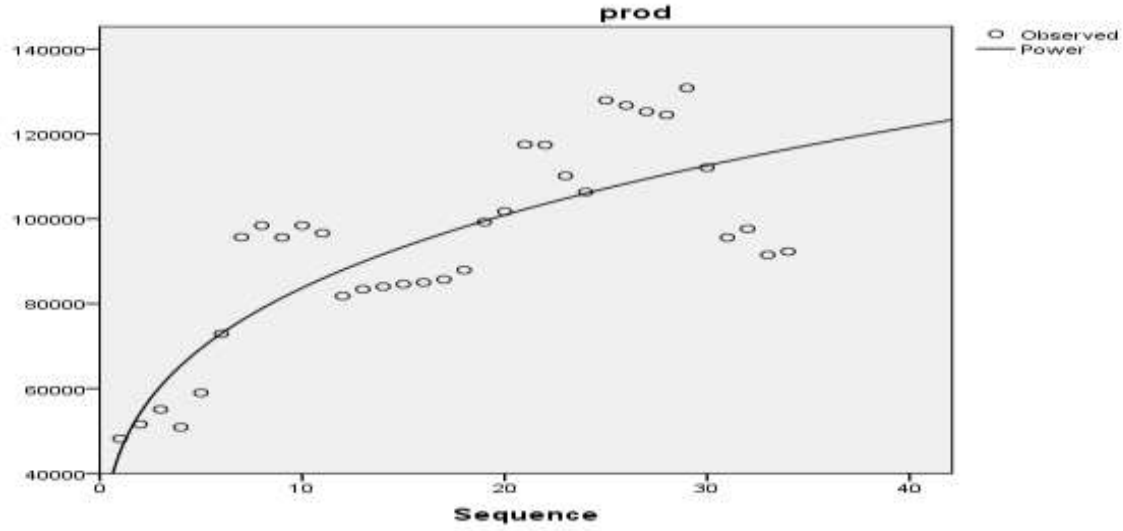

Figure:1.1:- Power Curve Plot for Apple fruit Production

Figure-1 shows that the fitted line provides a good fit as it passes through majority of the data points. The ten years forecast for Apple production along with their lower and upper limits with effect from 2014-15 to 2023-24 are recorded in Table-1.2.

Table 1.2: - Ten Years Forecasts for Apple Production

Period	Forecast	LCL	UCL
2014-15	117317.3	86822.95	158521.9
2015-16	118211.3	87457.18	159780
2016-17	119087.3	88077.72	161014.6

2017-18	119946.3	88685.24	162226.6
2018-19	120788.8	89280.32	163417.2
2019-20	121615.8	89863.54	164587.3
2020-21	122427.7	90435.42	165737.6
2021-22	123225.4	90996.44	166869.1
2022-23	124009.2	91547.05	167982.4
2023-24	124779.9	92087.69	169078.2

From Table 1.2, it is depicted that the forecast of production with effect from the period 2014-15 to 2023-24 shows an increasing trend which indicates that production will increase with respect to time.

2.1: -Trend Analysis for Citrus Production: The trend analysis for Citrus fruit production is performed to check the best-fitted trend models among the described above models and it has been found that the cubic trend model is the best-fitted model based on Accuracy measures. The trend curve and its corresponding parameter estimates are given in Table 2.1 and Figure 2.1.

Table 2.1:- Results of Trend Model for Citrus Production

Equation	Accuracy Measures				Parameter Estimates			
	R^2	MAE	MSE	MAPE	Constant	b1	b2	b3
Linear	0.383	2644	9547445	8	29147.727	248.195		
Logarithmic	0.566	2234	7255320	6	24399.316	3489.72		
Inverse	0.388	2835	8877554	18	35129.197	-13523.764		
Quadratic	0.853	1273	2280206	4	22563.224	1345.613	-31.355	
Cubic	0.909	785	1777075	2	25514.343	401.533	35.112	-1.266
Compound	0.414	2579	10167966	12		1.008		
Power	0.612	1873	7892344	23	24951.565	0.11		
S	0.43	2358	9863956	25	10.464	-0.432		
Growth	0.414	2579	10362967	12	10.275	0.008		
Exponential	0.414	2589	10366986	12	28992.764	0.008		

Logistic	0.414	2579	10067916	13	0.0000345	0.992		

The parameter estimates of all the selected models presented in Table-2.1 are found to be significant at 5% level of significance. Also, the cubic trend model is found to be best suitable model among the studied trend models, on the basis of forecast evaluation criteria.

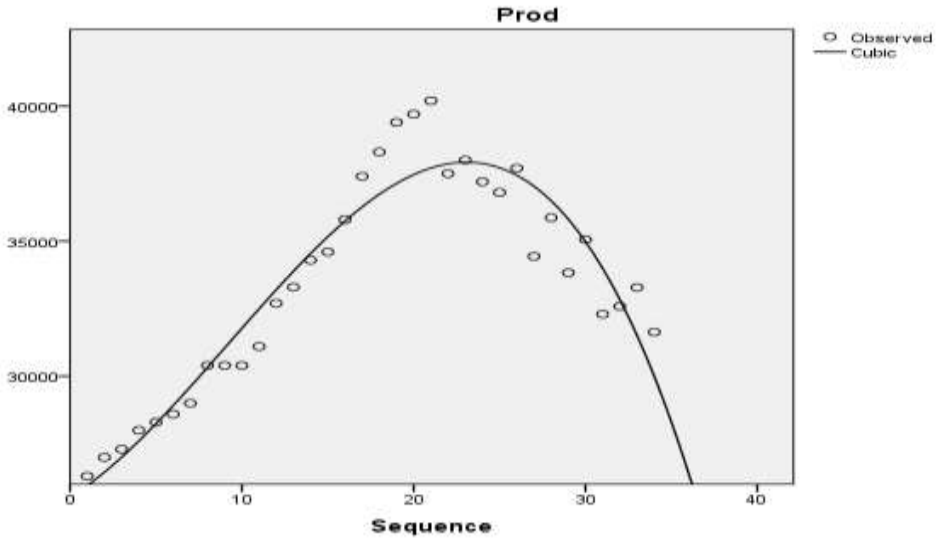

Figure:2.1:- Cubic Curve Plot for Citrus fruit Production

From Figure-2.1, it is depicted that the fitted line provides a good fit as it passes through majority of the data points.

Ten years forecast along with their lower and upper confidence limits for Citrus fruit production with effect from 2014-15 to 2023-24 and lower and upper confidence limits are found and presented in Table-2.2.

Table-2.2:- Ten Years Forecast for Citrus Production

Period	Forecast	LCL	UCL
2014-15	28298.94	25045.83	31552.06
2015-16	26406.55	22849.01	29964.1
2016-17	24310.93	20360.26	28261.59
2017-18	22004.46	17567.23	26441.7
2018-19	19479.57	14459.79	24499.35
2019-20	16728.64	11029.06	22428.23
2020-21	13744.1	7266.605	20221.59
2021-22	10518.33	3163.966	17872.7
2022-23	7043.749	-1287.6	15375.09
2023-24	3312.754	-6097.17	12722.68

From Table 2.2, ten ten-year forecasts for Citrus production with effect from 2014-15 to 2023-2024, represents a decreasing trend.

3.1-Trend Analysis for Peach Production: The trend analysis of Plum fruit production is performed to check the best-fitted trend models among the described above models in which it has been found that the exponential trend model is the best-fitted model based on Accuracy measures. The trend curve and its parameter estimates are presented in Table 3.1 and Figure-3.1

Table-3.1:- Results of Trend Model for Peach Production

Equation	Accuracy Measures				Parameter Estimates			
	R^2	MAE	MSE	MAPE	Constant	b1	b2	b3
Linear	0.674	9520	132491592	81	-8040.626	1687.537		
Logarithmic	0.496	7215	134456795	56	-22148.221	16750.154		
Inverse	0.181	11513	164476645	28	27217.781	-47278.203		
Quadratic	0.675	9302	131996808	72	-6322.534	1401.188	8.181	
Cubic	0.781	8757	91982345	53	14418.364	-5233.942	475.319	-8.898
Compound	0.889	3346	247477360	23	1637.125	1.12		
Power	0.795	3646	69070428	30	468.996	1.244		
S	0.366	8129	164386655	28	9.87	-3.95		
Growth	0.889	3345	248437260	23	7.401	0.114		
Exponential	0.889	3341	238437250	23	1637.125	0.114		
Logistic	0.889	9545	248477260	31	0.001	0.892		

From Table-3.1, it is showed that parameter estimates of all the selected models are found to be significant at 5% level of significance. Also, the exponential trend model is calculated to be best suitable model among the studied trend models, based on forecast evaluation criteria.

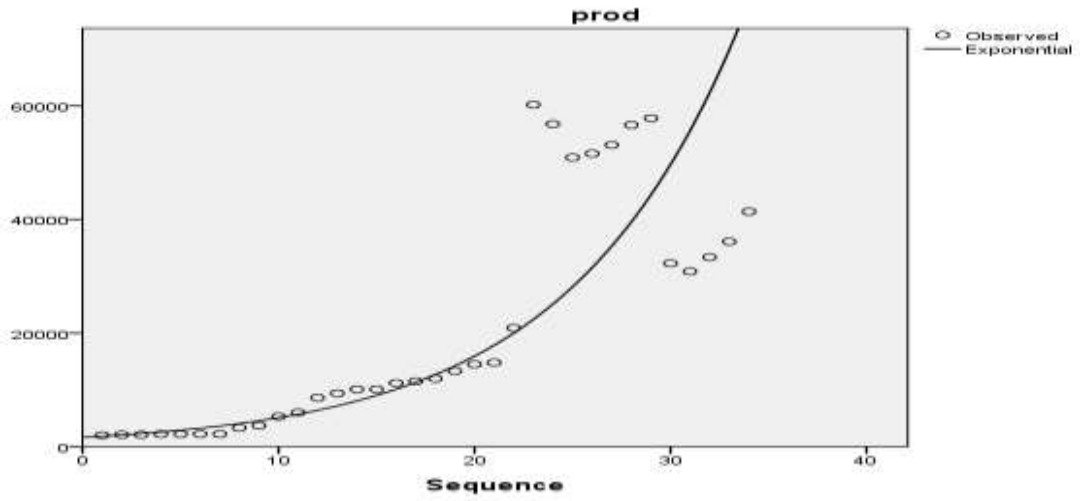

Figure-3:- Exponential Curve Plot for Peach Production

Figure 3.1 shows that the fitted trend line provides a good fit as compared to other selected models and it passes through majority of the data points.
Ten-year forecasts with their respective lower and upper confidence limits for Peach fruit production with effect from 2014-15 to 2023-24 are recorded in Table 3.2.

Table 3.2:- Ten Years Forecasts for Peach Production

Period	Forecast	LCL	UCL
2014-15	87744.5	36542.35	210689.7
2015-16	98315.92	40770.09	237086.1
2016-17	110161	45477.16	266847
2017-18	123433.1	50716.93	300407.3
2018-19	138304.3	56548.6	338259.1
2019-20	154967.1	63037.89	380958.4
2020-21	173637.5	70257.68	429134.4
2021-22	194557.3	78288.85	483498.5
2022-23	217997.5	87221.07	544855.7
2023-24	244261.7	97153.84	614116.7

From Table 3.2, the ten-year forecast for peach production is found to be increasing with effect from 2014-15 to 2023-24 i.e. represents an increasing trend.

4.1 Trend Analysis for Pear Production: The trend analysis of Pear fruit production is performed to check the best-fitted trend models among the studied models and it has been found that the cubic trend model is the best-fitted model based on Accuracy measures. The trend curve and its parameter estimates are given in Table 4.1 and Figure 4.1.

Table:4.1:-Results of Trend Model for Pear Production

Equation	Accuracy Measures				Parameter Estimates			
	R^2	MAE	MSE	MAPE	Constant	b1	b2	b3

Linear	0.407	3077	13554894	12	33836.043	-310.727		
Logarithmic	0.156	5057	21334412	21	34203.162	-2228.073		
Inverse	0.02	8527	35432136	38	27943.795	3752.591		
Quadratic	0.844	1423	3573469	5	26119.29	975.399	-36.746	
Cubic	0.881	1278	2279470	4	29057.359	35.494	29.426	-1.26
Compound	0.436	3313	15109276	13	34947.816	0.987		
Power	0.177	5123	23143124	18	35712.781	-0.094		
S	0.027	5312	28442312	32	10.217	0.173		
Growth	0.436	3306	15119976	11	10.462	-0.013		
Exponential	0.436	3306	15119976	12	34947.816	-0.013		
Logistic	0.436	3121	15119976	13	0.0000286	1.013		

From Table-4.1, the parameter estimates of all selected model is found to be significant except Inverse trend model and S-curve trend model at 5% level of significance. Also, cubic trend model is found to be best suitable model among the studied trend models, based on forecast evaluation criteria.

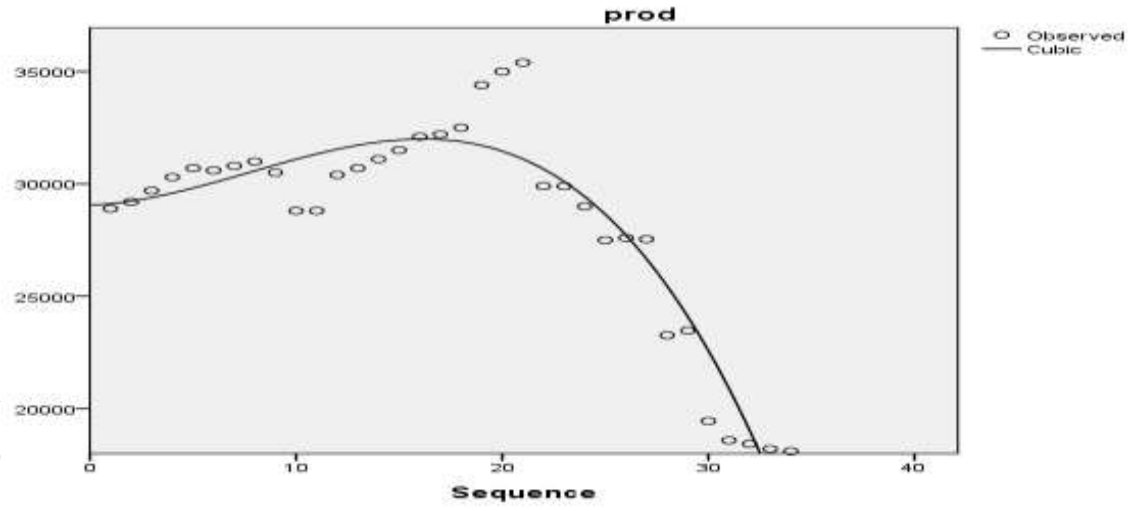

Table-4.2:-Ten Years Forecast for Pear Production

Period	Forecast	LCL	UCL
2014-15	12305.78	7792.359	16819.21
2015-16	9664.845	4729.053	14600.64
2016-17	6810.508	1329.29	12291.73
2017-18	3735.206	-2421.09	9891.5
2018-19	431.3788	-6533.15	7395.904
2019-20	-3108.54	-11016.2	4799.163
2020-21	-6892.1	-15879.1	2094.875
2021-22	-10926.9	-21130.5	-723.319
2022-23	-15220.4	-26779.5	-3661.4
2023-24	-19780.3	-32835.8	-6724.86

The forecast for pear production presented in Table 4.2 shows decreasing trend with effect from 2014-15 to 2023-24.

5.1-Trend Analysis for Plum Production: The trend analysis of Plum fruit production is performed to check the best-fitted trend models among the different trend models by which it has been found that the cubic trend model is the best-fitted model based on Accuracy measures. Trend curves and their parameter estimates are given below in Table 5.1 and Figure 5.1.

Table-5.1:-Results of Trend Model for Plum Production

Equation	Accuracy Measures				Parameter Estimates			
	R^2	MAE	MSE	MAPE	Constant	b1	b2	b3
Linear	0.014	3381	15261275	11	31794.877	47.505		
Logarithmic	0.13	3032	13241432	12	28266.351	1673.444		
Inverse	0.168	2865	12756423	18	33703.486	-8894.04		
Quadratic	0.802	1405	3060837	4	23263.365	1469.423	-40.626	
Cubic	0.871	1373	2519574	4	26517.75	428.327	32.671	-1.396
Compound	0.011	3410	15336119	11	31672.033	1.001		
Power	0.126	3321	13217234	9	28372.56	0.051		
S	0.174	3125	13123452	10	10.419	-0.279		
Growth	0.011	3411	15336119	11	10.363	0.001		
Exponential	0.011	3410	15336119	11	31672.033	0.001		
Logistic	0.011	3399	15437212	13	0.0000316	0.999		

The parameter estimates of the selected models are significant except linear trend model, compound trend model, growth trend model, exponential trend model and logistic trend model. Also, the cubic trend model is calculated to be best suitable model on the basis of forecast evaluation criteria among the studied trend models.

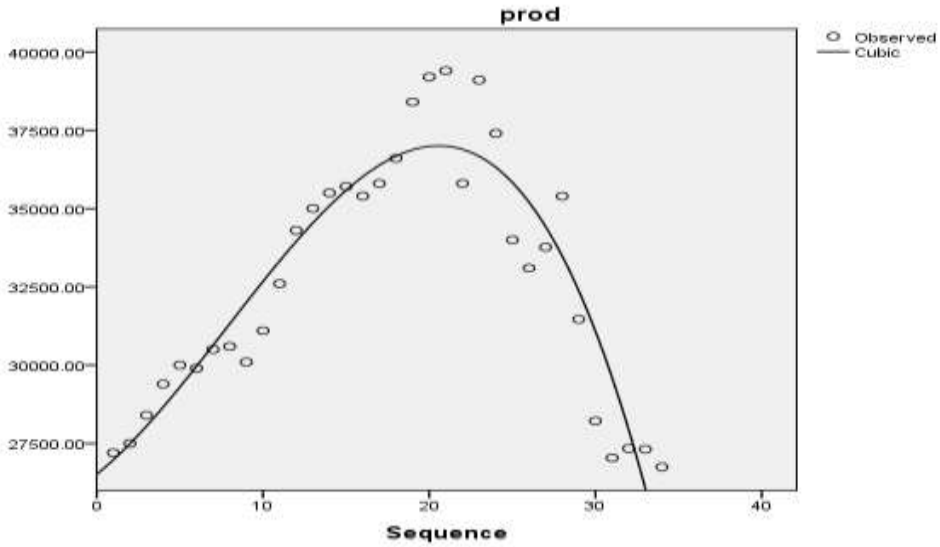

Figure: 5.1:- Cubic Curve for Plum Fruit Production

Figure 5.1 shows that the fitted line provides the good fit as it passes through the majority of the data points as compared to others among the studied trend curves.

Ten years forecast for Plum fruit production with effect from 2014-15 to 2023-24 and the upper and lower confidence limits are presented in Table-5.2.

Table 5.2:- Ten Years Forecasts for Plum Production

Period	Forecast	LCL	UCL
2014-15	21671.64	17794.05	25549.23
2015-16	19140.81	14900.35	23381.27
2016-17	16373.75	11664.71	21082.8
2017-18	13362.1	8073.081	18651.12
2018-19	10097.47	4114.08	16080.86
2019-20	6571.489	-222.208	13365.19
2020-21	2775.775	-4945.16	10496.71
2021-22	-1298.05	-10064.2	7468.086
2022-23	-5658.35	-15589	4272.303
2023-24	-10313.5	-21529.8	902.7602

From the forecast for plum production presented in Table-5.2 shows that production is on decreasing with effect from 2014-15 to 2023-24.

6.1:-Variability Analysis of Major Fruits Production in Khyber Pakhtunkhwa

The variability of major fruit production has a pivotal role in sustainable production as well as for the economy of the country. Therefore, an effort has been made to estimate the relative variability in major fruit production presented in Table 6.1.

Table-6.1:- Variability Index of Major Fruits of Khyber Pakhtunkhwa

Fruit Crop	CV (%)	AdR^2	Variability Index (I) $= CV * \sqrt{1 - AdR^2}$
Apple	24.217	0.989659	2.462644
Citrus	11.798	0.999464	0.273143
Peach	95.236	0.936107	24.07287
Pear	17.085	0.983365	2.203568
Plum	12.24	0.995346	0.835016

]The variability in production of major fruits of Khyber Pakhtunkhwa is estimated for period 1980-81 to 2013-14. It is observed that among all five major fruits i.e. apple, citrus, peach, pear, plum, the production of peach possesses highest variability (24.07%) whereas; the citrus production has the least variability (0.27%).

Conclusions and Recommendations:

The instant results suggest that trend analysis for each major fruit production provides a clear picture of the trend. The cubic trend model was found suitable for forecasting major fruits i.e. citrus, pear, and plum except for apple and peach fruit in which the Power trend model and Exponential trend model were found suitable. Moreover, variability analysis of peach fruit production was recorded to be highest i.e. 24.07%, as compared to other fruit crops under study and citrus possess the least variability i.e. 0.27% due to fluctuating results of crop acreage, area and productivity. Also, variability analysis of apple, pear, and plum was calculated to be 2.46%, 2.20%, and 0.84% respectively. Therefore, it can be suggested that these selected models could be used by researchers, businessmen, policymakers, and fruit producers for information, planning their resources as well as decision making regarding fruit production in Khyber Pakhtunkhwa.

References

- Box, G.E.P. and G.M. Jenkins, eds. Time Series Analysis: Forecasting and Control. 1976, Holden-Day San Francisco.
- Cuddy. J.D.A. and Della. V.P.A. Measuring of Instability of Time Series Data. Oxford Bulletin of Economics and Statistics. **1978** 40(1): 79-85.
- Food and Agricultural Organization STAT: FAO [online] **2011,** Food and Agriculture Organization of the United Nations, Retrieved from www.fao.org.com:http://faostat.fao.org/site/570.(accessed 13/12/15).
- Finger R. Evidence of Slowing Yield Growth- The example of Swiss Cereal Yield. Agri food and Agri-environmental Economics Group, ETH Zürich, Switzerland. **2007.**
- Food and Agriculture Organization of the United Nations (FAO). Current Situation and Medium-Term Outlook for Tropical Fruits. Sugar and Beverages Group Raw Materials, Tropical and

Horticultural Products Service Commodities and Trade Division. Food and Agriculture Organization of the United Nations. **2005**.

- Government of Khyber Pakhtunkhwa. Crops Statistics of Khyber Pakhtunkhwa, Crops Reporting Services, Agriculture, Livestock Cooperative Department, Peshawar (Various issues) 2013.
- Govt. of Pakistan, "Agricultural Statistics of Pakistan," Ministry of Food, Agriculture and Livestock, Islamabad, Pakistan. **2005-06**.
- Gujarati D N. 2003. Basic Econometrics, 4th edn. pp 465-7. McGraw-Hill Companies Inc., New York.
- Hazell. P.B.R. Instability in Indian Food grain Production. International Food Policy Research Institute. Washington, USA. **1982**. Research Report. 30.
- Pakistan Horticultural Development & Export Board [online] **2011**, http://www.nation.com.pk/business/15-Nov-2011/Fruit-vegetable-sectors-can-fetch-500-billion-by-exports.(accessed 12/11/15)
- Pakistan Economic Survey [online] **2014-15.** http://www.finance.gov.pk/survey_1314.html.(accessed 13/2/16).
- Pere, A. Comparison of two methods of transforming height and weight to Normality. The Annals of Human Biology, **2000**, 27, 35-45.
- Rao. C.H. Technical Change and Distribution of Gains in Indian Agriculture. Institute of Economic Growth. The MacMillan Co. Delhi, India. **1975**.
- Rao, V. M., Nadkarni, M. V. & Deshpande, R. S. Measurement of growth and fluctuations in crop output – An approach based on the concept of non-systematic component. Indian Journal of Agricultural Economics **1980**. 35(2), 21-30.
- Raw Materials Research and Development council [online] **2005**: Tropical Fruits and Vegetables http://www. rmrdc.org /Agro raw materials/ Tropical fruits & vegetables.htm(accessed 23/11/15)
- Rimi, R. H., S.H. Rahman, S. Karmakar, and G. Hussain. Trend analysis of climate change and investigation on its probable impacts on rice production at Satkhira, Bangladesh. Pakistan J. Meteorol. **2011**, 6 (11): 37-50.
- Sagar, V. Decomposition of Growth Trends and Certain Related Issues. Indian Journal of Agricultural Economics, **1980**.35(2), 42-59.
- Sen. S.R. Growth and Instability in Indian Agriculture. Address to the 20th Annual Conference of the Indian Society of Agricultural Statistics. January. **1967**, pp. 1-31.
- Sorva, R., Lankinen, S., Tolppaen, E.-M. and Perheentupa, J. Variation of growth in height and weight of children. II. after Infancy. Acta Paediatrica Scandinavica, **1990**, 79, 498–506.
- United Nation Commission for Trade and Development [Online] 2005: Info Comm Market information in the commodity area. http//:www.google.com /Report / 310 (accessed 15/4/2016).
- Wiktor L. A. & Travis. W. Manning. The measurement of growth rates from time series. Canadian J. of Agricultural Economics 1985. 38(2), 231-242.