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Growth and Instability in Area, Production and Productivity of Grape Crop in Afghanistan

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ABSTRACT

Grapes constitute a widely grown fruit in Afghanistan. Grapes can be grown just in anywhere but mostly in Kabul, Parwan, Kandahar, Zabul and Ghazni provinces. In Afghanistan there are three local varieties that offer the best commercial return for export: Shindokhani, Kishmishi and Taifi. New commercial varieties are also being introduced, such as Thompson Seedless and Red Globe, and are beginning to make inroads into foreign markets. The present study estimates the growth rate and instability of area, production, productivity of grape in top five provinces and Afghanistan as a whole during years 2011-12 to 2019-20. To analyse the growth rate and instability of area, production and productivity of grape, the statistical tools like Compound growth rate (CGR) and Coefficient of Variation (CV) were used. The result of the study showed that, the CGR for production in the Kandahar and Ghazni provinces were found positive and significant. While negative growth rate were found in Kabul, Parwan and Zabul provinces. The instability of production and area were very high in Kandahar province compare to the other selected provinces.

Keywords- Area, Compound growth rate, Instability, Production, Productivity.

I. INTRODUCTION

Grapes commonly known as grapevine (Vitis vinifera L.) is one of the old fruit crops belongs to the family of Vitaceae is a liana with flaky bark. (Zannat Urbi et al. 2014) It is believed to have originated in Armenia near the Black and Caspian Sea in Russia. An independent and recent origin of grapes is also traced to North America. From America grapes spread westwards to Europe and Eastwards to Iran and Afghanistan.

Grapes used as its raw form or used by making juice, jam, jelly, vinegar, grape seed oil, raisins and grape syrup. (Bakhshipour et al. 2012) Grapes contain different compounds having medicinal and health promoting affects. Grapes have antioxidant activity due to their phenolic contents; they have shown good source of phenolic antioxidants (115 and 361 mg/kg of total phenolics). (Parker, et al. 2007)

The total area under grape cultivation in the world is 6.9 million hectares with the production of 76 million tonnes resulting in a yield of 11 (tonnes/ha). The largest producer of grapes in the world is China 13.08 million tonnes that make a share of 16.8 percent of total production of grapes in the world. After China, Italy 7.17 million, USA 6.68 million, France 5.91 million, Spain 5.39 million, and Turkey 4.55 million are major grape producing countries.

Afghanistan with production of 9.55 thousand stand in 19th position among largest producing countries. (National Research Centre for grape, ICAR, India 2017) Grapes in Afghanistan are consumed fresh, dried and in the form of grape juice. Grapes are grown in

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nearly every part of the country, with commercial production in the provinces of Kabul, Parwan, Kapisa, Kandahar, Zabul, Jawzjan, Herat and Ghazni. In Afghanistan there are three local varieties that offer the best commercial return for export: Shindokhani, Kishmishi and Taifi. New commercial varieties are also being introduced, such as Thompson Seedless and Red Globe, and are beginning to make inroads into foreign markets. The study was carried out to analyse the growth of area, production and productivity of grape in Afghanistan, and to study the instability of area, production and productivity of grape in Afghanistan. (CHAMP 2016, Best Practices for Grape Production and Marketing in Afghanistan)

II. MATERIALS AND METHODS

The secondary data in respect of area, production and productivity of Grape in Kabul, Parwan, Ghazni, Kandahar, Zabul provinces and Afghanistan for the last 9 years (2011-12 to 2019-20) were collected from the Ministry of Agriculture, Irrigation and Livestock.

1. Growth Rates

Compound growth rate CGR is a key indicator to measure agricultural growth and can be used for forecasting area/production/productivity, etc. of various commodities. This plays a vital role in agricultural policy making. Therefore, predicted value of growth rate needs to be very precise so that suitable policies can be adopted accordingly. Accuracy of predicted value depends largely on proper statistical procedures followed to estimate it. The compound growth rates of area, production and productivity of grape were worked out using exponential function.

2. Instability

The magnitude of instability in area, production and productivity of Grape in Kabul, Parwan, Ghazni, Kandahar, Zabul provinces as well as Afghanistan as whole country measured by working out the coefficient of variation (CV) based on time series data. Area and yield of each province and Afghanistan were detrended by using following linear equation.

$$\mathbf{Z_t = a + bt + u_t}$$

Where:
Zt = Dependent variable (Area, Production and Yield)
a = Intercept
b = Parameters to be estimated
t = Time variable (years), and
u_t = Error term with usual assumptions

After detrending, the residuals (u) were centred t on the mean area and mean yield (Z) for each district. The detrended time series data (Z) for area and yield were calculated as:

$$\mathbf{Z = u + Zt}$$

The time series data of detrended production were calculated as the production of detrended area and yield. Finally, the coefficient of variation (CV) of mango production was estimated from the detrended series for the study period.

III. RESULTS AND DISCUSSION

This section in the link with the objective's layout in the study in respect of grape are presented and discussed under the following major heads area, production and productivity of grape in Kabul, Parwan, Ghazni, Kandahar, Zabul provinces and Afghanistan.

Growth in Area of Grape

The data relating to area and compound annual growth rate (CAGR) of grape in Kabul, Parwan, Ghazni, Kandahar, Zabul provinces and Afghanistan are stated in Table 1. The result revealed from the table that, the area were in Kabul (13.361 thousand ha), Parwan (9.500 thousand ha) and Zabul (10.700 thousand ha) in the year 2011-12 which were decreased to 11.545, 7.463 and 5.623 thousand ha respectively in the year 2019-20. It showed negative growth of area at rates of 1.25, 2.04 and 4.20 percent respectively. The main reasons for decreasing of area under grape cultivation are drought, insecurity, financial constraint and etc. (Mr. Samey general director of Agricultural Services in Parwan DAIL).

Whereas in Kandahar province recorded significantly positive and in Zabul province non significantly positive growth rate in area of grape. The whole Afghanistan recorded significant positive growth in area (2.51 % percent). The result is in line with results obtained from Zainullah Zahid et al. (2016) studied on production and export of raisins from Afghanistan during years 2000-2015.

Growth in production of Grape

From Table 2 it could be observed that, the highest production of grape was found in Kandahar 234.377 thousand MT followed by Ghazni (146.894 thousand MT), Kabul (115.450 thousand MT), Parwan (74.630 thousand MT) and Zabul (61.853 thousand MT) in the year 2019-20. Also, the table showed that, the production of grape was steadily increased from 2011-12 to 2018-19 it only decreased by ten percent in 2019-20 in Afghanistan as a whole. The positive growth rate in production were found in Kandahar (21.82 percent), Ghazni (5.26 percent) and as well as Afghanistan (4.31 percent). While, negative growth rate was found in Kabul, Parwan and Zabul with the value of 0.32, 1.93 and 3.05 percent respectively. The decreasing of grape production was largely due to decrease in the area under grape in these provinces.

Growth in productivity of Grape

The Table 3 depicted that, the productivity of grape in Afghanistan as a whole increased from 8.00 MT/ha in the year 2011-12 to 12.71 MT/ha in the year 2018-19 steadily, it only decreased by 15.55 percent in

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2019-20. The highest productivity of grape for Ghazni province was found to 22.00 MT/ha followed by Kandahar (13.00 MT/ha) in the year 2018-19. Whereas, the lowest productivity of grape were found in Parwan, Ghazni and Kandahar with the same value of 8.00 MT/ha in the year 2011-12. But the lowest productivity of grape for Kabul (7.01 MT/ha) and Zabul (6.50 MT/ha) were found in year 2014-15.

It is also inferred from the table that, the positive and significant growth rate of productivity of grape was found in Ghazni (2.89 percent) followed by Kandahar (1.67 percent) and in Afghanistan (1.78 percent) While, in Parwan, Kabul and Zabul provinces were nan-significant growth rate were found. The results obtained are in conformity with the results of Zainullah Zahid et al. (2016) studied on production and export of raisins from Afghanistan during years 2000-2015.

Instability in Area, Production and Productivity of Grape

The coefficient of variation of area, production and productivity of grape crop was estimated from detrended time series data for the last 9 years (2011-12 to 2019-20) for the Kabul, Parwan, Ghanzni, Kandahar and Zabul as well as Afghanistan. The perusal of Table 4 revealed that, the highest CV percentage for area under grape crop was found in Kandahar to 136.11 percent whereas, the lowest was found in Kabul 22. 72 percent. The table also showed that, the CV in production of grape markedly high for Kandahar 141.55 percent. While, the lowest CV was found in Kabul 32.74 percent. Thereby, the fluctuation in production was more in the Kandahar compared to other selected provinces.

The result from the table also showed that, the highest CV for grape productivity was found in Ghazni 66.89 percent while in Parwan it was lowest (17.04 percent). It can be clearly concluded the magnitude of instability for grape production was high in the country as a whole as well as in the selected provinces. The destabilizing effect on production was more compared to area and productivity. The results obtained were in conformity with the results of Bhosale et al. (2016) studied on trend in area, production and productivity of grape in Maharashtra India during years 2003-2013.

IV. CONCLUSION

The present study estimated the growth rate and instability of area, production, productivity of grape in top five provinces and Afghanistan as a whole during years 2011-12 to 2019-20. The result was observed that, the growth rate in the production of grape in Kandahar and Ghazni provinces have been increased due to the increase in the area under grape cultivation in Kandahar province but in case of Ghazni province it was because of yield. While, the growth rate in the production of grape has decreased in Kabul, Parwan and Zabul provinces due to declining area under grape cultivation and it is because of drought, low farmers' economy, insecurity and the conversion of the area under grapes cultivation to other crops. In this regard, the results show that the production instability have been very high in these provinces. In general, the productivity of grape in Afghanistan is very low compare to other countries. Therefore, varieties, production system, cultural practices, diseases-pest control, packaging and processing practices must to be improved.

AUTHOR CONTRIBUTIONS

Hamidullah Younisi designed the study and analysed the data. Zabihullah Farid provided critical feedback and Khalid Joya provided technical support. We all authors contributed to the interpretation of the results and approved the final version of the manuscript.

CONFLICT OF INTEREST

No potential conflict of interest was reported by the authors.

Table 1: CGR in area of grape in top five provinces and Afghanistan during 2011-12 to 2019-20 (ha)

Sr. No.	Year	Kabul		Parwan		Ghazni		Kandahar		Zabul		Afghanistan	
		Area	Percent change over previous year	Area	Percent change over previous year	Area	Percent change over previous year	Area	Percent change over previous year	Area	Percent change over previous year	Area	Percent change over previous year
1	2011-12	13361		9500		8120		1190		10700		61558	
2	2012-13	13390	0.22	9522	0.23	8120	0.00	1190	0.00	10700	0.00	61690	0.21
3	2013-14	13390	0.00	9522	0.00	8120	0.00	1590	33.61	10700	0.00	62118	0.69
4	2014-15	10690	-20.16	7281	-23.53	9904	21.97	20962	1218.36	5910	-44.77	78405	26.22

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5	2015-16	10690	0.00	7281	0.00	9904	0.00	20962	0.00	5910	0.00	78681	0.35
6	2016-17	10600	-0.84	6373	-12.47	10173	2.72	19840	-5.35	5529.1	-6.45	82450	4.79
7	2017-18	10622	0.21	6698	5.10	10173	0.00	19865	0.13	5534	0.09	87517	6.15
8	2018-19	10646	0.23	6712	0.21	10173	0.00	19878	0.07	5546	0.22	87593	0.09
9	2019-20	11545	8.44	7463	11.19	13353	31.26	21307	7.19	5623	1.39	92584	5.70
Total		**104934.00**	**-11.91**	**70352.00**	**-19.28**	**88040.00**	**55.95**	**126784.00**	**1254.01**	**66152.10**	**-49.52**	**692596.00**	**44.20**
Mean		**11659.33**	**-1.32**	**7816.89**	**-2.14**	**9782.22**	**6.22**	**14087.11**	**139.33**	**7350.23**	**-5.50**	**76955.11**	**4.91**
CAGR		**-1.25^{NS}**		**-2.04****		**2.30****		**19.82*****		**-4.20*****		**2.51****	

Source: (Ministry of Agriculture, Irrigation and Livestock, 2020)
**** and ** significant at 1 and 5 percent level.*
NS: Non-Significant

Table 2: CGR in production of grape in top five provinces and Afghanistan during 2011-12 to 2019-20 (Mt)

Sr. No	Year	Kabul		Parwan		Ghazni		Kandahar		Zabul		Afghanistan	
		Production	Percent change over previous year	Production	Percent change over previous year	Production	Percent change over previous year	Production	Percent change over previous year	Production	Percent change over previous year	Production	Percent change over previous year
1	2011-12	106888		76000		64960		9520		85600		492464	
2	2012-13	128075	19.82	91078	19.84	77668	19.56	11382	19.56	102346	19.56	590065	19.82
3	2013-14	132561	3.50	94268	3.50	80388	3.50	15741	38.30	105930	3.50	610570	3.48
4	2014-15	74973	-43.44	65529	-30.49	128752	60.16	188658	1098.51	38415	-63.74	744847	21.99
5	2015-16	96078	28.15	72810	11.11	130500	1.36	209620	11.11	38415	0.00	805072	8.09
6	2016-17	95391	-0.72	57348	-21.24	152580	16.92	238000	13.54	55290	43.93	874541	8.63
7	2017-18	106222	11.35	60282	5.12	101725	-33.33	178784	-24.88	49807	-9.92	984081	12.53
8	2018-19	106464	0.23	53694	-10.93	223780	119.99	258418	44.54	55458	11.35	1112927	13.09
9	2019-20	115450	8.44	74630	38.99	146894	-34.36	234377	-9.30	61853	11.53	993382	-10.74
Total		**962102.00**	**27.34**	**645639.00**	**15.91**	**1107247.00**	**153.80**	**1344500.00**	**1191.38**	**593114.00**	**16.22**	**7207949.00**	**76.88**
Mean		**106900.22**	**3.04**	**71737.67**	**1.77**	**123027.44**	**17.09**	**149388.89**	**132.38**	**65901.56**	**1.80**	**800883.22**	**8.54**
CAGR		**-0.32^{NS}**		**-1.93****		**5.26*****		**21.82*****		**-3.05*****		**4.31*****	

Source: (Ministry of Agriculture, Irrigation and Livestock, 2020)
**** and ** significant at 1 and 5 percent level.*
NS: Non-Significant

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Table 3: CGR in productivity of grape in top five provinces and Afghanistan during 2011-12 to 2019-20 (Mt/ha)

Sr. No	Year	Kabul		Parwan		Ghazni		Kandahar		Zabul		Afghanistan	
		Productivity	Percent change over previous year	Productivity	Percent change over previous year	Productivity	Percent change over previous year	Productivity	Percent change over previous year	Productivity	Percent change over previous year	Productivity	Percent change over previous year
1	2011-12	8.00		8.00		8.00		8.00		8.00		8.00	
2	2012-13	9.56	19.56	9.57	19.56	9.57	19.56	9.56	19.56	9.57	19.56	9.57	19.56
3	2013-14	9.90	3.50	9.90	3.50	9.90	3.50	9.90	3.51	9.90	3.50	9.83	2.76
4	2014-15	7.01	-29.16	9.00	-9.09	13.00	31.31	9.00	-9.09	6.50	-34.34	9.50	-3.35
5	2015-16	8.99	28.15	10.00	11.11	13.18	1.36	10.00	11.11	6.50	0.00	10.23	7.71
6	2016-17	9.00	0.13	9.00	-10.01	15.00	13.83	12.00	19.96	10.00	53.84	10.61	3.66
7	2017-18	10.00	11.12	9.00	0.02	10.00	-33.33	9.00	-24.98	9.00	-10.00	11.24	6.01
8	2018-19	10.00	0.00	8.00	-11.11	22.00	119.99	13.00	44.45	10.00	11.10	12.71	12.99
9	2019-20	10.00	0.00	10.00	25.00	11.00	-49.99	11.00	-15.39	11.00	10.00	10.73	-15.55
Total		**82.47**	**33.31**	**82.46**	**28.98**	**111.64**	**106.22**	**91.46**	**49.13**	**80.46**	**53.68**	**92.41**	**33.80**
Mean		**9.16**	**3.70**	**9.16**	**3.22**	**12.40**	**11.80**	**10.16**	**5.46**	**8.94**	**5.96**	**10.27**	**3.76**
CAGR		**0.94**^{NS}		**0.12** ^{NS}		**2.89****		**1.67****		**1.20** ^{NS}		**1.76****	

Source: (Ministry of Agriculture, Irrigation and Livestock, 2020)
*** significant at 5 percent level.*
NS: Non-Significant

Table 4: Coefficient of variation of area, production and productivity for grape crop in selected provinces and Afghanistan during 2011-12 to 2019-20 (Percent)

Particulars	Coefficient of variation		
	Area	Production	Productivity
Kabul	22.72	32.74	21.85
Parwan	33.76	39.60	17.04
Ghazni	33.40	79.93	66.89
Kandahar	136.11	141.55	29.65
Zabul	68.51	78.34	34.81
Afghanistan	31.74	52.39	23.87

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