

Growth and Variability of Major Horticultural Crops of Jammu and Kashmir

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ABSTRACT

The paper presents comprehensive trend analysis in terms of production, area and productivity of major horticultural crops of Jammu and Kashmir, India. Secondary data was collected from Ministry of Agriculture and Farmers' Welfare, Department of Horticulture and Planning, Jammu and Kashmir and Jammu and Kashmir, Statistical Office. Using Compound Annual Growth Rate and Cuddy-Della-Valle index, the sustainability of the major horticultural crops was analysed. It was found that apple is the most stable crop in terms of both growth as well as variability. Almond suffers with highest instability in all the three parameters. Cherry too faces low growth and high instability in the last thirty years as such it has lower acceptability with the farmers. Walnut on the other hand, suffers from high fluctuation in growth rate in all the three parameters and as such suffers moderate instability. Overall, the horticultural crops in Jammu and Kashmir are strongly established and provide significant amount to the Gross State Domestic Product. And among these crops, apple and walnut contribute 80 percent to the horticultural output value in the erstwhile state. The government, therefore needs to provide better incentives to the farmers for these crops and alongwith it, address the challenges that the farmers face with respect to other crops.

Keywords: Trend-Analysis, Instability, apple, Kashmir, pear, development

In Jammu and Kashmir, 68 percent of the population is dependent on agriculture with involvement of nearly 16-18 lakh families, thus clearly demonstrating its dominance in the economic sector of the Union Territory (Shaheen *et al.* 2019). Allaying with the national statistics, agriculture contributes 17.2 percent to the total Gross State Domestic Product (GSDP) (Government of Jammu and Kashmir, 2019a). Even more striking is the extremely high growth rate in agriculture which was nearly 25 percent in 2015-16 and 9 percent since then, contrary to the national growth rate of 2.9 percent during the same time period (Government of Jammu and Kashmir, 2019b).

With respect to the agri-climate and historical factors, horticulture is the dominant most sector in agriculture, contributing nearly 8 percent to the total GSDP of the Union Territory (Horticulture at a Glance, 2018). In terms of employment, nearly 33-34 lakh people are involved directly or indirectly with the sector (Jha *et al.* 2019). Among the horticultural crops, apple, pear, walnut, almonds, cherry, apricot and peach are famous. While among the cash

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crops, the Union Territory is known for its high-quality saffron.

Apple contributes 60 percent of the total horticultural output in Jammu and Kashmir, while nearly 48 percent of the total area currently is under apple cultivation. In terms of economy, the sector is ever-increasing with an annual export of more than 70 billion from the fruits alone (Naqash *et al.* 2019). Horticulture has tremendously grown in Jammu and Kashmir from the last five decades. The area and production of the horticultural crop have consistently increased by three-fold (300%) and tenfold (985%) respectively (Horticulture at a Glance, 2018). In the meantime, the productivity has witnessed a four-fold jump which is higher than the two-fold national average. While the acreage under Apple has witnessed a fall from 55-56% to 48%, however, the production has increased by manifolds (Hanan, 2015).

Walnut in India is one of the most important horticultural crops being exported to nearly 70 countries generating nearly 10 million USD (778 million INR) annually. Across the globe, India is ranked sixth in terms of acreage under walnut and eight in terms of walnut production, thus being one of the major contributors in walnut cultivation. The production of walnut crops has increased from 185 thousand metric tonnes in 2000-01 to 299 thousand metric tonnes in 2017-18, while the area has increased from 75 thousand hectares to 108 thousand hectares during the same time (Horticulture at a Glance, 2018).

Table 1 clearly depicts that the productivity or the yield per hectare of Jammu and Kashmir has been higher than the national average. For instance, in Apple alone, the UT's average yield is 11.43 tonnes/hectare which is higher than the national average of 9.73 tonnes/hectare. Himachal Pradesh which contributes 21% to the total production, has an average yield of 6 tonnes/hectare which is two-time lower than yield per hectare of Jammu and Kashmir (Malik and Choure, 2014). In Walnut too, there is a large difference in productivity between Jammu and Kashmir and the second largest producing state-Uttarakhand (Taili, 2014). However, when

we compare this average yield of Jammu and Kashmir and India as a whole with that of the World Average, we see a considerable difference of around 40 tonnes/hectare. The productivity of developed countries in temperate zones for instance Italy, Netherlands, New Zealand near almost 70-75 tonnes/hectare (Robinson *et al.* 2004).

Table 1: Comparative Yields of Horticultural Crops in 2018-19. (tonnes/hectare)

Crop	J&K Average Yield	National Average	World Average
Apple	11.43	9.73	55-63
Pear	6.17	5.3	55-60
Peach	2.16	3.6	15-20
Cherry	4.35	3.03	9-11
Almond	1.85	0.7	3-5
Walnut	3.3	1.64	6-8
Others	1.06	1.63	5-7

MATERIALS AND METHODS

Secondary Data were collected from Directorate of Horticulture, Jammu & Kashmir, National Horticultural Board, Economic Survey, 2018-19 and Readers' Digest, Jammu & Kashmir. The secondary data was used to estimate the Compound Annual Growth Rate and Cuddy-Della-Valle-Variability Index. Data for four major horticultural crops was collected to prepare a detailed analysis of the growth pattern as well as the variability from 1990-2019. The crops were selected on the basis of their niche and high percentage of their output value in the agricultural market of Jammu and Kashmir.

Production variability may arise due to the variability in area, yield and/or interaction between area and yield. Variability in yield has been shown to be the main source of production instability and therefore Cuddy-Della-Valle index was used (Deb, Joshi and Bantilan, 1999). Cuddy-Della Valle index is a measure of regional variability in time-series data. It is an improvement over the simple coefficient of variations, as it corrects the coefficient of variation which is usually over-estimated in the simple coefficient of variation (Deb *et al.* 1999).

Growth and instability in production, area, and yield for major crops is examined at regional level. To examine the extent of variability in the production, area, and yield the Cuddy-Della Valle Index is used (Cuddy and Della Valle 1978). The simple coefficient of variation overestimates the level of instability in time-series data characterized by long term trends whereas the Cuddy-Della Valle index corrects the coefficient of variation. Ideal condition of a crop is high growth and low instability, which correlates to higher technological and market development in the region, smart applicability of scientific knowledge in farming and low fluctuations of production/productivity of the crop.

The Cuddy-Della-Valle-Index was estimated on the secondary data for time-trend of 2004-2017.

The formula for Cuddy-Della-Valle index is:

$$CV = CV * \sqrt{1 - R^2}$$

Where CV is the Cuddy-Della-Valle index, CV^* is the simple coefficient of variation in percent, R^2 is the coefficient of determination from a time-trend regression analysis adjusted by the number of degrees of freedom.

$$\text{Coefficient of Variation, } CV^* = \frac{\text{Standard Deviation}}{\text{Mean}} \times 100$$

Compound Annual Growth Rate was estimated to assess the growth in area, production and yield per hectare of walnut in Jammu and Kashmir, India. Compound Annual Growth Rate is the rate of return of an investment for over a period of time (Naqash, 2015; Wani *et al.* 2014).

The formula for Compound Annual Growth Rate is:

$$CAGR = \left(\frac{V_{final}}{V_{begin}} \right)^{\frac{1}{i}} - 1$$

Where, $CAGR$ is Compound Annual Growth Rate, V_{final} is the value of area, production and yield per hectare at the end, here in 2016-17 and V_{begin} is the value of area, production and

yield per hectare at the beginning in 2004-05 and “ t ” is the time-period from 2004 to 2017.

On the basis of the CAGR and Cuddy-Della-Valle Index, following classification was used for the analysis:

- ♦ Compound Annual Growth Rate:
 - (a) Very Low Growth Rate – 0-1%
 - (b) Low Growth Rate – 1-2%
 - (c) Moderate Growth Rate – 2-5%
 - (d) High Growth Rate – >5%
- ♦ Cuddy-Della-Valle Index:
 - (a) Low Variability – 0-5 %
 - (b) Moderate Variability – 5-10%
 - (c) High Variability – 10-15 %
 - (d) Very High Variability – >15%

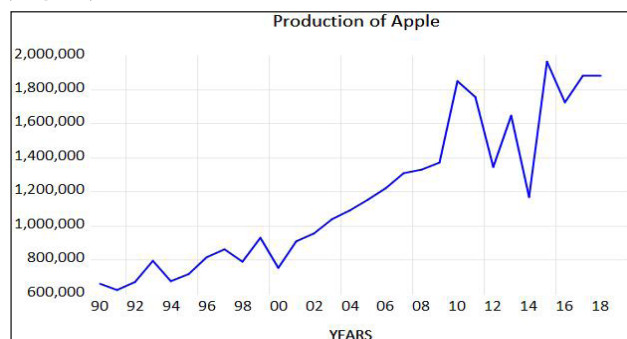
Domination of Apple Crop

Apple crop is one of the highly profitable economic activity in Jammu and Kashmir. Owing to the superior quality as well as high-production and productivity of Apples in the erstwhile state of Jammu and Kashmir than the other states, the cultivation of apple generates 80 percent of the output value and generates 20 lakh employment (75 percent of the total horticultural employment in the Union Territory. High employment is primarily due to farm-based labour intensive and commercially attractive supply-chain of the crop in the erstwhile state (Economic Survey, JK 2018-19, Horticulture at a Glance, 2019). Apple crop contributes nearly 50 percent of the total area under fruit crops and contributes significantly to the economic and ecological development, employment generation, export and nutritional requirement of the people of the state as well as of the country as a whole (Zulfikar, 2015).

Even in the entire Western Himalayan area, Apple crop is the most predominant crop contributing immensely to the economy of the region. Jammu & Kashmir, Himachal Pradesh and Uttarakhand -the major producers of apple in the country, contribute with 60 percent, 21 percent and 7 percent of the total production of

apple in the country (Rajesheri and Ali, 2016). In wholesome analysis, Apple clearly leads all the charts in terms of area, production and yield per hectare among the major agricultural crops produced in the Union Territory of Jammu and Kashmir. In other words, it represents the fruit industry of Jammu and Kashmir, representing 60-70 percent of the total fruit production in the Union Territory (Bhat, 2014).

In the last three decades, the area under Apple crop has increased from 68723 hectares to 164742 hectares with an annual growth rate of 3.4 percent. Compared to this, the acreage under other horticultural crops has grown at a slower rate of 2.5 percent (Directorate of Horticulture, Jammu & Kashmir, 2019). The production in the meantime has grown at even a higher rate, increasing from 6.5 lakh tonnes in 1990-91 to 19.1 lakh tonnes in 2018-19. Analysing the years from 1990-2000, there have been some minor hiccups with a relatively constant growth rate in production, as it increased from 6.5 lakh to 9.2 lakh in 8 years before falling back to 7 lakh tonnes in 2000. However, post 2000 owing to the infrastructural developments, free neoliberal market in the country, use of some scientific methodologies at the farming stage and the higher-purchasing power of the public ramping up the demand, the growth rate in production of apples has increased at an exponential rate. The total production, therefore, increased to 17.8 lakh tonnes in 2010 tripling in just 10 years of time (Fig. 1).



Source: Horticulture at a Glance, National Horticulture Board

Fig. 1: Production of Apple from 1990-2019

In the subsequent years, 2012 and 2014

the production however witnessed a sharp decline. Bhat and Choure (2014) have aptly highlighted the reasons responsible for this lower production. Firstly, the low-snowfall in the preceding winter and the hailstorm just before the harvesting season had wreaked havoc to the apple orchards thus destroying the production of the apple crop. Secondly, the political instability and the strikes in 2014-15 also resulted in lowering the availability of the pesticides and fungicides which resulted in high incidence of the diseases lowering the production overall (Hanan, 2015). From, 2016 the production again has increased and the growth-rate has been relatively good for the benefit of the farmers in the Union Territory, the production has reached to 19.1 lakh tonnes in 2018-19 and is expected to cross the 20-lakh figure in the coming years.

Productivity or the yield per hectare of Jammu and Kashmir has been higher than the national average. In Apple alone, the UT's average yield is 11.43 tonnes/hectare which is higher than the national average of 9.73 tonnes/hectare. Himachal Pradesh which contributes 21% to the total production, has an average yield of 6tonnes/hectare which is two-time lower than yield per hectare of Jammu and Kashmir (Malik and Choure, 2014).

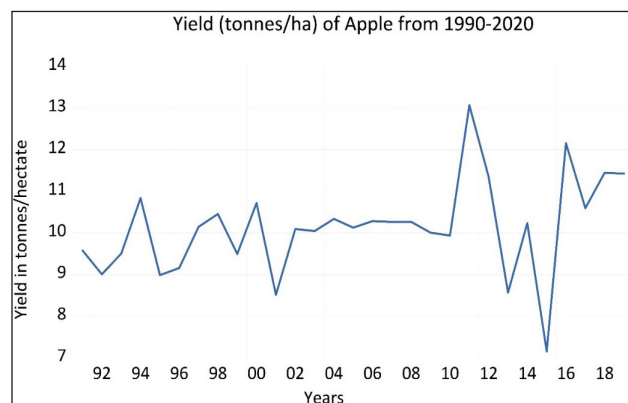


Fig. 2: Yield (tonnes/hectare) of Apple from 1990-2020

Over the last three decades in particular, the yield per hectare has increased from 9.58 tonnes/hectare to 11.43 tonnes/hectare. During this period, the yield per hectare has fallen to 7 tonnes/hectare in 2014-15 owing to the drastic climate change during that year (Fig.

2). In 2010, this yield per hectare increased to nearly 14 tonnes/hectare which is considerably high as compared to the national average during that year (9.12- Horticulture at a Glance, 2018) (Fig. 2). The increase shows the considerable potential of the crop in the region, which is a testimony to the favorable agri-climate conditions of Jammu and Kashmir.

Variability and Growth of the Apple Crop

Instability is one of the most critical parameters in agricultural development. High instability means wide fluctuations in the production and other parameters of the crop which directly impact the crop output. Therefore, it directly impacts the farmer income as well as the crop development in the region. The magnitude of instability, therefore, the fluctuations in the parameters of the crop development largely depend on the technological prowess of the farmers, the sensitivity of the crop towards the weather conditions, the market infrastructure and the institutional development for the crop in the region (Tripathi, 2009).

Compound Annual Growth Rate and Cuddy-Della Valle index of production, area and productivity of Apple crop in Jammu and Kashmir from 1990-2019 gives a clear perspective of the sustainability of the crop in the region. Roughly, Apple contributes 70 percent of the total horticulture crop from Jammu and Kashmir, while Jammu and Kashmir, alone contributes 60-65 percent of the total apple production in the country. Thus, stability of the apple crop is important for the economy of the Union

Territory, per se as well for the development of the apple crop in the country.

Growth rate in Area, Production and Yield per hectare in apple crop together with coefficient of variation in these respective parameters was analyzed to bring forward a clear perspective of the sustainability of the crop. In the first five years (1991-95), area and production witnessed low growth and very low instability, while the yield per hectare witnessed negative growth and very low instability. From 1996-2000, the growth rate in area and yield has been moderate while coefficient of variation in area was 3.89 which is very low. However, the production showed high growth and moderate instability, which is statistically significant considering the changes that had occurred in the period (Table 2).

In the next five years, (2001-2005), area and yield per hectare showed moderate growth and low instability while production showed high growth and low instability catering to the effective development of the crop. Growth Rate of Yield per hectare entered negative territory however the area and production were in the moderate growth rate bracket from 2006-10 phase. On the other hand, the instability in area and yield was low while in production it increased to moderate which is statistically significant. Due to low production and low yield in the subsequent years, 2012 and 2014, both faced negative growth rate and high to moderate instability, respectively. Growth rate and instability of area was moderate during the phase. Therefore, this phase from 2011-15

Table 2: Trend Analysis of Apple crop in Area, Production and Yield from 1990-2019

	APPLE								
	CAGR			R ²			Cuddy-Della Valle index		
	Area	Production	Yield	Area	Product	Yield	Area	Production	Yield
1991-95	1.76	0.47	-1.26	0.81	0.91	0.91	1.6	4.25	2.77
1996-2000	2.12	5.38	3.19	0.77	0.81	0.82	3.89	12.8	5.44
2001-05	4.13	7.79	3.53	0.92	0.87	0.82	6.44	5.03	8.2
2006-10	4.36	3.57	-0.76	0.87	0.85	0.91	6.03	12.71	8.49
2011-15	2.89	-0.77	-1.33	0.85	0.84	0.85	8.1	17.36	12.89
2016-19	0.45	1.09	1.54	0.83	0.92	0.86	5.35	9.27	9.04
1991-2019	2.62	2.92	0.82	0.84	0.867	0.86	4.90	8.57	7.14

was the worst phase in terms of growth rate as well as instability of the apple crop in the region. On the ground, low disposable income of farmers and poor quality of apples in the market vindicated this ebb in the development of apple crop in the region (Hanan, 2015).

From 2016, there is resurgence in the statistical parameters of the apple crop as all the three major parameters- area, production and yield per hectare showed positive growth while the instability or the coefficient of variation was low too. Overall, in the last three decades, the growth rate of apple in area as well as in production has been moderate but the growth rate in yield has been low. In the meantime, the instability has been low in all the parameters showcasing lower fluctuations and easier adaptability of the farmers for the crop.

The Delicious Cherry

Cherry entered Kashmir during the reign of Akbar from Kabul and infact the varieties cultivated in Kashmir were found to be even sweeter than their place of origin. Currently, 75-77 percent of the cherry produced in the country comes from Jammu and Kashmir, holding the monopoly of cultivating high quality cherry in the country (Horticulture at a Glance, 2018). In the last three decades the production of cherry has increased from 3.8 thousand tonnes to nearly 12 thousand tonnes. The production so far has peaked in 2013, when it crossed nearly 13 thousand tonnes (Fig. 3).

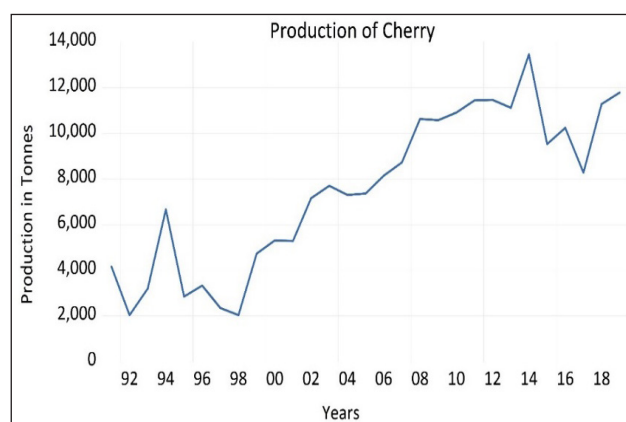


Fig. 3: Production of Cherry in Jammu and Kashmir from 1991-2019

Meanwhile, the growth rate in production has been consistent and incremental which is in consonance to the overall development and demand of cherries in and around the country.

Yield of cherry hasn't increased manifolds rather it has seen high fluctuations within the 3-5 tonnes/hectare range. Overall, the yield per hectare has remained at the lower side with no signs of substantial growth in the last three decades (Fig. 4). The major reason for this can be attributed to the lower acceptability of the crop as a primary crop by the farmers, as it continues to grow as a secondary crop in Apple orchards (Ismael *et al.* 2019).

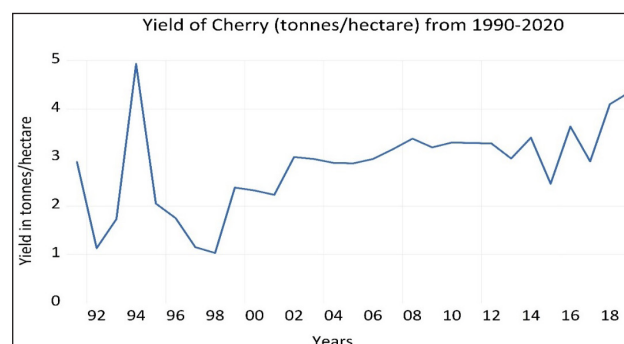


Fig. 4: Yield of Cherry from 1990-2020

Sustainability of the Crop

In 1990-91, nearly 4.1 thousand tonnes of cherry were produced from 1.4 thousand hectares of area under cherry cultivation, which increased to 11.7 thousand tonnes from 2.7 thousand hectares of area in 2018-19. Thus, the area has nearly doubled while production has tripled implying that there is slight increment of yield per hectare in cherry during the period.

Variability and Growth Rate in Area, Production and yield per hectare for the six phases from 1991 to 2019 has shown high instability and low growth rate overall. In the first phase (1991-95), all the three parameters shows negative growth rate whereas yield and production shows high variability. In the years from 1996 to 2010, production has increased at a relatively higher growth rate while the variable in production also remained high. During this time, area and yield showed moderate growth rate and moderate to high variability/instability. The results are

statistically significant considering there is high-level dependency of farmers on cherry-crop generating quick and early revenue during the course of each year (Table 3).

From 2011-15, the compound annual growth rate of production and yield again entered the negative territory while the variability was very high during the period, only area which increases due to extraneous factors showed positive (low) growth and moderate variability. The low-base effect of these years, paved way for positive growth in production and yield but with high instability or variability during 2016-19, but area entered the negative territory. The cherry crop witnessed low growth and high instability in the region. The future of the crop vests in adaptation of newer technologies, timely usage of chemicals and higher propensity to have cherry orchards.

Walnut- The Cracked- Nut

Walnut in India is one of the most important horticultural crops being exported to nearly 70 countries generating nearly 7780 lacs INR annually. In terms of acreage under walnut, India is ranked sixth while in production, it is ranked eight, thus being one of the major contributors in walnut cultivation (Singh *et al.* 2012). The production of walnut crop has increased from 1.85 lakh metric tonnes in 2000-01 to 2.99 lakh metric tonnes in 2017-18, while the area has increased from 0.75 lakh hectares to 1.08 lakh hectares during the same time (Horticulture at a Glance, 2018).

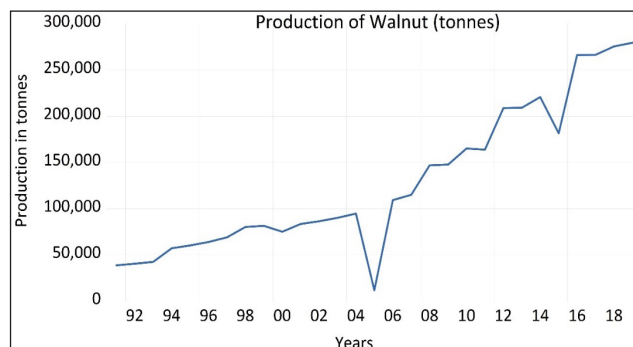


Fig. 5: Production of Walnut from 1990-2020

Among the states, walnut is usually grown in Jammu & Kashmir, Himachal Pradesh,

Uttarakhand and Arunachal Pradesh. Jammu & Kashmir, alone contributes over 95 percent of the total production in the country from over 85 percent of the area (Fig. 1). In terms of acreage, 89,000 hectares out of the total 1.08 lakh hectares in the country under walnut cultivation are in Jammu and Kashmir, while in 2017-18, from 2.99 lakh metric tonnes of walnut produced in the country, 2.75 lakh metric tonnes came from Jammu and Kashmir (Horticulture at a Glance, 2018).

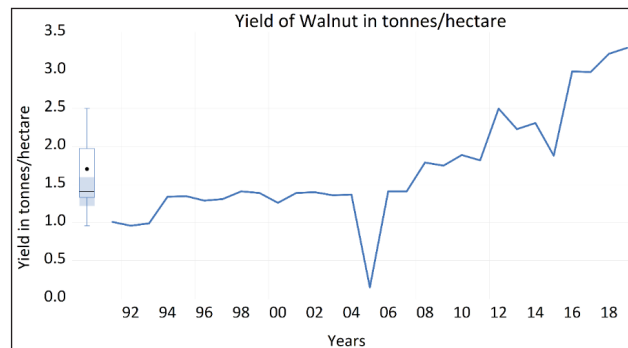


Fig. 6: Yield of Walnut in tonnes/hectare from 1990-2020

Sustainability of the Walnut crop in Kashmir

The second most important crop in terms of production and acreage, walnut shows varied levels of growth pattern as well as instability in the past three decades. In the first decade, from 1991-2001, the growth rate has remained moderate in area, while it has fluctuated largely in production and yield. In the first five years under study (1991-95), the growth rate in production and yield was 9.27 percent and 5.97 percent respectively and is significant (Table 4). However, in the next five years, the growth rate in these two plummeted to 3.27 percent and minus 0.46 percent respectively showcasing high fluctuation. In this decade, the variability remained on the higher side in all three parameters. Therefore, despite that the crop witnessed an upward trend in area it faced high instability owing to extraneous factors like poor marketing, lack of technological interventions at the production and processing stage.

In the next five years, (2001-2005), the growth rate in area was moderate but it was negative in productivity and production, owing to the low

Table 3: Growth Rate and Variability in Area, Production and Yield per hectare

Cherry									
	CAGR			R ²			Cuddy Della Valle Index		
	Area	Production	Yield	Area	Production	Yield	Area	Production	Yield
1991-95	-0.7	-7.28	-6.76	0.82	0.87	0.92	4.33	14.11	17.38
96-2000	3.78	9.76	5.8	0.82	0.87	0.89	3.11	17.63	15.53
2001-05	1.53	6.83	5.27	0.91	0.9	0.84	4.11	13.6	13.6
2006-10	4.95	6.01	1.02	0.82	0.89	0.92	8.5	10.31	11.21
2011-15	2.25	-3.59	-5.7	0.87	0.83	0.91	12.7	15.3	12.25
2016-19	-0.92	3.57	4.54	0.9	0.82	0.89	10.77	5.37	14.28
	1.81	2.55	0.69	0.85	0.86	0.89	7.25	12.72	14.04

Table 4: Growth Rate and Variability in Area, Production and Yield of Walnut

Walnut									
	CAGR			R ²			Cuddy Della Valle Index		
	Area	Production	Yield	Area	Production	Yield	Area	Production	Yield
1991-95	1.62	9.27	5.97	0.91	0.92	0.91	8.9	14.3	13.24
96-2000	3.74	3.24	-0.46	0.83	0.89	0.88	11.14	11.35	10.28
2001-05	4.56	-3.01	-7.21	0.85	0.86	0.91	11.6	11.96	15.01
2006-10	2.43	8.61	5.98	0.86	0.97	0.89	9.76	6.26	5.86
2011-15	1.43	2.07	0.63	0.89	0.91	0.92	2.21	4.41	4.13
2016-19	-1.18	1.225	2.43	0.91	0.89	0.89	5.2	5.81	4.68
AEG	2.1	3.56	1.22	0.875	0.91	0.9	8.13	9.01	8.86

base effect and the continuous negligence that the crop is facing from the farmers as well as the government. In consonance with the growth parameters, the instability was moderate in area while it was on the higher side in production and productivity.

The next decade witnessed low growth rate in area while the production and productivity witnessed fluctuations of higher magnitude. The growth rate in production was high in the first five years (2006-10), which dropped to just 2.07 percent (moderate growth rate) in the next five years (2011-15). The productivity too witnessed a similar story, in the first phase (2006-10), the growth rate was 5.98 percent while it lowered down to 0.83 (very low growth rate). Therefore, the increment vis-à-vis the development of the crop in the region continued to languish while the overall profitability from the crop fell. In the last phase of our analysis, a significant development came up, with the growth rate

in acreage falling into the negative territory, even significant was the very low growth rate in production and productivity.

Regarding the instability index during these fifteen years, all the parameters have witnessed moderate variability in different phases, owing to the frequent fluctuations in the growth rates. The moderate instability however implies that the crop is conducive to the agri-climatic conditions of Kashmir but there are issues at the production stages which need to be addressed to ensure that the crop shows higher sustainability per se. Overall, in the last three decades the area and the production have grown steadily at a moderate place, while the productivity has grown at a lower pace. Even in terms of variability, all the three parameters show moderate instability which is inclining towards the higher side, highlighting the need to address issues concerning the walnut crop in Kashmir.

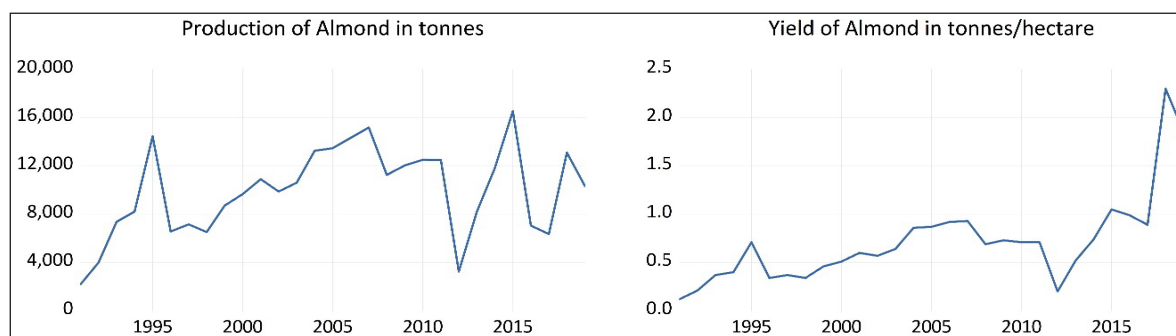


Fig. 6: Production (tonnes) and Yield (tonnes/hectare) of Almond from 1990-2020

Table 5: Growth Rate and Variability of Almond from 1990-2020 (Percent)

Almond									
CAGR			R ²			Cuddy Della Valle Index			
	Area	Production	Yield	Area	Production	Yield	Area	Production	Yield
1991-95	1.04	5.69	12.69	0.91	0.92	0.91	19.49	28.72	18.72
96-2000	-0.52	8.04	8.44	0.85	0.87	0.89	15.8	8.03	19.08
2001-05	-3.09	4.32	7.78	0.88	0.91	0.87	12.43	16.75	9.42
2006-10	2.43	-2.66	-4.98	0.86	0.89	0.87	10.6	14.8	15.78
2011-15	-2.22	5.74	8.15	0.89	0.84	0.88	16.22	19.1	16.88
2016-19	-5.91	9.9	16.88	0.88	0.89	0.84	14.61	11.22	18.01

Almond

Almond showcases the most peculiar characteristics among the horticultural crops of Jammu and Kashmir. The area under almond crop is decreasing vindicating the poor health of the crop in the erstwhile state, despite enjoying the monopoly in the production of almond in the country. In 1990, the area under almond cultivation was 19.2 thousand hectares which produced 2.2 thousand tonnes of almond at a very low yield per hectare of 0.18. Fast-forward to 2018-19, the acreage under almond was just 5.5 thousand while the production has increased to 10.3 thousand tonnes witnessing quite a turnaround.

The yield in 2018-19 was 1.85 tonnes per hectare which is considerably low as compared to other almond producing nations of the world. Figure A shows considerable fluctuations in the total production of almond in the country. Year on Year, the production has witnessed highs and lows with the cumulative increase in the total production. In the meantime, the yield has

seen a recent uptick in 2016-17 while remaining in the range of 0.5-1.0 tonnes/hectare for almost 25 years from 1991-2015. In 2016-17, the yield peaked at 2.2 tonnes/hectare before falling back to 1.85 tonnes/hectare (Figure A).

Sustainability of the Crop

During the first phase of the analysis (1991-1995), the compound annual growth rate of area is low but it is high in production and yield owing to the lower base of the preceding years. However, the variability during that phase is very high in all the three parameters, bringing back the discussion of the feasibility of the crop in the region. The second phase correlates to negative growth and high variability/instability in area, high growth and moderate variability in production while very high growth rate but unfortunately high instability in yield. Therefore, the sustainability of the crop during this phase was also under serious threat considering the crop underwent high variability.

In the third phase (2001-05), there was considerable decrease in the acreage under almond due to higher adoption of apple crop by the farmers. The growth rate in area, therefore witnesses negative growth at -3.09 percent while the variability was high. For production, the growth rate was moderate while the variability was very high, while for the yield, the growth rate surprisingly went north- showing high growth rate and low instability. The fourth phase (2006-10), varied further from the preceding phase as the area showed positive (moderate growth), while production and yield for almond showed negative growth. Meanwhile, correlating to the positive growth rate in area, the variability in area was moderate while the variability was very high in production and yield (Table 5).

In the fifth phase, (2011-15), there was a reverse trend as the growth rate again entered the negative territory while production and yield showed high positive growth just what was observed in the third phase. The variability among the three parameters was observed to be very high during this phase, showing that the crop at present level is pretty unsustainable in the region. In the last phase (2016-19), the area witnessed steep fall reaching to -5.91 percent while the production and yield witnessed very high compound growth. Again, the variability among all the three parameters was very high which brought forward the high instability the crop is suffering. While at present, the market is flooded with almonds from US, Canada and other European Nations, the higher instability of the crop and the frequent variations further create doubts among the farmers as a result of which the adaptability of the crop has fallen considerably.

CONCLUSION

Amongst the major fruit crops grown in Jammu & Kashmir, apple and walnut lead the charts in production, yield per hectare and the total area which force us to further analyze these two crops. However, considering the stability of these crops there is high growth potential and sustainability prospects of these two crops. The instability of walnut points out to the

negligence and disregard regarding the crop while at the same time it directs questions the production processes undertaken presently in the valley. However, apple showcases low instability and high growth bringing out its wide acceptability, comparably better marketing structure and higher remuneration for the farmers- small, marginal and large equally. On the other hand, the other crops like almond, pear also showcase tremendous potential but due to lower acceptability, higher inputs and lack of modernization in terms of new varieties, scientific methodologies and poor marketing structure face problems at the production stage. This creates issues like high fluctuations in production, area as well as in productivity of the crops while the instability too remains on the higher side.

Therefore, the government has to bring out a holistic policy to support each crop from the production to the marketing level. Horticulture is the backbone of the agricultural economy of Jammu and Kashmir; therefore, timely intervention is needed. Scientific intervention, right amount of fertilizers and chemicals, availability and accessibility to timely usage of chemicals, proper information dissemination for their usage and adequate marketing infrastructure would go a long-way in the overhauling of the sector in the Union Territory.

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