Decomposition and instability analysis of peal millet in Jodhpur Region vis-à-vis Rajasthan

ABSTRACT

Aims:-The main purpose of this study was to examine the growth, instability and source of output growth in area, production and productivity of pearl millet in Jodhpur & Barmer districts, Jodhpur Region and entire Rajasthan.

Study Design:-The present study was completely based on secondary time series data.

Place & Duration of Study:-This study area was covered to Jodhpur & Barmer districts, Jodhpur Region and entire Rajasthan.The entire study period was divided into three sub-periods viz., period-I (2006-07 to 2013-14), Period-II (2014-15 to 2021-22) and Overall period (2006-07 to 2021-22).

Methodology:-The time series data were analyzed using statistical tools exponential growth model, Cuddy-Della Valle instability index and Minhas &Vaidyanthan decomposition model to accomplish the study's objectives.

Results:-The results of the study indicated that highest growth rate were observed in the productivity (36.20%) and production (30.83%) of pearl millet in Barmer district during period-I. The maximum variability was observed in production (77.88%) and productivity (77.30%) of pearl millet in Barmer district during period-II. The yield effect (300.43%) was reported as major contributor to boost-up the production of pearl millet in selected study area. The state government should establish Agri-Export Zones for millet crops in the state.

Conclusion:- The highest growth rate was recorded in pearl millet's productivity in Barmer district. The highest instability was reported in production of pearl millet in Barmer district. Yield effect was major source of output growth in production of pearl millet in Barmer district.

Keywords: Pearl millet, Decomposition analysis, Instability, Barmer, Jodhpur region

1. INTRODUCTION

Pearl millet grains keep distinctive feature of small seed and hardy crop which can be easily grown under marginal conditions of moisture (rainfed), less fertile soil and inputs. Its grain is main supplier of fibre and nutritional carbohydrates in the human diet in Western part of India (Kolageri and Israel, 2018).During 2021-22, Pearl millet is the fourth most grown food crop after rice wheat, maize in India (Ministry of Agriculture & Farmers Welfare, Government of India, 2022). During 2021-22, India hasproduced 10.86 million tonnes pearl millet grain from 7.65 million hectares cultivated area (Ministry of Agriculture & Farmers Welfare, Government of India, 2022). More than 90 per cent pearl millet production of India is contributed by Rajasthan (38.98%), Uttar Pradesh (20.25%), Haryana (11.64%), Gujarat (10.97%) and Madhya Pradesh (9.03%) states.In the country, Rajasthan is leading

state in area and production of pearl millet with contribution of 55.74 per cent and 38.98 percent respectively (Ministry of Agriculture & Farmers Welfare, Government of India, 2022). In Rajasthan, Pearl millet is cultivated in summer (June-December) season. During 2021-22, Jodhpur region (Jodhpur and Barmer districts) of Rajasthan is covered more than 30 per cent area of pearl millet in the state (Department of Agriculture, Govt. of Rajasthan, 2021-22). Among all millet namely Sorghum, Pearl millet, Maize and small millets, pearl millet has better nutrient value, adaptability to dry land, marginal lines and can survive under extremely unfavourable weather conditions. Apart from these attributes, the policy makers did not give much more attention toward its changing scenario because favouring of wheat and rice cultivation with urbanization and industrialization throughout the country (Kolageri and Israel, 2018)). Now days, people are being more aware about their health and giving more emphasis on millet being complex of carbohydrates with low glycemic index (GI). There high incidences of diabetes are found in the country which can be cured by including pearl millet or any other small millets in our regular diet (Das, *et al.*, 2019). Due to rich in micro nutrient and nutritional value, pearl millet might create domestic and global demand to the people. On the proposal of Indian Government, the United Nations has declared 2023 as International Year of Millets (IYoM-2023) on 5th March, 2021.Status of millets in terms of area, production and productivity was measured by various research scholars and scientists in the different segment of India. However, In context of Rajasthan particularly Jodhpur region, such type of studies were not recognized therefore, it is necessary to analysis the past scenario and present performance of area, production and productivity of pearl millet in Rajasthanstatewith special concentration on Jodhpur region. The present stidy is confined on following major objectives:- (i) To workout the growth pattern in area, production and productivity of pearl millet in Rajasthan and Jodhpur region, (ii) To measure the variability indices of pearl millet in Rajasthan and Jodhpur region and (iii) Sources of output growth of pearl millet in Rajasthan and Jodhpur region.

2. METHODOLOGY

The present study was carried out on 16 years (from 2006-07 to 2021-22) secondary time series data on area, production and productivity of pearl millet in Jodhpur region and Rajasthan state. According to Commissionerate of Agriculture, Government of Rajasthan, Jaipur, the Jodhpur region includes only two districts namely Jodhpur and Barmer. The secondary data on area, production of productivity of pearl millet were collected from various issues of Agriculture Statistics at a Glance, Commissionerate of Agriculture, Jaipur, Department of Agriculture, Government of Rajasthan. To arrive at convenient interpretation of the results, the entire study period was divided into three sub-periods *viz.*, period-I (2006-07 to 2013-14), period-II (2014-15 to 2021-22) and overall period (2006-07 to 2021-22).

2.1 Analytical framework:

According to pre-determined objectives of the study, the collected data on area, production and yield of pearl millet was compiled and analyzed logically. For the present investigation, the following analytical techniques were used to compute the compound annual growth rate and instability in area, production and productivity of selected crop. The detailed explanations of these techniques are given as follow.

2.1.1 Compound annual growth rate:

The compound annual growth rate in area, production and yield of pearl millet in Jodhpur region and Rajasthan state as a whole were computed by following exponential equation.

$Y_t = A(1 + r)^t$ .....(1)

After taking log on both sides of equation (1),

$\ln Y_t = \ln A + t \ln (1 + r)$.....(2)

Where,

Y_t is the variable (area/production/productivity) of pearl millet for which growth rate calculated for t^{th} period,

t is period-I(2006-07 to 2013-14)/II (2014-15 to 2021-22)/III (2006-07 to 2021-22)

r is the compound annual growth rate, and

ln is the natural logarithm.

Now putting

$$\ln Y_t = Y$$

$$\ln A = a \text{ and}$$

$$\ln (1 + r) = b$$

Therefore, the above equation becomes, $Y = a + bt$

Now, a and b parameters were estimated by Ordinary Least Squares (OLS) method and the CAGR was computed as given below:

$$r = (\text{Antilog of b-1}) \times 100$$

Student 't' test was used to test the significance level of growth in area, production and productivity of pearl millet. This model was mostly used for measuring trend and growth rate in chronological data series of various variables (Meera and Sharma, 2016; Sharma *et al.*, 2017; Bairwa *et al.*, 2020a; Bairwa *et al.*, 2020b; Bairwa *et al.*, 2021a;Bairwa *et al.*, 2022 and Meena *et al.*, 2022).

2.1.2 Instability Analysis:

There are graphical and quantitative methods to measure the instability in variable(s). However, graphical methods provide only a comparative views and not the extent of instability. Therefore, the instability in area, output and productivity of pearl millet could be calculated by using quantitative methods. The Cuddy-Della Valle instability index was developed by John Cuddy and Della Valle in 1978 for measuring the instability over the period. This index is better than the coefficient of variance (CV) and index of dynamic instability, since simple CV over estimate the extent of variability in secular data series characterized by long term trend. This method removes this distortion in coefficient of variation. The variability was estimated in relative terms by this index, which is commonly used as measure of instability in chronological data (Singh and Byerlee, 1990; Deb *et al.*, 1999; Bairwa *et al.* 2020a; Bairwa *et al.* 2021b; Balai *et al.* 2021 and Bairwa *et al.*, 2022). This index is expressed algebraically as follow:

$$I = CV \times \sqrt{(1 - \text{Adj } R^2)}$$

Where,

I is the instability index (%),

CV is the coefficient of variation (%), $CV = \frac{SD}{AM} \times 100$

SD is standard deviation

AM is Arithmetic mean

Adj R^2 is the adjusted R square = coefficient of determination from a time trend regression adjusted by the number of degrees of freedom.

2.1.3 Decomposition Analysis:

Decomposition analysis was used to measure the relative contribution of area, yield and combined of both towards the change in total output of pearl millet. The decomposition analysis model was used by many researchers such as Bastine and Palanisami (1994) and Kakali and Basu (2006) earlier to examine the growth performance of different crops. The general outline of decomposition model for pearl millet production in Rajasthan state was depicted as below:

$$P_i = A_i Y_i \text{.....(1)}$$

Where:

P_i = Production of pearl millet,

A_i = Area of pearl millet and

Y_i = Yield of pearl millet

Then, $P_0 = A_0 Y_0$ (2) and

$P_c = A_c Y_c$ (3)

Where:

P_0, A_0 and Y_0 stand for production, area and yield of pearl millet in base year and

P_c, A_c and Y_c stand for production, area and yield of pearl millet in current year.

Now $(Y_c - Y_0) = \Delta Y_c$ and $(A_c - A_0) = \Delta A_c$

$(P_c - P_0) = \Delta P_c$ (4)

Now substituting the terms represented in equation number 4 into equation number 3

$$P_c = (A_0 + \Delta A_c)(Y_0 + \Delta Y_c)$$

$$\Delta P_c = (P_c - P_0) = \{(A_0 + \Delta A_c)(Y_0 + \Delta Y_c)\} - A_0 Y_0$$

or

$$\Delta P_c = (A_0 \Delta Y_c) + (Y_0 \Delta A_c) + (\Delta A_c \Delta Y_c) \text{.....(5)}$$

Yield Effect + Area effect + Interaction Effect

Thus, the total change in pearl millet production was attributed due to yield and area that can be decomposed into three components.

3. RESULT AND DISCUSSION

3.1 Growth rate and instability analysis:

In the country, Rajasthan state is having prime position in coverage of area under pearl millet and its production. The favourable climate and soil condition coerced to cultivate the pearl millet in Rajasthan. However, the shortage of annual rainfall in the Jodhpur region is affecting to level of output. Wide ranging operational and strategic technologies are required to enhance the production and productivity of pearl millet in Jodhpur region as well as Rajasthan.

3.1.1 Jodhpur district: The compound annual growth rate and instability in area, production and productivity of pearl millet in Rajasthan is depicted in Table-1. During period-I, the production and productivity of pearl millet were augmented at 7.57 and 12.70 per cent per annum, respectively. In the mean time, the growth rate in area of pearl millet was -4.14 per cent per annum. Kumawat and Meena (2005) recorded a significant growth rate in area, production and productivity of coriander in Rajasthan and India for the period of 1967-68 to 2000-01. During period-II, the growth rate in area, production and productivity of pearl millet was -0.38, -2.79 and -2.47 per cent per annum, respectively. During this period, the negative growth rate might be due to shortage and scattered annual rainfall in Jodhpur district and attractive change in minimum support price of competing crops green gram. During this period, the minimum support price for green gram was increased nearby two fold from 4600/quintal in 2014-15 to 7275/quintal in 2021-22. Therefore, the cultivated area under pearl millet was replaced by the competitive crop green gram in Jodhpur district. During overall period (2006-07 to 2021-22), the production was increased at the annual growth rate of 3.74 per cent. Production (3.74%) was mainly augmented due to enhancing productivity at 7.51 per cent per annum. In case of area, the pearl millet shows negative growth rate of -3.38 per cent.

Table 1: Growth rate and instability analysis of pearl millet in Jodhpur district of Rajasthan

(In Per cent)

Particulars	Period-I (2006-07 to 2013-14)		Period-II (2014-15 to 2021-22)		Overall Period (2006-07 to 2021-22)	
	CAGR	CDVI	CAGR	CDVI	CAGR	CDVI
Area	-4.14 ^{NS} (0.132)	12.45	-0.38 ^{NS} (0.055)	5.40	-3.38* (0.107)	11.04
Production	7.57 ^{NS} (1.171)	75.90	-2.79 ^{NS} (0.273)	26.60	3.74 ^{NS} (0.805)	50.37
Productivity	12.70 ^{NS} (1.139)	67.63	-2.47 ^{NS} (0.263)	25.46	7.51 ^{NS} (0.793)	42.42

Source: Author's own computation from compiled time series data

Note:-Figures in parentheses are standard errors of exponential model

CAGR—Compound Annual Growth Rate and CDVI—Cuddy Della Valle Instability Index

*Significant at 1 per cent level of significance and ^{NS}Non-significant

It could be observed from the table that, the CDVI for area of pearl millet during period-II (5.40%) was smaller than the period-I (12.45%) and overall period (11.04%). Similar pattern of instability index for production of pearl millet was also smaller in period-II (26.60%) than period-I (75.90%) and overall period (50.37%). The instability index for productivity of the crop in period-I(67.63%) was larger than period-II (25.46%) and overall period (42.42%). This indicated that the pearl millet growers pointed out higher profitability of pearl millet production since they were appreciated by the nutritionist and dieticians in term of healthy heart, low calories, weight loss, prevent diabetes, etc. Naik and Hosamani (2016) in their study also depicted that the degree of instability in production of turmeric was higher than area and productivity in the Karnataka state as a whole.

3.1.2 Barmer district:

The growth rate and instability index in area, production and productivity of pearl millet in Barmer district is presented in Table-2. The production of pearl millet shows affirmative growth rate at30.83, 21.92 and 5.49 per cent per annum in period-I, II and overall period, respectively. Similarly, the productivity of pearl millet also reported positive growth rate at 36.20, 17.45 and 5.74 percent per annum in all three periods namely, period-I, II and overall period, respectively. In case of area, the growth rate under pearl millet was -3.90, 3.74 and -0.21 per cent in period-I, II and overall period, respectively. Bairwa *et al.* (2021) reported similar results of growth pattern in area, yield and production of cumin in the Rajasthan during 1991-92 to 2010-11 period.

The instability index was also measured for area, production and productivity of pearl millet in Barmer district for all three periods and presented in Table-2. It could be seed from the table that the CDVI for Production during period-II (77.88%) was higher than period I (68.89%) and overall period (73.92%). Similarly, the extent of instability index for productivity of pearl millet in period-II (77.30%) was higher than period-I (67.44%) and overall period (71.30%).In case of area under pearl millet, the CDVI during period-II(3.62%) was smaller than period-I (8.30%) and overall Period (10.18%). This instability in cultivated area under pearl millet was mainly affected by the variation in annual rainfall and other climatic conditions.

Table 2: Growth rate and instability analysis of pearl millet in Barmer District of Rajasthan

(In Per cent)

Particulars	Period-I	Period-II	Overall Period

	(2006-07 to 2013-14)		(2014-15 to 2021-22)		(2006-07 to 2021-22)	
	CAGR	**CDVI**	**CAGR**	**CDVI**	**CAGR**	**CDVI**
Area	-3.90 ^{NS} (0.089)	8.30	3.74* (0.037)	3.62	-0.21 ^{NS} (0.106)	10.18
Production	30.83* (1.062)	68.89	21.92 ^{NS} (0.670)	77.88	5.49 ^{NS} (0.894)	73.92
Productivity	36.20 ^{NS} (1.082)	67.44	17.45 ^{NS} (0.670)	77.30	5.74 ^{NS} (0.908)	71.30

Source: Author's own computation from compiled time series data

Note:-Figures in parentheses are standard errors of exponential model

CAGR—Compound Annual Growth Rate and CDVI—Cuddy Della Valle Instability Index

*Significant at 1 per cent level of significance and ^{NS}Non-significant

3.1.3 Jodhpur region:

The growth rate and extent of instability in area, production and productivity were presented in Table-3. It could be revealed from the table that production and productivity of pearl millet were augmented at the rate of 17.56 and 22.44 per cent per annum, respectively during period-I. In the mean time, the area under pearl millet was reported negative growth rate (-3.98%) in the Jodhpur region. During period-II, a positive growth rate was observed for all three aspects *viz.,* area, production and productivity in the Jodhpur region. The area, production and productivity in period-II were augmented at annual growth rate of 2.56, 9.42 and 6.69 per cent per annum, respectively in the selected region. During overall period, the production and productivity of the crop was enhanced at 5.44 and 4.46 per cent per annum, respectively in the Jodhpur region. In case of cultivated area, the growth rate was observed at -1.21per cent per annum during overall period.

Table 3: Growth rate and instability analysis of pearl millet in Jodhpur Region of Rajasthan

(In Per cent)

Particulars	**Period-I (2006-07 to 2013-14)**		**Period-II (2014-15 to 2021-22)**		**Overall Period (2006-07 to 2021-22)**	
	CAGR	**CDVI**	**CAGR**	**CDVI**	**CAGR**	**CDVI**

Area	-3.98 ^{NS} (0.101)	9.38	2.56* (0.028)	2.81	-1.21** (0.098)	9.74
Production	17.56 ^{NS} (1.110)	70.81	9.42 ^{NS} (-0.096)	32.97	5.44 ^{NS} (0.805)	55.21
Productivity	22.44 ^{NS} (1.109)	66.62	6.69 ^{NS} (-0.153)	31.65	4.46 ^{NS} (0.813)	51.26

Source: Author's own computation from compiled time series data

Note:-Figures in parentheses are standard errors of exponential model

CAGR—Compound Annual Growth Rate and CDVI—Cuddy Della Valle Instability Index

*Significant at 1 per cent level of significance, **significant at 5 per cent level of significance and ^{NS}Non-significant

The instability index for area, production and productivity of pearl millet in Jodhpur region, during period-I, II and overall period are depicted in Table-3. It could be observed from the table that the instability indices of area, production and productivity for the pearl millet during period-I, II and overall period were (9.38, 70.81, 66.62); (2.81, 32.97, 31.65) and (9.74, 55.21, 51.26), respectively. These figures indicated that during period-I, the instability pattern for production and productivity were higher than period-II and overall period. However, after period-I there was much decline in the instability for production and productivity of this crop.

3.1.4 Rajasthan State:

The growth rate and extent of instability in area, production and productivity of pearl millet in Rajasthan were presented in Table-4. It is observed from the table that production and productivity of pearl millet were augmented at the rate of 13.54 and 6.73 per cent per annum, respectively during period-I. At the same time, the area under pearl millet was reported negative growth rate of -3.46 per cent per annum in the state. During period-II, a positive growth rate was observed for all three aspects *viz.,* area, production and productivity of pearl millet in Rajasthan state. The area, production and productivity were augmented at annual growth rate of 0.83, 6.74 and 5.86 per cent per annum, respectively in the whole state. During overall period, the production and productivity of the crop was augmented at 5.85 and 2.94 per cent per annum, respectively in the state. In case of area under pearl millet, the growth rate was observed at -1.59 per cent per annum during overall period.

Table 4: Growth rate and instability analysis of pearl millet in Rajasthan

(In Per cent)

Particulars	Period-I (2006-07 to 2013-14)		Period-II (2014-15 to 2021-22)		Overall Period (2006-07 to 2021-22)	
	CAGR	CDVI	CAGR	CDVI	CAGR	CDVI
Area	-3.46 ^{NS} (0.094)	8.92	0.83* (0.009)	0.94	-1.59* (0.077)	7.84
Production	13.54 ^{NS} (0.824)	47.98	6.74 ^{NS} (0.169)	17.25	5.85 ^{NS} (0.591)	33.58
Productivity	6.73^{NS} (0.348)	29.24	5.86 ^{NS} (0.166)	16.90	2.94^{NS} (0.259)	21.83

Source: Author's own computation from compiled time series data

Note:-Figures in parentheses are standard errors of exponential model

CAGR—Compound Annual Growth Rate and CDVI—Cuddy Della Valle Instability Index

*Significant at 1 per cent level of significanceand ^{NS}Non-significant

The instability index for area, production and productivity of pearl millet in Rajasthan for all three periods *viz.,* period-I, II and overall period are depicted in Table-4. It could be observed from the table that the instability indices of area, production and productivity for the pearl millet during period-I, II and overall period were (8.92, 47.98, 29.24); (0.94, 17.25, 16.90) and (7.84, 33.58, 21.83), respectively. These figures indicated that during period-I, the instability pattern for all three aspects was higher than period-II and overall period. However, after period-I there was much decline in the instability for area, production and productivity of this crop. It means instability effect on area was not much higher than production and productivity. Boyal *et al.* (2015) reported in their study that instability in production of fenugreek was superior to area and yield at district as well as state as whole except Jhunjhunu district during 1991-92 to 2000-01.

3.2 Source of growth in production:

It was discussed in the earlier section about fitted growth model of area, production and productivity of pearl millet in Jodhpur, Barmer districts, Jodhpur region and Rajasthan state. However, this method does not able to quantify the contribution of yield and area to the output growth. Therefore, it is

essential to examine the contributors of production growth. The growth in production of pearl millet was computed and apportioned to the different factors by splitting the production growth into three sources namely yield effect, area effect and interaction effect.

3.2.1 Jodhpur and Barmer districts:

In Jodhpur and Barmer districts, the relative share of yield, area and interaction effect to growth in output of pearl millet was depicted in Table 5. It was revealed from the table that during period-I in Jodhpur district, the interaction effect was prime contributor in output growth of pearl millet. The interaction effect in the output growth was 140.58 per cent in this period. The relative contribution of yield (109.37%) in output growth was smaller than interaction effect. However, the contribution of area was negative as-149.95 per cent of total output growth. During period-II, the increase in production of pearl millet was predominantly contributed by growth in productivity (106.85%). In the same way, area effect and interaction effect had contribution of 3.26 and -10.11 percent, respectively on output growth. i.e. area and yield components were responsible for the increase in pearl millet crop output. During overall period, yield effect and area effect was quite high to the extent of 149.45and 114.87 per cent respectively. However, stronger yield effect was counterbalanced by negative extent of area effect (-164.31%). Since gift of nature (land) is limited, therefore yield of pearl millet should be mounted up by adoption of good package of practices and hybrid seeds. Devi *et al.* (2017) in their study reported that growth in output of pulses during 1995-2014 was predominantly due to productivity growth.

Table 5: Sources of output growth in pearl millet production in Jodhpur and Barmer Districts of Rajasthan

(In Per cent)

Periods	Yield Effect		Area Effect		Interaction Effect	
	Jodhpur	Barmer	Jodhpur	Barmer	Jodhpur	Barmer
Period-I (2006-07 to 2013-14)	109.37	121.91	-149.95	-34.68	140.58	12.77
Period-II (2014-15 to 2021-22)	106.85	194.78	3.26	-125.65	-10.11	30.87
Overall Period (2006-07 to 2021-22)	149.45	300.43	-164.31	-379.81	114.87	179.39

Source: Author's own computation

In case of Barmer district, the yield effect was more prominent contributor for output growth during period-I. The relative contribution of yield, area and interaction effects were 121.91, -34.68 and 12.77 per cent in pearl millet output growth during period-I. It could be pointed out from the table that during period-II, the contribution of yield effect (194.78%) for enhancing the output of pearl millet in the Barmer district was maximum followed by interaction effect (30.87%). However, the entire interaction effect and quite half part of yield effect were counter balanced by area effect (125.65%). During overall period, the growth in output of pearl millet is mainly contributed by yield effect (300.43%) followed by interaction effect (179.39).It could be conclude from the table that pearl millet production in Barmer and Jodhpur districts were mainly contributed by yield effect.

3.2.2 Jodhpur region and Rajasthan:

Decomposition of output growth into its component forces of pearl millet in Jodhpur region and Rajasthan state were depicted in Table 6. It could be seen from the table that during period-I, the relative contribution of yield component was prime force with extent of 189.13 percent followed by interaction effect (62.53%) for output growth in Jodhpur region. Thus, the yield effect was more dominant than area and interaction force for increase in production of pearl millet in Jodhpurregion. During period-II, the relative contribution in pearl millet production was mainly forced by yieldcomponent (231.55%). In the mean time, output is also negativelyforced by area and interaction effect at -103.27% and -28.27 per cent, respectively. Das (2016) represented contrary results in their study that in most of the North Eastern states, ginger production growth was mainly contributed by area effect with extent of 49.2 per cent at national level and more than 100 per cent in states like Mizoram, Manipur and Nagaland during 1991-92 to 2014-15.

In the overall period, the output of pearl millet in Jodhpur region is also expanded by yield effect (189.80%) followed by interaction effect (49.30%). During all three periods, namely period-I, II and overall period, the individual effect of yield was pointed out positively high in percentage. Thus, yield effect in all three period was positive for pearl millet production which indicated thatpearl millet growers in Jodhpur region are receiving appropriate institutional intervention supports to enhance the production.

Table 6: Sources of output growth in pearl millet production in Jodhpur Region and Rajasthan

(In Per cent)

Periods	Yield Effect		Area Effect		Interaction Effect	
	Jodhpur Region	Rajasthan	Jodhpur Region	Rajasthan	Jodhpur Region	Rajasthan
Period-I (2006-07 to 2013-14)	123.23	189.13	-68.90	-151.65	45.67	62.53
Period-II (2014-15 to 2021-22)	115.48	231.55	44.62	-103.27	-60.10	-28.27
Overall Period (2006-07 to 2021-22)	150.38	189.80	-136.43	-139.20	86.05	49.30

Source: Author's own computation

Table 6 is also depicted sources of growth in production of fenugreek in Rajasthan. It could be observed from the table that during overall study period, the production of pearl millet in Rajasthan was contributed by spread out in yield effect (189.80%) followed by area effect (-139.20%) and interaction effect (49.30%). Thus, the production of pearl millet in the state was expanded due to prime force of productivity. During period-, the production of pearl millet was also augmented by prime force of yield effect (189.13%) followed by interaction effect (62.65%) in the Rajasthan. However, area effect in production of pearl millet was negative (151.63%) for this period. Alike period-I and overall period, the most powerful source of output growth ofpearl milletin Rajasthan was also yield effect (231.55%). However, area effect (-0.35%) and interaction effect 28.27%) were adversely forced to production of pearl millet in period-II. Thus, it could be inferred from the discussion that pearl milletproduction in Jodhpur region and the Rajasthan state were increased mainly due to improvement in productivity of this crop in all three periods.

4. CONCLUSION AND POLICY IMPLICATIONS

It could be concluded from the results of study that during period-I, the production and yield of pearl millet in all selected study areas grew at higher rate than period-II and entire study period.In the mean time, the variability in area, production and productivity of pearl millet were also notified higher in the period-I than period-II and overall period. After period-I, the appreciable and significant growth rate were not recorded in area, production and yield of pearl millet for the selected study area. The findings of decomposition analysis indicated that during period-I, II and Overall periods, the yield

effect was more dominant than area effect and interaction effect in selected districts, regions and entire Rajasthan.

Based on findings of statistical analysis, researchers should emphasis on expanding area under cultivation of pearl millet and improving productivity as Rajasthan lag behind than Uttar Pradesh, Haryana, Madhya Pradesh and Gujarat states in pearl millet productivity. Region based varieties should be developed through All India Coordinated Research Project on Pearl millet, SAUs and Department of Agriculture, Rajasthan, etc. The pearl millet grainsare good source of minerals and vitamins therefore; it is moredemanded throughout the world market. The Rajasthan Government should establish Agri-Export zones for millet crops in major producing districts so that farmers can access better world class facilities to produce high quality pearl millet that can be exported to rest of the world.

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