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Economic analysis of growth rates and cropping pattern changes in irrigated north western plain of Rajasthan

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Abstract

The present study was conducted in Zone IB (Irrigated north western plain) of Rajasthan. The study based on secondary data. Zone IB comprises Sriganganagar and Hanumangarh District. These districts have four micro-farming situations viz; irrigated micro-farming situation, Ghaggar river belt micro-farming situation, Salt affected micro-farming situation and Rain-fed micro-farming situation. Then mostly all crops are covered in this region hence this study was carried out in this region. This paper estimates and analysis the growth rates in area, production, productivity and cropping pattern of major crops in this zone. For this study twenty years data of area, production and productivity was divided in two periods, period I (1998-99 to 2008-09) & period II (2009-10 to 2018-19). The largest output growth rate in period I was area, production and productivity found in pearl millet and cluster bean. With the growth rate change in cropping pattern take place due to agro climate reasons and incidence of insect pest attack and disease then for this quinquennial changes in 20 years data on area was studied.

Keywords: Compound annual growth rates, area cropping pattern

Introduction

Rajasthan is one of the largest states of India in terms of area. Due to the uncertain rainfall in Rajasthan and mostly area in rainfed, the area, production and productivity in this region may fluctuate from time to time. Due all these reasons, in this region also affects the cropping pattern due to all of these the study of growth rate and change in cropping pattern is important. Rajasthan is located on the northwestern side of India. The state covers an area of 3, 42,239 square kilometers or 10.4 percent of the total geographical area of India (Agriculture Census 2015-16). In Gross Cropped Area, Rajasthan is having second position with 24.4 million ha (12.8 percent) gross cropped area among all States/UTs. Over 70% area is rain-fed with average precipitation of 575 mm. The soils are coarse and poor in fertility and the cropping intensity is 125%.

Therefore, in light of the above facts, it is concluded that Zone 1B, has diverse farming situations like dry land (Rain-fed) situations. The present study will focus on comparative economics, and growth in area, production and productivity in these diverse situations. Due to diverse farming situations, the incomes accruing to farmers are different.

Chapter gives an overview of the results and discussion, on following sections: Growth in area, production and productivity of major crops and cropping pattern in Rajasthan.

Methods

Selection of samples and collection of data

The present study was based on secondary data collected from Sriganganagar and Hanumangarh district. Secondary data in respect of area and production and productivity of selected crops, were collected from Directorate of Economics and Statistics, Govt. of Rajasthan, Jaipur.

Statistical analysis

Following statistical tools has been carried out for the present study.

Estimation of Compound growth rates

CAGRs (Compound Annual Growth Rates) were computed by fitting exponential function to the figures of area, production and productivity.

$$Y_t = ab^t U_t \dots\dots\dots (i)$$

Where, Y_t = area/production/productivity of selected crop in time period t

t = time element which takes the value 1, 2, 3...n

a and b are parameters to be estimated and $b = (1+g)$, where g is the rate at which y grows every year in relation to its value in preceding year.

U_t = is the disturbance term.

On logarithmic transformation of equation (i) we get

$$\log y_t = \log a + t \log b + \log U_t$$

This can be expressed as:

$$y^*_t = a^* + b^*t + U^*_t$$

Where $y^*_t = \log y_t$; $a^* = \log a$; $b^* = \log b$ and $U^*_t = \log U_t$

The estimate of compound growth rate can be obtained as

$$g = (\text{anti log } b^* - 1) \times 100$$

The F test was used for testing significance of the CAGR.

Results and Discussion

Growth in area, production and productivity

The twenty years data on area, production & productivity was divided in to two periods, Period I(1998-99 to 2008-09) & Period II(2009-10 to 2018-19).The compound growth rates of area, production and productivity of major crops in the state of Rajasthan during the period I(1998-99 to 2008-09) is presented in Table 1 This Table shows that the area of pearl millet registered positive and significant compound growth rates of 2.5, 21.7 and 4.7 per cent in Rajasthan, Sriganganagar and Hanumangarh respectively. The growth rates of production during the same period were also observed to be 11.4, 45.5 and 32.3 per cent, and for productivity it was 8.7, 19.7 and 26.3 per cent, respectively. The table indicates that there has been substantial increase in area, production and productivity of pearl millet during the period in Sriganganagar district as compared to Hanumangarh & Rajasthan as a whole.

Table further shows that the area of paddy crop registered negative compound growth rates of -3.7, -1.9 and -7.1 per cent in Rajasthan, Sriganganagar and Hanumangarh respectively. The growth rates of production during the same

period were positive and significant in Rajasthan and Sriganganagar district (3.2%) but negative in Hanumangarh district (-0.3%). The Table reveals that area of cotton crop registered negative compound growth rates of -5.4, -8.7 and -1.8 per cent in Rajasthan, Sriganganagar and Hanumangarh respectively. The growth rates of production and productivity during the same period were observed positive.

The table indicates that there has been increase in area, production and productivity of cluster bean during the period in Rajasthan, Sriganganagar and Hanumangarh. The area of cluster bean registered positive and significant compound growth rates of 4.2, 8.2 and 8.1 per cent in Rajasthan, Sriganganagar and Hanumangarh respectively. The growth rates of production during the same period were also observed to be 24.1, 22.2 and 28.5 per cent, and that of productivity were 6.8, 12.8 and 18.5 per cent, respectively.

This Table further reveals that CAGR of area under wheat crop during the period in Rajasthan showed positive and significant (0.3 per cent) compound growth rate but in Sriganganagar & Hanumangarh district it was negative (-1.6 & -0.3) per cent respectively. The growth rates of production during the same period were also observed to be 2.4, 1.8 and 0.1 per cent, and that of productivity were 2.1, 3.4 and 0.3 per cent in Rajasthan, Sriganganagar and Hanumangarh respectively.

Table 4 further shows that the area of mustard crop registered positive and significant compound growth rates of 6.6, 5.1 and 6.5 per cent in Rajasthan, Sriganganagar and Hanumangarh respectively. The growth rates of production during the same period were positive and significant viz. 9.2, 4.3 & 9.8 in Rajasthan, Sriganganagar and Hanumangarh respectively. The growth rates of productivity during the same period were positive and significant in Rajasthan (2.4%) and Hanumangarh district (3.0%) but negative in Sriganganagar district (-0.3%).

Table 4 shows that the area of chickpea crop registered positive and significant compound growth rates of 5.8, 4.8 and 9.3 per cent in Rajasthan, Sriganganagar and Hanumangarh respectively. The growth rates of production during the same period were positive and significant 4.9, 15.4 & 25.6 in Rajasthan, Sriganganagar and Hanumangarh respectively. The growth rates of productivity were negative in Rajasthan (-0.9%) but positive and significant in Sriganganagar district (10.1%) & in Hanumangarh district (14.7%). The compound growth rates of area, production and productivity of major crops in the state of Rajasthan during the period II (2009-10 to 2018-19) is presented in Table 2 This table shows that the area of pearl millet registered negative compound growth rates of -2.8 and -8.5 per cent in Rajasthan and Hanumangarh but positive and significant (2.1 per cent) growth rate in Sriganganagar.

Table 1: Compound annual growth rate (CAGR) in area, production & productivity of major crops in Rajasthan during 1998-99 to 2008-09 (Period I).

Crop	Area			Production			Productivity		
	Rajasthan	Sriganganagar	Hanumangarh	Rajasthan	Sriganganagar	Hanumangarh	Rajasthan	Sriganganagar	Hanumangarh
Pearl millet	2.5	21.7	4.7	11.4	45.5	32.3	8.7	19.7	26.3
Paddy	-3.7	-1.9	-7.1	3.2	3.2	-0.3	7.2	5.2	7.3
Cotton	-5.4	-8.7	-1.8	4	0.6	10.8	10	10.2	12.8
Cluster bean	4.2	8.2	8.1	24.1	22.2	28.5	6.8	12.8	18.5
Wheat	0.3	-1.6	-0.3	2.4	1.8	0.1	2.1	3.4	0.3
Mustard	6.6	5.1	6.5	9.2	4.3	9.8	2.4	-0.8	3
Chickpea	5.8	4.8	9.3	4.9	15.4	25.6	-0.9	10.1	14.7

All values significant at 1% level of significance

The growth rates of production registered -0.2, and -12.8 per cent in Rajasthan and Hanumangarh but in Sriganganagar it was positive and significant (3.5 per cent) growth rate. The growth rates of productivity were 2.6, and 1.3 per cent in Rajasthan, Sriganganagar respectively, but in Hanumangarh district, it was negative (-4.8) growth rate in period II. Table 2 further shows that the area of paddy registered positive and significant compound growth rates of 8.3, 4.6 and 5.6 per cent in Rajasthan, Sriganganagar and Hanumangarh respectively. The growth rates of production during the same period were 10.8, 5.3 and 3.9 per cent, and for productivity these were 2.3, 0.7 and -1.6 per cent in Rajasthan, Sriganganagar and Hanumangarh respectively.

The table reveals that area under cotton crop during the period II in Rajasthan showed positive and significant 3.5 per cent compound growth rates but in Sriganganagar & Hanumangarh district these were negative -3.2 & -0.1 per cent respectively. The growth rates of production during the same period were also observed to be 7.5, 2.6 and 3.1 per cent, and that of productivity were 3.8, 6 and 3.2 per cent respectively.

Table further shows that the area of cluster bean registered positive and significant compound growth rates of 2.1, 11.2 and 7.1 per cent in Rajasthan, Sriganganagar and Hanumangarh respectively. The growth rates of production were also observed to be 7.8, 20.2 and -2.3 per cent, and for productivity these were 5.3, 8.3 and -8.7 per cent, respectively. The table indicates that there has been substantial increase in area in Hanumangarh district but in production and productivity of cluster bean during the period

show negative growth rates. However, in Sriganganagar, the CAGRs of area, production and productivity were positive.

The table further indicates that there has been increase in area, production and productivity of wheat during the period II. The area of wheat registered positive and significant compound growth rates of 1.7, 2 and 1 per cent in Rajasthan, Sriganganagar and Hanumangarh respectively. The growth rates of production during the same period were also observed to be 3.4, 3.7 and 4.7 per cent, and that of productivity were 1.7, 1.6 and 3.7 per cent, respectively.

Table shows that the area of mustard crop registered positive and significant compound growth rates of 0.5, and 3.2 per cent in Rajasthan and Hanumangarh and but in Sriganganagar district it showed negative growth rate (-1.3 per cent). The growth rates of production during the same period were positive and significant (2.7, 0.4 & 3.5 in Rajasthan, Sriganganagar and Hanumangarh) respectively. The growth rates of productivity during the same period were positive and significant (2.1, 1.8 & 0.3 in Rajasthan, Sriganganagar and Hanumangarh) respectively.

Table reveals that area under chickpea crop during the period II in Rajasthan showed positive and significant (2.3 per cent) compound growth rates but in Sriganganagar & Hanumangarh district these were negative (-1.8 & -5.2 per cent) respectively. The growth rates of production during the same period were observed to be 7.4, 2.3 and 0.6 per cent, and that of productivity were 4.9 & 4.2 and 6.2 per cent, respectively for Rajasthan, Sriganganagar and Hanumangarh.

Table 2: Compound annual growth rate (CAGR) in area, production & productivity of major crops in Rajasthan during 2009-10 to 2018-19 (Period II).

Crop	Area			Production			Productivity		
	Rajasthan	Sriganganagar	Hanumangarh	Rajasthan	Sriganganagar	Hanumangarh	Rajasthan	Sriganganagar	Hanumangarh
Pearl Millet	-2.8	2.1	-8.5	-0.2	3.5	-12.8	2.6	1.3	-4.8
Paddy	8.3	4.6	5.6	10.8	5.3	3.9	2.3	0.7	-1.6
Cotton	3.5	-3.2	-0.1	7.5	2.6	3.1	3.8	6	3.2
Cluster bean	2.1	11.2	7.1	7.8	20.2	-2.3	5.3	8.3	-8.7
Wheat	1.7	2	1	3.4	3.7	4.7	1.7	1.6	3.7
Mustard	0.5	-1.3	3.2	2.7	0.4	3.5	2.1	1.8	0.3
Chickpea	2.3	-1.8	-5.2	7.4	2.3	0.6	4.9	4.2	6.2

* All values significant at 1% level of significance

Cropping pattern changes over time in Sriganganagar district

Over time, changes in cropping pattern take place due to agro climatic reasons and incidence of insect pest attacks & diseases. For this, quinquennial changes in 20 years data on area, production and productivity were studied. Table 3 &

Table 4 indicate quinquennial changes in cropping pattern in absolute as well as percentage terms in Sriganganagar district. There were 4 quinquennial periods; Period I (1999-00 to 2003-04), Period II (2004-05 to 2008-09), Period III (2009-10 to 2013-14) and Period IV (2014-15 to 2018-19).

Table 3: Quinquennial changes in cropping pattern over time in Sriganganagar district (ha)

Year	Paddy	Pearl millet	Cotton	Wheat	Mustard	Chickpea	Others	Total
Period I	4229 (0.47)	6234 (0.69)	213466 (23.56)	205602 (22.69)	200637 (22.14)	76369 (8.43)	199527 (22.02)	906063 (100)
Period II	3612 (0.37)	13981 (1.44)	147057 (15.13)	189904 (19.54)	272353 (28.02)	89682 (9.23)	255334 (26.27)	971924 (100)
Period III	8402 (0.76)	6703 (0.60)	126605 (11.39)	239381 (21.54)	247744 (22.29)	91447 (8.23)	391026 (35.19)	1111308 (100)
Period IV	11671 (0.92)	7085 (0.56)	97725 (7.70)	260666 (20.54)	222095 (17.50)	77721 (6.12)	592318 (46.67)	1269280 (100)

*Figures in parentheses are corresponding to percentage

Source: Ministry of Agriculture and Farmers Welfare, 2019

It is inferred from Table 3 that area under paddy crop has decreased from 4229 ha to 3612 ha during period II and in period III & IV, it registered continuous increase from 8402 ha in period III to 11671 ha in period IV. Further, table shows that area under pearl millet crop has increased from 6234 to 13981 ha during period II and in period III & period IV, area under pearl millet decreased as compared to period II. Area

under cotton crop has been continuous decreasing from 213466 to 97725 ha during period I to period IV. Table further shows that area under wheat crop has decreased from 205602 to 189904 ha during period II and in period III & IV, it registered continuous increase from 239381 ha in period III to 260666 ha in period IV. The table reveals that area under mustard crop has increased from 200637 to 272353 ha during

period II and in period III & IV, it registered continuous decrease from 247744 ha in period III to 222095 ha in period IV. Further the table reveals that area under chickpea crop has been continuous increasing from 76369 to 91447 ha during period III, and in period IV it decreased from 91447 to 77721 ha. These fluctuations in area under various crops over time may be due to rainfall pattern, price situation in the market and incidence of insect-pest/diseases.

The analysis of Table 4 reveals that there was reduction in area under paddy in period II (-14.6%) as compared to period I. However, there was an increase in area under paddy in period III to the extent of 132.6% over period I. However this increase in area slowed down to 38.9% in period IV (38.9%) over period I. Further table shows that area under pearl millet in period II increased (124.3%) as compared to period I. However, there was decrease in area under pearl millet in

period III to the extent of -52.1% over the period I. However, the increase in area was 5.7% in period IV. Area under cotton crop decreased in period II (-31.1%) as compared to period I. There was also reduction in area in period III (-13.9%) and period IV (-22.8%) over the period I. Further, table shows that area under wheat crop decreased in period II (-7.6%) as compared to period I. However, there was an increase in period III to the extent of 26.1% over the period I. This increase in area slowed down to 8.9% in period IV over period I. Area under mustard crop increased in period II (35.7%) as compared to period I. Area under mustard crop decreased continuously in period III (-9.0%) and in Period IV (-10.4%). Area under chickpea crop increased in period II (17.4%) as compared to period I. However, it slowed down in period III (2.0%) but there was decreased in period IV (-15.0%).

Table 4: Quinquennial changes in cropping pattern over time in Sriganaganar district (Percent)

Year	Paddy	Pearl millet	Cotton	Wheat	Mustard	Chickpea	Others
Period I	-	-	-	-	-	-	-
Period II	-14.6	124.3	-31.1	-7.6	35.7	17.4	28.0
Period III	132.6	-52.1	-13.9	26.1	-9.0	2.0	53.1
Period IV	38.9	5.7	-22.8	8.9	-10.4	-15.0	51.5

Source: Ministry of Agriculture and Farmers Welfare, 2019

Cropping pattern changes over time in Hanumangarh district

For this, quinquennial changes in 20 years data on area, production and productivity were studied. Table 5 & Table 6 indicate quinquennial changes in cropping pattern in absolute as well as percentage in Hanumangarh district. It is inferred from Table 5 that area under paddy crop has decreased from 28398 to 18504 ha during period II and in period III & IV, it registered continuous increase from 22860 ha in period III to 32262 ha in period IV. The table shows that area under pearl millet crop has increased from 75611 to 82388 ha during period II and in period III & period IV area under pearl millet decreased from 56843 ha in period III to 34507 ha in period IV. Table further shows that area under cotton crop has decreased from 150687 to 149368 ha during period II and in

period III increased from 149368 to 169099 ha. In period IV, area decreased from 169099 to 168324 ha. The area under wheat crop has decreased from 194197 to 188680 ha during period II and in period III & IV, it registered continuous increase area from 234841 ha in period III to 245764 ha in period IV. Table shows that area under mustard crop has increased from 77213 to 123627 ha during period II, in period III, it registered decrease from 123627 to 97930 ha. In period IV, area increased from 97930 to 115992 ha. Area under chickpea crop has increased from 130256 to 169032 ha during period II, and in period III to IV it registered continuous decrease from 169032 to 96899 ha. These fluctuations in area under various crops over time may be due to rainfall pattern, price situation in the market and incidence of insect-pest/diseases.

Table 5: Quinquennial changes in cropping pattern over time in Hanumangarh district (ha)

Year	Paddy	Pearl millet	Cotton	Wheat	Mustard	Chickpea	Others	Total
Period I	28398 (2.91)	75611 (7.75)	150687 (15.45)	194197 (19.91)	77213 (7.92)	130256 (13.35)	319087 (32.71)	975448 (100)
Period II	18504 (1.62)	82388 (7.19)	149368 (13.04)	188680 (16.47)	123627 (10.79)	169032 (14.75)	414148 (36.15)	1145746 (100)
Period III	22860 (1.91)	56843 (4.75)	169099 (14.15)	234841 (19.64)	97930 (8.19)	134147 (11.22)	479733 (40.13)	1195453 (100)
Period IV	32262 (2.52)	34507 (2.70)	168324 (13.17)	245764 (19.23)	115992 (9.08)	96899 (7.58)	583971 (45.70)	1277719 (100)

*Figures in parentheses are corresponding to percentage

Source: Ministry of Agriculture and Farmers Welfare, 2019

The analysis of Table 6 reveals that there was reduction in area under paddy in period II (-34.8%) as compared to period I. However, there was an increase in area under paddy in period III to the extent of 23.5% over period I. There was increase in area to the extent of 41.1% in period IV. Further, Table revealed that area under pearl millet in period II increased by 9.0% as compared to period I. However, there was decrease in area in period III (-31.0%) and in period IV (-39.3%). Table shows area under cotton crop registered decline in period II (-0.9%) as compared to period I. However, there was increase in area in period III (13.2%). However, there was decrease (-0.5%) in period IV. The table shows that area

under wheat crop decreased period II (-2.8%) as compared to period I. However, there was an increase in area under wheat in period III to the extent of 24.5% over period I. This increase in area slowed down to 4.7% in period IV over period I. Area under mustard increased in period II (60.1%) as compared to period I. In period III area under this crop decreased to the extent of -20.6%. However there was increase in area in period IV (18.4%). Area under chickpea crop increased in period II (29.8%) as compared to period I. However, there was decrease in period III (-20.6%) and in period IV (-27.8%).

Table 6: Quinquennial change in cropping pattern over time in Hanumangarh district (Percent)

Year	Paddy	Pearl millet	Cotton	Wheat	Mustard	Chickpea	Others
Period I	-	-	-	-	-	-	-
Period II	-34.8	9.0	-0.9	-2.8	60.1	29.8	29.8
Period III	23.5	-31.0	13.2	24.5	-20.8	-20.6	15.8
Period IV	41.1	-39.3	-0.5	4.7	18.4	-27.8	21.7

Conclusion

Comparison of changes that occurred in growth rates and cropping pattern of major crop of Rajasthan. In the period I CAGR in area, production and productivity of pearl millet crop found positive in Hanumangarh, Sriganaganagar as well as in Rajasthan. While in second period the negative CAGR in area as well as production in pearl millet crop found. In paddy crop the area decreased in period I whereas the area did not decreased in period II. If we look at area of cotton crop in period I and period II area was reduced. The area of cluster bean crop in Kharif has increased while the area of Rabi crop wheat was in period I decreased while in period II this not decreased and area of mustard and chickpea increased in period I and II.

In Sriganaganagar district area under paddy crop has decreased during period second and in period third & forth, it registered continuous increase this same trend is follow in Hanumangarh district. Area under pearl millet crop increased in period second in both district. Area under cotton crop continuous decreased from period first to forth in Sriganaganagar district but in Hanumangarh district this is increased in period third and in forth. Area under wheat crop in both districts almost same trends follow. To increase the area of mustard crop in both districts, in period second after that has decreased, the area of in fourth period this has increased in both districts. If we talk about the area of chickpea, there is no major difference in Sriganaganagar during all periods, but in Hanumangarh district, the area during the second period is increased and after that this decreased in period in third and fourth.

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