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An Analytical Study on Growth Performance of Major Food Grain and Oilseed Crops in Context of Food Security: Rajasthan, India

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ABSTRACT

Background: Productivity, as a source of growth has been a significant premise of analytical investigation in economics all along, however it gained an empirical momentum in the recent years only and has become a necessary index to growth. Present paper estimates growth rate of area, production and productivity of food grain and oilseed crops in Rajasthan.

Methods: To analyse growth performance of food grain and oilseed crops Rajasthan time series, data on area, production and yield were collected from 1976-77 to 2018-19. The time-series data were collected on area, production and yield of selected crops from the Directorate of Economics and Statistics (DES), Directorate of Agriculture (DOA) and Rajasthan State Agriculture Department. The compound growth rates (CGRs) of area, production and productivity of selected crops in Rajasthan were calculated using the exponential function.

Result: The study revealed that production, productivity and area of total food grains was recorded a positive and highly significant annual growth at the rate of 3.18%, 2.19% 0.63% per annum, respectively. The production, productivity and area of total oilseed was observed a positive and highly significant annual growth rate of 7.63%, 2.07% and 4.27% per annum, respectively. The area under barley, gram and sesamum reduced during the study period. Therefore, the technological support through the varietal improvement and extension support is required.

Key words: Area, Crops, Growth, Production, Productivity.

INTRODUCTION

Agriculture sector in India contributes as the most strategic component in the country's economy. Agricultural research plays an essential role in improving production of crops and livestock as the agricultural research system has expanded research productivity and research resource allocation, which are the issues of prime concern. Farming in India is characterized by wide differences in output and productivity growth performance amongst states and regions. For a rapid and progressive agricultural growth to meet demand of food and other raw materials, it is imperative to increase productivity growth at a sustainable rate as the scope of increasing net cultivated area is meagre. The term productivity in agriculture is often used with reference to efficiency in production of land, labour and capital separately or together. Improvements in productivity can lessen the overall burden on the subsistence farming community (Verma *et al*., 2021).

The Indian economy has undertaken essential changes over time with continuous decline in the share of agriculture in the Gross Domestic Product (GDP). Reports show that agriculture share to GDP has declined from 55.11 to 13.90 per cent between 1950-51 to 2015-16 (Verma and Singh, 2022). However, significance of agriculture could not be overlooked basically by two reasons. Firstly, even if the country achieved self-reliance in food grains production at the macro level, still there is a food deficiency in the sense of huge challenges of high occurrence of malnourished children and high frequency of rural poverty. The pressure on agriculture in terms of higher production as well as high income is tremendous. Secondly, dependence of the rural labour force on agriculture for employment has not yet reduced in proportion to the sectoral contribution towards GDP. This is the reason for widening

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of income disparity between the agricultural and non-agricultural sectors (Chand and Chauhan, 1999). Whereas, from the experiences of developed countries, it showed transfer of labour forces from agricultural to non-agricultural sector in general and towards manufacturing sector became more common. This was due to enhanced productivity growth in agriculture and hence encouraged higher income (Gollin *et al*., 2002). Under these circumstances, higher growth in agricultural productivity assumes great prominence and is a matter of alarm for policy makers and research scholars in recent times (Balakrishnan, 2000).

The aim of this study was to determine the growth of area, production and productivity of major food grain and oilseed crops in Rajasthan. This study find out the which crop area, production and productivity significantly increasing or decreasing during the study period and what is the reason behind this.

MATERIALS AND METHODS

The present investigation was based on information collected from Cost of Cultivation Scheme running in the Department of Agricultural Economics and Management, Rajasthan College of Agriculture, Udaipur. Total twenty-two crops undertaken in the scheme at national level for computation of cost of cultivation of crops for which data were collected in Rajasthan. Out of these, eleven crops were taken under the present study. The crops included namely Wheat, Barley, Bajra, Maize, gram, urad and moong. Whole Rajasthan state has been purposively selected for the study. The study was based on secondary data for the analysis. Time series data on area, production and yield per hectare of selected crops in Rajasthan were collected from the Directorate of Economics and Statistics (DES), Directorate of Agriculture (DOA) and Rajasthan State Agriculture Department (RSAD). The annual compound growth rates of area, production and productivity of selected eleven crops in Rajasthan are grouped in three periods and discussed below. As per convenience the entire study period has been divided into three periods namely first period (1976-77 to 1997-98), second period (1998-99 to 2018-19) and overall period (1976-77 to 2018-19).

Compound growth rates

The compound growth rates (CGRs) of area, production and productivity of selected crops in Rajasthan as well as across the important crops producing states were calculated using the exponential function of the following specification,

$$Y_t = ab^t \quad \ldots.(1)$$

In the log form, the above function (1) was formulated as:

$$\text{Log } Y_t = \text{Log } a + t \log b \quad \ldots.(2)$$

Where,

Y_t = Area/production/productivity of crops in the year 't'.

t = Time variable in years taking the value of 1, 2, 3.....n.

a = Intercept .

b = Regression coefficient (1+r).

r = Compound growth rate.

The compound growth rate (%) was computed using the formulation,

Compound growth rate (r) = [(Antilog of log b) -1] *100

Student 't' test was used to determine the significance of the growth rates obtained for which the following formulation was employed.

The calculated 't' values, were compared with the table 't' values and the significance was tested for 1 per cent and 5 per cent probability levels and 't' values were calculated from following formula:

$$t = \frac{\bar{X} - \mu}{\frac{S}{\sqrt{n}}}$$

$\bar{X}$ = Sample mean.

μ = Population mean.

S = Standard deviation.

n = Number of observations (Chaudhari and Pawar, 2010).

RESULTS AND DISCUSSION

Compound annual growth rates of food grains (1976-77 to 2018-19)

The annual compound growth rates of area, production and productivity of food grain crops in Rajasthan during selected period (1976-77 to 2018-19) are shown in Table 1. The production of wheat recorded highly significant and positive growth rate of 3.88 per cent per annum during the study period (1976-77 to 2018-19). It was largely attributed due to the significant improvement in productivity of wheat to the tune of 2.37 per cent per annum which was supplemented by highly significant area growth of 1.54 per cent per annum. There was also positive impact of increase in irrigated area under wheat crop. Wheat production was going upward direction over the years which shows Rajasthan framers were interested to produce wheat crop due to many factors, role of government also helps the farmers to divert farmer in wheat production. Similar results were also reported by (Gautam and Sisodiya, 2018) in their study which was conducted for wheat crop in Uttar Pradesh state. The *rabi* cereal barley showed highly significant and positive growth in production by 1.49 per cent per annum which was largely due to positive and highly significant growth in productivity by 2.50 per cent per annum though it had marginal reduction in area (-0.99 per cent per annum) during the study period from 1976-77 to 2018-19. The area of barley crop showed negative growth rate due to shifting of area to other commercial/remunerative crops. The relative growth in productivity contributed for the growth in production of barley, but area was not contributed for growth in production. Therefore, efforts should be made to enhance the productivity of barley cultivation to achieve higher production through increasing the use of improved seeds, technology transfer and quality input supply. The production of gram recorded negative annual growth by

-0.05 per cent annually which was due to negative growth in area by -0.61 per cent per annum and non-significant growth in productivity with 0.56 per cent per annum during the study period. The growth rate in production of gram during the study period was negative. It calls for concerted collaborative effort in Rajasthan state to increase the production at a higher rate, as there was limited or no scope for supply of additional land. Implementation of advanced extension services and timely input supports to the gram growers, enhances the process of growth in productivity of gram. The area and production of gram registered negative growth in study period due to varying climatic condition, lack of adequate availability of certified seed and lack of awareness of high yielding variety seed developed, low incidence of mechanized farming. These results were confirmative with (Jaslam *et al*., 2018) in their study on gram in Haryana state. The production of *rabi* maize recorded highly significant annual growth rate of 2.57 per cent per annum from 1976-77 to 2018-19. It was largely due to highly significant growth in productivity to the tune of 2.18 per cent per annum which was supplemented by highly significant area growth rate of 0.34 per cent per annum. Maize had shown positive and significant growth in area, production and productivity. Rapid expansion in area under maize crop was mainly due to its high productivity as compared to other cereals, short crop duration, wide adoption to soils and climatic conditions and its industrial use in starch industry, animal and poultry industry. These finding were also in consonance with studies done by (Acharya *et al*., 2012) in Karnataka state. The production growth of bajra registered positive and highly significant growth by 4.24 per cent per annum which was due to positive and significant growth in yield at the rate 4.26 per cent per annum. The area of bajra had shown negative and non-significant growth of -0.03 per cent per annum. However, there was increase in production and productivity for bajra during the study period. It was due to effective price support by government, favourable policy for providing inputs to farmer at subsidised rates and adoption of high yielding varieties. These results were in confirmative with (Sunita *et al*., 2017) study of bajra in Haryana state. The pulse crop urad registered highly significant and positive growth in production by 2.78 per cent per annum and it had significant growth in area by 1.68 per cent but non-significant growth was recorded in productivity by 1.07 per cent per annum. Similar finding was observed by Rijoy and Bhatt (2017). The production of moong was boosted by growth rate of 7.86 per cent during the study period, which was

Table 1: Compound annual growth rate of area, production and yield of food grain crops. (% per annum)

Crops	Period	Area	Production	Yield
Wheat	1976-77 to 1997-98	0.81 (0.79)	4.49** (0.52)	3.30** (0.37)
	1998-99 to 2018-19	2.08** (0.48)	3.83** (0.68)	2.15** (0.21)
	1976-77 to 2018-19	1.54** (0.24)	3.88** (0.21)	2.37** (0.12)
Barley	1976-77 to 1997-98	-4.38** (0.49)	-2.27 (0.60)	2.19** (0.32)
	1998-99 to 2018-19	2.43** (0.58)	4.99** (0.64)	2.79** (0.31)
	1976-77 to 2018-19	-0.99 (0.32)	1.49** (0.36)	2.50** (0.11)
Gram	1976-77 to 1997-98	-0.59 (0.88)	-0.75* (1.22)	-0.17 (0.53)
	1998-99 to 2018-19	2.15 (1.37)	4.45 (1.70)	2.25** (0.76)
	1976-77 to 2018-19	-0.61 (0.41)	-0.05 (0.55)	0.56* (0.24)
Maize	1976-77 to 1997-98	0.77** (0.20)	2.33 (1.17)	1.55 (1.09)
	1998-99 to 2018-19	-0.64 (0.29)	2.35* (0.93)	2.80** (0.78)
	1976-77 to 2018-19	0.34** (0.10)	2.57** (0.37)	2.18** (0.34)
Bajra	1976-77 to 1997-98	0.46 (0.38)	4.44* (1.80)	3.97* (1.64)
	1998-99 to 2018-19	-0.30 (0.52)	4.59* (1.70)	4.85** (1.40)
	1976-77 to 2018-19	-0.03 (0.16)	4.24** (0.62)	4.26** (0.53)
Urad	1976-77 to 1997-98	0.53 (0.42)	0.10 (1.61)	-0.40 (1.56)
	1998-99 to 2018-19	6.50** (1.73)	10.52** (2.27)	3.78** (1.14)
	1976-77 to 2018-19	1.68** (0.48)	2.78** (0.78)	1.07 (0.51)
Moong	1976-77 to 1997-98	5.20** (0.59)	6.09** (2.53)	0.86 (2.10)
	1998-99 to 2018-19	7.22** (0.88)	14.78** (3.02)	7.33** (1.82)
	1976-77 to 2018-19	5.71** (0.27)	7.86** (1.01)	2.41** (0.73)
Total food grain crops	1976-77 to 1997-98	0.40 (0.33)	2.94** (0.70)	2.00** (0.40)
	1998-99 to 2018-19	1.41** (0.39)	3.71** (0.74)	2.80** (0.36)
	1976-77 to 2018-19	0.63** (0.13)	3.18** (0.25)	2.19** (0.14)

**and *Significant at 1 and 5 per cent level of significance, respectively.

Figures in the parenthesis indicates standard error of respective coefficients.

largely attributed because of highly significant and positive growth in area and productivity by 5.71 and 2.41 per cent per annum respectively. Boost up growth in production for moong was due to adoption of improved technologies like hybrid seed and various technique of production. Consistent improvement in the yield of moong was a notable feature which shows that improved technology and implementation of government programme has paidoff in the state. These results were confirming the findings of (Avinsah and Patil, 2018) in various study of moong in Rajasthan state.

Compound annual growth rates of food grains (1976-77 to 1997-98)

Annual compound growth rate of area, production and productivity of food grain during the first period of study are given in Table 1. In cereals, the production of wheat recorded the highest and significant positive growth rate of 4.49 per cent per annum which was mainly due to highly significant positive growth in productivity by 3.30 per cent per annum and 0.81 per cent annually growth rate of area. The production of barley recorded lowest and negative growth rate among the food grains (-2.27 per cent per annum) which was largely due to negative growth in area by (-4.38 per cent per annum) in spite of positive and significant growth rate of productivity by 2.19 per cent per annum. The *rabi* cereal crop maize recorded non-significant and positive growth in production by 2.33 per cent per annum due to non-significant and positive growth in area and productivity by 0.77 and 1.55 per cent per annum, respectively. Bajra crop recorded significant and positive growth rate of production by 4.44 per cent per annum during the first period. It was due to significant and positive growth in productivity (3.97 per cent per annum) and non-significant and positive growth in area (0.46 per cent per annum). In the first period, among the cereals, wheat crop recorded paramount growth rate of production, area and productivity. Barley recorded lowest and negative growth rate of production during the first period. In pulses, the production of moong recorded highly significant and positive growth rate of 6.09 per cent per annum which was largely due to highly significant and positive growth rate of area (5.20 per cent). However, moong crop recorded non-significant growth in productivity (0.86 per cent) during the first period (1976-77 to 1997-98). Gram crop recorded significant and negative growth rate of production (-0.75 per cent per annum) due to non-significant and negative growth in area and productivity (-0.59 and -0.17 per cent per annum), respectively. Urad crop recorded non-significant and positive growth rate of production (0.10 per cent per annum) and area (0.53 per cent per annum) but negative and non-significant growth recorded in productivity (-0.40 per cent per annum) during the first period of study. The reduction in annual compound growth rate of area, production and productivity for gram and productivity of urad crop during the first period was as a result of deteriorating production base. Most of the cultivated areas have started showing signs of stress with production fatigue and deterioration of soil. The diseases (wilts, root rots, stem rots, downy mildews, powdery mildews, leaf spots, blights, rusts, mosaics and stunted growth resulting from attack by root knot nematodes) caused by fungi, bacteria, viruses and nematodes adversely affected the yielding potential of gram and urad crop.

Compound annual growth rates of food grains (1998-99 to 2018-19)

The annual compound growth rates of area, production and productivity of food grain crops in second period (1998-99 to 2018-19) are given in Table 2. The *rabi* cereal crop wheat recorded highly significant and positive growth rate of production, area and productivity *i.e*. 3.83, 2.08 and 2.15 per cent per annum, respectively during the second period. Barley recorded highly significant and positive growth rate of production by 4.99 per cent per annum which was largely due to highly significant and positive growth in area and productivity (2.43 and 2.79 per cent per annum, respectively). In production, maize and bajra crop recorded significant and positive growth (2.35 and 4.59 per cent per annum, respectively) mainly due to highly significant and positive growth in productivity (2.80 and 4.85 per cent per annum, respectively). The maize and bajra crop recorded marginally negative growth in area by - 0.64 and -0.30 per cent per year, respectively in the time of study period. When we compare growth rate of different cereal crops in second period, bajra crop showed the highest growth rate in production and yield and barley recorded highest growth rate in area. All pulses recorded positive growth rate in production and yield during second period (1998-99 to 2018-19). The production and area of gram recorded the non-significant with positive growth rate by (4.45 and 2.15 per cent per year), respectively and significant positive growth rate of productivity (2.25 per cent per annum) was recorded. The urad and moong crop recorded positive and highly significant growth rate in production, area and productivity by (10.52, 6.50 and 3.78 per cent annually and 14.78, 7.22 and 7.33 per cent annually), respectively.

Compound annual growth rates of oilseeds and cash crops (1977-78 to 2018-19)

The compound growth rates of area, production and productivity of oilseed and cash crops in Rajasthan during overall period (1977-78 to 2018-19) are given in Table 2. The production of rapeseed and mustard recorded highly significant and positive growth rate of 7.38 per cent per annum largely due to highly significant and positive growth in area by 4.93 per cent per annum with highly significant and static growth in productivity by 2.40 per cent per annum during the period (1976-77 to 2018-19). The increased industrial and domestic demand for mustard seed oil induced an increasing trend in production of the rapeseed and mustard crop in Rajasthan. Moreover, high domestic demand for it was also one of the reasons for the rise in production. Results of present investigation corroborate with the finding of Pandey and Rai (2018) in rapeseed and mustard in

Table 2: Compound annual growth rate of area, production and yield of oilseed and cash crops during the period 1976-77 to 2018-19.

(% per annum)

Crops	Period	Area	Production	Yield
Rapeseed and Mustard	1976-77 to 1997-98	12.91** (0.64)	15.90** (1.17)	2.74** (0.59)
	1998-99 to 2018-19	1.45 (0.90)	3.84** (1.09)	2.35** (0.40)
	1976-77 to 2018-19	4.93** (0.56)	7.38** (0.65)	2.40** (0.18)
Soybean	1976-77 to 1997-98	18.65** (1.83)	22.32** (1.77)	3.42** (0.50)
	1998-99 to 2018-19	3.67** (0.59)	3.99** (1.21)	0.30 (1.08)
	1976-77 to 2018-19	11.07** (0.74)	12.62** (0.88)	1.53** (0.31)
Sesamum	1976-77 to 1997-98	0.20 (0.88)	3.60 (2.86)	3.30 (2.01)
	1998-99 to 2018-19	1.31 (1.21)	7.01* (2.68)	5.61** (1.96)
	1976-77 to 2018-19	-0.47 (0.37)	2.78* (0.97)	3.15** (0.69)
Total oilseed crops	1976-77 to 1997-98	9.46** (0.47)	15.29** (0.96)	3.10** (0.41)
	1998-99 to 2018-19	1.90* (0.73)	3.87** (1.04)	1.62* (0.64)
	1976-77 to 2018-19	4.27** (0.39)	7.63** (0.59)	2.07** (0.19)

**and *Significant at 1 and 5 per cent level of significance, respectively.

Figures in the parenthesis indicates standard error of respective coefficients.

Uttar Pradesh. The production of soybean registered a impressive positive and highly significant growth at the rate of 12.62 per cent per annum with highly significant and positive growth in area and productivity by 11.07 and 1.53 per cent per annum, respectively. The technology mission programme implemented for oilseeds during mid -1980s and suitable market situations for soybean crop encouraged the farmers towards soybean cultivation. The *rabi* oilseed sesame registered significant and positive growth in production by 2.78 per cent per annum which was largely due to highly significant growth in productivity by 3.15 per cent per annum. Although sesamum recorded negative growth in area by -0.47 per cent per annum. Similar results reported Gupta *et al*. (2015).

The production of total oil seeds recorded highly significant growth in production by 7.63 per cent per annum which was largely due to highly significant and positive growth in area and productivity (4.27 and 2.07 per cent per annum, respectively).

Compound annual growth rates of oilseed and cash crops (1976-77 to 1997-98)

The annual compound growth rates of area, production and productivity of oilseeds and cash crops in Rajasthan during first period (1976-77 to 1997-98) are given in Table 2. The rabi oilseed crop rapeseed and mustard recorded highly significant and positive growth in production by 15.90 per cent per annum due to highly significant and positive growth in area by 12.91 per cent per annum with static increase in productivity by 2.74 per cent per annum. The production of soybean was boosted the growth at the rate of 22.32 per cent per annum during the first period. It was largely due to highly significant and positive growth in area and productivity by 18.65 and 3.42 per cent per annum, respectively. The rapeseed and mustard recorded non significant and positive growth of production, area and yield (3.60, 0.20 and 3.30 per cent per annum, respectively) during the first period.

Compound annual growth rates of oilseeds and cash crop (1998-99 to 2018-19)

The compound growth rates of area, production and productivity of oilseeds and cash crop in second period (1998-99 to 2018-19) are given in Table 2. All oilseed crops recorded significant positive growth rate in production during the period 1998-99 to 2018-19. The production of rapeseed and mustard recorded highly significant and positive growth by 3.84 per cent per annum which was due to highly significant and positive growth in productivity by 2.35 per cent per annum. It had recorded non-significant and positive growth in area by 1.45 per cent per annum. The production of soybean observed highly significant and positive growth rate of 3.99 per cent per year during the period (1998-99 to 2018-19). It was largely attributable to the highly significant growth in area to the tune of 3.67 per cent per annum. The yield of soybean recorded non significand and positive growth of 0.30 per cent per annum. Sesamum crop recorded significant and positive growth in production by 7.01 per cent per annum. It was mainly due to highly significant and positive growth in productivity by 5.61 per cent per annum while sesamum crop recorded non significant growth of area by 1.31 per cent per annum.

The production of total oil seeds recorded highly significant growth in production by 3.87 per cent per annum which was largely due to significant and positive growth in area and productivity by 1.90 and 1.62 per cent per annum, respectively.

CONCLUSION

The foregoing analysis indicated that production of total food grain was recorded a positive and extremely significant annual growth (3.18 per cent) which was largely attributable

by highly significant and positive growth in productivity and area by 2.19 and 0.36 per cent per annum, respectively. The production of total oil seeds recorded highly significant growth in production by 7.63 per cent per annum which was largely due to highly significant and positive growth in area and productivity (4.27 and 2.07 per cent per annum, respectively). Significant changes have been observed in food grain and oil seed crops cultivation over the past decades in Rajasthan, largely driven by the crop yield enhancement to meet the demand for food due to the increase in population. The area of barley, gram and sesamum crop showed negative growth rate in area due to shifting of area to other commercial/remunerative crops. Therefore, efforts should be made to enhance the area of these crops by efficient technological breakthrough to increase productivity by evolving varieties which sustain in adverse monsoon conditions.

Conflict of interest

All authors declare that they have no conflicts of interest.

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