Growth and variability of rice in Raisen district of Madhya Pradesh

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ABSTRACT

The present study was undertaken in Raisen district of Madhya Pradesh using the secondary collected data of area, production and productivity to estimate the variability in area, production and productivity, to find out the trend and growth rates of area production and productivity and to identify the major factors affecting the production and productivity of rice. Coefficient of variation was used to find out the variability in growth rate and least square method for the trend analysis and fitting the linear model. It was found that high variability in production of rice was mainly due to variability in area and productivity in the study area. The growth in area of paddy has positive and significant impact on production and productivity in all the tehsils except Udaipura. Near about 89 per cent of variation of yield of paddy was contributed by all four variables like net irrigated area, gross irrigated area, irrigated area of rice and irrigated area of HYV rice in the study area.

Key words: Growth, variability, area, production, productivity

South Asian countries have achieved tremendous progress in cereal production through Green revolution in the last decades (Alauddin and Quiggin, 2008). The region's total production assumed to be increased by 18 percent between the period 2000 and 2010 (Katherine et al., 2012). Rice a major cereal crop is a means of livelihood for millions of Indians and plays vital role in food security. Rice is principally grown in the Indo-Gangetic plains with ground water as a principal source of irrigation (Samra et al., 2004). Significant change in global climate effects local agriculture which ultimately influences the world's food security. Indian agriculture has wide variations in growth performance for about six decades after independence. The variability of rice yield was due to the subsistence nature of farming in India and heavy dependence on monsoon and other climatic parameters. After green revolution, technologies has been improved many fold. The trend growth rates of cereals, pulses and oilseed are due to improved seeds associated with adoption of modern cultivation practice. Among the cereals, rice and wheat have shown a sharp increase in production. Improved technology, agricultural practices, high-

yielding varieties, plant protection measures, chemical fertilizers, and mechanization have been the drivers of increased production per unit area of farm land (Hobbs and Morris, 1996). Everywhere in India, production trend is not similar. Hazell (1984a) has shown a decrease in production stability in some areas. Rice productivity has been varied mainly due to variation in production, area, germplasm, variety and climate. Yield variation is a major cause of productivity variation of cereals (Larson et al., 2004).

Madhya Pradesh agriculture growth rate had been 18 per cent during year 2011-12. The total agriculture production in Madhya Pradesh was 142.45 lakh million tonnes in the year 2002-03 which has been increased to 254.86 lakhs million tonnes in the year 2010-13. The growth rates in area yield and production for cereal secured a different micro-farming situation of Madhya Pradesh. The technical advancement resulted higher productivity of rice specially, Raisen District. Agricultural activities are carried out in two seasons namely rainy and winter. In district Raisen, there found great deal of variation in productivity of rice from block to block. Variation of area, production

was assumed in that district. Keeping in this view, the following objectives were undertaken, to find out the trend and growth rates of area, production and productivity of rice, to estimate the variability in area, production and productivity, to identify the major factors affecting the production and productivity.

The specific methods concern to the analysis of time series data related to area, production and productivity of paddy. Seven tehsils namely Raisen, Gouharganj, Begamganj, Gairatganj, Silwani, Udaipura and Bareli were selected randomly from Raisen district. The Secondary data of area, production and productivity of rice were collected from District Agriculture Office, Statistical Office and different published and unpublished records of District. The study covered a period from the year 2002-03 to 2011-12. The mean was worked out by using the time series secondary data, on production of selected crops. To measure the magnitude of variability in each of the three variables-area, production and productivity the coefficient of variation (C.V.) was computed using formula

$$S.D. = \frac{\sum Y^2 - \left(\sum Y\right)^2 / N}{N}$$

Where,

Y= area, production and productivity,

N= Number of observation (years)

To study of the growth rates of paddy was carried out using least square method. The following linear model was fitted to area, production and productivity.

$$Y = a \pm Bx + E$$

Where,

Y= Area/production/productivity

a= Constant or intercept value

b = Regression coefficient

x = Time period

E = Error term with mean zero and constant variation

Where regression coefficient 'b' was worked out as follows

$$t = b/SE \text{ of } b$$

The intercept value 'a' was estimated as following formula

$$a = y - bX$$

The linear growth rates of area, production of rice has been worked out by fitting the linear function.

Linear growth rate (%) = $b / \bar{y} \times 100$

b=Trend value

$\bar{y}$ = Average of production

The determinants of Yield rice crops were estimated multiple linear equation

$$Y = a + b_1 X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4$$

Where,

Y is rice yield in kg/ha

X_1 is net irrigated area

X_2 is total irrigated area;

X_3 is gross sown area of rice

X_4 is gross sown area of rice Hybrid

a is constant

b_i is respective regression coefficients of independent variables.

The variability in area, production and productivity of paddy in different tehsils of the district is given in Table 1. It was found that more the cultivated area variability more is the production and productivity variability of rice in all the tehsils of Raisen district except bareli tehsil. Area variability ranges from 21 to 47% in different tehsils. Rice is grown in an area of 20.76 thousand hectare in the district. It was revealed that Bareli tehsil was the main paddy growing area

Table 1. Extent variability in area, production & productivity of rice in different tehsils of Raisen district.

Tehsils	Area		Production		Productivity	
	Mean	CV%	Mean	CV %	Mean	CV %
Raisen	654.20	30.06	11315.06	37.57	17.04	8.78
Gairatganj	66.10	24.16	1213.50	30.52	18.30	10.32
Begumganj	94.00	26.71	1749.36	36.67	18.18	11.72
Silwani	515.10	29.62	8795.68	36.28	16.84	9.58
Goharganj	4007.40	29.19	69114.74	43.47	16.78	13.59
Udaipura	110.60	46.76	2035.32	51.18	18.14	12.91
Bareli	15317.20	21.72	751102.36	70.66	44.62	54.51
Raisen District	20764.60	23.52	845326.02	66.91	21.41	21.07

accounted about 15.32 thousand hectare followed by Goharganj and Raisen tehsil. The mean of production of paddy in the district was 845.32 thousand tonnes with high variability mainly due to high acreage variability. The production and productivity variability was as high in bareli tehsil 70.66%, 54.51 and least in Gairatganj 30.52%, 8.78%.

The linear as well as compound growth rate rice area in different tehsils of Raisen district are given in Table 2. It was observed that there is a positive and significant growth in area of paddy in Udaipura, Silwani and and Raisen tehsils during the study period 2002-03 to 2011-12. The tehsil like udaipura showed highest linear growth rate of (10.61%) followed by Silwani (9.75%), Raisen (9.46%) and Goharganj (8.99%) with an overall rate of 7.51%. Compound growth rate was also highest in Udaipura (11.6%), followed by Silwani (10.72%), Raisen (9.88%), Begamganj (9.45%) and Goharganj (9.01%) the tehsil with an average growth rate of 7.68 %. From the table, it was concluded that, the area of paddy showed highest positive linear as well as compound growth rate in Udaipura tehsil and tehsils like Bareli and Gairatganj showed considerably low growth of area which are major paddy growing belt of Raisen district.

Linear as well as compound growth rate of rice yield in different tehsils are presented in Table 3. It was observed that there is a positive and significant growth rate *i.e.,* liner as well as compound growth rate. On an average linear growth rate rice production in the district was 20.92%. Bareli tehsil has highest linear

Table 2. Area growth rate of paddy in different tehsils of Raisen.

Tehsils	b' value	t' value	Linear growth rate (%)	Compound growth rate (%)
Raisen	61.89	8.88**	9.46	9.88
Gairatganj	5.08	10.26**	7.69	7.99
Begumganj	8.25	29.22**	8.78	9.45
Silwani	50.21	33.20**	9.75	10.72
Goharganj	360.46	7.33**	8.99	9.01
Udaipura	11.73	2.67*	10.61	11.06
Bareli	1062.61	10.72**	6.94	7.10
Raisen District (Total)	1560.24	10.76**	7.51	7.68

(* Significant at 5% level of significance, ** significant at 1% level of significance)

Table 3. Growth rate of paddy production in different tehsils of Raisen.

Tehsils	b' value	t' value	Linear growth rate (%)	Compound growth rate (%)
Raisen	1310.91	7.37**	11.59	11.93
Gairatganj	95.90	3.57**	7.90	7.56
Begumganj	206.64	12.47**	11.81	13.02
Silwani	1011.50	9.66**	11.50	12.55
Goharganj	8736.67	5.25**	12.64	12.38
Udaipura	261.75	3.32*	12.86	13.45
Bareli	165222.97	7.98**	22.00	28.11
Raisen District	176846.33	8.31**	20.92	25.82

growth rate (22.00%) and lowest in tehsil Gairatganj (7.905). Overall compound growth rate of rice production was 25.82% in the district. Compound growth rate of paddy production was also higher in Bareli tehsil (28.11%) followed and lowest in Silwani tehsil (12.55%).

Linear as well as compound growth rate of average productivity of paddy in different tehsil and Raisen was given in table 4. It was found from the table there was significant linear as well as compound growth rate of rice productivity in all the tehsils of the district. The linear as well as compound growth rate of paddy productivity was highest in Bareli tehsil (16.56% and 19.62%) followed by Goharganj tehsil(3.20% and 3.09%), Begamganj tehsil (3.18% and 3.26%) Udaipura tehsil (2.33% and 2.15%), Raisen tehsil (1.89% and 1.87%), Silwani tehsil (1.66% and 1.65%) while negative growth rate (linear as well as compound) was in Gairatganj (-0.23% and -0.40%). Growth in yield is more important than that of area and production because it serve as a barometer to gauge the technical development of a crop over a period. The foregoing

Table 4. Growth rate rice productivity in different tehsils of Raisen.

Tehsils	b' value	t' value	Linear growth rate (%)	Compound growth rate (%)
Raisen	0.32	2.44*	1.89	1.87
Gairatganj	-0.04	-0.19	-0.23	-0.40
Begumganj	0.58	4.08**	3.18	3.26
Silwani	0.28	1.74	1.66	1.65
Goharganj	0.54	2.87*	3.20	3.09
Udaipura	0.42	1.85	2.33	2.15
Bareli	7.39	6.62**	16.56	19.62
Raisen District(Total)	1.35	6.19**	6.33	6.46

Table 5. Factors affecting variation in rice yield.

Tehsils	Constant	Net irrigated area	Total irrigated area	Total irrigated area of rice	Total irrigated area of HYV rice	R^2
Raisen	8.5142	0.001	-0.0007	0.0055	-0.0023	0.5512
Gairatganj	84.1064*	-0.0009	-0.0043*	0.7021**	-0.5468	0.8374
Begumganj	11.4219	-0.0013	0.0013	0.0556	0.0944	0.794
Silwani	43.1242*	-0.0014	-0.0003	0.0712	-0.384	0.702
Goharganj	10.1396	0.0001	0	0.0024	0.0012	0.6144
Udaipura	7.4168	-0.0011	0.0004	0.1502	0.437	0.431
Bareli	-258.3609*	-0.001	-0.0029	0.1649	0.0035	0.9451
Raisen District	19.1561	0	-0.0005	0.0188	0.0005	0.8952

discussion reveals that growth rates of area and production of paddy were not only considerably high in Bareli and Udaipura and Goherganj tehsil but also its overall growth rates of production were as high as 25.82%. It did not follow the same trend in tehsil as per productivity growth concerned, it is due to the current higher prices of paddy have given boost to its area and production, inadequate and non adoption of modern techniques of farming .As paddy crop is a rain fed crop, sufficient and timely rainfall is an essential per-requisite for a good harvest.

Factors affecting rice yield has been shown in the Table 5. It was found that none of the variables emerged as the most important factors in determining yield variation for paddy at district level. However, at tehsil levels, total irrigated area Gairatganj tehsil exhibited negative and significant impact on yield of paddy, while net irrigated area showed negative and irrigated area (rice) positive and highly significant influence on yield of paddy. About 89.5 % variation was explained by all the four independent variables in Raisen district. Four independent variables were net irrigated area, total irrigated area, irrigated area of rice, irrigated area of HYV of rice. Therefore, any crop planning in this regard should follow above observation to obtain higher returns and minimum risk in the productivity of paddy.

High variability in production of paddy was mainly due to high acreage variability rather than productivity variability. Both the production and productivity variability was mainly due to the variation in cultivation area. A positive and significant growth in area i.e. both linear and compound growth of paddy in Udaipura, Silwani and Raisen tehsils was seen during the study period 2002-03 to 2011-12. There is a positive and significant growth rate *i.e.,* liner as well as compound growth rate of production and productivity

in all the tehsils of Raisen district due to introduction of hybrid technology. None of the variables emerged as the most important factors in determining yield variation for paddy at district level. However, at tehsil levels, total irrigated area Gairatganj tehsil exhibited negative and significant impact on yield of paddy, while net irrigated area showed negative and irrigated area (rice) positive and highly significant influence on yield of paddy

High Variability in production and productivity of rice was mainly due to variability in area in the study area except udaipura tehsil. Tehsil bareli has shown highest variation in yield of rice due to highest variation in area of rice *i.e.,* net irrigated area. Net irrigated area of rice had positive and significant impact on yield of paddy. Near about 89 per cent of variation in yield of paddy was contributed by all four variables like net irrigated area, gross irrigated area, irrigated area of rice and irrigated area of HYV rice in the study area out of which about 94.5 percent variation was in tehsil bareli. Some of the other variables like rainfall during crop season, fertilizer consumption determining the yield of rice. It was suggested that an efficient and effective analysis of the impacts of area variability requires a good understanding of the systems processes involved in growth, development and production of crop like rice which allows an excellent assessment of the vulnerability of the production systems.

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