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Growth and Instability of Rice Production in Vidarbha Region of Maharashtra State

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Abstract

The study is based on secondary data collected from various publications for the period 1990-91 to 2010-11. The performance of paddy crop in different districts of Eastern Vidarbha region is studied by estimating growth rates of area, production and productivity using "Exponential function". Co-efficient of variation and Coppock's Instability Index has been computed to measure the degree of instability in productivity of rice. Similarly, Nerlovian lagged adjustment model is estimated to know the various factors affecting the acreage planted under the rice crop.

In case of area under paddy for the period-I (1990-91 to 2000-01) and period-II (2001-02 to 2010-2011) almost all districts shows non-significant growth except for Gadchiroli district where very low and positive growth was observed. The growth in paddy production was negative and non-significant in almost all districts for different periods except for Chandrapur district for period-II where significant negative growth was observed. Similar picture of negative and non-significant growth was obsersved in case of productivity of paddy except for Chandrapur and Eastern Vidarbha for period-II where significant negative growth were observed. The variability in area of paddy was highest in Chandrapur and lowest in Gadchiroli District. Eastern Vidarbha as a whole has observed constant variability; it means that the area under paddy is stagnant. In general Eastern Vidarbha has shown cosntant instability in area for different periods. Chandrapur and Bhandara districts shows high variability in the production of paddy for various time period. Similarly, Bhandara districts has observed the highest Coppock's instability index for period-I.

In case of productivity lowest variability was observed in Bhandara district for period-II. In general it is observed that variability and instability was found lower in period-II in all districts as compare to period-I. In acreage response model, lagged year price of paddy and gross irrigated area were found positively significant for Bhandara district for overall period of study. In cast of Chandrapur district lagged year area found negatively significant i.e. lagged year area is negatively affecting the acreage allocation of paddy. However, in Gadchiroli district, lagged year price and price risk were positive and significant impact on acreage allocation of paddy.

In forgoing analysis for overall period area, production and productivity of has shown non-significant growth. For acreage allocation of rice, lagged year price, lagged year area, gross irrigated area, and price risk has significant effect.

Keywords: Growth, Instability, lagged year price, Price risk

Introduction

Rice occupies a prominent place in Indian agriculture. The area under rice in the country is the largest accounting for about 1/3 of the world area under the crop. India ranks second in term of its production, next to Chiana. However, productivity of about 2.00 tonnes per ha. is very low as compared to 4.04 tonnes of Democratic Republic of Koria, 3.73 tonnes of Japan, 2.97 tonnes of Taiwan and 2.86 tonnes of Chiana.

Rice contributes 42 per cent of total food grain production of India. Rice commended recognition as a supreme commodity to mankind, because rice is truly life, culture, tradition and men's livelihood to million. It is an important staple food providing 60 to 70 per cent body calories intake consume.

The United Nationa General Assembly in a resolution declared the year of 2004 the International year of rice. Thus rice plays an important role in the national income. Its contributes nearly 25 per cent of gross domestic product.The agriculture output however, depends on good monsoon as nearly 60 per cent of area sown is dependent on rainfall.

Aim of the Study

The important rice growing region in Maharashtra are all districts of Konkan region and Bhandara, Chandrapur, Gadhiroli and Gondia districts of Eastern Vidarbha. The instability in productivity and production has raised many problem in paddy production. The breeder has to face the challenge of evolving new varieties which are less prone to natural calamity and insurance stability in production. With these issues in the mind, the study of growth and instability in production of rice is undertaken with following specific aims of objectives for meaningful conclusions.

1. To study the growth in area, production and productivity of rice.
2. To worked out the instability index in rice production.
3. To estimate the acreage response of rice.

Review of Literature

Bharti et al., (2003) reported the growth of pulses in India. They declared that India was a major player in the world pulses market. Brothakur and Bhattacharyya (1999) used compound growth rates which computed for area, production and productivity of rice based on the exponential function for three periods [viz., pre-green revolution period (1951-52 to 1970-71), post-green revolution period (1971-72 to 1993-94) and the total period (1951-52 to 1993-94)]. Although, the high yielding varieties were introduced in the State of Assam during 1965-66, its impact was felt only after 1971-72. Hence, the period 1951-52 to 1970-71 was considered as the pre-green revolution period. Pillai (2001) highlighted paddy productivity growth in West Bengal and Orissa. She found that input productivity had indeed played an important role in the growth performance in the 1980s and early 1990s in this region. Singh and Chandra (2001)29 analyzed the growth trends in area, yield and production of food grains in Uttar Pradesh.They found that the state of Uttar Pradesh had registered a considerable change in agricultural development during different phases of the green revolution.

Methodology

The major aspect of present study is to assess the extent of growth and instability of paddy in different districts of Vidarbha region. The study is based on secondary data collected from various official publications of Government of Maharashtra. Data is collected for the period from 1990-91 to 2010-2011. For estimating the growth rates of area, production and productivity of rice the time period has been divided into three group i.e. Period – I(1990-91 to 2000-2001),Period – II(2001-2002 to 2010-2011) and overall Period(1990-91 to 2010-2011).

Analytical Tool

The performance of rice is examined by estimating districtwise growth rates of area, production and productivity. The growth rates of area, production and productivity is studied by estimating compound growth rates for period-I, period-II and overall period of study. The growth rate is estimated using following equation -

$Y = a\, b^t$

Where

Y = area, production and productivity

t = time variable

a, b = parameters

The compound growth rate (r) is worked out by $r = (b-1) \times 100$

t - test is used to test the significance of b.

To measure the degree of instability in the area, production and productivity of paddy in different districts of Eastern Vidarbha, Coefficient of variation and Coppock's Instability Index has been computed with the help of following formulae.

Coefficient of variation

$$CV = \frac{\sigma}{\bar{x}} \times 100$$

where σ = standard deviation and

$\bar{x}$ = Arithmetic mean

Coppock's Instability Index (C.I.I.)

C. I.I. = Antilog $\left(\sqrt{V\log} - 1\right) \times 100$

Where Vlog = logarithmic variance of the series.

Acreage Response Analysis

The acreage response means the changes in acreage with the unit change in the variables affecting on during the period of study. Acreage response is studied for Bhandara, Chandrapur, Gadchiroli district and Eastern Vidarbha region as a whole.

Following Nerlovian lagged adjustment model has been used for the purpose of present study.

$A_t = b_0 + b_1 P_{t-1} + b_2 Y_{t-1} + b_3 PR + b_4 YR + b_5 I_t + b_6 W_t + b_7 A_{t-1} + e_t$

Where $b_0, b_1, ...b_7$ are the parameters of the model and e_t error term.

Dependent Variable

Total acreage planted under rice (A_t) in hundred hectares is considered as dependent variable to estimate the acreage response of paddy in different districts of Eastern Vidarbha region.

Independent Variables

Lagged Year Price (P_{t-1})

To examine the effect of price variation on the decision of area allocation under paddy, lagged year price of paddy is included in the model. It is considered in the form of farm harvest prices (Rs./qtl.) in the present study.

Lagged Year Yield (Y_{t-1})

Productivity realised in the previous year influence the acreage allocation as such this variable is considered. So lagged year yield of paddy in kg/ha is considered as independent variable in the model.

Price Risk (PR) and Yield Risk (YR)

Allocation of area under paddy depends upon the risk involved in the production of that crop.This risk is mainly involved due to variation in the price as well as variation in the yield over a period of time. In order to examine the effect of price variability and yield variability as risk factors, price risk and yield risk are considered as independent variables. These risks are calculated by taking the standard deviation of preceding three years price or yield respectively.

Gross Irrigated Area (I_t) is considered as one of the independent variable as it is used to protect the paddy crop.

Rainfall (W_t)

The amount of rainfall received before sowing period is also considered as an independent variable.The June month rainfall in (mm) is considerable as presowing rainfall.

Lagged Year Area (A_{t-1})

The area under paddy during current year is a function of its area one year back and hence one year lagged area of paddy is considered as one of the independent variable for studding acreage response relationship.

Results and Discussion

Growth in Area

The performance of paddy in Bhandara, Chandrapur and Gadchiroli districts of Eastern Vidarbha is ascertained by studding the growth rates of area, production and productivity. The growth rates of area estimated for the period 1990-91 to 2010-11 is presented in Table-1.

Table-1

Compound Growth Rates of Area of Paddy in Eastern Vidarbha

District	Period-I (1990-91 to 2000-01)	Period-II (2001-02 to 2010-11)	Overall Period (1990-91 to 2010-11)
Bhandara	0.948 (2963)	- 3.000 (3122)	0.098* (3039)
Chandrapur	- 2.730 (1629)	- 0.662 (1479)	0.903 (15.57)
Gadchiroli	0.759*** (1330)	1.199 (1380)	0.471*** (1354)
Eastern Vidarbha	-0.273 (5922)	- 0.273 (5982)	- 0.107 (5950)

Figures in Parenthesis are the Mean Area of Rice in '00' Ha

*Significant at 10% level of significance,

**Significant at 5% level of significance

***Significant at 1% level of significance

It can be observed from Table-1, that non-significant growth rates were observed in almost all districts for period-I as well period-II except for Gadchiroli district for period-I (i.e. 0.759%) and for overall period (i.e. 0.471%). Very low and positive growth were observed in almost all districts for overall period except for Chandrapur district.

Growth in Production

The growth rate of paddy production for different districts of Vidarbha is presented in Table-2.

Table-2

Compound Growth Rates of Production of Rice in Eastern Vidarbha

District	Period-I	Period-II	Overall Period
Bhandara	0.263 (3552)	- 3.854 (3921)	0.605 (3728)
Chandrapur	- 4.795 (1957)	- 5.546** (1993)	-1.008 (1974)
Gadchiroli	-2.860 (1470)	-3.724 (1533)	-0.474 (1500)
Eastern Vidarbha	-1.881 (6979)	- 4.278* (7447)	0.191 (7202)

Figures in Paranthesis are the Mean Production of Rice in M Tonnes

It can be observed from Table-2 that in general negative and non-significance growth is observed in almost all districts for different period except in Chandrapur district and Eastern Vidarbha for second period where -5.546 and -4.278 per cent significant growth is observed respectively.

Growth in Productivity

Productivity is the most important criteria in measuring the growth in the crop output.The performance of productivity of paddy in Eastern Vidarbha is presented in Table-3.

Table-3

Compound Growth Rates of Productivity of Rice in Eastern Vidarbha

District	Period-I	Period-II	Overall Period
Bhandara	-0.751 (1172)	- 1.914 (1221)	0.222 (1196)
Chandrapur	- 2.289 (1211)	- 8.246*** (1265)	1.146 (1237)
Gadchiroli	- 3.174 (1096)	-4.504 (1125)	-0.719 (1109)
Eastern Vidarbha	-1.611 (1069)	- 3.032* (1235)	0.085 (1201)

(Figures in Parenthesis are the Mean Yield of Rice in Kg/Ha)

As seen from table-3 that in Eastern Vidarbha region for various periods registered negative and non-significant growth rates except for Chandrapur (-8.246) and Eastern Vidarbha (-3.032) .

Variability and Instability in Area, Production and Productivity

Performance of a particular crop during a given time period is measured not only from the point of view of increase in area, production and productivity, but also on the extent of fluctuations taking place in the area, production and productivity of that cop. In order to examine the extent of variability in area, production and productivity, coefficient of variation is worked out. Coefficient of instability is another measure of instability besides coefficient of variation.The Coefficient of variation measures the absolute variation while instability index, measures the variation around the trend.It is a close approximation of the average year to year percentage variation adjusted for trend.Thus the variations around the trend are more pronounced than the absolute variation. The instability index for area, production and productivity of paddy is computed using Coppock's Instability Index. The results of Coefficient

of Variation and Coppock's Index are presented in Table-4 to 6.

Area

Table-4
Coefficient of Variation and Coppock's Instability Index of Area of rice in Eastern Vidarbha

District	C.V.			Coppock's Instability Index		
	Period-I	Period-II	Overall	Period-I	Period-II	Overall
Bhandara	11.83	15.06	13.81	12.33	12.39	12.37
Chandrapur	26.90	4.77	21.12	14.57	10.61	13.10
Gadchiroli	3.51	5.66	5.05	10.29	10.76	10.57
Eastern Vidrbha	9.33	7.94	8.70	11.66	11.14	11.39

As seen from Table-4 that the variability in area of paddy measured by coefficient of variation is highest in Chandrapur district for first and overall period under study. However, in Gadchiroli district lowest variability in area is observed. For Eastern Vidarbha the variability in area is more or less constant for all periods.

The Coppock's Instability Index for entire Eastern Vidarbha during overall period is 11.39 per cent.The instability index for Chandrapur and Bhandara and Gadchiroli districts are 13.10 per cent, 12.37 per cent and 10.57 per cent, respectively. In general, Eastern Vidarbha has shown constant variability in area for different periods.

Production

Table-5
Coefficient of Variation and Coppock's Instability Index of Production of rice in Eastern Vidarbha

District	Coefficient of Variation			Coppock's Instability Index		
	Period-I	Period-II	Overall	Period-I	Period-II	Overall
Bhandara	32.28	19.89	26.97	21.79	13.89	18.27
Chandrapur	36.07	23.38	30.57	15.55	14.55	15.06
Gadchiroli	24.40	22.00	24.95	15.88	14.87	15.42
Eastern Vidrbha	27.06	20.47	24.15	17.14	14.08	15.74

As revealed from Table-5 that Coefficient of Variation for Eastern Vidarbha region for overall period is 24.15per cent. Highest variability is observed in Chandrapur district for period-I.

Bhandara district has observed a highest Coppock's Instability Index of 21.79 per cent for period -I however, it is lowest (13.89 per cent) for period -II.

Productivity

Table-6
Coefficient of Variation and Coppock's Instability Index of Productivity of rice in Eastern Vidarbha

District	Coefficient of Variation			Coppock's Instability Index		
	Period-I	Period-II	Overall	Period-I	Period-II	Overall
Bhandara	28.10	12.64	21.89	18.20	11.82	15.57
Chandrapur	23.10	28.79	26.19	14.32	13.37	13.89
Gadchiroli	27.32	21.89	24.84	15.68	15.05	15.40
Eastern Vidrbha	24.61	16.06	20.92	16.02	13.04	14.70

From Table-6, it reveals that the lowest variability is observed in Bhandara district for period-II which is lower than the first period. Similar result is observed for Eastern Vidarbha region.

In case of Coppock's Instability Index lowest Instability of yield (11.82 per cent) is observed in Bhandara district for period-I. In general it is observed that variability / instability is lower in period-II as compared to period-I for all districts.

Acreage Response Model

Acreage response model is fitted to examine the effect of price and non-price factors on farmers decision in allocating the area under paddy in Eastern Vidarbha region.

Bhandara

From Table-7 it is observed that for overall period (1990-91 to 2010-11) lagged year price and gross irrigated area are found positive and significantly affecting the acreage allocation of paddy.

It is to note that gross irrigated area is found significant for all three periods.

Table-7
Acreage Response of Rice in Bhandara District

Variables	Period-I	Period-II	Overall Period
Constant	1607.307	953.020	2058.486
Lagged year price	-1.927 (2.741)	3.944** (0.549)	1.550** (0.607)
Lagged year yield	-0.0259 (0.388)	-0.602** (0.108)	- 0.0557 (0.234)
Price risk	13.582	10.172 (4.255)	3.930 (4.140)
Yield risk	0.233 (0.801)	1.026 (0.463)	0.09119 (0.555)

Gross irrigated area	1.455* (0.605)	1.002** (0.133)	0.818*** (0.234)
Pre-sowing rainfall	-1.612 (1.282)	-0.975** (0.157)	-0.536 (0.534)
Lagged year area	-0.213 (0.452)	-0.149 (0.109)	-0.241 (0.230)
R^2	0.832	0.992**	0.696**

Chandrapur

It reveals from Table-8 that only lagged year area has negative and significant effect on acreage response of paddy for overall period. However, for period-I and period-II none of the variables shown significant effect on acreage allocation of rice or paddy.

Table-8

Acreage Response of Rice in Chandrapur District

Variable	Period-I	Period-II	Overall Period
Constant	5303.890	2754.298	3301.872
Lagged year price	-0.992 (2.542)	-2.063 (0.832)	-0.616 (0.516)
Lagged year yield	0.148 (0.308)	0.001 (0.091)	0.180 (0.222)
Price risk	5.167 (10.235)	17.276 (7.907)	-2.273 (5.194)
Yield risk	-2.134 (0.937)	1.091 (0.452)	-0.961 (0.768)
Gross irrigated area	-2.724 (1.427)	-0.128 (0.384)	-0.980 (0.709)
Pre-sowing rainfall	-2.138 (1.260)	0.783 (0.327)	-0.478 (0.822)
Lagged year area	-0.397 (0.187)	-0.555 (0.376)	-0.408** (0.180)
R^2	0.866	0.912	0.442

Gadchiroli

From Table-9, it is observed that for overall period lagged year price and price risk found significant and positive impact on acreage allocation.

All independent variables shown non-significant effect on acreage allocation of paddy for period-I as well as for period-II.

Table-9

Acreage Response of Rice in Gadchiroli District

Variable	Period-I	Period-II	Overall Period
Constant	1452.322	1050.184	1174.868
Lagged year price	0.554 (0.670)	1.205 (1.476)	0.367** (0.128)
Lagged year yield	0.035 (0.90)	-0.130 (0.143)	-0.078 (0.056)
Price risk	-0.004 (1.655)	-2.085 (8.007)	2.052* (1.048)
Yield risk	-0.118 (0.145)	0.344 (0.335)	0.294 (0.152)
Gross irrigated area	0.057 (0.845)	0.007 (0.282)	-0.054 (0.046)
Pre-sowing rainfall	0.199 (0.201)	-0.469 (0.299)	-0.188 (0.142)
Lagged year area	-0.292 (0.919)	-0.010 (0.336)	0.145 (0.584)
R^2	0.881	0.867	0.584*

Eastern Vidarbha

From Table-10, it reveals that for overall period as well as for period-II non-significant results are observed. However, in case of period-I, lagged year price, price risk, gross irrigated area and pre-sowing rainfall are found significant impact on acreage allocation of rice.

Table-10

Acreage Response of Rice in Eastern Vidarbah Region

Variable	Period-I	Period-II	Overall Period
Constant	1310.587	-179.501	5668.549
Lagged year price	-9.162* (3.319)	7.002 (3.500)	1.140 (0.928)
Lagged year yield	-0.900 (0.451)	-0.718 (0.485)	-0.083 (0.456)
Price risk	46.579** (13.263)	13.393 (19.622)	4.934 (8.948)
Yield risk	0.510 (1.095)	3.019 (1.315)	-0.194 (1.274)
Gross irrigated area	2.811*** (0.739)	1.230 (0.483)	0.453 (0.353)
Pre-sowing rainfall	-8.692** (2.192)	-1.547 (1.087)	-0.502 (1.349)
Lagged year area	-0.233 (0.250)	-0.006 (0.569)	-0.214 (0.277)
R^2	0.980	0.924	0.314

Conclusion

The conclusions of the study are summarise as given below

1. In case of area under paddy for the period-I (1990-91 to 2000-01) and period-II (2001-02 to 2010-2011) almost all districts shows non-significant growth except for Gadchiroli district where very low and positive growth was observed.
2. The growth in paddy production was negative and non-significant in almost all districts for different periods except for Chandrapur district for period-II where significant negative growth was observed.
3. Similar picture of negative and non-significant growth was observed in case of productivity of paddy except for Chandrapur and Eastern Vidarbha for period-II where significant negative growth was observed.
4. The variability in area of rice was highest in Chandrapur and lowest in Gadchiroli District. Eastern Vidarbha as a whole has observed constant variability, it means that the area under paddy is stagnant. In general Eastern Vidarbha has shown constant instability in area for different periods.
5. Chandrapur and Bhandara districts shows high variability in the production of paddy for various time period. Similarly,Bhandara districts has observed the highest Coppock's instability index for period-I.
6. In case of productivity lowest variability was observed in Bhandara district for period-II. In general it is observed that variability and

instability was found lower in period-II in all districts as compare to period-I.

7. In acreage response model, lagged year price of paddy and gross irrigated area were found positively significant for Bhandara district for overall period of study.
8. In cast of Chandrapur district lagged year area found negatively significant i.e. lagged year area is negatively affecting the acreage allocation of paddy.
9. However, in Gadchiroli district, lagged year price and price risk were positive and significant impact on acreage allocation of paddy.

In general for overall period area, production and productivity of rice has shown non-significant growth.For acreage allocation of rice, lagged year price, lagged year area, gross irrigated area, and price risk has significant effect.

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