VARIABILITY AND DECOMPOSITION ANALYSIS OF CEREALS PRODUCTION ACROSS DIFFERENT AGRO-CLIMATIC ZONES OF UTTAR PRADESH

Sharad Sachan* and H.L. Singh

Department of Agricultural Economics and Management
SVP University of Agriculture and Techonology, Meerut, Uttar Pradesh, India, 250110
Email: sharad.indianeconomist@gmail.com

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Abstract: Present study in based on the secondary information collected on area, production and productivity of cereal crops grown among different agro climatic zones of Uttar Pradesh. The variability and decomposition analysis were analysed to measure the variation and decomposition analysis in area, production and productivity of cereals during three phases i.e 1981-82 to 2011-12. The decomposition analysis indicates increase in production of cereals was due to positive area and yield effect. The contribution of yield effect was greater than area effect in increasing the production of cereals in the state. Variability in area, production and productivity was also observed lowest i.e 1.34 per cent, 3.35 per cent and 3.43 per cent respectively during 2001-02 to 2011-12 and highest i.e 1.91 per cent, 6.17 per cent and 5.21 per cent respectively.

Keywords: Area, Cereals, Decomposition Analysis, Production, Productivity, Variability

INTRODUCTION

Agriculture is the backbone of Indian economy, contributing about 14 per cent to national GDP and providing employment to 54.8 per cent of the total work force. India occupies an important place in production of cereals, is predominant by smallholders that are characterized by low level output. Cereal crop contributes largely to achievement of food security level of a given country. Therefore, factors that affect the cereals production also have direct impacts on food security as majority of poor population depend on cereals as it is comparatively cheaper than any other form of diet. The increase in cereals production witnessed in India over the period 1950-51 to 1976-77 cannot be considered insignificant. The figure nearly 125 million tonnes for 1977-78 presents a sharp contrast to the 1950-51 production estimate of a little over 55 million tonnes. The total cereal production has increased from 2.33 per cent in the 1970`s to 2.84 per cent in the 1990`s and declined to 2.02 per cent in following decades and the same trend was experienced in the yield growth of total cereals. The share of rice and wheat to total cereals production has shown increasing trend from about 20 per cent during the 1970`s to about 57 per cent per year in total grain production during 21st century.

The negative growth rates of area under coarse grains were experienced from the period of 1970 to 2010. A higher positive growth rate registered in yield (2.54) per cent and production (1.92 per cent) during 1970`s. The decline in coarse cereals production, which is largely grown for self consumption, has occurred along with changes in consumption pattern in rural India. Such decline trend in the growth rate of food grain production during 1990`s had serious implications for national food security in recent times. Prior to green revolution, increase in food production has been achieved through the expansion of area, but during post green revolution, technological impact witnessed the shift towards rise in productivity, becomes a major factor contributing to the increase in output. However, during the 2000`s there was stagnation on both the accounts.

The stagnation in expansion of area and increase in productivity has forced us to give emphasis on variability and decomposition analysis. Instability associated growth not only hampers the agricultural development, but also reduces the economic health of the country, where agriculture still constitutes a sizeable proportion of the gross domestic product. So, it is always desirable to maintain higher rise in farm production with minimum variability in order to achieve sustained economic growth. Sometime, it is argued that high growth rate is associated with higher degree of instability. Again, variability in production affects both producers and consumers along with intermediaries involved in the movement of products through price fluctuations. Instability in agriculture and food production is also important for food management and macroeconomic stability. Although natural factors are mainly responsible for fluctuations in agriculture production but influence of technological factors cannot be also ignored. However, the impact of new technology on instability in agriculture and food production has not been quite clear and has remained a matter of concern. Whereas the decomposition analysis will allow us to understand the reason for the decrease or increase of production on the basis of three parameters i.e area, yield and their interaction. Keeping in view the present study is an attempt to examine variability in area, production and productivity and decomposition analysis of cereals.

*Corresponding Author

DATA BASE AND METHODOLOGY

Uttar Pradesh was selected purposively for the present study and divided into nine agro-climatic zones (NARP classification). The secondary data was collected and utilized for arriving at various conclusions of the study which was collected from different publications of Directorate of Agriculture Statistics, Uttar Pradesh and other related sources. The collected data was categorized, classified and then tabulated as per need and then suitable statistical tools and techniques were employed to analyse them. The statistical tools employed were:

Variability: Instability in area, production and productivity of cereal crops is measured in relative terms by the Cuddy-Della Valle index which is used in recent years by a number of researchers as a measure of variability in time series data. The simple coefficient of variation over estimates, the level of variability in time-series data characterized by long-term trends and the Cuddy-Della Valle index corrects the coefficient of variation. The variability index is given as:

Variability = $C.V.\times \sqrt{1} - R^2$

Where, $C.V.= \frac{\text{standard deviation}}{\text{Mean}} \times 100$

R^2 is coefficient of multiple determinations.

Decomposition Analysis: To determine the extent of relative contribution of area, yield and their interaction on the change in production of cereals, decomposition analysis is employed as suggested by Bastine et al. (1994)

The following additive scheme of decomposition was used:

$\Delta P = A_0\Delta Y + Y_0\Delta A + \Delta A\Delta Y$

Where,

A_0 = Total area under crops in base period

Y_0 = Total yield under crops in base period

$\Delta P/ \Delta Y/ \Delta A$ = Average difference in total production/ yield/ area during two periods.

RESULT AND DISCUSSION

The perusal of table 1 shows variability in area, production and productivity of cereal crops in the state and across different agro-climatic regions. It is the state as a whole overall variability, was estimated to be 2.23 per cent in comparison to 1.91 per cent, 1.34 per cent, and 1.77 per cent during the I, II and III phase respectively. Across the region variability as specified was found highest 4.48 per cent in Bhabhar and Tarai Zone and lowest 1.07 per cent in the Eastern Plain Zone during the first phase (1981-90). In the second phase (1991-2000) the same was varying from 0.91 per cent (Central Zone) to 4.92 per cent (Vindhayan Zone). Similarly in the III phase (2001-2011) it was found to be highest 6.58 per cent (Vindhyan Zone) and minimum 0.67 per cent in North Eastern Plain Zone. Overall growth across the region was observed to be highest 12.17 per cent in Vindhayan Zone and lowest 1.52 per cent in North Eastern Plain Zone.

Table also indicates the variability in production and shows during the first phase (1981-90) was highest 9.19 per cent in Bhabhar and Tarai Zone and lowest 5.54 per cent was reported in Eastern Plain Zone. 8.96 per cent variability was in Vindhayan Zone and 2.92 per cent production variability was estimated during the second phase. In the third phase more variation in production was to be observed than I and II. Overall variability in production was highest 32.08 per cent in Vindhayan Zone and 7.10 per cent in Western Plain Zone. State as a whole it was 17.23 per cent.

The overall variability in productivity of cereal crops in the state was 15.85 per cent, which was 4.30 per cent, 3.43 per cent and 5.21 per cent during I, II and III phases respectively. The overall variability across different zones, Vindhayan Zone shows highest 22.96 per cent variability and minimum in Bundelkhand Zone. During I and II phase, no more variation was observed while in the third phase yield variability was found from 3.75 per cent to 17.09 per cent.

Decomposition analysis of cereals production is showed in the table 2. The result from the table shows that there was increase in production in the state during the Phase I, Phase II, Phase III and overall situation due to positive area and yield effect. The yield effect has the major contribution in increasing the production than area effect.

In phase I, the production of cereals increased throughout all the regions of the state i.e. Western Plain Zone, South Western Semi-Arid Zone, Bhabha and Tarai Zone, Bundelkhand Zone and North Eastern Plain Zone due to low negative area and high positive yield effect and Mid-Western Plain Zone, Central Zone, Eastern Plain Zone and Vindhayan Zone indicates positive area and yield effect.

In phase II, increase in production throughout all the regions. In South Western Semi-Arid Zone, Mid-Western Plain Zone, Bhabhar and Tarai Zone, Central Zone, Eastern Plain Zone, Vindhayan Zone and North Eastern Plain Zone is due to positive area and yield effect while in case of Western Plain Zone and Bundelkhand Zone due to low negative area and positive yield effect. In phase III, production has increased in all the regions of the state with positive area and yield effect except the Vindhayan Zone.

The overall situation show an increase in overall production during all three phases in all the regions of the state was due to positive area and yield affect except, in North Eastern Plain Zone, it was observed negative area and positive yield effect. Mainly increase in production was more due to yield effect than area effect. Therefore, more emphasis is to be given on yield aspects of such crops.

Table 1. Variability of area, production and productivity of total cereals in different zones of Uttar Pradesh. (in percentage)

Character	Phases	Regions									State
		Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8	Zone 9	
Area	**I**	4.22	3.59	4.21	4.48	3.50	2.74	1.07	2.12	1.61	1.77
	II	2.02	1.82	3.96	3.94	0.91	2.72	4.16	4.92	0.92	1.34
	III	3.51	2.43	3.88	3.24	2.94	6.07	1.52	6.58	0.67	1.91
	Overall	11.29	4.93	6.46	5.95	3.03	9.47	3.10	12.17	1.52	2.23
Production	**I**	8.69	7.25	8.40	9.19	7.40	7.17	5.94	8.90	6.22	5.63
	II	3.56	4.19	2.92	3.52	4.05	6.44	5.49	8.96	5.89	3.35
	III	6.32	4.64	5.55	3.19	5.78	19.88	8.56	22.64	6.92	6.17
	Overall	7.10	19.88	21.33	17.87	18.09	18.33	18.07	32.08	19.17	17.23
Productivity	**I**	5.76	5.01	5.06	6.91	4.50	5.77	5.52	8.89	5.54	4.30
	II	3.47	3.63	3.41	4.18	3.86	5.58	5.30	9.31	5.51	3.43
	III	4.08	4.07	4.38	3.75	4.55	14.42	7.91	17.09	7.15	5.21
	Overall	13.61	16.49	16.17	14.58	16.91	13.04	16.31	22.96	19.80	15.85

Note : Zone I- Western Plain Zone, Zone II- South Western Semi Arid Zone, Zone III- Mid Western Plain Zone, Zone IV- Bhabhar and Tarai Zone, Zone V- Cental Zone, Zone VI- Bundelkhand Zone, Zone VII- Eastern Plain Zone, Zone VIII- Vindhyan Zone, Zone IX- North Eastern Plain Zone

Table 2. Decomposition Analysis of total cereal production into area, yield and interaction effect in different zones of Uttar Pradesh. (in percentage)

Regions	Effects	Phase I	Phase II	Phase III	Over all
Zone 1	**Area**	-3.99	-0.05	+2.82	-2.74
	Yield	+8.63	+4.20	+4.39	+5.49
	Interaction	-0.11	-0.06	+0.33	-0.41
	Increase(+) /Decrease(-)	+	+	+	+
Zone 2	**Area**	-0.11	+11.58	+5.97	+4.24
	Yield	+11.75	+9.30	+10.52	+10.89
	Interaction	-0.38	+2.04	+1.01	+0.74
	Increase(+) /Decrease(-)	+	+	+	+
Zone 3	**Area**	+2.39	+7.87	+7.13	+3.92
	Yield	+11.46	+8.17	+9.09	+9.23
	Interaction	+0.82	+1.32	+1.18	+0.66
	Increase(+) /Decrease(-)	+	+	+	+
Zone 4	**Area**	-0.09	+2.88	+1.18	+0.82
	Yield	+5.39	+2.28	+2.28	+3.55
	Interaction	-0.31	+0.30	+0.11	+0.12
	Increase(+) /Decrease(-)	+	+	+	+
Zone 5	**Area**	+2.14	+9.32	+4.25	+2.69
	Yield	+20.53	+9.48	+25.22	+18.42
	Interaction	+0.66	+1.06	+1.01	+0.47
	Increase(+) /Decrease(-)	+	+	+	+
Zone 6	**Area**	-1.21	-0.01	+4.75	+0.06
	Yield	+3.02	+3.79	+7.55	+5.09
	Interaction	-0.28	-0.04	+1.33	+0.11
	Increase(+) /Decrease(-)	+	+	+	+

Zone 7	**Area**	+4.11	+1.76	+9.22	+4.59
	Yield	+17.95	+4.84	+20.84	+15.17
	Interaction	+1.32	+0.13	+2.17	+0.78
	Increase(+) /Decrease(-)	+	+	+	+
Zone 8	**Area**	+2.52	+2.23	-1.66	+0.23
	Yield	+9.81	+3.29	+2.03	+1.76
	Interaction	+0.55	+0.82	-0.37	+0.45
	Increase(+) /Decrease(-)	+	+	+	+
Zone 9	**Area**	-1.07	+0.71	+0.79	-0.41
	Yield	+22.03	+16.48	+26.22	+17.33
	Interaction	-0.40	+1.55	+2.30	-0.79
	Increase(+) /Decrease(-)	+	+	+	+
State	**Area**	+2.94	+35.39	+33.77	+13.65
	Yield	+10.12	+62.39	+109.28	+86.84
	Interaction	+0.95	+5.44	+7.43	+2.38
	Increase(+) /Decrease(-)	+	+	+	+

Note : Zone I- Western Plain Zone, Zone II- South Western Semii Arid Zone, Zone III- Mid Western Plain Zone, Zone IV- Bhabhar and Tarai Zone, Zone V- Cental Zone, Zone IV- Bundelkhand Zone, Zone VII- Eastern Plain Zone, Zone VIII- Vindhyan Zone, Zone IX- North Eastern Plain Zone

CONCLUSION

The state registers the high instability during 1991-92 to 2000-01 i.e II phase in area, production and productivity with minimum instability during 2001-02 to 2011-12 (III phase) Decomposition analysis reveals that yield is the main contributor in increasing the production of cereals. Due to positive effect of area and yield the cereal production increased drastically. The present analysis clearly indicates limited scope for the horizontal expansion of area, thus more emphasis should be given to increase in productivity through technological impact.

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