International Journal of Multidisciplinary Research and Development
Online ISSN: 2349-4182, Print ISSN: 2349-5979, Impact Factor: RJIF 5.72
www.allsubjectjournal.com
Volume 4; Issue 6; June 2017; Page No. 304-308

Food grains in India: Growth, instability and decomposition analysis

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Abstract
Indian Economy is an emerging economy but still it is an agricultural economy because here majority of people earn their livelihood from agriculture. The present research work focused on area, production and yield of Food grains in India using time series data ranging from 2001-02 to 2015-16. To fulfill the objectives of the study, statistical data has been collected from RBI Hand book. Simple statistics tools have been used for examine the data related to trends of area, production and yield. The relative share of area and productivity in the growth of Food grains production also estimated. The results revealed that the growth in production was due to the growth in area or both the interaction of area and yield of Food grains in India. future the study concluded that the production of Food grains has increased over the time period because of increase in area under Food grains also supplemented by the increase in yield of the crops as it is not possible to increase the area in the long run; so there is vital need to adopt the appropriate/alternate production technologies which will further improve the productivity of Food grains.

Keywords: area, production, yield, decomposition, coefficient of variation, food grains

Introduction
Agriculture forms the foundation and it is the prime sector of the Indian economy. The performance of the agriculture sector influences the growth of economy and it helps in the development the industrial sector since agriculture sector provides the raw material to the industrial sector. Hence the growth of industrial sector also depends on agriculture sector. According to the estimates of CSO for 2016-17, it accounts about 15.10 per cent in Gross Value Added and provides livelihood to 58.2 per cent of the total population directly or indirectly. The share of agriculture sector in the GDP of the country is declining continuously as it was 55.1 per cent in 1950-51 and 17.4 per cent in 2013-2014. Notwithstanding a steady decline of its share in the GDP, it is still the most important sector for the economy of the country because of two reasons; first, the agriculture sector provides food security to the growing population and secondly, it also provides employment to the workforce as government policies in India also focuses on self-sufficiency and self-reliance in Food grains. After the introduction of green revolution the production and productivity of food grains has increased due to the availability of High Yielding Variety seeds, new technologies and better irrigation facilities. The Food grains production in India has increased from 52 million tonnes in 1951-52 to 272 million tonnes in 2016-17; it was increased by 8 per cent as compared to that of in 2015-16 which was 251.57 million tonnes. The production of wheat, rice and pulses also increased during the same time period. The production of wheat was 93.50 million tonnes and that of rice was 104.32 million tonnes while the pulses recorded 16.47 million tonnes in 2015-16 (Agricultural Statistics at Glance, 2016)**.** Better irrigation facilities, pre monsoon and adoption new technologies were the main factors responsible for the remarkable improvement in the production of Food grains.

Objectives of the study
1. To examine the growth rate and instability in area, production and yield of Food grains in India.
2. To explain the decomposing changes in the variability of Food grains production in India.

Review of Literature
Review of literature is an important exercise in research because it helps the researcher to find out the research gap. A number of research studies have been undertaken by different researchers in the field of horticulture crops in India.

Kumar, S. and Prashar, D. (2012) [5]: analyzed the trends pattern of Food grains in Himachal Pradesh. The study used simple percentage method to analyze the data. The study reveals that the negative trends in area and positive trends in production except barley and gram under all Food grains over the time period.

Sharma, A. (2013) [9]: studied "Trends of Area, Production and Productivity of Food grain in the North Eastern States of India". The study used time series data ranging from 1980-81 to 2011-12. The study used descriptive method, instability index for analyzed the data. The result of the study showed that the positive trends in production and yield of Food grains in North eastern states. The study also revealed that the Change in the production is the result of increase in area as well as the combination of area effect, yield effect and interaction of both.

Mishra, V.K. (2016) [6]: paper examined the impact of globalization on the area, production and productivity of the Food grains in India. By using paired sample t test this study showed the post reform period has adverse impact on the growth of area, production and productivity under Food grains in India. Due to decrease the area under Food grains which resulted decreased the production of Food grains.

Data and Research Methodology

This study is based on secondary data ranging from 2001-02 to 2015-16 and to fulfill the objectives of the study, statistical data has been fetched from the Handbook of Statistics on Indian Economy, publication of RBI and Economic Survey of India (2013-14 and 2015-16).

Analysis of growth rates

Based on the availability of data, the simple statistical tools are applied for the analysis of the secondary data about Least Square Growth Rate, coefficient of variation of area, production, and yield of total Food grains from 2001-02 to 2015-16.

Least Square Growth Rate Formula

The method of least square growth rate is used in that case when time series data will be given for a long time series. We can't estimate the growth rate when half of the observations in a series are missing. Linear regression trend line is fitted to the logarithmic annual values of the variable in the relevant period to estimate the least-squares growth rate, *r*. The form of the regression equation

$$\mathbf{Y_t = Y_0 (1+r)^T} \quad \text{--- (1)}$$

Where,

Y_t= Current year value

Y_0 = Base year value

t = time period, t=1, 2, 3, 4, -------n.

Taking both sides log of equation 1

$$\mathbf{Log\ Y_t = log\ Y_0 + t log b}$$

b = (1+r)

$Y_t^* = Y_0^* + tB^*$

$Y_t^* = \log Y_t$

$Y_0^* = \log Y_0$

$B^* = \log b$

$B^* = \log (1+r)$

Taking Antilog

Antilog $B^* = (1+r)$

$r = \text{Antilog}B^* - 1$

i) Coefficient of Variation

Coefficient of variation is used for estimating the instability of area, production and yield. I have calculated coefficient of variation by using the formula:

Standard deviation/ Mean*100

ii) Decomposition Analysis

To measure the relative contribution of area and productivity and the interaction of the two in the total output change the following decomposition analysis model can be used: -

Change in production =
Area effect + productivity effect + interaction effect

$\Delta P = A\circ \Delta Y + Y\circ \Delta A + \Delta A\, \Delta Y$

ΔP = Change in production

$A\circ$ = Area in base year

An = Area in current year

$Y\circ$ = Yield in base year

Yn = Yield in current year

ΔA = Change in area (An -$A\circ$)

ΔY = Change in yield (Yn - $Y\circ$)

Table 1: Trends in Area under Cultivation in India (2001-02 to 2015-16) (Million hectares)

Year	Rice	Wheat	Coarse Cereals	Pulses	Total Food Grains
2001-02	44.90	26.34	29.52	22.01	122.77
2002-03	41.18	25.20	26.99	20.50	113.87
2003-04	42.59	26.60	30.80	23.46	123.45
2004-05	41.91	26.38	29.03	22.76	120.08
2005-06	43.66	26.48	29.06	22.39	121.60
2006-07	43.81	27.99	28.71	23.19	123.70
2007-08	43.91	28.04	28.48	23.63	124.06
2008-09	45.54	27.75	27.45	22.09	122.83
2009-10	41.92	28.46	27.68	23.28	121.33
2010-11	42.86	29.07	28.34	26.40	126.67
2011-12	44.01	29.86	26.42	24.46	124.75
2012-13	42.75	30.00	24.76	23.26	120.70
2013-14	43.95	31.19	25.67	25.23	126.04
2014-15	43.86	30.97	24.15	23.10	122.07
2015-16	43.39	30.23	23.78	25.26	122.65
Average	43.35	28.30	27.39	23.40	122.44
S.D	1.16	1.87	2.07	1.48	3.00
C.V	2.68	6.61	7.56	6.32	2.45
LSGR	0%	1%	-1%	1%	0%

Source: Hand book of Statistics on Indian Economy, publication of RBI

Table 2: Trends in Production of Food grains in India (2001-02 to 2015-16) (Production in Million tonnes)

Year	Rice	Wheat	Coarse cereals	Pulses	Total food grains
2001-02	93.34	72.77	33.37	13.37	212.85
2002-03	71.82	65.76	26.07	11.13	174.78
2003-04	88.53	72.16	37.60	14.91	213.19
2004-05	83.13	68.64	33.46	13.13	198.36
2005-06	91.79	69.35	34.07	13.38	208.60
2006-07	93.36	75.81	33.92	14.20	217.28
2007-08	96.69	78.57	40.75	14.76	230.78
2008-09	99.18	80.68	40.04	14.57	234.47
2009-10	89.09	80.80	33.55	14.66	218.11
2010-11	95.98	86.87	43.40	18.24	244.49
2011-12	105.30	94.88	42.01	17.09	259.29
2012-13	105.24	93.51	40.04	18.34	257.13
2013-14	106.65	95.85	43.29	19.25	265.04
2014-15	105.48	86.53	42.86	17.15	252.02
2015-16	104.32	93.50	37.94	16.47	252.22
Average	95.33	81.05	37.49	15.38	229.24
S.D	9.76	10.32	4.97	2.29	25.93
C.V %	10.24	12.73	13.26	14.89	11.31
LSGR	2%	3%	2%	3%	2%

***Source*:** Hand book of Statistics on Indian Economy, publication of RBI

Above table depicts that the production of Food grains in India. The production under coarse cereals has decreased with growth rate 2 per cent and the higher growth rate has been recorded in pulses and wheat which revealed that production of pulses and wheat has increased. The C.V of rice showed less variation as compared to others Food grains production. The high value of C.V shows instability in the production of pulses during the period of study.

Table 3: Trends in Yield of Food grains in India (2001-02 to 2015-16) (Million/ hectare)

Year	Rice	Wheat	Coarse cereals	Pulses	Total food grains
2001-02	2.079	2.762	1.131	0.607	1.734
2002-03	1.744	2.610	0.966	0.543	1.535
2003-04	2.077	2.713	1.221	0.635	1.727
2004-05	1.984	2.602	1.153	0.577	1.652
2005-06	2.102	2.619	1.172	0.598	1.715
2006-07	2.131	2.708	1.182	0.612	1.756
2007-08	2.202	2.802	1.431	0.625	1.860
2008-09	2.178	2.907	1.459	0.659	1.909
2009-10	2.125	2.839	1.212	0.630	1.798
2010-11	2.239	2.988	1.531	0.691	1.930
2011-12	2.393	3.177	1.590	0.699	2.078
2012-13	2.461	3.117	1.617	0.789	2.129
2013-14	2.424	3.075	1.677	0.764	2.101
2014-15	2.390	2.872	1.729	0.744	2.070
2015-16	2.404	3.093	1.596	0.652	2.056
Average	2.20	2.86	1.38	0.66	1.87
S.D	0.20	0.19	0.24	0.07	0.19
C.V	9.09	6.64	17.39	10.61	10.16
CAGR	2%	1%	4%	2%	2%

***Source*:** Hand book of Statistics on Indian Economy, publication of RBI

Table 3 reveals that the coefficient of variation in the respective yields of Food grains in India ranging the time period from 2001-02 to 2015-16. The value of coefficient of variation in the yield of Food grains was high in case of coarse cereals with 17.39 per cent followed by rice, wheat, pulses and total Food grains; with the values 9.09 per cent, 6.64 per cent, 10.61 per cent and 10.16 per cent respectively. Higher C.V value for coarse cereals shows higher risk in the production of the crops compared to other crops with less coefficient of variation.

Table 4: Coverage of Irrigation of Food grains in India

Year	All India Crop wise Irrigation Coverage (%)				
	Rice	Wheat	Coarse Cereals	Pulses	Total Food grains
1950-51	31.7	34	7.9	9.4	18.1
1955-56	34.9	32.7	8	8.4	18.5
1960-61	36.8	32.7	7.7	8	19.1
1965-66	36.5	43.1	8.1	9.4	20.9
1970-71	38.4	54.3	8.3	8.8	24.1
1975-76	38.7	61.8	9.9	7.9	26.5
1980-81	40.7	76.5	9.2	9	29.7
1985-86	42.9	74.6	8.4	8.5	31.4
1990-91	45.5	81.1	9	10.5	35.1
1995-96	49.9	85.8	11	12.9	40.1
2000-01	53.6	88.1	12.5	12.5	43.4
2005-06	56	89.6	13	15	45.5
2010-11	58.6	92.1	14.4	14.8	47.8
2013-14	59.6	93.6	NA	19.7	51.9

***Source*:** Agricultural Statistics at Glance (2016)

The above table-4 shows that irrigation coverage in agriculture sector has increased over the years in India.

Table 5: Projected Demand and Supply of Food grains for the 12th five Plan Period (In million tonnes)

Crop	Projected Demand		Projected Supply	Actual Production	
	2016-17	2020-21	2016-17	2006-07	2011-12
Rice	110	117	98-106	93	105
Wheat	89	98	93-104	76	95
Coarse Cereals	36	38	42-48	34	42
Pulses	22	25	18-21	14	17
Food grains	257	277	258-272	217	259
Oil seeds/ Edible Oils	59	71	33-41	24	30

***Source*:** Agricultural Statistics at Glance (2016)

The above table highlights the demand and supply of Food grains for the year 12th five year plan period. India is self-sufficient in Food grains after Green Revolution. But still India dependent on the foreign countries to meets its domestic requirements for pulses and edible oils. The above table reveals that the deficit between the domestic demand and supply in case of pulses and edible oils, while it shows that there was surplus between domestic demand and supply in cases of wheat, coarse cereals and in the total Food grains. It was resulted by using of better adoption of resources and appropriate technologies improve the productivity of Food grains. Notwithstanding the various efforts being made and also it showed that there is no technological come through in pulses, the productivity of pulses still it was very low around 0.652 million/ hectare in 2015-16. The reason behind the low productivity was that the pulses mainly grown by the marginal and small farmers on minor lands under rained conditions. Although significant increment in MSP under pulses but due to the feeble remunerative/ or price support mechanism, poor marketing facilities, rising burden of credit, farmers not agreed to increase the land or production under the pulses.

Table 6: Growth Decomposition in Production of Food grains in India (%)

Effects	Rice	Wheat	Coarse cereals	Pulses	Total food grains
Area	133.12	42.02	300.44	31.83	100.64
Productivity	-28.65	51.76	-142.01	63.34	0.53
Interaction	-4.47	6.22	-58.43	4.82	0.10

***Source*:** Calculated from Table-1 and 3

Table 6 explains the decomposing changes in the variability of Food grains production in India. The table shows the different components of increased production variability where it indicate inputs and outputs relation. This method analyses the importance of changes in area-productivity correlations accounted for the increased production instability; it also explain why fluctuations in area and productivity have become more coordinated. The above analysis shows the area effect is maximum in case of coarse cereals (300.44 per cent) followed by rice (133.12 per cent) and minimum in pulses (31.83 per cent) respectively. The productivity effect is high in case of pulses (63.34 per cent). Rice and coarse cereals shows negative productivity and interaction effect and the same has been positive for wheat.

Concluding Remarks

It was found during the survey and reviewing the literature regarding the present work that the agriculture sector faces many challenges like; 1) decline the land holding size for all operations classes like (marginal, small, medium and large). 2) In agriculture sector the pressure are increasing on land due to the demand of urbanization, modernization, industrialization

and also due to the infrastructure and over population is forcing the transfer of agriculture land to non-agriculture land. 3) Deficiency of farm-labor. 4) The total Food grains in India has increased sharply in the production of wheat and rice however it decline in coarse cereals and pulses due to shift of area towards high yielding crops. 5) Increasing the costs of cultivation and also uncertainties related with price which are some of the difficult challenges in agriculture sector is also focused problem as reported by farmers.

Conclusion

Indian Economy is an emerging economy but still it is an agricultural economy since here majority of people earn their livelihood from agriculture. The study highlighted that negative growth rate has been recorded for the area under coarse cereals which was -1 percent and high value of C.V shows instability in the production of coarse cereals during the study period. The production of wheat as well as pulses has increased. While the production of coarse cereals has decreased but maximum growth rate of yield i.e., 4 per cent per annum was accounted for coarse cereals. The result of the study shows that the production of Food grains has increased given the time period for the reason that of increase in area under Food grains which is further supplemented by the increase in yield of the crops as it is not possible to increase the area in the long run; hence there is urgent requirement to adopt the appropriate/alternate production technologies which will further improve the productivity of Food grains

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