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DISPARITY IN PRODUCTION AND PRODUCTIVITY OF FOOD GRAINS IN INDIA

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ABSTRACT

In India, Agriculture sector has experienced significant changes after independence. During different periods, the circumstances that caused these changes were different. Institutional reforms like land reforms and the improvement in irrigation facilities, infrastructure, played significant roles in output growth during the 1950s and 1960s. During the period of 1970s, technological breakthrough was the driving force, and during the 1980s, the extension of technological improvements to new areas and crops was the driving force. The period following the 1991 is known as the period of economic reforms. During the post reform period, Agriculture growth is unevenly distributed among different regions of the country. This caused regional disparities which are a major source of worry. This paper examines the disparities in food grains output and productivity across Indian states after 1991. The paper uses covariance analysis and finds out that the regional disparity in production and productivity of food grains declined during this period. The results also suggest that there has been a tendency of sigma convergence in agricultural development across states. Moreover, there is still presence of regional disparities among different regions.

1.0 Introduction

The contribution of agriculture sector in India's economy remains vital. It not only provides food or fodder, adds to national wealth, and offers a means of subsistence, but also contributes in India's exports with the world. Agricultural products such as sugar, tea, rice, spices, tobacco, and coffee, are the most important export items for most agrarian economies. Agriculture sector also has impact in improving India's terms of trade and helps make the conditions of trade more favourable and save foreign exchange reserves.

Agricultural sector's contribution to the national economy is directly represented by its percentage of total GDP, foreign exchange profits, and function as a source of savings and labour for other industries. The sector's role in state economies is rapidly changing, in line with national economic changes. This is also true that its share in India's overall GDP is falling overtime.

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However, this fall is due to structural changes and transition from a traditional agrarian economy to one dominated by industry and services. Despite agriculture's declining share in India's economy, the majority of the workforce continues to rely on it for employment. Furthermore, dependency on agriculture is even greater in rural areas, where agriculture employs nearly 65 percent of the population.

Agricultural production instability increases the risk associated with farm output. It also has negative impact on farmers' income as well as their decisions to embrace high-paying technologies and make capital investments in farming. Instability in agricultural production also affect price stability and consumer confidence and increases the susceptibility of low-income households to the market.

India's agricultural sector is facing several challenges for last two decades. These challenges include slow rate of growth, inter-sectoral inequality in regions, decline in input efficiency and depletion of natural resources. India's economy has diverse range of resource bases, that also varies between regions in the country. This also creates diverse agricultural pattern between regions. Presence of unbalanced development and regional disparities in India also hampers growth in India's agriculture sector. In addition, differences in technological deployment and policies also increased the level of disparities in agricultural productivity. Therefore, a strategy is required to be devised to strengthen it.

With the objective to understand disparities in India's agricultural production that can help devise such strategies to uplift the sector, the present research paper is an attempt to examine regional disparity in India's agriculture during post-reform period. It investigates the patterns that have emerged in agricultural productivity. The paper alsodiscusses the convergence/divergence in production and productivity of food grains over the period from 1991-92 to 2016-2017.

2.0 Review of Literature

India's economy has experienced a structural change over the period of time with the anticipated decline in the share of agriculture and allied activities in GDP from 55.1 percent to 17 percent in 2015. At the same time, this is also a fact that agriculture remains important not only for the purpose to achieve self sufficiency in food production but also to provide food to a food deficit countries (FAO, 2009).

Mukherjee and Kuroda (2002) presented analysis of productivity growth in Indian agriculture across 14 major states using panel data for the period 1973 to 1993. They found no signs of a decline in the disparity of productivity between states over time. However, according to the convergence analysis, the total factor productivity (TFP) gap, as measured by the distance

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between each state's productivity level and the overall average, is stationary. This indicates that the process of convergence is ongoing for a considerable amount of time. The factors that contributed to the findings of their study reveal that increasing investment in infrastructure, such as irrigation, roads, electricity, government social spending, research, and extension services is crucial in regions where TFP is lower than the national average.

Ghosh Madhusudan (2006) examined convergence in land and labour productivity as well as per capita agricultural output among 15 major states from 1960-61to 2001-02 using regression analysis. The research found that sigma convergence and differences across states in land productivity decreased over time as a result of the implementation of High Yield Variety (HYV) technology. It also found a significant increase in both labour productivity and per capita agricultural output and significant divergence in labour productivity in early 1990s. Also, Somasekharan et al. (2011) in their study examined the convergence theory in per capita agricultural output and food grains productivity across 15 major states of India using data from 1971 to 2007. The paper reveals that Indian states does not demonstrate sigma convergence in their per capita agricultural output but has presence of divergence. A weak divergence is observed where states with higher initial per capita output enjoyed higher growth grates after excluding West Bengal from the analysis. It also finds a clear convergence in Indian states, after excluding Gujarat, Bihar and Orissa as these states experienced negative growth rates during the same period. Similarly, Balaji and Suresh (2014) examined whether land and labour productivity converging in Indian agriculture between 1991 and 2011 by measuring unconditional beta convergence and Galton's fallacy approach. According to the findings of their analysis, land productivity is improving steadily in all states since 1991. Increase in land productivity is higher in states with low initial land productivity levels than in states with high initial land productivity levels. This paper also suggests that the disparity in land productivity between states is narrowed down in the country.

Khatkar et al. (2016) showed that the area under wheat cultivation has accelerated significantly in comparison to other cereals and millets during 2000-01 to 2010-11. Dhingra (2015) analyzed yield of principal crops in India and found that the compound annual growth rate of foodgrains is 2.0 but in the cases of rice and wheat, major constituents of food grains, it is 1.97 and 1.35 respectively whereas for maize it is slightly better and is to the order of 3.00. In the case of cereals CAGR is 2.34 and for pulses it is 2.44 during the same period. Ahmed et al. (2015) also reported that production of major cereals in India increased with positive growth rates and it was due to adoption of high yielding varieties. Kumar and Mittal (2006) analyzed agricultural productivity trends in India. The findings revealed that paddy and wheat, the major staple food crops, have performed well in productivity gains. A study by Larson et al. (2004) showed that increase in crop yields and crop acreages have contributed positively to the increased production

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for most crops. Priscilla et al. (2017) observed that during 1995-96 to 2004-05, the contribution of yield to foodgrains production was found to be higher and even offsetting the area effect and interaction effect which can be attributed to the increased use of high yielding varieties and fertilizers. Dhanalakshmi (2017) found that during study period (2000-01 to 2015-16) the cultivated area of total foodgrains has reduced from 95.32 million hectare in 2000-01 to 92.43 million hectares in 2015-16 with a negative CAGR of 0.19 per cent. Pathak et al. (2017) studied challenges and options for meeting the needs of pulses and found that the annual compound growth of chickpea recorded the highest growth rate in area (4.5 per cent), production (9.6 per cent) and in yield (5.1 per cent) during 2008-09 to 2013-14.

Kumar Shiv, et al. (2014) looked into whether the overall agricultural output value across Indian states and studied converging or diverging by using total of 15 major states from the period 1980-81 to 2009-10. It suggests that agriculturally underdeveloped states performed better than the other states in terms of growth throughout the period after reform. The result of absolute convergence provides sign of declining regional inequalities in India following the WTO in 2004-05, and this is especially true in the initial phase when the country's reforms are implemented. The review indicates that many research are undertaken in this area. However, there is a gap in presenting research exclusively on post reform period with the objective to devise strategies to tackle challenges in agriculture sector in the country. This paper tries to update the existing study and also suggest some important policy measures.

3.0 Analysing Foodgrains Production

There is wide variation in the production of foodgrains across Indian states during the period 1991-92 to 2016-17. In some states like Andhra Pradesh, Assam, Bihar, Madhya Pradesh Gujarat and Maharashtra, the production of foodgrains was low in the initial period and it started increasing at a very slow growth rate up to the year 2000-01**.** But after 2002-03 production of foodgrains in these states increased due to initiatives taken by government like improving irrigation facilities, providing fertilisers at subsidised rate and easy availability of banks credit for agriculture. Foodgrains production in Haryana, Punjab, Uttar Pradesh and West Bengal has increased at a higher rate. Kerala is the only state where production of foodgrains declined during the whole period.

The coefficient of variation shows variability in the production of foodgrains in Indian states. There is fluctuation in foodgrains production in all states, which increases variability in their production. High variability is registered in Madhya Pradesh and Rajasthan. The value of coefficient of variation in Madhya Pradesh is 35.9 percent and in Rajasthan is 29.6 percent. Gujarat (28 percent) and Tamil Nadu (27.6 percent) also has high value of coefficient of variation. The states of Punjab (13.6 percent) and Maharashtra (16 percent) has lowest variation

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in the foodgrains production during the period. The main reason for the fluctuation is instability in the area used for cultivation of food grains in these states. Table 1 presents annual growth rate in agricultural productivity in Indian states since 1991-92. The table brings interesting picture. Most of the states experienced negative growth during initial few years of reforms which continued later.

Table 1: Annual Growth Rate of Productivity (in %)

Year	AP	ASS	BIH	GUJ	HAR	J&K	KAR	KER	MP	MAH	ORI	PUN	RAJ	TN	UP	WB
1992-93	5.71	2.60	-7.42	44.75	1.89	0.52	4.81	3.55	6.41	57.72	-6.57	1.09	26.45	2.96	-0.45	-3.73
1993-94	7.09	2.30	35.08	-24.62	1.90	4.94	7.27	-1.18	10.21	-5.34	18.48	4.72	-32.10	-3.21	3.26	2.35
1994-95	-3.93	1.40	-1.43	32.03	3.68	-0.43	-7.10	-2.95	0.83	-10.97	-2.53	0.08	49.26	14.97	4.52	3.54
1995-96	-1.17	-0.15	-0.41	-12.41	-7.00	2.58	9.46	3.74	-5.15	2.58	-2.44	-5.78	-11.26	-18.66	-1.67	-5.63
1996-97	10.87	-0.92	-19.72	19.10	11.97	-10.59	-0.95	5.31	6.69	20.71	-24.81	9.08	24.13	-55.63	10.71	8.93
1997-98	-10.82	1.55	35.90	7.44	-2.81	6.15	-9.21	-9.30	-11.72	-31.37	34.11	-5.02	0.90	160.05	-2.92	2.39
1998-99	20.79	-1.98	-3.25	1.86	-2.28	8.70	18.87	4.63	12.24	34.53	-10.90	4.03	-4.67	15.77	-4.05	0.55
1999-00	-5.09	9.39	6.38	-16.83	12.85	-12.58	-4.60	7.83	10.72	-4.41	-5.00	7.67	1.56	-8.55	12.49	-0.91
2000-01	8.86	3.41	-2.84	-30.27	0.43	-18.83	9.80	0.05	-31.01	-18.69	-7.32	0.10	-9.44	5.04	-4.66	2.43
2001-02	0.62	0.21	-0.31	70.98	2.22	22.96	-14.16	0.10	36.69	15.46	47.26	0.20	24.46	-10.24	7.26	8.65
2002-03	-19.41	-2.95	-6.55	-21.22	-0.80	0.20	-21.70	2.58	-25.05	-3.20	-48.82	-5.25	-20.56	-27.03	-11.95	-2.06
2003-04	18.77	3.88	7.71	46.23	-1.13	12.80	0.53	-10.04	45.56	1.65	85.47	2.64	47.54	-4.53	9.96	1.98
2004-05	6.26	-4.55	-23.78	-13.32	0.78	-0.88	45.49	17.73	-12.57	-2.79	-2.11	2.83	-21.74	21.77	-10.11	2.40
2005-06	10.62	0.78	4.63	9.84	-1.52	-0.36	27.95	-2.59	3.43	13.40	3.77	-1.34	-8.83	-1.44	4.34	-2.26
2006-07	-5.67	-9.18	29.50	-8.25	11.43	3.15	-27.42	5.05	3.35	-0.84	0.74	0.78	21.76	41.31	0.53	3.63
2007-08	17.12	7.15	-2.48	28.67	0.80	-1.27	20.09	-4.72	-3.44	22.34	9.20	5.92	5.45	-18.58	6.95	0.56
2008-09	5.01	12.55	10.48	-12.89	-0.96	8.18	-2.39	9.86	0.82	-12.96	-8.15	-0.56	7.03	4.71	6.78	-1.27
2009-10	-16.40	7.16	-15.02	-2.19	-0.12	-24.10	-8.87	1.23	6.80	3.80	2.49	-2.06	-26.29	11.33	-5.14	1.16

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2010-11	10.28	6.08	-3.68	18.14	4.23	16.65	22.29	-2.83	2.28	13.96	2.51	3.28	34.26	-3.39	6.64	3.13
2011-12	-0.42	-3.35	40.72	1.68	10.01	3.11	-3.27	12.29	19.53	-2.45	-9.01	1.96	7.84	32.14	4.78	1.69
2012-13	6.10	15.14	10.66	5.12	-4.90	16.09	-0.49	-5.49	10.47	-10.13	22.18	-0.39	9.79	-32.61	1.78	2.72
2013-14	-0.45	-2.34	-11.25	6.45	4.50	-2.40	6.79	-0.75	-2.97	16.28	2.07	3.52	-9.86	19.85	-2.13	0.15
2014-15	0.63	5.48	-2.32	-3.86	-11.10	-33.42	-2.43	11.67	11.30	-18.14	6.95	-9.91	14.62	6.50	-20.22	-0.85
2015-16	-6.64	-1.19	4.10	-0.64	6.45	48.86	-10.42	-2.37	1.86	-20.95	-23.48	5.30	-9.09	12.61	11.41	4.63
2016-17	3.81	-7.01	12.96	-2.55	2.41	-7.85	-11.90	-8.13	7.22	58.64	39.47	1.97	-2.23	-54.10	12.40	-3.01

Source: Agricultural Statistics at Glance, Ministry of Agriculture, and Farmers Welfare, Government of India

** AP= Andhra Pradesh, ASS = Assam, BIH= Bihar, GUJ = Gujarat, HAR = Haryana, J&K = Jammu and Kashmir, KAR= Karnataka, KER= Kerala, MP= Madhya Pradesh, MAH= Maharashtra, ORI= Orissa, PUN= Punjab, RAJ= Rajasthan,, TN= Tamil Nadu, UP= Uttar radish, WB = West Bengal*

There has been a consistent decline in the growth of agricultural sector since 1990.During 1993-94 the share of agriculture in GDP was 29.76 percent which fell down to 23.15 percent during 2002-03 and further came down to 13 percent in the year 2016-17.

The agriculture sector is confronting with a number of issues, including a decrease in the extent of land holdings for all types of farmers (marginal, small, medium, and large). Due to urbanization, modernization, industrialization, infrastructural expansion, and overpopulation, pressure on land is increasing. As a result, agricultural land is being converted for non-agricultural purposes. After economic reforms in India, areas under foodgrain for cultivation decline in some states. For example, in Andhra Pradesh the area under foodgrain decline to 6870.9 thousand hectare in 1994-95 from 7431.4 thousand hectares in 1991-92. There is fluctuation in area under food grain in Andhra Pradesh. Area under foodgrains cultivation declined to 7138 thousand hectares in 1999-00 from 7431.4 thousand hectare in 1991-92 but slightly increased to 7383.1 thousand hectares in 2016-17. All states witnessed a sharp decline in the area under foodgrain cultivation during the period from 1991-92 to 2016-17, except the states of Haryana, Madhya Pradesh, Punjab, Rajasthan and a small increase was noted s in UP and West Bengal. The highest increase in the area under foodgrain cultivation is seen in Rajasthan rose to 13809.6 thousand hectare in 2016-17 from 11288.2 thousand hectare in 1991-90. Madhya Pradesh also witnessed a rise in area under food grain to 18981.6 thousand hectares in 2016-17 from 16859.4 thousand hectares in 1991-92.

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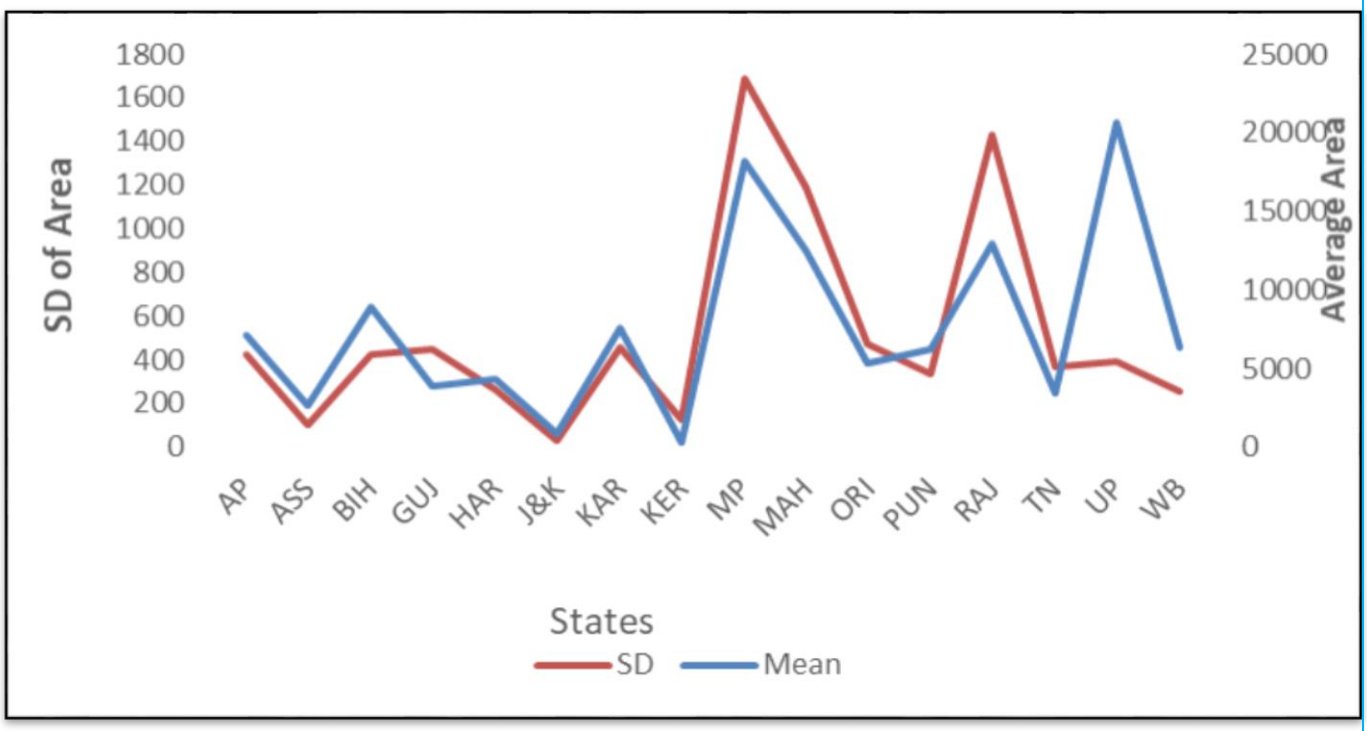
Average area under foodgrain cultivation is highest in Uttar Pradesh, Madhya Pradesh is at a second place in area of food grain cultivation. The variation in area under food grain cultivation is found to be low in Uttar Pradesh which has coefficient of variation 1.9 percent, 4 percent in West Bengal, 4.7 percent in Bihar and 2.9 percent in Jammu and Kashmir. The variability in area under food grain is highest in Kerala at 40.0 percent because of continuous fall in area of food grain, Gujarat also has a high variation of 11.5 percent in area of food grain cultivation and Rajasthan has a variation of 11.1 percent during the whole period. Graph 1 presents Mean and Standard Deviation in aoodgrain area under cultivation.

Figure 1: Mean and Standard Deviation of Area under Foodgrain Cultivation (2015)



Source Author's Calculation

4.0 Production of foodgrain in major Indian States

India was heavily dependent on foodgrain imports to meet the food demand of the country during early post-Independence ear. Due to low yielding nature of Indian foodgrain under high fertility conditions, there remained a continuous need for a breakthrough in foodgrain production. It was finally the dream of Dr. Norman E. Borlaug, the father of green revolution during mid 1960s that came true to materialize the spurt of the Green Revolution in the Indo Gangetic plains by which India became a foodgrain surplus country from deficient one.

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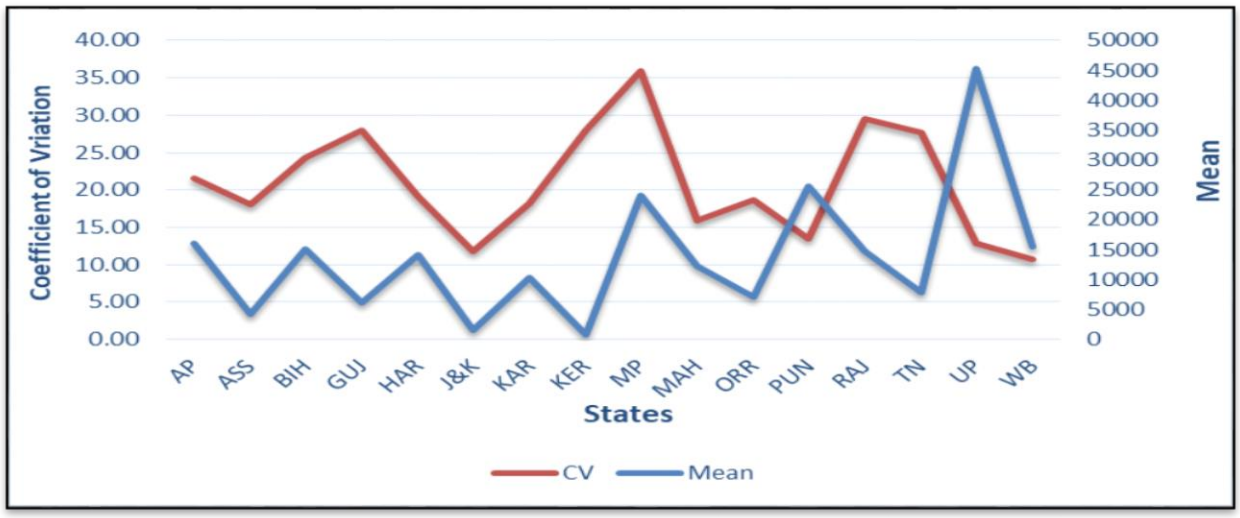
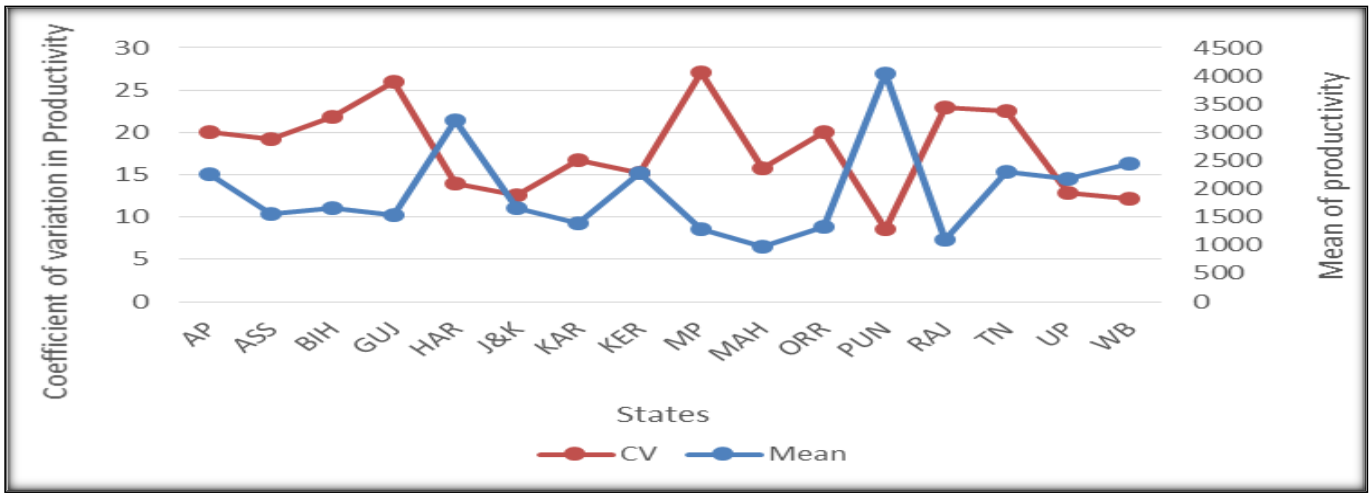
Figure 2: Mean and CV of foodgrains Production in Major States (2015)



Source: Author's calculation

The productivity of foodgrains is not stable in all the states. There is disparity in the productivity of foodgrains during the concerned period. As per figure 2 and 3, value of coefficient of variation can be noticed in Madhya Pradesh (27.15 percent), followed by Rajasthan (22.9 percent), Tamil Nadu (22.5 percent) and Andhra Pradesh (19.9 percent).

Figure 3: Mean and CV of foodgrains productivity in major states (2015)



Source: Author's calculation

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4.1 Sigma Convergence on foodgrains production

Regressing the coefficient of variations across states on time trend, we get an idea about the convergence/divergence in the crop. The result of the estimated equation is given below:

$$\text{CV of Production of Food Grains} = 167.35 - 0.04\,t \qquad R^2 = 0.009$$

$$(0.93) \quad (-0.48) \qquad F = 0.25$$

The estimate of the equation shows a negative relationship between coefficient of variation and time period but it is not significant. This shows a weak tendency that disparity in foodgrains production is decreasing during the period. Therefore, the Indian states have not shown a tendency of sigma convergence or divergence in the production of foodgrains across 16 major states. But a negative sign of the coefficient, though insignificant, reflects weak tendency towards sigma convergence in the production of food grains across Indian states. The result is also clear from the figure above that coefficient of variation has decreased over time across states.

4.2 Sigma Convergence in Productivity of Food grains in India

Here we try to measure whether disparity in the productivity of foodgrains has decreased overtime or not across Indian states. We have computed the CV of yield of foodgrain across states and regress it over time. The estimated coefficient of variation of yield of foodgrain is presented in figure which displays a fluctuating trend in the initial period. However, after 2004-05 the variation in the yield showing a decreasing trend that has resulted in a decline in disparity in yield of food grains across states.

$$\text{CV of Productivity of Food grains} = 1003.905 - 0.48\,t \qquad R^2 = 0.35$$

$$(3.94) \quad (-3.77) \qquad F = 14.24$$

The estimate of equation gives a negative relationship between CV of foodgrains productivity and time**.** The value of R^2 is found to be high and t-ratios for slope coefficient are highly significant. It is clear from the result that Indian states has exhibited sigma convergence during the period under review. In other words, the result shows that Indian states converge in terms of productivity of food grains, which shows that variation in the food grains productivity across states has decreased. Thus, the hypothesis that productivity of foodgrains has no sigma convergence in the post liberalization period is rejected. Alternatively, we accept that there is the presence of sigma convergence in productivity of foodgrains in Indian states.

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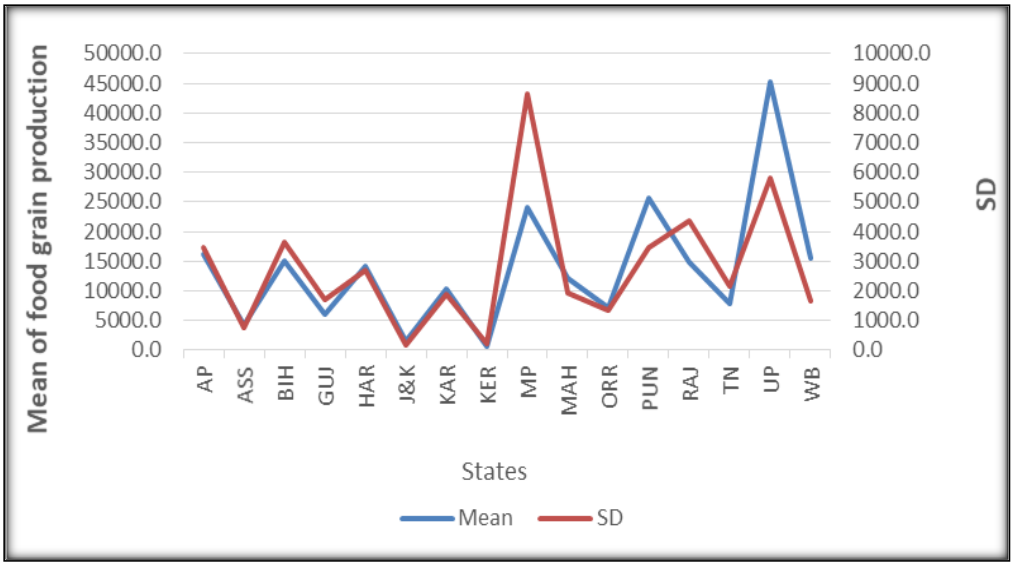
The coefficient of variation shows variability in the production of foodgrains in Indian states. There is more fluctuation in the production of foodgrains in all states which increases variability in their production. The high variability in the production of foodgrains in witnessed in Madhya Pradesh and Rajasthan. The value of coefficient of variation in Madhya Pradesh is 35.9 percent and in Rajasthan is 29.6 percent. Gujarat (28 percent) and Tamil Nadu (27.6 percent) also has high value of coefficient of variation. The states of Punjab (13.6 percent) and Maharashtra (16 percent) has lowest variation in the food grain production during the period (Figure 3). Main reasons for the fluctuation in production of food grain is instability in the area used for cultivation of food grain in these states.

Figure 3: Mean and SD of food grain production in major states (2016)



Source: Author's calculation

5.0 Productivity of food grain in major Indian states

During the years preceding the Green Revolution, the productivity levels of wheat, coarse grains, and pulses were nearly completely static. When compared to the pre-Green Revolution Phase, rice was the only foodgrains that experienced a little improvement in productivity levels. This increase in the productivity level of rice was the sole reason why the productivity levels of cereals and foodgrains saw some increasing tendencies during the pre-Green Revolution period. Wheat productivity levels, which were lower than rice productivity levels prior to the Green Revolution, not only surpassed rice productivity levels after the Green Revolution but have been consistently greater than rice productivity levels throughout the post-Green Revolution period. This is consistent with the fact that wheat has served as the foundation of India's Green

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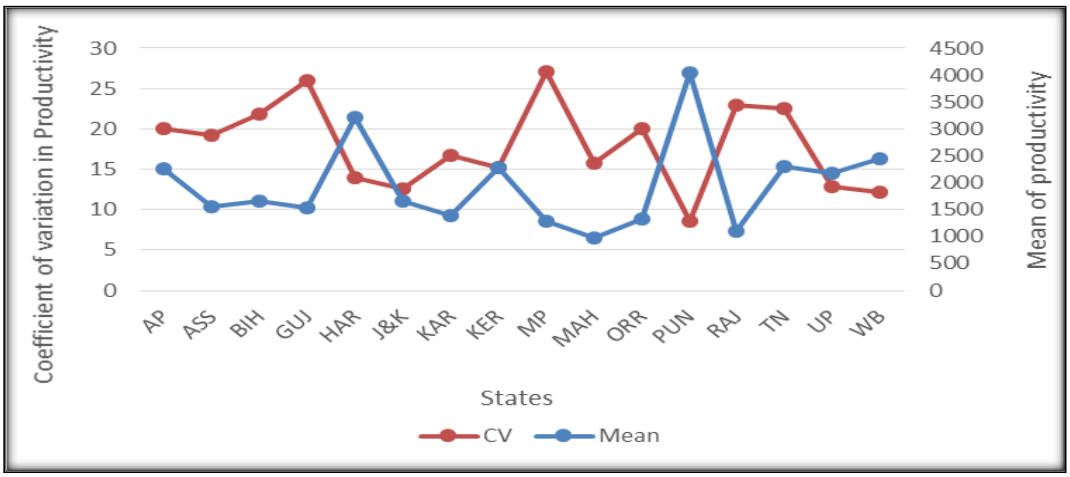
Revolution. But it can't be denied that the rise in the productivity levels of rice has contributed to the rise in the productivity levels of cereals and food grains after the Green Revolution, and that the significant upward trend in the productivity levels of cereals and food grains can be attributed to the rise in the productivity levels of wheat and rice, respectively.

Figure 4: Mean and CV of food grain productivity in major states (2016)



Source: Author's calculation

5.1 Growth Rate in Area, Production and Productivity of food grain in major Indian States

The Annual Growth Rate shows the percentage increase in the value of a variable in the current year based on the value in the previous year, whereas the CAGR shows a steady rate of growth between two points in time. CAGR is a consistent rate of growth during the period being looked at and smooths out any annual fluctuations in growth that may occur during the period. We have to find out growth rate in area, production and productivity of food grain crop in major states of India during the period from 1991-92 to 2016-17.

6.0 Conclusion

The expansion of agricultural sector is essential to the growth of an economy as a whole as well as the growth rates of other sectors, such as industries. It has to be seen that agriculture growth provides the foundation for successful industrialisation in all the developed and emerging countries. When agriculture begins to expand, it offers raw materials and releases resources that can be used by other sectors of the economy.

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The production and productivity of the different foodgrain crops have increased over the period under review mainly due to the effects of area and productivity. Therefore, the productivity can be further raised by adopting appropriate technologies.

It is a general observation that growth in productivity of crop is skimpy because of poor availability of HYV seeds, wide spread infestation of pest and diseases, destruction of crops by wild animals, inadequate and irregular water supply etc. Therefore, steps should be taken to overcome these difficulties faced by the cultivators at the field level.

The regional disparity in production and productivity of food grains declined during the period. The result suggests that there has been a tendency of sigma convergence in agricultural development across states.

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