INDIAN DEVELOPMENT POLICY REVIEW
Vol. 2, No. 2, 2021, 103-115

URL : www.esijournals.com

Determinants of Agricultural Inter-Regional Disparity: A Case Study of Uttar Pradesh

Jaspal Singh[1], Shilpi Kapoor[2], Tanima Dutta[3], Jagdeep Singh[4], Nirmal Singh[5] and Saira Banoo[6]

[1]Consultant, NITI Aayog, New Delhi-110001
[2]Research Scholar, Lovely Professional University, Phagwara-144411
[3]Associate Professor, Department of Economics, Lovely Professional University, Phagwara-144411
[4]Assistant Professor, Guru Nanak College, Budhlada-151502
[5]Research Scholar, Barkatullah University, Bhopal-462026
[6]Research Scholar, DAVV, Indore-452001

Article History

Received : 28 August 2021
Revised : 15 September 2021
Accepted : 4 October 2021
Published : 30 December 2021

Citation

Jaspal Singh, Shilpi Kapoor, Tanima Dutta, Jagdeep Singh, Nirmal Singh & Saira Banoo (2021). Determinants of Agricultural Inter-Regional Disparity: A Case Study of Uttar Pradesh. *Indian Development Policy Review*, Vol. 2, No. 2, 2021, pp. 103-115.

Abstract: Uttar Pradesh with the advantage of its larger size contributed 18.9 per cent of cereals, 8.65 per cent of pulses, 3.65 per cent of oilseeds and 46.56 per cent of sugarcane to the country during 2017-18. This study has been conducted to explore the trends, patterns and spatial variations of agricultural growth in Uttar Pradesh. Furthermore, the study builds the phases of agricultural growth and clustering of districts. It has been well established from the analysis that the western part is more developed in terms of agriculture than other parts of Uttar Pradesh. Results of Bai and Parron test established four break points (1999-00, 2006-07, 2011-12 and 2016-17) in agricultural productivity of the state. The growth pattern of agriculture of the state was found to be cyclical. Moreover, the averages values of development indicators were estimated to be different. Consequently, level of agriculture also varied across regions in Uttar Pradesh. To reduce the gap between levels of development, it is necessary that less developed regions should catch up the average level of the developed regions. State should make different region specific policies instead of state as a whole.

Keywords: Agriculture, Inter-regional Disparity, Structural change, Agricultural Productivity.

BACKGROUND

Agriculture sector is the foundation of the Indian economy providing basic requirements of food to the people and contributing to employment opportunities in India. Research on agriculture plays an important role in identifying the problems

of regions having disparity in agricultural growth. Spatio-temporal disparities in agriculture are one of the glaring issues in the developing countries like India.The regional disparity in agriculture has increased between developed and backward regions in different states in India.Uttar Pradesh being the fourth largest state covers about 7.34 per cent area of India which is equivalent to the area coverage of United Kingdom. The projected population has been reported to be 22.4 crorein 2018-19 (CSO, 2020) which is largest among states in India.Awide part of the state belongs to the upperGangetic plain (highly fertile) area with a dense population (average density 828 per km).Uttar Pradesh being a dominant agrarian economy contributes about 25 per cent of the state gross domestic product by the agriculture sector (MOSPI, 2020). It also provides employment to more than half of the workforce in the state (NSSO, 2019). Due to the larger size of the state, Uttar Pradesh contributed 18.9 per cent of cereals, 8.65 per cent of pulses, 3.65 per cent of oilseeds and 46.56 per cent of sugarcane to the countryduring 2017-18 (DES, 2019).This is due to the reason that the state lies in Indo-Gangetic plains and the availability of fertile land, artificial irrigation facilities like canals and tubewells. During 1991, there was agricultural disparity in Uttar Pradesh due to many factors such as, lack of agricultural inputs and technology, lack of balanced impact of the second green revolution in the districts etc, (Kumari, 2014). The districts have even transformed from low to the better performance and vice versa in the agriculture sector in Uttar Pradesh (Raman &Kumari, 2012). Moreover, the western part of the state is more developed in terms of agriculture as compared to the other parts of the state. This part of the state adopted modern agricultural technology in the initial stage of green revolution. In contrast, theother parts of the state were not having similar characteristics as were found in the western part and therefore, they lagged behind in terms of agricultural development. Wheat, paddy, rapeseed, mustard, potatoes, and sugarcane etc. form the major crops grown in Uttar Pradesh.

Increased agricultural growth became a matter of concern for the various policy makers (Chand *et al.*, 2007). Number of studies has been conducted on regional disparities in agriculture (Mohanty, 2009; Ohlan, 2013; Singh & Kaur, 2018) at the state and national level with the application of different tools. Uttar Pradesh possessing the largest number of districts in India exhibits the variations in agricultural productivity in various districts. Meerut topped with productivity greater than Rs 81000/ha and Sonebhadra with lowest productivity of Rs 14,600/ha (Chand *et al.*, 2011).Baig& Salam (2019) revealed regional disparities in agricultural development across district Aligarh in Uttar Pradesh during 2017-18. It was suggested to give

attention to the blocks with low agricultural development by improving the awareness of technological advancement and use of fertilizers and manures to the farmers. However, there is lack of such study of agricultural growth in different phases with suitable tool which identifies multiple breaks in systematic manner during the period. Analysis of agriculture growth in different regions will be useful in knowing the disparity which exists in agriculture in different phases in different regions.

The present study has been executed to know the trends and patterns of agriculturalgrowth in Uttar Pradesh. It becomes important to know what type of issues are dealt by the state when the neighboring states of Madhya Pradesh have noteworthy performance (Singh *et al.* 2018; Singh et al 2019) during the past decade. The present study seeks to explore growth performance of agriculture in terms of overall gross value added and agricultural productivity.Furthermore, the study builds the phases of agricultural growth with the help of appropriate tools which becomes worth pursuing for more deep analysis. In the last section, we explore the spatial variation of agricultural productivity and clustering of the districts on the basis of agricultural development indicators.

DATA AND METHODOLOGY

The present study covers 75 districts of Uttar Pradesh. To fulfill the objectives of the study, time series data of gross state domestic product (GSDP) by economic activities was collected for the period 1993-94 to 2018-19 at current and constant pricesfrom Central Statistics Organisation (CSO), Ministry of Statistics and Programme Implementation, Government of India. To estimate the growth behaviour, data has been considered using constant prices at 2011-12 base and back series has been converted using appropriate approach. We estimate agricultural productivity as used by other authors (Singh et al, 2012; Singh et al, 2019) by formula given as below:

$$Agricultural Productivity\ (Rs./\ Ha) = (Rs./Ha) = \frac{GDDP_{it}}{NSA_{it}}$$

Where,

$GDDP_{it}$ = gross district domestic product of 'ith' district in 'tth' time and

NSAit = net sown area of 'ith' district in 'tth' time.

MULTIPLE BREAKPOINT TESTS

Chow (1960) tested the regime change at a priori known date point using F- statistics.

It was Quandt (1960) who modified the Chow framework to considerthe F-statistic with the largest value over all possible break-dates and helps to ease the requirement that the researcher break-date be known.But later, Bai (1997) and Bai and Perron (1998, 2003a) further extended the Quandt-Andrews framework by allowing for multipleunknown breakpoints which provided theoretical framework and computationalresults.

To estimate break-dates test we consider a standard multiple linear regression model with periods T and n potential breaks (producing n+1 regimes). For the observations T_j, $T_j + 1$,…., $T_{j+1} - 1$ regime j and using regression model:

$$y_t = X_t'\beta + Z_t'\delta_j + \varepsilon_t$$

For the regimes $j = 0, \ldots, n$. It is to be noted that the regressors are divided into two groups. One group of variables are those whose parameters do not vary across regimes, while the other have coefficients that are regime specific. Although it is more convenient to define breakdates to be the last date of a regime, we follow the breakdate to be the first date of the subsequent regime. The procedure tie down the endpoints by setting $T_0 = 1$ and $T_{m+1} = T + 1$.

CLUSTER ANALYSIS

To identify the homogenous region of the state on the basis of agricultural development indicators, cluster analysis has been used. Cluster analysis is used for classifying the district into groups that are relatively homogeneous within themselves and heterogeneous between each other. The technique classifiedthe cases on the base of a defined set of variables and these groups are called cluster. For classifying the districts into clusters, the procedure is followed as below:

$$D_{ij} = \sqrt{\sum_{k=1}^{n}\left(x_{ki} - x_{kj}\right)^2}$$

Where

D_{ij} = distance between case i and j

x_{ki} = value of variable i for case j

CONTRIBUTION OF AGRICULTURE SECTOR OF UTTAR PRADESH TO INDIA

Uttar Pradesh is the pre-agricultural dominant economy especially in terms of employment. About half of the workforce is engaged in agricultural activity. Table

1 shows the contribution of the agriculture sector in gross value addedto the country and the employment over different rounds of National Sample Surveys. In the year 1993-94, the contribution of agriculture sector to the economy was reported as 36.3 percent and about 62.86 per cent of the workforce was found to be engaged in this sector during the same year. The contribution in income by the sector has been continuously reduced by 29.7, 26.9, and 25.4 in the years 2004-05, 2011-12 and 2018-19 respectively.Contribution of agriculture sector in terms of providing employment also declined from60.90 per cent in 2004-05 to 52.41 per cent in 2011-12 and further 50.91 per cent in 2018-19respectively. In the last 25 years, the contribution of the agriculture sector to the economy has declined 10.9 percentage points and its contribution in terms of employment has lessen by 11.9 percentage points during the same time period.

Table 1: Changing contribution of agriculture in Income and employment in Uttar Pradesh

Year	*Agriculture Contribution (%)*	
	State Economy	*Employment*
1993-94	36.3	62.86
2004-05	29.7	60.90
2011-12	26.9	52.41
2018-19	25.4	50.91

Source: Estimated by authors

GROWTH PERFORMANCE OF AGRICULTURE IN UTTAR PRADESH

Decadal ending growth trends of agriculture sector and agricultural productivity has been presented in figure 1. It is clear from the figure that growth trend of both variables followed declining trend till decade ending 2008-09. After this, the growth trend makes its headwayupwardand has been progressive till decade ending 2013-14. Subsequently, the growth trend again declines and then turned upward.

Figure 2 shows the performance of agricultural development indicators over the time in Uttar Pradesh. Cropping intensity has increased from 150 per cent in 2000-01 to 162.1 per cent in 2018-19. There was a slight trend inincreased area under double cropping system resulting increase in agricultural productivity. This increase in cropping intensity was due to increasing net area under irrigation facilities. In the recent years, about 90 per cent of the net sown area has been insured under irrigation in Uttar Pradesh.

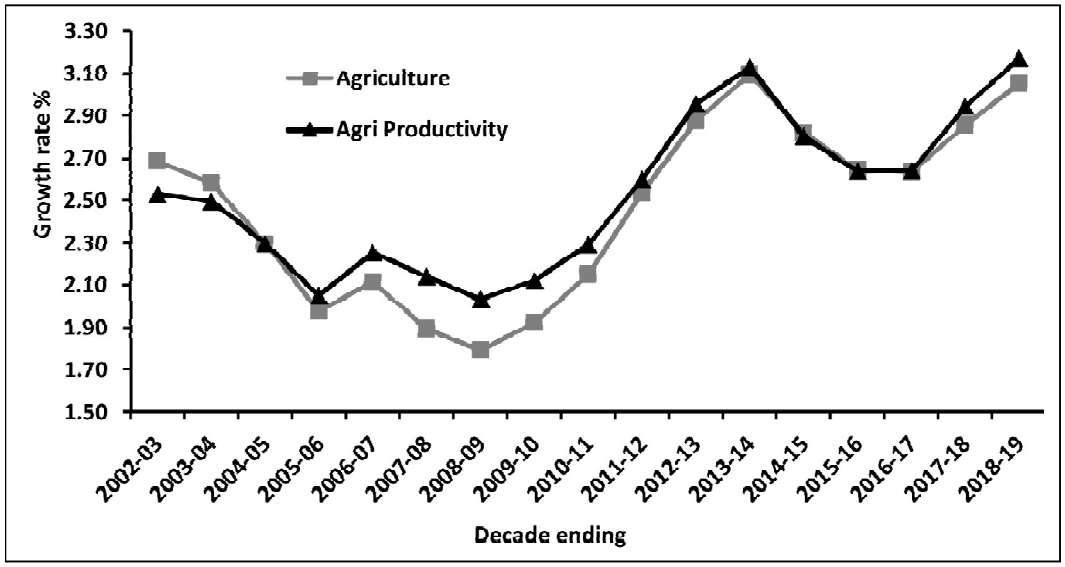


Figure 1: Growth trend of agriculture sector and agricultural productivity in Uttar Pradesh

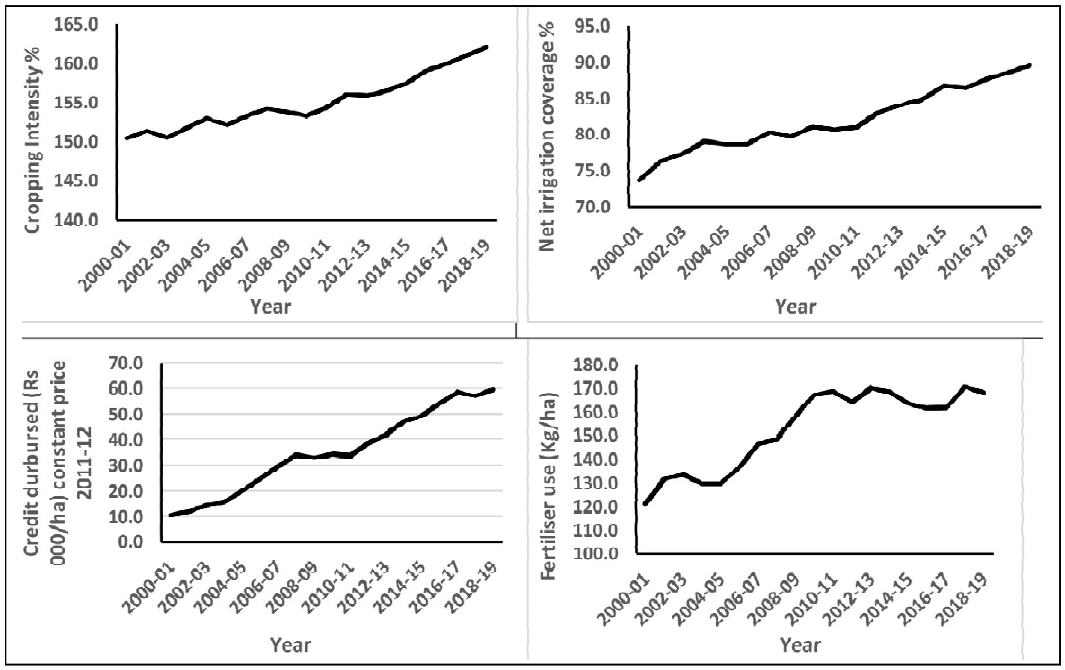


Figure 2: Performance of agricultural development indicators over the time in Uttar Pradesh

Disbursement of scheduled commercial bank credit to agriculture at constant prices at 2011-12 prices also increased during 2000-01 to 2018-19. As a result, farmers have beenable to buy more modern inputs which helps in enhancing productivity. Use of fertilizer per hectare also increased and reached to national average.

ESTIMATION OF STRUCTURAL CHANGES IN AGRICULTURAL PRODUCTIVITY AND GROWTH DURING DIFFERENT PHASES

As observed in theforegoing figure 1, the growth trends of agriculture sector as a whole and agricultural productivity followed a cyclical pattern. It has been observed that there is no compelling turning point, therefore, further analysis of the agriculture sector of the state can be done through estimation of structural break test.

Table 2: Results of multiple breaks test (Bai and Perron test)

Particulars	*Estimated number of breaks*				*Time period*
Break Point	*T-I*	*T-II*	*T-III*	*T-IV*	
	1999-00	1999-00	1999-00	1999-00	1993-94 to 1999-00
		2006-07	2006-07	2006-07	1999-00 to 2006-07
			2011-12	2011-12	2006-07 to 2011-12
				2016-17	2011-12 to 2016-17
					2016-17 to 2018-19
F- Statistics	67.77*	13.97*	15.33*	17.37*	
Critical value	8.58	10.13	11.14	11.83	

Source: Estimated by authors

Bai and Parron test identifies multiple structural breaks in the time series of agricultural productivity. In table 2, results of test have been presented. For a selection of break point,a critical value of Bayesian information criteria (BIG)(Bai and Parron,2003) has been applied. The test recommendedfour breakpoints(1999-00, 2006-07, 2011-12 and 2016-17) in the series. At the base of Bai and Parrontest, the series was divided into five phases.

- Phase first (1993-94 to 1999-2000): Period of accelerated growth
- Phase second (1999-2000 to 2006-07): Period of decelerated growth.
- Phase third (2006-07 to 2011-12): Period of accelerated growth.
- Phase fourth (2011-12 to 2016-17): Period of decelerated growth.
- Phase fifth (2016-17 to 2018-19): Period of accelerated growth.

The test identifies all sub periods being significantly different from each other. It is clear from the F-statistics that all values are higher than the critical value which implies that all break dates are statistically significant. It has been found that the growth pattern of agriculture is cyclical which is due to the reason thatsome part of the Uttar Pradesh lies in Bundelkhand region (Districts named Banda, Chirakut, Hamirpur, Mahoba, Jalaon, Jhansi, and Lalitpur are in this region). Due to high dependency of agriculture on rainfall in this region, agricultural productivity remains very low and highlyvolatilic due to drought conditions. As indicated by Indian Metrological Department, the region received only 400-450 mm rainfall during the last five years which is excessively below the long period average.

Table 3: Trends of Growth rate of Economy, Agriculture sector and Agricultural Productivity in different phases

Period	*Economy*	*Agriculture & allied*	*Agriculture Productivity*
1993-94 to 1999-00	4.58	2.91	2.56
1999-00 to 2006-07	4.71	1.38	1.60
2006-07 to 2011-12	6.93	3.12	2.98
2011-12 to 2016-17	5.87	1.78	1.94
2016-17 to 2018-19	6.58	4.21	4.36

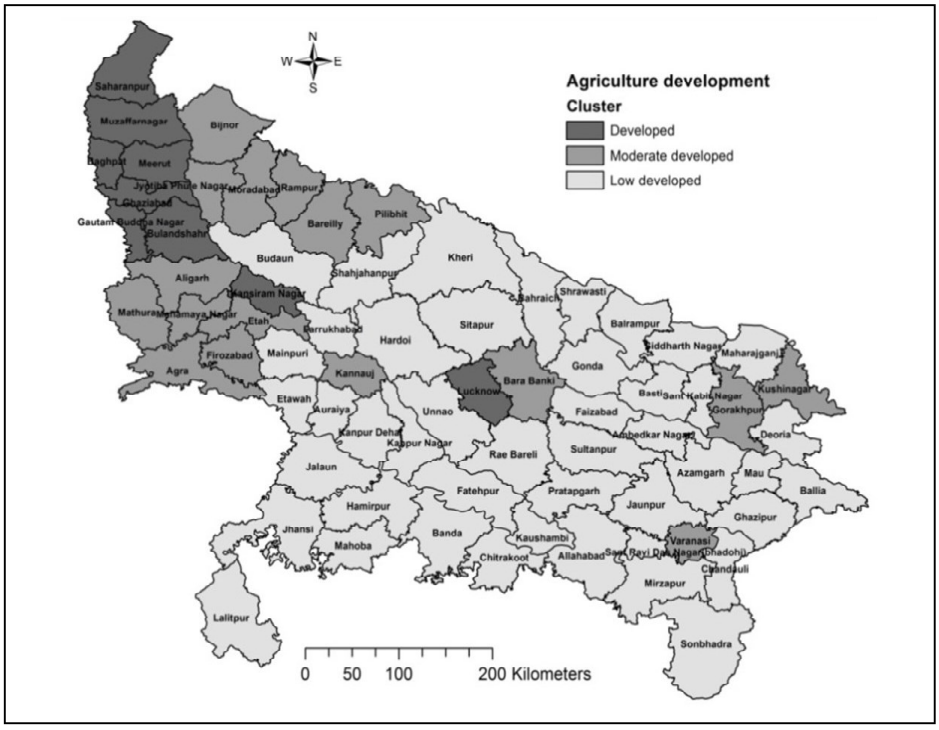
Source: Estimated by authors

Table 3 pertains to the growth rate of the Uttar Pradesh's economy, agricultural sector and agricultural productivity. The state achieved the highest growth rate of 6.93 percent between 2006-07 and 2011-12. During the same period, the agricultural sector grows at 3.12 per cent and agricultural productivity at 2.98 per cent. The highest growth rate in the agricultural sector was recorded as 4.21 per cent between 2016-17 and 2018-19.Interestingly, agricultural productivity alsoindicated highest growth rate during the same period and it increased to 4.36 per cent. The reason for the low growth rate in the agricultural sector from 1999-2000 to 2006-07 was due to low rainfall. In addition, the state was declared a drought prone area during this period.

STATUS OF INTER-REGIONAL AGRICULTURAL PRODUCTIVITY AND ITS DETERMINANTS

The previous section has established the growth pattern of agricultural sector of Uttar Pradesh. Spatial pattern of agricultural development has been explored in this

section.The state of Uttar Pradesh has been divided into three categoriesin the map 1 on the basis of agricultural development. The districts which witnessed the high agricultural development are Lucknow, Saharanpur, Muzaffarnagar, Bhagpat, Meerut, Ghaziabad, Budh Nagar, Bulandshahr, Kanshi Ram Nagar.Districts named,Bijnor, JyotibaPhule Nagar, Moradabad, Rampur, Bareilly, Pilibhit, Aligarh, Mathura, Agra, Firozabad, Etah, Mahamaya Nagar, Kannauj, Bara Banki Nagar, Gorakhpur, Kushinagar, Varanasi Nagarliedlie in moderate agricultural development region of the state. The remaining districts have found to fall back with the other districts in agricultural development.



Map 1: Regionalisation of districts accounting to agricultural development in 2016-17

It is cleared that there are 9 districts which are most developed in agriculture out of which 8 districts belong to North West and one district (Lucknow) belongs to Centre Uttar Pradesh. In addition, there are total of 17 districts related to moderate agricultural development. Most of these districts are in the north-western region. The remaining 49 districts are lagging behind in agricultural development.

Table 4: Region-wise average value of Agricultural Development Indicators

Indicator	*Mean values of Cluster*		
	Developed	*Moderate developed*	*Less developed*
Agricultural Productivity (Rs./ha)	361525.55	228047.78	138901.59
Agricultural coverage %	69.42	74.64	66.87
Cropping intensity %	164.50	169.47	156.18
% Gross Irrigated area	96.91	84.92	74.05
Credit disbursed (Rs./ha)	143500.17	104657.13	52478.45
Fertilizer Use (Kg./ha)	181.45	163.10	157.58
% Workforce in agriculture	39.77	42.51	59.53

Source: Estimated by authors

Table 4 shows the average values of the development indicators by cluster of development. It shows that the agricultural productivity of agriculturally developed districts is Rupees 361525.59 per/ha while that of less developed districts are only INR 138901.59 per/ha which implies 60 percent less than developed areas. Moderate developed districts have the highest crop intensity of 169.47 percent. Average area under insured irrigation in developed region is 96.91 percent whereas in less developed districts merely74.05 per cent area has been found to be underinsured irrigation.Irrigation is an important source of agriculture which acts as a catalyst for the development of agriculture and provides gainful use of chemical fertilizers and improved seeds. Therefore, the use of irrigation (surface or groundwater) is a major concern for the agricultural sector.However, the growth of canal irrigation in the state has been hampered since the mid-1990s due to changes in the use of groundwater instead of canal water.

Table 5: Analysis of Variance between Clusters

Indicator	*Cluster*		*Error*		*F*	*Sig.*
	Mean Square	*df*	*Mean Square*	*df*		
Agricultural Productivity (Rs./ha)	235363980258	2	1164519837	72	202.1	0.000
Agricultural coverage %	378.5	2	97.1	72	3.90	0.025
Cropping intensity %	1210.3	2	281.8	72	4.30	0.017
% Gross Irrigated area	2608.6	2	277.9	72	9.39	0.000
Credit disbursed (Rs./ha)	44938885396.3	2	925554533.7	72	48.55	0.000
Fertilizer Use (Kg./ha)	2547.0	2	608.4	72	4.19	0.019
% Workforce in agriculture	2897.2	2	270.5	72	10.71	0.000

Source: Estimated by authors

It has also been observed that in the agriculturally developed districts, the disbursement of institutional credit was Rs. 1,43,500 per hectare as compared to Rs. 52478per hectare in the less developed districts.It is nearly one third of the developed region. It has been observed that there is sizeable difference between developed region and the less developed region in terms of fertilizer per hectare useas it wasabout 181 kg/ha of fertilizer use in the developed region compared to 157 kg/ha in disadvantageous region.The use of fertilizers in the state has increased tremendously in the last few years (as seen in figure 2), but in later years, it stabilized. It hasbeen found that 39.77 percent of workforce is engaged in agricultural activities in advanced regions ascompared to 59.53 per cent in lagged regions. Low dependency on agriculture makes worker highly productive and reduce land worker ratio. This has been reflected in high level of agricultural productivity.

It has been established from the table 3 that there is a considerable difference in mean values between clusters. Table 4 provided the evidence that these mean values are statistical significantly different from each other. It can be clearly noticed from the table that agricultural productivity, per cent gross irrigated area to gross sown area, institutional credit disbursed to agriculture (Rs/ha), and per cent workforce engaged in agriculture significantly differ from each other at 1 per cent level whereas cropping intensity %, per cent area under agriculture, and use of fertilizer (kg/ha) were found to be significantly different from each other at 5 percent.

CONCLUSION

Uttar Pradesh being a dominant agrarian economy contributes about 25 per cent of the state gross domestic product by the agriculture sector and provides employment to more than half of the workforce in the state. Due to the larger size of the state, Uttar Pradesh has contributed 18.9 per cent of cereals, 8.65 per cent of pulses, 3.65 per cent of oilseeds and 46.56 per cent of sugarcane to the country during 2017-18. This study seeks to explore growth performance of agriculture in terms of overall gross value added and agricultural productivity.Furthermore, the phases of agricultural growth with the help of appropriate toolshave been built. The spatial variations of agricultural productivity and clustering of the districts on the basis of agricultural development indicators has been done.The findings revealed the decadal ending growth trends of agriculture sector and agricultural productivity has been volatilicas the growth trend of both variables were declining trend till decade ending 2008-09. After that, the growth trend turned upward, later the trend has been progressive till decade ending 2013-14. Subsequently, the growth trend again declined and then turned upward.

In the halfway of study,Bai and Perrontestestablished four break points (1999-00, 2006-07, 2011-12 and 2016-17) in the series. In the execution of Bai and Perrontest, the series was divided into five phases. The test identified all sub periods were significantly differ from each other. The growth pattern of agriculture of the state was cyclical due to the some area of the state lying in Bundelkhand region (Districts named Banda, Chirakut, Hamirpur, Mahoba, Jalaon, Jhansi, and Lalitpur are in this region). High dependency of agriculture on rainfall in this region makes very low and highly volatileagricultural productivity.

It is estimated that the averages values of development indicators are different. Consequently, level of agriculture also varied across regions in Uttar Pradesh. To reduce the gap between levels of development, it is necessary that less developed regions should catch up the average level of the developed regions. State should make different region specific policies instead of state as a whole.

References

Bai, Jushan(1997), "Estimating Multiple Breaks One at a Time", *Econometric Theory*, Vol. 13 (3), PP: 315-352.

Bai, Jushan and Pierre Perron (1998), "Estimating and Testing Linear Models with Multiple Structural Changes", *Econometrica,* Vol 66,pp 47-78.

Bai, Jushan and Pierre Perron(2003), "Computation and Analysis of Multiple Structural Change Models", *Journal of Applied Econometrics*, Vol 18, pp 1-22.

Baig, I. A., & Salam, M. A. (2019). "Regional disparities in agricultural development: An analysis of micro level". *International Journal of Research and Analytical Reviews,*Vol 6, pp-1154-1160.

Chand, R, S. S. Raju, & L. M. Pandey, (2007), "Growth crisis in agriculture: Severity and options at national and state levels". *Economic andPolitical Weekly,* Vol 26, pp 2528-2533.

Chand, R., Raju, S. S., Garg, S., & Pandey, L. M. (2011), "Instability and regional variation in Indian agriculture". Policy Paper No. 26. Retrieved fromhttps://krishi.icar.gov.in/jspui/bitstream/123456789/732/1/pp26.pdf

Chanh Ramesh and P. Shinoj (2012), "Temporal and Spatial Variations in Agricultural Growth and Its Determinants", *Economic & Political Weekly*, Vol 47, pp 55-64.

Chow, G.C. (1960), "Tests of equality between sets of coefficients in two linear regressions", *Econometrica*,Vol 28, PP: 591-605

CSO (2020), "State wise Value added by economic activity", Central Statistics Office, Ministry of statistics and programme implementation, Government of India. Retrieve:http://www.mospi.gov.in/GSVA-NSVA

DES (2019), "Agricultural statistics at a glance", Directorate of economics and statistics, Ministry of Agriculture & Farmers Welfare, Government of India. Retrieve: https://eands.dacnet.nic.in/PDF/Agricultural%20Statistics%20at%20a%20Glance%202018.pdf

GoI (2019), "Annual Report of Periodic Labour Force Survey (PLFS)", Ministry of statistics and programme implementation, National Statistical Office, Government of India. Retrieve:http://www.mospi.gov.in/sites/default/files/publication_reports/Annual%20Report%2C%20PLFS%202017-18_31052019.pdf

GoI (2019), "National Accounts statistics", Ministry of statistics and programme implementation, National Statistical Office, Government of India. Retrieve:http://www.mospi.gov.in/publication/national-accounts-statistics-2019

Kumari, R. (2014),"Growing regional disparity in Uttar Pradesh: inter-district analysis", *ArthaVijnana*, *56*(3), 339-360.

Mohanty, B. B. (2009). Regional disparity in agricultural development of Maharashtra. *Economic and political weekly*, Vol 6, pp 63-69.

Ohlan, R. (2013). Pattern of regional disparities in socio-economic development in India: District level analysis. *Social Indicators Research*, *114*(3), 841-873.

Quandt, R.E. (1960), "Tests of the hypothesis that a linear regression system obeys two separate regimes", *Journal of the American Statistical Association*, Vol. 55, PP: 324-330.

Raman, R., &Kumari, R. (2012). Regional disparity in agricultural development: a district level analysis for Uttar Pradesh. *Journal of Regional Development and Planning*, *1*(2), 71-90.

Singh, Jaspal and Amritpal Kaur (2018), "Tackling Regional Imbalancesin Agriculture", *Kurukshetra*, Feb. PP: 60-64.

Singh, Jaspal, Amarjeet Singh, Nirmal Singh, Tresha Singh Tomar and HimaniSachdeva (2018), "Growth trajectory and inter-regional agricultural disparity: a study of Madhya Pradesh", *Indian journal of economics and development*, Vol 14, No 4, pp-464-472.

Singh,Jaspal, S.K. Srivastava, S.J. Balaji and Nirmal Singh (2019), "Agricultural Growth Trajectory in Madhya Pradesh: Is It Sustainable?",*International Journal of Social Science & Management Studies,*Vol 5, No 1, pp-27-35.

Srivastava, S. K., N. P. Singh, Jaspal Singh, K. V. Rao and S. J. Balaji (2019) "Agriculture development-based mapping of agro-ecological sub-regions and its implications for doubling farmers' income in India", *Current Science*, Vol. 117 (02), PP: 282-287.