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Spatial variation in level of agricultural development in Bulandshahr district of western Uttar Pradesh (India)

Gomatee Singh *, Syed Waseem A. Ashraf

Department of Geography, Aligarh Muslim University, Aligarh-202001, U.P. India

Abstract

In the present paper an attempt has been made to find out the spatial variation in the adaptation of improved agricultural practices to ascertain the level of agricultural development in Bulandshahr district of western Uttar Pradesh. The spatial variation of agricultural development is determined with the help of nine variables viz. net sown area, irrigated area, cropping intensity, crops productivity, area under HYV, agricultural labourers, role of banks and agricultural machinery. Beside this, the development of blocks are taken with their respective categories viz. high, medium and low on the basis of scores (like mean SD) of these variables. These analyses have been carried out by transforming and combining the data related to nine variables, using 'Z' score to get the composite score. On the basis of Composite Score, developments of blocks have been again categorized in to three categories i.e. high, medium and low. Results of the aforesaid analysis shows that the modern technological inputs have reciprocal relationship with agricultural development in the study area.

Keywords: Cropping intensity, Crop productivity, HYV, Gramin (rural) bank, Agricultural implements

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1. Introduction

* Corresponding author. E-mail address: gomatee87@gmail.com

There are concerns regarding the agriculture sector in India as the compound growth rate of total food grains were less than two percent in the last decade i.e. area: 0.29, production: 1.96, yield: 2.94 (Ministry of Finance, 2011); making traditional farming a non viable agricultural activity. Disparities in productivity across regions/districts and even within crops persist with significant increase in small and marginal farm holdings. Agricultural development denotes the quality of agricultural system of a region; it is a multi dimensional concept which mainly includes development in a real strength of cropped land, improvement in farm practices/system, improved farm implements, irrigation system and irrigated area, high yielding improved varieties of seeds, chemical fertilizers, insecticides and pesticides, intensity of cropping and specialization and commercialization of agriculture (Mohammed, 1980).

The changing agro-economic scenario drew attention of research workers on diffusion of technological development in agriculture. In India majority of its population depend upon agriculture. So a vast rural mass tries to earn their livelihood from agricultural land. With fast increasing pressure of population on agricultural land, old methods and techniques of production cannot cope with growing demand. As a result, new technologies and commercial crops are adopted to develop agro-economy. For these reason emphases on the diffusion of agricultural innovation are stressed.

The present study is an attempt towards accelerated agricultural production in Bulandshahr district of western Uttar Pradesh through the analysis of cropping pattern and level of agricultural development at block level, as well as assessing the role of modern agricultural technology in the development of agriculture in different blocks of this area.

2. Data base and methodology

For the assessment of agricultural development secondary data have been used for the period 2010-2011, collected from District Statistical Handbook, Statistical Abstract and ICT based district profile of Bulandshahr District. The major crops of this district are wheat, rice, sugarcane, potato, oilseeds, pulses and coarse cereals.

For determining the levels of agricultural development various variables have been used such as crop productivity index, net sown area, cropping intensity, irrigated area, use of fertilizers, area under HYV (High Yielding Variety), agricultural labourers, commercial and Gramin banks, and agricultural implements.

To determine the overall levels of agricultural development and its uneven distribution in the study area the data of the all variables have been transformed into indices using Z-score technique. The formula is

$$Z_i = \frac{X_i - \bar{X}}{SD} \quad (1)$$

where Z_i = standard score for the i th observation, X_i = original value of the i th observation, \bar{X} = mean of the value of X variable, SD = standard deviation of X variable.

In order to classify blocks according to their levels of development the composite Z-score have been grouped into high, medium and low.

Further, the result of the standard score obtained for different indicators were aggregated by composite standard score (CSS) so that regional disparities in the level of development of block may be obtained on a common sale. The composite standard score may be algebraically expressed as

$$CSS = \frac{\sum Z_{ij}}{N} \quad (2)$$

where CSS= composite standard score, Z_{ij} = Z-score of an indicator j in block i , and N = number of indicators.

In order to classify the blocks according to the magnitude of the development the composite score were divided into three classes that are high, medium and low.¹

Table 1. List of selected variables

S.N	Variables	Definition
1	X ₁	Percentage of net sown area to the gross cropped area
2	X ₂	Cropping intensity
3	X ₃	Agricultural crop productivity yield index
4	X ₄	Percentage of total irrigated area to gross cropped area
5	X ₅	Percentage of area under HYV.
6	X ₆	Chemical fertilizer (NPK) consumption Kg/hectare
7	X ₇	Number of agricultural implements per 10,000 hectare
8	X ₈	Number of agricultural laborers to the total population
9	X ₉	Number of commercial and Gramin banks/ 100,000 population

3. Study area

¹ Z-score technique and the composite standard score (CSS) have been taken from "Statistical Methods in Geographical Studies" (<http://psychassessment.com.au>).

Bulandshahr, one of the important district of western Uttar Pradesh, lies between 28°4' to 28° 12' north latitude and between 77° 0' to 78° 0' east longitude and located in upper Ganga –Yamuna Doab (figure 1). The river Ganga separates it from Jyoti Ba Phule Nagar and Badaun districts in east. The district is bounded by Aligarh in south, Gautam Budh Nagar in west and Ghaziabad in the north. The district has 7 tehsils, 15 blocks, and covers an area of 4353 square kilometers with a population of 3,498,507 in 2011. The north to south length of the district is 84 kilometers while east to west width is 62 kilometers. Wheat, rice, sugarcane, maize and potato are the major crops which are grown in plenty.

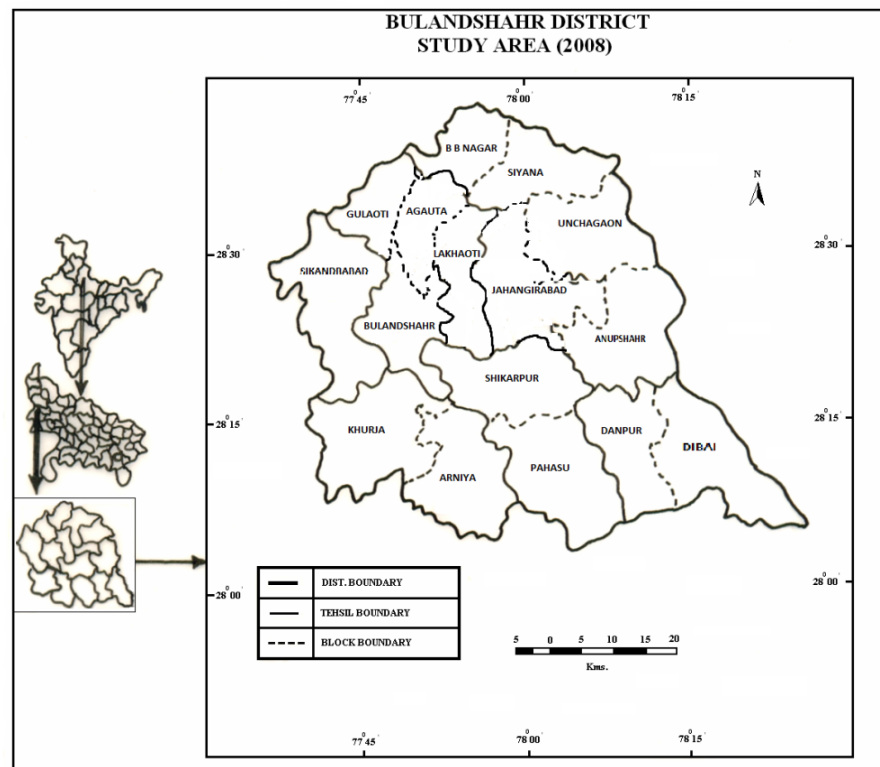


Figure 1. Study area (Source: District Statistical Handbook, 2010)

4. Discussion

Agricultural development is a multidimensional activity and key to which is crop productivity as one of the vital aspects of rural development. The primary objective of the agricultural development is usually increased growth of agricultural output to provide the livelihood to the growing population.

4.1. Distribution of variables

4.1.1. Net sown area (X_1)

The net sown area can be defined as the total area sown in a year. Higher the net sown area; higher will be the crop production and in turn will be reflected in agricultural development. It is evident from the Table 2 the top position is occupied by Sikandrabad block (1.33) in net sown area (NSA). The Z-score of the blocks categorized under three groups. The high levels of NSA are in Sikandrabad (1.33), Arniya (1.31), Danpur (1.15), Khurja (1.02), Jahangirabad (0.80), and Pahasu (0.73). The value under high level of NSA ranges from 0.20 to 1.33. The six out of sixteen blocks fall under this category.

The medium group ranges from -0.83 to 0.20. There are only five blocks under this category mainly Unchagaon (0.20), Anupshahr (0.16), Lakhaothi (-1.79), and Agauta (-0.98). The blocks under low NSA ranging from -0.22 to -0.83, include Siyana (-0.22), Shikarpur (-0.26), and Bulandshahr (-0.31).

4.1.2. Cropping intensity (X_2)

The intensity of crop refers to the use of a field several times during a cropping year. It is a measure of land efficiency, which is defined as the extent to which the net area sown is cropped or sown. The value of cropping intensity is ranging from 0.81 to 2.35 under high category which is listed in Table 2. Only one blocks, namely Arniya (2.31) come under this category. In medium category the value ranges from -0.16 to 0.81 and eight blocks, namely Khurja (0.81), Sikandrabad (0.74), Danpur (0.46), Jahangirabad (0.53), Danpur (0.46) Anupshahr (0.12), Dibai (0.11), and Pahasu (0.06). Remaining blocks are under low category which ranges from -0.93 to -0.16 including Bulandshahr (-2.28), Bhavan Bahadur Nagar (-0.93), Gulaothi (-0.83), Agauta (-0.65), Unchagaon (-0.55), Siyana (-0.27), and lakhaothi (-0.16). The lowest cropping intensity is recorded in Bulandshahr (-2.28).

4.1.3. Crop productivity yield index (X_3)

Agricultural productivity determines the level of agricultural development in any region. It refers to per acre or hectare of yield in a unit (kgs/quintals etc.) of any crop in a region or field. A farmer adopts each kind of technique to increase the productivity of crop because it leads to the overall development (economic as well as social) of the farmer. The agricultural productivity of the selected crops is calculated for each sixteen blocks of the Bulandshahr district. In order to reveal the spatial variation and to demarcate the productivity region the index value further calculated the Z-score and categorized under three groups. The value of the high productivity blocks ranges from 0.68 to 2.67. The highest productivity blocks are Unchagaon (2.67) and Agauta (1.61). The highest value recorded in Unchagaon (2.67), in which productivity is very high. Under the medium level of crop productivity is recorded in -0.28 to 0.69. Five blocks, namely B.B.Nagar (-0.26), Arniya (0.19), Gulaothi (0.33), Anupshahr (0.38) and Jahangirabad (0.68) come under this category. The low productivity is recorded in remaining eight blocks, namely Dibai (-0.28), Danpur (-0.39), Bulandshahr (-0.51), Sikandrabad (-0.67), Lakhaothi (-0.67), Khurja (-0.84), Siyana (-0.89) and Pahasu (-1.30). The lowest crop productivity is recorded in block Pahasu (-1.30).

4.1.4. Irrigated area (X_4)

Irrigation is necessary for almost any kind of agricultural development and prerequisite for the success of modern technology in agriculture. The need of additional and artificial water supply is always felt in successful farming operation. Irrigation plays a significant role in entire agriculture sector. The changing trends in the intensity of irrigation, portrays man's dynamic attempt to overcome environmental limitations to transform the potential of the area into agricultural resources (Singh, 1974).

The total irrigated area has been calculated as percent of the total sown area and further calculated Z-score of the percentage of total irrigated area. Table 2 indicates that high level of irrigation has been observed in Jahangirabad (0.53), Pahasu (0.61), Dibai (0.65), Arniya (0.83), Danpur (1.16), and Siyana (1.65). The medium level of irrigation has been observed in Gulaothi (-1.50), Anupshahr (-1.23), Lakhaothi (-1.22), Agauta (-0.46), Khurja (-0.33), Shikarpur (0.06), Bulandshahr (0.29), Sikandrabad (0.35), and unchagaon (0.38). There is only one block namely Bhavan Bahadur Nagar (-1.78), which come under the low level of irrigation.

4.1.5. Area under HYV seeds (X_5)

The HYV of seeds are the most important factor in agricultural production under the new technique. The success of this programme has revolutionized agriculture and brought about a phenomenal and rapid increase in the food grain production in India and study region. Table 2 shows that area under high yielding varieties of seeds in different blocks of the district Bulandshahr. It has been grouped into three categories. In the high category there are seven blocks, namely Lakhaothi (0.71), Bulandshahr (1.28), Shikarpur (1.28), Jahangirabad (1.28), Anupshahr (1.28) and Pahasu (1.28). Only three blocks ranging from -0.62 to 0.13 have been observed under medium category. Remaining seven blocks are under low level using HYV seeds. These are Agauta (-1.18), Dibai (-1.02), Gulaothi (-1.01), Danpur (-0.94), Unchagaon (-0.86), Arniya (-0.70), and Khurja (-0.62). The lowest area under HYV is observed in Agauta (-1.18) in this district.

4.1.6. NPK Consumption (X_6)

For improving the yield rate, timely and adequate provision of inputs like fertilizer, HYV seeds and insecticides is of prime importance. Chemical fertilizers have played their crucial role in increasing food grain production and solving the problem of low yield in India. The consumption of fertilizers in different blocks is ranging from 0.15 to 2.30 of their z-score. High level of consumption of fertilizer has been recorded in blocks namely Agauta (1.08), B.B.Nagar (1.09), Bulandshahr (1.25), Lakhaothi (1.28), and Gulaothi (1.69). There are six blocks having medium level of consumption; Anupshahr (-0.25), Sikandrabad (-0.33), Jahagirabad (-0.38), Dibai (0.16), Unchagoan (0.08), Siyana (0.15). The low level of fertilizer consumption recorded in five blocks of the district, namely; Arniya (-0.74), Danpur (-0.98) Pahasu (-1.05), khurja (-1.15), and sikandrabad (-1.33).

Table 2: Standard score of the variables for the agricultural development in Bulandshahr district of western Uttar Pradesh (District Statistical Handbook, 2010)

NAME OF THE BLOCKS	Xi	Xii	Xiii	Xiv	Xv	Xvi	Xvii	Xviii	IX	Composite Z score
SIKANDRABAD	1.33	0.74	-0.7	0.35	0.13	-0.4	-0.4	0.89	-0.2	0.0474
GULAOTHI	-0.8	-0.8	0.33	-1.5	-1	1.69	-0.9	0.82	3.01	0.0519
LAKHAOTHI	-1.8	-0.2	-0.4	-1.2	0.71	1.28	0.24	-1.1	1.71	-0.0446
BULANSHAHAR	-0.3	-2.3	-0.5	0.29	1.28	1.25	0.62	-0.5	0.19	0.0002
SHIKARPUR	-0.3	0.53	-0.3	0.06	1.28	-0.7	1.57	0.89	-0.2	0.177
BHAVAN BAHADUR NAGAR	-1.2	-0.9	-0.3	-1.8	-0.4	1.09	-0.4	-1.2	-0.5	-0.3454
SYANA	-1.2	-0.3	-0.9	1.65	-0.5	0.15	-1.1	-0.5	-0.9	-0.2171
JAHANGIRABAD	0.8	0.53	0.68	0.53	1.28	-0.4	-0.1	1.42	-0.2	0.2842
KHURJA	1.02	0.81	-0.8	-0.3	-0.6	-1.2	1.02	0.76	-0	0.0401
ARNIYA	1.31	2.35	0.19	0.83	-0.7	-0.7	-1.2	-1.3	-0.7	0.0038
PAHASU	0.73	0.06	-1.3	0.61	1.28	-1.1	-0.3	-0.9	-0.5	-0.0817
UNCHAGAON	0.2	-0.6	2.67	0.38	-0.9	0.08	-0.7	-0.8	-0.2	0.0136
DANPUR	1.15	0.46	-0.4	1.16	-0.9	-1	-0.9	1.16	0.19	0.0553
DIBAI	-0.2	0.11	-0.3	0.65	-1	0.01	-0.4	0.14	-0.2	-0.0782
ANUPSHAHAR	0.16	0.12	0.38	-1.2	1.28	-0.3	0.64	1.21	-0.5	0.1173
AGAUTA	-1	-0.7	1.61	-0.5	-1.2	1.08	2.3	-1	-0.9	-0.0113

4.1.7. Agricultural implements (X_7)

New agricultural technology is not only a package of hybrid seeds and other modern input, but it also incorporates new agricultural practice. This has made the mechanical power necessary for some operations which are very necessary during scarcity of labour and relatively high wages rates particularly during the peak season. Agricultural implement are other important factors of agricultural development or we can say that these are the key to the modern agricultural development. The backwardness of the Indian agriculture is their traditional agricultural development. If we use modern agricultural implements we can advance our agriculture in time saving period. The largest number of agricultural implements has been recorded in Bulandshahr (0.62), Anupshahr (0.64), Shikarpur (1.57), and Agauta (2.30) which ranges from 0.24 to 2.30. While, the block under medium categories ranges from -0.44 to 0.24 which covers the blocks Dibai (-0.42)

B.B Nagar (-0.39), Pahasu (-0.31) Jahangirabad (-0.10), and Lakhaothi (0.24); remaining eight blocks, Sikandrabad (-0.44), Unchagaon (-0.67) Gulaothi (-0.85), Danpur (-0.93), Khurja (-1.02), Siyana(-1.05), Arniya (-1.21), and Anupahasu (-1.21) fall under low category.

4.1.8. Agricultural labourers (X_8)

Like the other inputs such as chemical fertilizers, HYV seeds, machineries etc. agricultural labourers are also the important factor for agricultural development because there are many activities in the field which they perform. Table 2 indicates that highest number of agricultural labour has been found in Jahangirabad (1.42). Other blocks in high category are Gulaothi (0.82), Sikandrabad (0.89), Shikarpur (0.89), Danpur (1.16), Anupshahr (1.21), and Jahangirabad (1.42), ranging from 0.76 to 1.42. The blocks ranging from -0.88 to 0.76 are under medium category of having numbers of agricultural labourer. Only five blocks namely, Unchagaon (-0.80), Bulandshaahr (-0.53), Siyana (-0.52), Dibai (0.14), and Khurja (0.76) are under medium category. Remaining five blocks namely Arniya (-1.26), B.B.Nagar (-1.23), Lakhaothi (-1.05), Agauta (-1.01), and Pahasu (-0.88) are under the low category.

4.1.9. Commercial and Gramin banks (X_9)

Commercial and Gramin bank play a very important role in the agricultural development. The phenomenal growth in the consumption of chemical fertilizers and other modern agricultural inputs can be made possible largely because of liberal provision of credit or loan to the cultivators by the co-operative of the government. These banks provide loan and subsidies to the farmers in term of cash or machines and tools like tractors and pump set. With the help of these facilities farmers accelerate their productivity.

Table 2 shows that Gramin and commercial banks are not equally distributed in the study region. It has been categorized into three groups such as high, medium and low with the help of calculated Z-score. The high Z-score ranging from 0.19 to 3.01 of commercial and Gramin banks has been recorded in Lakhaothi (1.71) and Gulaothi (3.01). The highest score has been recorded in Gulaothi (3.01). Eight blocks have been fall in medium category which ranges from -0.45 to 0.19. the block under this category are Bulandshahr (0.19), Danpur (0.19), Khurja (-0.02), Sikandrabad (-0.23), shikarpur (-0.23), Unchagaon (-0.23), Jahangirabad (-0.23), Dibai (-0.23). Remaining six blocks fall under low category. These are Pahasu (-0.45), Anupshahr (-0.45), B.B. Nagar (-0.45), Arniya (-0.67), Agauta (-0.88), and Siyana (-0.88).

5. Levels of agricultural development

To assess the level of agricultural development in Bulandshahr district of western Uttar Pradesh, all the nine variables have been aggregated. The Z-score value of nine variables transformed and combined with the help of Z-score and composite score was prepared (Table 3). The composite score ranges from 0.284 (highest) in Jahangirabad to -0.345 (lowest) in B.B.Nagar. Jahangirabad is the most developed block in Bulandshahr district and B.B. Nagar is at the bottom. On the basis of composite Z-score, the blocks have been categorized

into three classes viz. high, medium and low (Figure 1) which clearly shows the spatial variation in level of agricultural development in Bulandshahr district. On an aggregate five blocks namely, Jahangirabad (0.2842), Shikarpur (0.1770), Anupshahr (0.1173), Danpur (0.0553) and Gulaothi (0.0519), which ranges their composite Z-score above 0.05, are highly developed blocks while majority of the district fall under medium category having their composite Z-score ranging from -0.07 to 0.05.

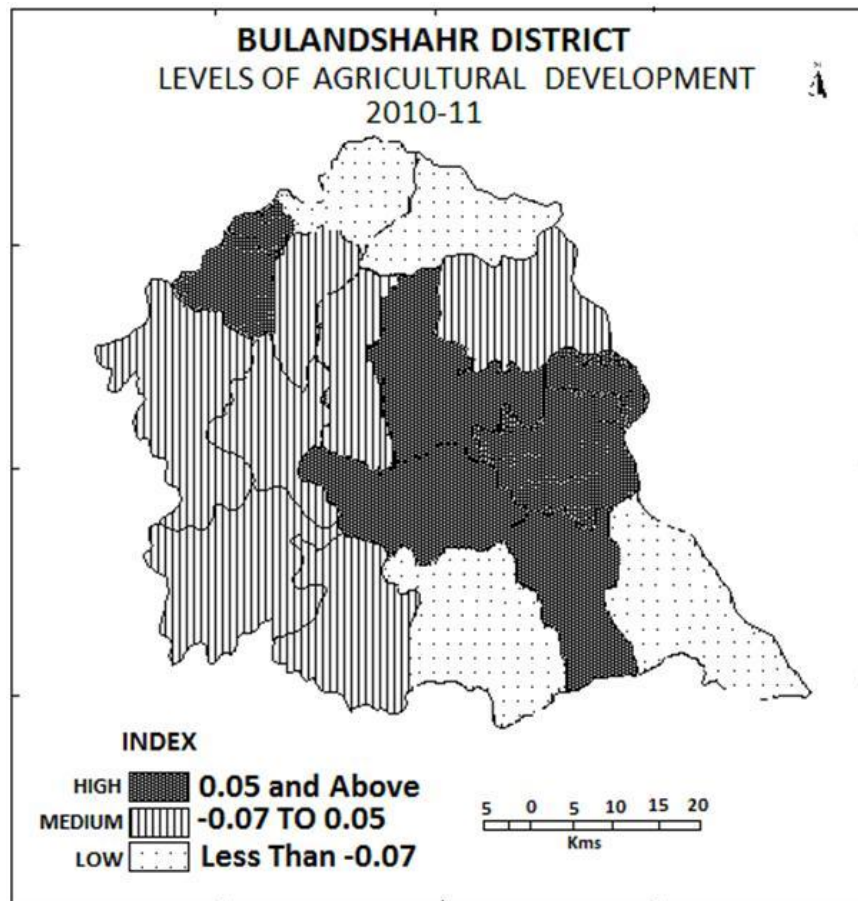


Figure 2. Bulandshahr district levels of agricultural development prepared by composite Z-score technique

This category cover seven blocks namely Sikandrabad (0.0474), Khurja (0.0401), Unchagaon (0.0136), Arniya (0.0038), Bulandshahr (0.0002), Agauta (-0.0113), and Lakhaothi (-0.0446). Only four block having their composite Z-zcore below -0.07 fall under low level of agricultural development and these are Bhavan Bahadur Nagar (-0.3454), Siyana (-0.2171), Pahasu (-0.0817) and Dibai (-0.0782) that show low level of agricultural development.

Table 3. The spatial pattern and the level of agricultural development in Bulandshahr district

z-score value	Level of agricultural development	No. of blocks	Name of the blocks
0.05 and above	High	5	Shukarpur, Jahangirabad, Anupshahr, Danpur, Gulaothi
-0.07 to 0,05	Medium	7	Sikandrabad, lakhaothi, Bulandshahr, khurja, Arniya, Agauta, Unchagaon,
Less than -0.07	low	4	Bhavan Bahadur Nagar, Siyana, Pahasu, Dibai

6. Conclusion

The present study reveals that the spatial distribution of variables and agricultural development is not uniform in Bulandshahr district. It provides very significant information about the level of agricultural development in Bulandshahr district of western Uttar Pradesh. The study highlight that the majority of the district come under the medium category of agricultural development and the high level of agricultural development is seen in blocks lying in middle part of the study region, while the blocks lying on the northern boundary of the district or near to Ghaziabad, are agriculturally less developed because of development of industrialization due to influence of National Capital Region. For development there is a need for restructuring of the agriculture which has to be done within certain limits of economic, social, and political factors, as well as the national goal; and to making the agricultural society more dynamic. The study highlights the impact of location and spatial input on the agricultural development planning in Bulandshahr district.

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