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INTRA-DISTRICT VARIATIONS AND EMERGING CONCERNS IN AGRICULTURAL DEVELOPMENT OF SIDDHARTHNAGAR DISTRICT, UTTAR PRADESH

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Abstract

A higher level of development in the agriculture sector contributes positively to the economic condition and livelihood security of the farmers. In India, more than 60% of the population lives in villages and is highly dependent on agriculture for their socio-economic well-being. Agricultural development is one of the major challenges in the less developed districts in the country as these are poor in terms of natural resources and also in socio-economic aspects. The study area, Siddharthnagar district, has more than 93% of rural population which is mainly dependent on agriculture. The present study is concerned with the analysis of intra-district variations in agricultural development measured with the help of 10 selected indicators which are processed through the composite index method. The study uses secondary data sources on various indicators which are combined into 4 groups representing agricultural extent, fertilizers use and cropping intensity, irrigation status, and availability of modern tools and technology. The results show wide variations in the agricultural development at the block level which ranges from 0.89 in Mithwal and Khesraha blocks to 1.16 in Uska Bazar blocks and represent the least and very highly developed block in agriculture, respectively. The study also identifies emerging concerns like limited scope to extend agriculture, high dependence on food grain crops, comparatively low cropping intensity, efficient use of water in irrigation, etc. which requires policy intervention. The findings recommend that proper decision-making in these areas can help in achieving the rural development of the area through agricultural development.

***Keywords*:** Agriculture, Irrigation, Disparities, Rural Development, Siddharthnagar

Introduction

Agriculture is the largest economic activity performed in the world and the biggest use of land by men (Foley, 2011). Agriculture is an important sector of economy which has a considerable impact on the gross domestic product of any region. The development of agriculture plays a crucial role for the rural poor depending upon agriculture as it helps in improving the economic condition and purchasing power for the livelihood (Hajer et al., 2016). The whole rural local economy revolves around the primary activities in general and agriculture in particular. In the present time, agriculture is facing several challenges (Foley

et al., 2011) and agricultural development is one of them in developing countries like India where regional disparities are widening inspite of various governmental efforts (Kurian, 2000).

Agriculture and allied activities contribute to one-fourth of the GDP of the Indian economy and engage three-fifth of the total workforce (Singh, 2007). Agriculture has experienced various peaks and valleys in its development since India's independence. The marginalized and peripheral states and districts of India have always suffered from the negligence of government and also received least researcher's attention. Their contribution to economic development has never been emphasized. Over the period, regional disparities in development have widened and a need is felt to redesign policies for socio-territorial justice (Singh, 2005). Regional disparities in India have been examined through the social, economic, demographic and agricultural points of view at the state and district level. Most of them have been focusing on socio-economic development using demographic, social and economic activities related indicators (Kurian, 2000; Sohal and Kaur, 2006). A range of work has been done in the field of identifying regional disparities in the levels of development by taking different types of indicators (Das, 2018). But, again it is limited to mainland areas of the country. Further, various studies have also been found on analyzing the different dimensions of agricultural development like agricultural modernization tubewell irrigation (Sohal and Kaur, 2006; Ali and Abustan 2013). But, very few studies have been conducted to explain the block-level agricultural disparities in the districts of Uttar Pradesh.

Equipped with the most basic resources, Siddharthnagar district is lagging far behind the rest of other major developed districts in the state of Uttar Pradesh. The agricultural land provides a base and huge potential for the development of various economic activities. Yet it is rural, poor socio-economic condition, low agricultural production, poor agricultural benefits, least infrastructural development, and rate of rural and economic development is very slow. Therefore, the Siddharthnagar district presents a good example to analyze the above-mentioned issues. The present study has addressed two research objectives: Firstly, it measures the intra-district variations in the levels of agricultural development, and secondly, identifies concern areas required to achieve future agricultural prosperity and sustainability in Siddharthnagar.

Study Area

The Siddharthnagar district is located in the north-eastern part of Uttar Pradesh and shares an international border with Nepal towards its northern side (Figure 1A). The district lies between 27^{o} 0' to 27^{o} 28' North latitude and 82^{o} 45' to 83^{o} 10' East longitude covering a geographical area of 2895 sq km. It is one of the 75 districts of Uttar Pradesh. The state capital, Lucknow, is located approx. 43 km in the southwest of the Siddharthnagar district (Figure 1B). It is surrounded by six districts of Uttar Pradesh, namely Maharajganj and Gorakhpur district on the east; Gonda, Basti and Sant Kabir Nagar districts in the south; and Balrampur district in the west (Census of India, 2011). The district has 5 tehsils, namely Naugarh, Shoharatgarh, Bansi, Itwa and Domariyaganj. Further, the district is also divided

into 14 CD Blocks (Vikas Khand). These blocks are Bansi, Barhni Bazar, Bhanwapur, Birdpur, Domariyaganj, Itwa, Jogia Khas, Khesraha, Khuniyaon, Lotan, Mithwal, Naugarh, Shoharatgarh and Uska Bazar (Figure 1C; District Census Handbook, 2011).

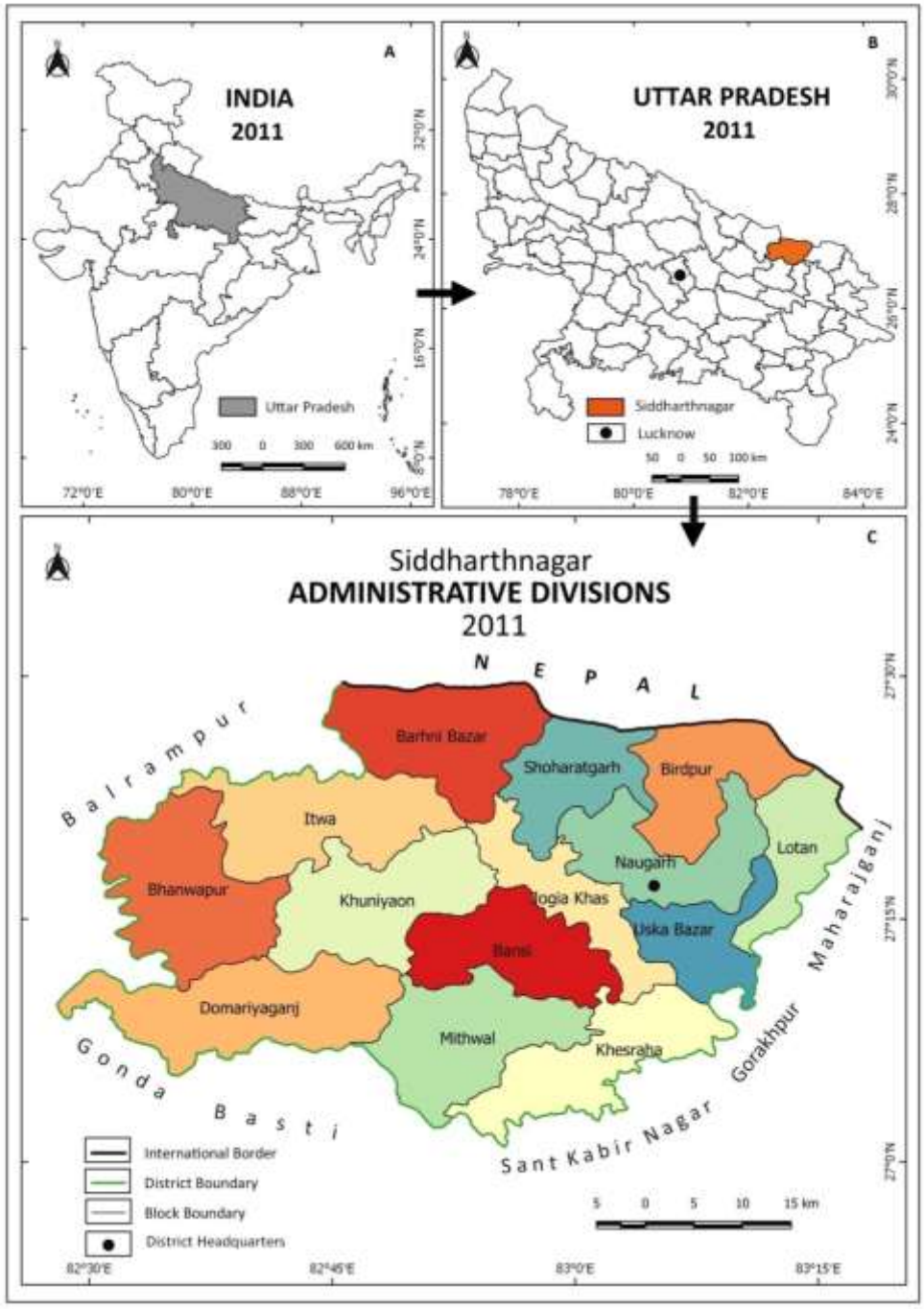

Fig. 1. Location of the Study Area

The study area, Siddharthnagar district, is adjoining to Nepal in the north and lies in the *Tarai* region. It is a part of Indo- Gangetic Plains (Middle-Ganga Plain Region) of India. Most of the land represents plain topography and the soil is very much fertile that provides suitable conditions for the cultivation. Many rivers flow in the Siddharthnagar district, such as Rapti, Budhi Rapti, Baanganga, Parasi, etc which provides sufficient water to irrigate fields and also contributes to groundwater recharge.

The total population of the district is 25,59,297, of which 93.72% is rural and the remaining is urban. The density of population in the district is 884 persons per sq km (Census of India, 2011). Agriculture is the backbone of the district economy. Rabi, Kharif and Zaid are the three agricultural seasons. Crops sown in the Rabi season are Wheat, Barley, potato, sugarcane, pulses (Masoor, Gram, Pea and Arhar), oilseeds, etc. and in the Kharif season Paddy, Maize, Urad, Moong, etc. and the Zaid season is mainly dominated by different vegetables (District Census Handbook, 2011).

Database and Methodology

The study is based on secondary data sources collected from District Census Handbook, Directorate of Statistics and Economics, Uttar Pradesh (2011), and Statistical Patrika Internet-based Data Entry and Retrieval System (SPIDER) (2016-17). This study is conducted at the block level. As mentioned above, the district comprises of 5 tahsils, and 14 blocks, therefore, a block is a viable unit of analysis. Regional variations will emerge convincingly at the block level as they are more in number in comparison to tehsils level which are just 5 in number. On the other hand, at the village level (2505 in number), it was not feasible due to the non-availability of data on several indicators. Data at the block level is easily available from reliable sources, therefore, chosen as a viable scale of study. In the present study, from a wide range of indicators, 10 indicators have been selected to reflect the agricultural development and have been combined into four groups. All the indicators have been chosen very carefully to reflect the overall status of agricultural development considering the study area and availability of data. The 4 groups of indicators are: (i) extent of agriculture and major crops, (ii) fertilizers use and cropping intensity, (iii) irrigation status, and (iv) modern tools and technology (Table 1).

The first indicator *Net Sown Area* (NSA) represents how much area is cropped, and the second indicator explains the agriculture under the major crops grown in the Siddharthnagar district under the first group of indicators, i.e. extent of agriculture and major crops. *NSA* is the actual land area cropped in a year as a proportion to the total geographical area of the block. The second indicator is the *area under food grain crops* which represents the main cereal crops cropped by a majority of the population in the block. It particularly includes rice and wheat in the study area. Fertilizers use and cropping intensity directly help in improving the farm income of the farmer. Agricultural development has been guided by package technology in which fertilizers played an important role (Qureshi, 2019). *Fertilizer consumption* helps in increasing production if used judiciously and *cropping intensity* is directly linked with agricultural productivity. The fourth indicator is

the *copping intensity* which is a measure of land efficiency and defined as the extent to which the NSA is cropped or sown (Singh and Ashraf, 2012). Assured irrigation provides physical support to the development of agriculture. Over time, the increase in certainty of irrigation facilities contributes to assured production. It is analyzed through four indicators: net irrigated area (NIA), net irrigated area to NSA, irrigation by state canals, and irrigation by tube wells in the district. *NIA* includes the area on which irrigation is applied for growing crops in an agricultural year. *NIA to NSA* indicator shows that the actual percentage of the area irrigated at least once a year. Canals are one of the most important sources of irrigation. *Irrigation by Tube Wells* is also a very important indicator of agricultural development which reflects the use of groundwater extraction. These modern tools and technology in the Siddharthnagar district are studied by analyzing the availability of harrow, harvesters and advanced threshing machines within 10 sq km of area. The *availability of advanced threshing machines* has become crucial for separating wheat, gram and other grains and seeds from their chaff and straw as it saves labour, cost and time. The agricultural development is positively related to all the indicators like net sown area, irrigation, the intensity of cropping, use of modern technology like advanced harrows and threshing machines. Hence it is chosen for the study.

Table 1. Selected indicators to Measure Agricultural Development in Siddharthnagar

Group		Indicators	
A	Extent of Agriculture and Major Crops	X_1	Net Sown Area (%)
		X_2	Area under Foodgrain Crops (%)
B	Fertilizers Use and Cropping Intensity	X_3	Consumption of Fertilisers (Kg/ ha)
		X_4	Cropping Intensity (%)
C	Availability of Irrigation Facilities	X_5	Net Irrigated Area (%)
		X_6	Net Irrigated Area to Net Sown Area (%)
		X_7	Irrigation by State Canals (%)
		X_8	Irrigation by Tubewells (%)
D	Availability of Modern Tools and Technology	X_9	Availability of Advanced Harrow and Cultivators (Per 10 sq km)
		X_{10}	Availability of Advanced Threshing Machines (Per 10 sq km)

***Source**: Compiled by Authors*

For the present study, we have applied *"Kundu's method of normalization of data through calculation of composite index"* (Kundu, 1980). At the block level, the information on 10 indicators is computed. This is followed by the computation of the scale-free index obtained by dividing each observation (block-level value) of a particular indicator by its column mean. Scale-free values are then combined for each of the blocks, followed by dividing the summed value by *N (Eq. 1)*. Such an index avoids the dominance of the composite index by one or two of these variables.

$$\text{Composite Index} = \sum_{i=1}^{n} \left(\frac{X_i}{\bar{X}_i}\right)/N \qquad \text{------ Eq. 1}$$

Where, X_i is indicator i.

$\bar{X}_i$, mean of indicator i.

and, N is the number of indicators. There are 10 indicators.

Finally, obtained scores are arranged in descending order with their respective blocks for easy interpretation and analysis. Here, higher the index value represents a higher level of development. The agricultural development is measured at the block level which is classified into very high, high, moderate and low levels of agricultural development. The data below this scale is not available. Further, various underlying factors have been explained which causes these disparities based on which policy interventions have been recommended.

Results and Discussion

Indicators of Agricultural Development

All the chosen indicators, to measure the overall status of agricultural development, are combined into 4 groups. These are discussed below:

Extent of Agriculture and Major Crops

These indicators represent the extent of agriculture in the district based on two indicators, i.e. net sown area and area under major food grain crops (Figure 2). The total NSA of the district is 76.10%. It ranges from 70.26 (Birdpur) to 81.46 % in Khesraha. Four districts that have a very high percentage of the NSA: Khesraha, Domariyaganj, Mithwal and Khuniyaon located in the south-central part of the district (more than 79, Figure 2A). The second indicator is the *area under food grain crops* which covers two-third area (66.8%) of the district. It is the highest in the Domariyaganj (79 %) while lowest in Lotan (61.1 %). Blocks growing very high percentage of food grain crops are Domariyaganj, Bansi, Uska Bazar and Mithwal (More than 69 %), while the northeastern blocks (Lotan, Naugarh and Jogia Khas) have a low percentage of area under food grain crops (less than 63 %, Figure 2B). Both indicators point towards that agriculture is an extensively pursued activity in the district where wheat and rice crops are dominantly grown by the local farmers.

Fertilizers Use and Cropping Intensity

Fertilizers are used for enhancing productivity and production. It was found that per hectare average consumption of chemical fertilizers in Siddharthnagar district is 156 kg per hectare (ha). The use of chemical fertilizers in the block ranges from 98.6 kg (Khesraha block) to 208 kg per ha in Jogia Khas block. Overall, high consumption of chemical fertilizers is found in northern parts of the district than in the south (Figure 2C). Overall cropping intensity in Siddharthnagar district is 169 %. The Domariyaganj (137.77 %) has the lowest and Lotan block (192.39) has the highest cropping intensity. The regional patterns reflect that the northeastern parts show very high (more than 180%) cropping intensity (Birdpur, Naugarh, Lotan and Uska Bazar block) while blocks in southeastern parts (Bansi, Mithwal and Domariyaganj block) show low (less than 160%) cropping intensity (Figure 2D).Higher consumption of fertilizer is attributed to the fact of high cropping

intensity. High cropping intensity reduces soil fertility which further requires fertilizer application to keep it productive. Therefore, it creates a great challenge to the farmers and planners to keep the soil sustainable for the future.

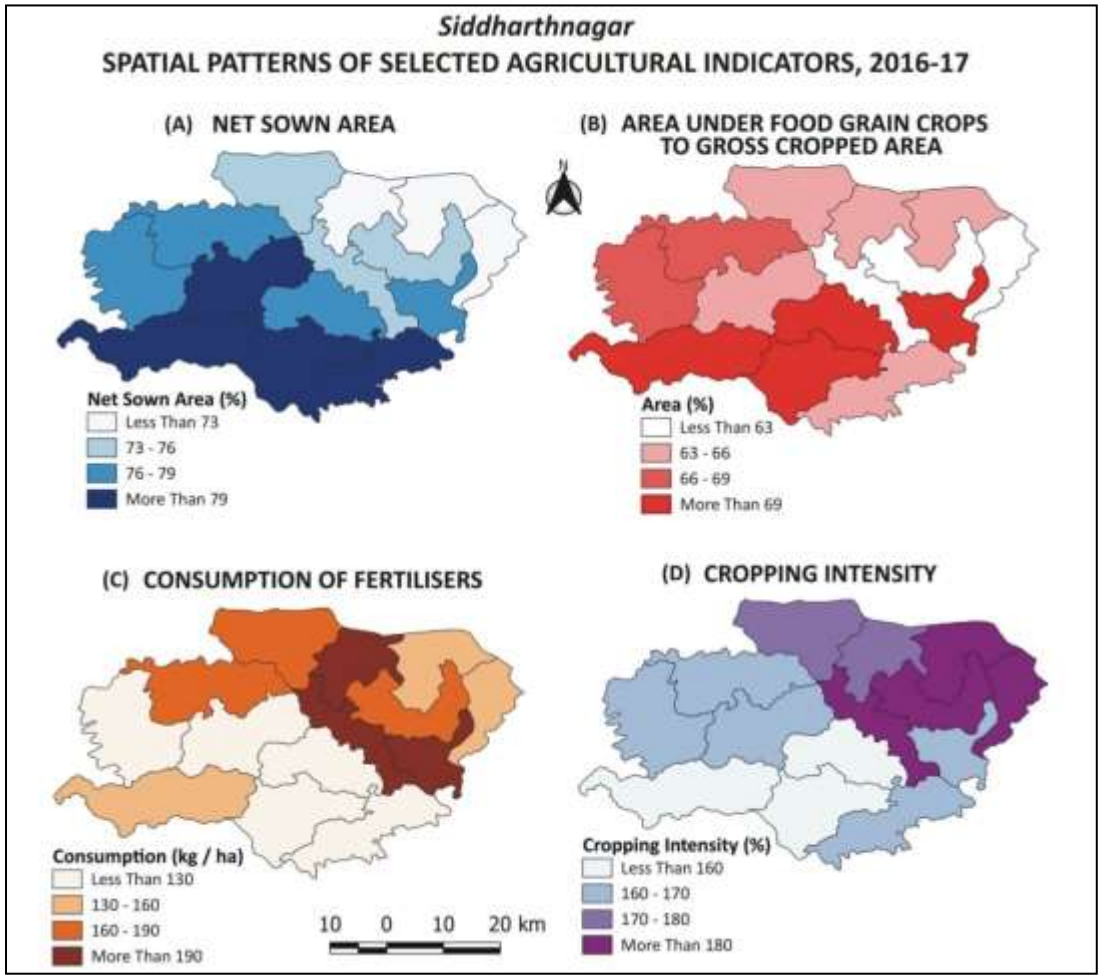

Fig. 2. Spatial Patterns of Selected Agricultural Indicators, 2016-17

Irrigation Status

The total net irrigated area in the district is 59.36% and ranges from 42.01 in Birdpur (lowest) to 84.73 % in the Bansi block (highest) (Figure 3A). It is high in the blocks of Bansi, Uska Bazar and Domariyaganj (more than 70%) located towards the southern half of the district. While blocks in northern parts show less percentage of irrigated area. In the district, net irrigated area to the net sown area is 77.61 % ranges from 67.17 % (Shoharatgarh) to 91.69 % (Domariyaganj) (Figure 3B). There are two blocks-Domariyaganj and Itwa- which have a very high percent of NIA to NSA. Two blocks-Shoharatgarh and Birdpur-have low percent of the area and they are located at the border areas (Figure 3).

Wide regional variations are visible in the NIA, and NIA to NSA at the block level which can be attributed to the drainage factor. Mostly rivers cross the district from the west to east direction in the district. They are less in the northern parts which affect the local irrigation patterns.

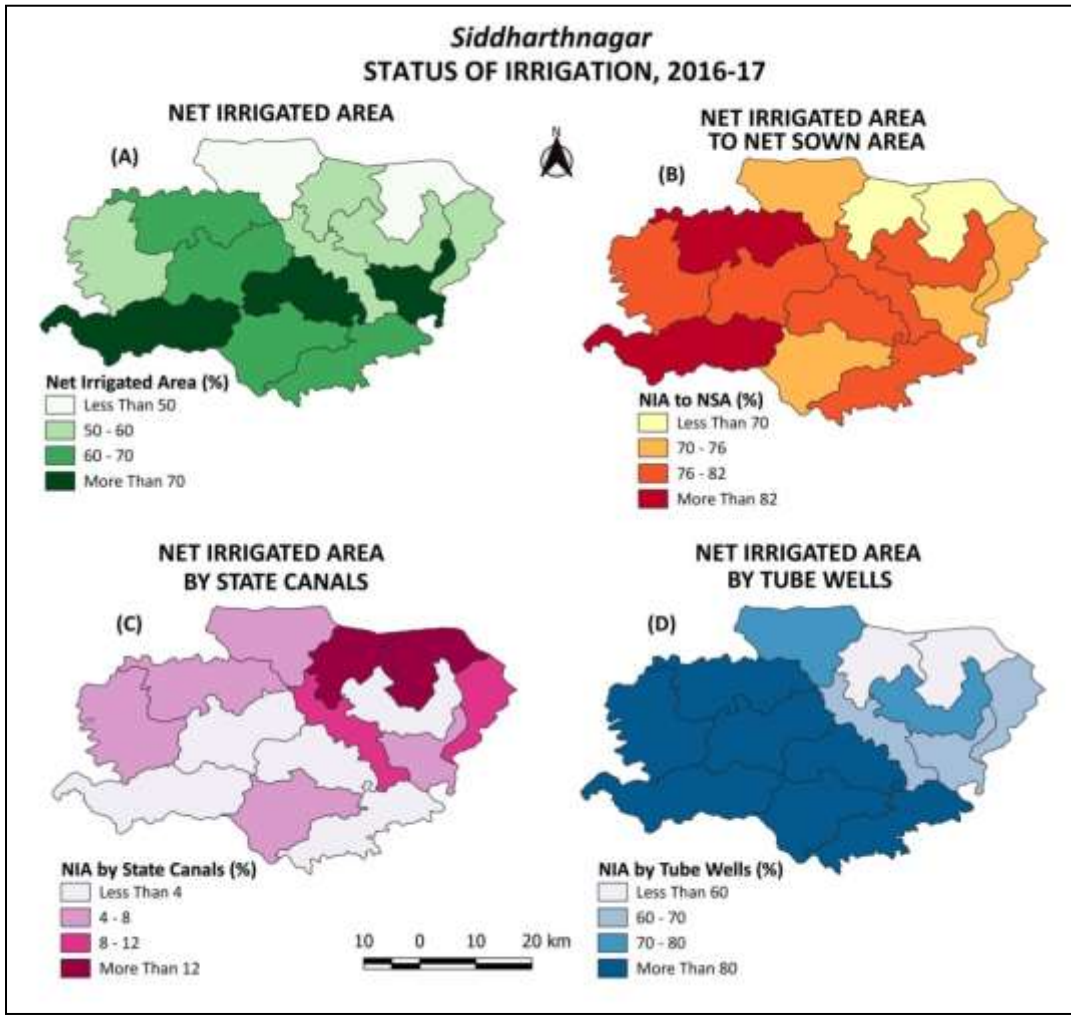

Fig. 3. Status of Irrigation in the Siddharthnagar District

The percentage of NIA by state canals is 6.9 % in the district. It is maximum in Shoharatgarh block (19.05) followed by Birdpur located along the Nepal border. It is the lowest in the Naugarh block (1.67) alongwith four blocks having less area irrigated by state canals in the district (Figure 3C).Most of the study area depends upon tube well irrigation covering approximately 74.83 % of the district. It ranges from 56.09 % in Shoharatgarh block to 85.65 % in the Domariyaganj (Figure 3D). Overall south-western blocks of the district are highly dependent on tube wells for irrigation (Figure 3). It is inferred that despite having many rivers in the district, the percentage of area irrigated by the canals is very less.

It is inferred that there is a huge scope for the development of canals for the agricultural development in the study area.

Availability of Modern Tools and Technology

The average availability of advanced harrow and cultivators in the district is 34 per 10 sq km or 3 to cover a square kilometer of area. It ranges from 28.89 (Domariyaganj) to 50.16 (Uska Bazar) in different blocks of the district (Figure 4A). Overall blocks on the periphery towards the north-west, west and south-west parts have low availability of harrow and cultivators.The average availability of threshing machines in the district is 55 per 10 sq km. The availability ranges from 22.83 in Khesraha to 107.31 in Bhanwapur per 10 sq km of area (Figure 4B). In all the blocks, the numbers of advanced threshing machines are not uniformly distributed. It explains that blocks are facing variations related to the availability of modern machinery within a very short distance.

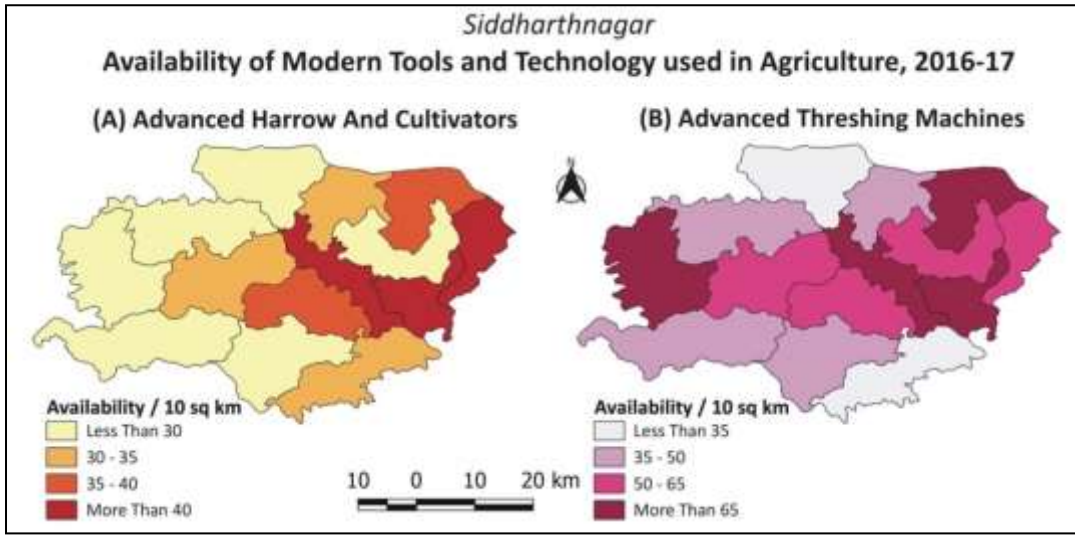

Fig. 4. Availability of Modern Farm Implements in Siddharthnagar District

Intra-District Variations in Agricultural Development

Based on the composite index score, agricultural development in Siddharthnagar district is assessed. The score ranges from 0.89 in Mithwal and Khesraha blocks to 1.16 in Uska Bazar block which represents the least developed block and very highly developed block in agriculture respectively (Figure 5). Very high agricultural development is found in 3 blocks, namely Uska Bazar, Jogia Khas and Shoharatgarh (score is more than 1.08; Figure 5). These blocks are located in the north-central parts and towards the east. The development is reasoned due to the proximity to district headquarters which acts as a nearby market and helps in getting more profit. The low transport cost alongwith easy availability of various inputs at low price contributes to getting more profit from agriculture. These benefits also help farmers in the purchase of modern farm implements, fertilizers,

and various other inputs which helps in the process of agricultural development. Four blocks are in the high agricultural development category with a composite score between 1.00 and 1.08 (Birdpur, Bhanwapur, Bansi and Lotan blocks). These are mainly located in the surrounding areas of very highly developed blocks except Bhanwapur located in the west.

Low-developed blocks scored a lower value in terms of agricultural development. These are Barhni Bazar, Mithwal and Khesraha block with a composite score of less than 0.92. These blocks show low fertilizers consumption and low availability of modern machinery. The low irrigation facility through the canal is also contributing to the low agricultural development of these blocks. Four blocks have moderately developed (Domariyaganj, Itwa, Khuniyaon and Naugarh) scoring between 0.92 to 1.0 . Interestingly, Itwa and Domriyaganj are the only blocks where some percentage of the urban population exists, but nevertheless they have attained moderate agricultural development. These blocks are located inside the above-discussed categories and towards the western parts of the district. These disparities are the result of the performance of the selected indicators in the district contributing positively as well as negatively in different blocks.

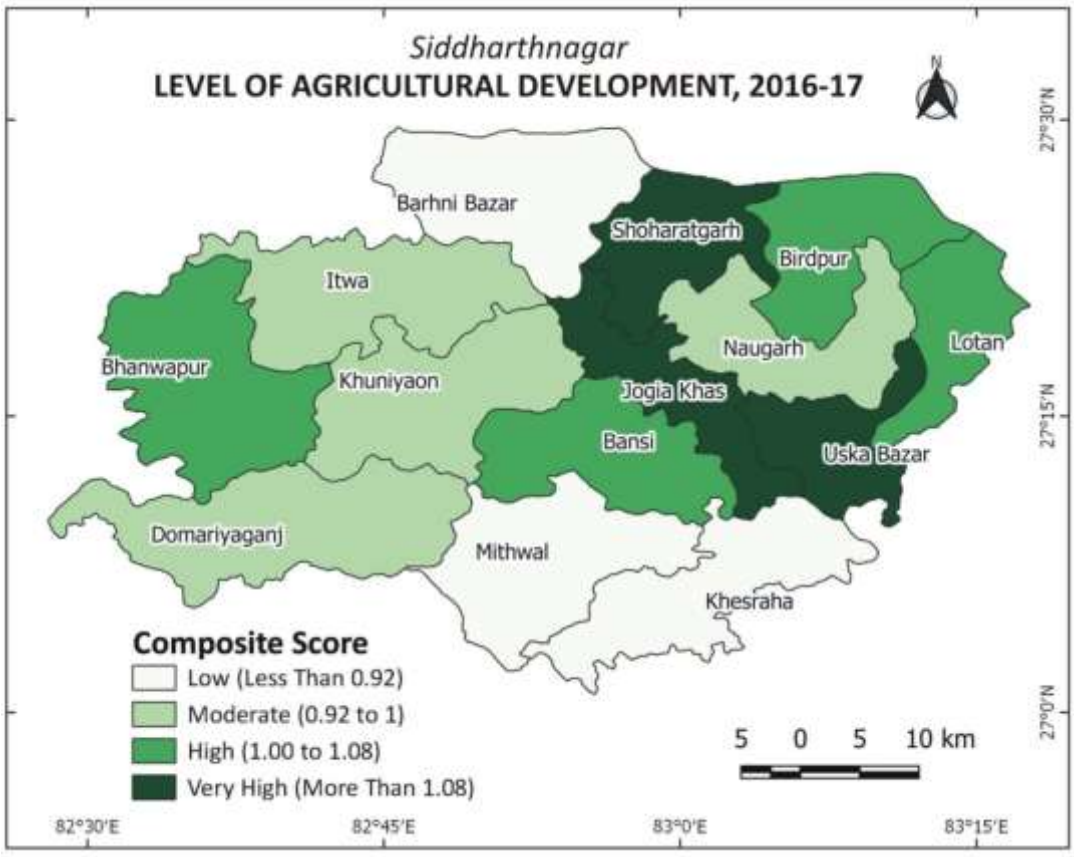

Fig. 5. Level of Agricultural Development in Siddharthnagar District

Besides, physical and economic factors affecting agricultural development discussed above, social factors also play a significant role in producing the disparities in agricultural development in the district. In the study carried out by Garia (2008), it is found that 79% of farmers have the lowest size of landholding (less than 1 ha), and 14% have 1-2 ha size in Siddharthnagar district. Both these categories cover 55% geographical area of the district. The small agricultural landholdings are not profitable for cultivation and income. It puts a great challenge to the economic development of the Siddharthnagar district. Smaller sizes of holdings alongwith a higher rate of fragmentation reduce productivity and make agriculture unsustainable in long run. The literacy rate in the district is very low (59%). The high literacy rates have a positive association with the level of awareness. Newspaper reading provides information about government subsidies, market prices about various inputs (seed quality), crop production, farm management, etc. This information help farmers to make appropriate decisions about the farming practices, ultimately leading to agricultural development.

Emerging Concerns for Policy Interventions

While mapping the intra-district variations in agricultural development, many issues and concerns have emerged which require policy interventions. The development of the agriculture sector and rural sustainability should not be seen in isolation. More than 93 % of population of the district depends upon agriculture for their livelihood, therefore, the economic prosperity of the region is very much dependent upon agricultural development. It is found that there is no more scope for extending agriculture as more than three-fourth area of Siddharthnagar is already the net sown area. The land is also required for other types of infrastructure development. Thus, an important concern is that more focus should be on improving production with higher productivity. Another concern is that area under food grain crops is high, so it is important to promote crop diversification and crop rotation.

Cropping intensity in the study area (169 %) as well as in the state (Uttar Pradesh, 159 %) is low in comparison to the agriculturally developed state of the country (Roy and Ahmad, 2015). The state of Punjab has a cropping intensity of more than 180 % since 2000-2001 (Grover et al., 2016) and also the Haryana state (186.9 % in 2015-16; Panwar and Dimri, 2018). Looking at the production potential, Siddharthnagar has a very high potential to produce more with more intensity as it forms the part of the Middle-Ganga Plain. The annual floods revitalize the soil fertility along the river course, so flood-resistant variety of seeds to be given to the farmers for further agricultural development. Fertilizer consumption is highly varied in blocks. It ranges from 98.6 kg/ha in the Khesraha block to 208 kg/ha in the Jogia Khas block. Its availability, distribution, accessibility, and reasonability are important concerns of the farmers. Further, there is also a need to rationalize fertilizer use without yielding any loss, for which farmers need to be educated. It will not only help in keeping the land productive, but also ensure an ultimate rural sustainability of land resources of the area.

Another concern is to use the resources efficiently, particularly water in irrigation. Foley (2011) estimated that to grow one calorie of food, on average, it takes about one litre of irrigation water. In the study area, due to the easy availability of water through rivers, canals, and tubewells, farmers are not using the water resource efficiently. More than three-fourth area of the net sown area is irrigated (Table 2). Canal irrigation is the least developed, inspite of many perennial rivers like Rapti, Burhi, etc. crossing the district. Mostly, the groundwater is used through tubewells and pump sets. If the existing groundwater extraction scenario remains to continue, the district will face rapid depletion of groundwater resources due to increasing aridity and associated problems. Therefore, irrigation management is a big concern in the near future.

Table 2. Comparison of Highly and Least Developed Block based on Indicators (2016-17)

Indicator	Unit	Siddharthnagar District	Highest Agricultural Development Uska Bazar Block)	Least Agricultural Development (Khesraha Block)
1. Net Sown Area	%	76.10	78.19	81.46
2. Area under Foodgrain Crops	%	66.8	69.30	66.00
3. Consumption of Fertilizers	Kg/ ha	156	192.70	98.60
4. Cropping Intensity	%	169	166.49	165.66
5. Net Irrigated Area	%	59.36	70.92	68.33
6. Net Irrigated Area to Net Sown Area	%	76.61	70.29	79.82
7. Irrigation by State Canals	%	6.9	7.95	3.96
8. Irrigation by Tubewells	%	74.83	67.65	82.47
9. Availability of Advanced Harrow and Cultivators	Per 10 sq km	34	50	31
10. Availability of Advanced Threshing Machines	Per 10 sq km	55	91	23

***Source**: Statistical Patrika Internet-based Data Entry and Retrieval System (SPIDER) (2016-17), Uttar Pradesh*

Agriculture is under continuous modification (Talukder et al., 2020) and there is a need to modernize it by efficient means of modern machinery. These tools manage land effectively and efficiently. In the study area, the status of modern tools and technology is very poor. Distribution andaccessibility are major challenges for the farmers.All these

issues need immediate attention from agricultural planners and policy-makers for proper decision-making in these areas, so that, rural development can be achieved through agricultural development.

Conclusions

The above analyses clearly explain the variations in agricultural development with the help of selected indicators. Based on the selected indicators like net sown area, cropping intensity, fertilizer consumption, irrigation and modern technology, and wide variations,the agricultural development is identified at the block level in the Siddharthnagar. Identified concerns require policy interventions from the policy-makers for the agricultural development at micro-level. The population of the Siddharthnagar district is highly dependent on agriculture for the livelihood. The emerging concerns have the potential to become critical, if not tackled in a time-bound manner. The present research provides critical insights into the agricultural development aspects of the Siddharthnagar district. We hope this work can initiate goal-oriented dialogues among the policy-makers and administrators for achieving agricultural sustainability in the study area.

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