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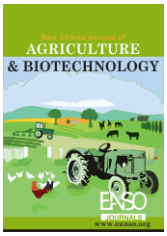

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Original Article

Inter-State Analysis of Agricultural Development in Northeast (NE) India

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ABSTRACT

This study was conducted in 2024 using the secondary data pertaining to the years 2016-2020, aimed at investigating the spatial pattern of agricultural development across eight sister states of Northeast (NE) India namely, Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura. The level of agricultural development was measured based on composite Z-Scores calculated using six variables namely, net irrigated area, cropping intensity, area under High Yielding Variety (HYV) seeds, consumption of Nitrogen Phosphorous and Potassium (NPK) fertilizers, yield of paddy and food grains. Results showed a significant inter-state disparity in the level of agricultural development. Among the eight states, the highest level of agricultural development (Rank 1) in the entire NE India was found in Assam, followed by Tripura, Meghalaya, Manipur, Sikkim, Mizoram, Nagaland, and Arunachal Pradesh, respectively. Low productivity of crops, limited usage of NPK fertilizers, and a small share of farm area under irrigation altogether have resulted in poor agricultural development in the majority of the NE states. Therefore, widespread adoption and application of NPK fertilizers, increasing the net irrigated area and cropping intensity are key to elevating the level of agricultural development in the region. Overall, the findings indicated the need for policy intervention through a new agricultural development model for the region, especially one that addresses the issue of closing the gap, and ensures sustainable inclusive development in the long run.

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INTRODUCTION

"Agricultural Development" is widely considered a multi-dimensional concept (Krishna, 1992) and is defined as "the process that creates the condition for the fulfilment of agricultural potential. These conditions include accumulation of knowledge and availability of technology as well as allocation of inputs and outputs" (De Laiglesia, 2006). In India, inter-state disparity in agricultural development and agricultural income is a matter of grave concern (Bhalla & Singh, 1997) because disparities in agricultural performance are so great that they persist even in agriculturally developed states like Haryana (Kumar et al., 2012). There is an urgent need for improvement on technological, institutional and infrastructural fronts to accelerate the growth rate in productivity. Some parts of India like Bihar, Odisha, eastern Uttar Pradesh, Assam and hilly regions are in need of prompt special focus (Chand & Chauhan, 1999). Scrutiny of literature indicates that several authors in India studied agricultural development both at the regional and sub-regional level (Mohanty, 2009; Singh & Ashraf, 2012; Ayyoob et al., 2013; Patra, 2013; Jena, 2014; Lata & Lata, 2019; Harish & Yayamane, 2019; Baig & Salam, 2019). With respect to Northeast (NE) India, very few research works have been advanced on agricultural development to date. Upon scrutinizing the available literature, it becomes evident that Singh (1987) stands out as pioneering in the context of NE India. A decade later, Sharma and Sharma (1997) studied the levels of agricultural development in the mountainous states of India namely, Meghalaya, Nagaland, Sikkim, Assam, Manipur, Mizoram, Himachal Pradesh, Jammu and Kashmir. This study, however, excluded Arunachal Pradesh and Tripura, which could be due to a paucity of data. Both studies reported significant regional disparity. These are the only known existing literature that provides an idea of the agriculture development scenario during the late 1980s and 1990s. Against this backdrop, therefore, the present study aims to investigate the spatial pattern of agricultural development across eight sister states of NE India.

METHODOLOGY

Study Area

Located between 21.5° N to 29.5° N latitudes and 85.5° E to 97.5° E longitudes, representing the eastern-most territory of India, the NE India comprised of eight states namely, Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura (Figure 1), popularly known as "Eight Sisters of NE India". The region spreads across a geographic area of 26.2 million hectares (ha), which accounts for 8 percent of the country's total geographical area. Arunachal Pradesh covers the largest geographical area (83743 Km^2) in the region, followed by Assam (78438 Km^2), Meghalaya (22429 Km^2), Manipur (22327 Km^2), Mizoram (21081 Km^2), Nagaland (16579

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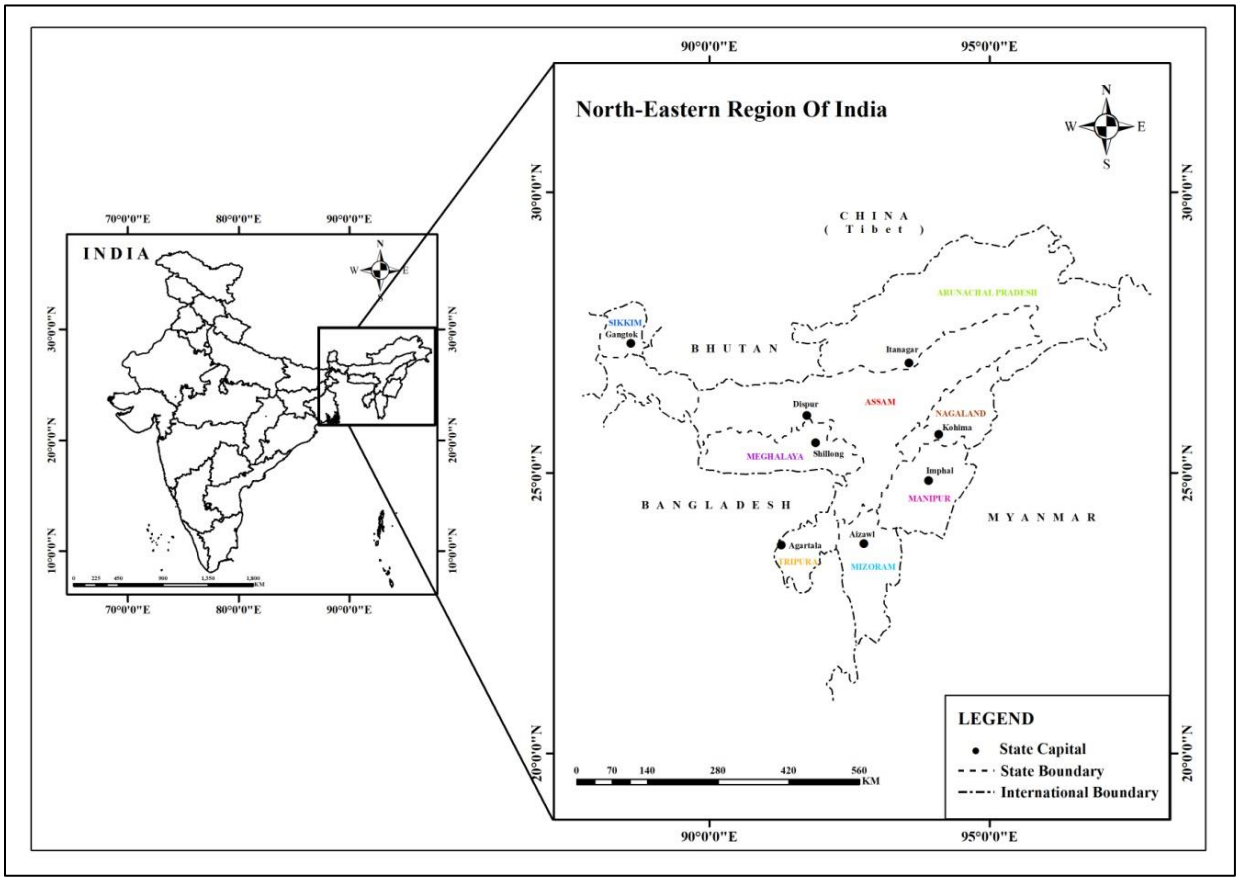
Km^2), Tripura (10491 Km^2), and Sikkim (7096 Km^2), respectively. The countries bordering Northeast India include China to the north, Myanmar to the east, northeast, and south, and Bangladesh to the southwest. A narrow stretch of land measuring 60 km in length with an average wide of 22 km popularly known as the "Chicken's Neck" or the "Siliguri Corridor" connects Northeast India to mainland India (Lama, 2018).

Figure 1: Location Map of Study Area



The region is home to 40 million human population, which constitutes 4 percent of the country's total population (Birthal, 2010). The economy of the region continues to be agrarian. Nevertheless, it is to be noted that the contribution of agriculture sectors to the gross domestic product is declining across Northeast India, yet a large share of the population in the region continues to rely on the agricultural sector directly or indirectly for their livelihood and employment (Bhagawati et al., 2017). Despite possessing huge potential for development due to endowments of vast natural resources, diverse agro-climatic conditions, varied geo-environmental settings, and rich biodiversity (Giribabu, 2013), the region continues to remain backward (Ghosh et al., 2010). Additionally, the area under agricultural crops has been significantly low owing to the restrictions imposed by the region's varied physiographic conditions (Selvan & Kumar, 2016). The Green Revolution (GR) of the mid-1960s, also called the "New Agricultural Strategy" (Tripathi & Prasad, 2010), failed to contribute towards the agricultural development of NER even though the region was abundantly blessed with the basic elements of development: soil, water, plants, and animal diversities (Kaul, 2001). As the gap between food demand and supply is consistently widening, the problems of food and

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nutritional insecurity still persist in NE India (Giribabu, 2013).

Materials and Methods

Agricultural development is measured based on six explanatory variables and the data used were obtained from various secondary sources such as open-access portals and reports as shown in Table 1. It is important to mention here that there was a lack of the required recent secondary data related to the chosen variables both in the open-access portals and in the most recent published survey reports. As a result, the data pertaining to different years of estimate (2016–17, 2017–18, 2018–19, and 2019–20) had to be utilised by compulsion.

Table 1: List of Data

Variables' Code	Variables' Name	Year	Source	Date of Access
X_1	Net Irrigated Area (In Thousand Hectare)	2017-18	Open Access Portal of Reserve Bank of India	July, 2024
X_2	Cropping Intensity (%)	2017-18	Open Access Portal of Reserve Bank of India	July, 2024
X_3	Area in Hectares under HYV Seeds (Irrigated+Unirrigated)	2016-17	Portal Access Portal of Input Survey Database, Agricultural Census Division, Ministry of Agriculture and Farmers Welfare, Government of India	July, 2024
X_4	Consumption of NPK Fertilizers (kg/ha)	2018-19	Report on Agriculture Statistics at a Glance, Ministry of Agriculture and Farmers Welfare, Government of India 2021	July, 2024
X_5	Yield of Food Grains (kg/ha)	2019-20	Open Access Portal of Reserve Bank of India	July, 2024
X_6	Yield of Paddy (kg/ha)	2019-20	Open Access Portal of Reserve Bank of India	July, 2024

Source: Authors' compilation

The Z-Score statistics, also called "standard deviation score", was used to measure the level of agricultural development. The formula used for Z-Score computation is given below:

$$Z = \frac{X - \bar{X}}{SD_x}$$

Where,

X = Raw Score

$\bar{X}$ = Mean of X

SD_x = Standard Deviation

The Z-Score value above the mean (0) would be positive (+) and below the mean (0) would be negative (-) (Curtis et al., 2016). The positive values mean high levels of agricultural development and negative values mean low levels of agricultural development. Thus, the greater the Z-Score value above the mean (0), the higher the level of agricultural development, and *vice-versa*. It is important to note that the larger the gap between the computed Z-Score values, the higher the regional disparity of agricultural development. Moreover, to examine the spatial pattern of agricultural development across the study region, the estimated Z-Score values were grouped into five categories of agricultural development: very low (-1 to -0.5), low (-0.5 to 0), medium (0 to 0.5), high (0.5 to 1), and very high (1 to 1.5).

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RESULTS AND DISCUSSION

The net irrigated area, cropping intensity, area under HYV seeds, consumption level of NPK fertilizers, yield of food grains, and yield of paddy with respect to NE India are shown in Table 2. Irrigation is paramount since it helps increase the value of agricultural land, stabilizes the yields, and has also proven effective in dealing with the problem of drought (Manap et al., 2017). Additionally, studies found higher yield and cropping intensity in irrigated agricultural land as compared to rainfed areas (Faurès et al., 2002). Moreover, empirical findings have shown that irrigated land has a significant positive impact on food production (Manap et al., 2017), helps produce higher crop yield, lowers the risk of crop failure, and increases cropping intensity (Siebert et al., 2014). In Northeast India, the 2017-18 data showed largest net irrigated area in Assam (357 thousand ha), followed by Nagaland (116 thousand ha), Meghalaya (100 thousand ha), Tripura (80 thousand ha), Manipur (73 thousand ha), Arunachal Pradesh (55 thousand ha), Mizoram (16 thousand ha), and Sikkim (15 thousand ha), respectively.

Table 2: Northeast States of India and Indicators of Agricultural Development

Year	2017-18	2017-18	2016-17	2018-19	2019-20	2019-20
Variables / North-East States	**X_1**	**X_2**	**X_3**	**X_4**	**X_5**	**X_6**
Arunachal Pradesh	55	136	30940	0	1631	1833
Assam	357	149	663278	74	2105	2176
Manipur	73	100	109611	33	2030	2195
Meghalaya	100	122	16196	0	2562	2734
Mizoram	16	129	3621	49	1676	1704
Nagaland	116	138	12668	1	1660	1675
Sikkim	15	198	18198	0	1669	1858
Tripura	80	191	194897	32	2770	3031
National Average (India)	**69474**	**147**	**123949806**	**132**	**2343**	**2723**

Source: Authors' compilation.

Higher cropping intensity shows intensive use of land for agricultural production, and *vice-versa* (Deshmukh & Tanaji, 2017). During 2017-18, three NE states namely Assam (149 %), Sikkim (198 %) and Tripura (191 %) recorded higher cropping intensity than the national average (147 %). On the contrary, lower cropping intensity compared to the national average (147 %) was found in the remaining NE states.

During the GR, the yield of wheat and rice recorded a phenomenal rise in India. This was attributed partially to improved irrigation facilities, widespread adoption of HYV seeds and partially to several other factors (Sharma & Sharma, 2018). In the context of NE India, the highest area (irrigated + unirrigated) under HYV seeds was recorded in Assam (663278 ha) in the entire Northeast region. This was followed by Tripura (194897 ha), Manipur (109611 ha), Arunachal Pradesh (30940 ha), Sikkim (18198 ha), Meghalaya (16196 ha), Nagaland (12668 ha), and Mizoram (3621 ha).

Application of NPK fertilizers is vital as it provides macronutrients that are highly essential for healthy plant growth. By the next 30 years, the dose of NPK

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fertilizers is estimated to double to enhance agricultural productivity (Savci, 2012). A vast literature underscores the significance of NPK fertilizers as critically important for deriving better growth and yield of agricultural crops. Umami et al. (2019), for instance, observed the positive effects of higher doses of NPK fertilizers on the growth and yields of agricultural crops. Abbas et al. (2012) and Hariyadi et al. (2019) suggested the combined application of NPK fertilizers and organic manure for higher productivity of crops. On the other hand, Naz et al. (2011) and Hervé et al. (2017) highlighted the importance of appropriate doses of NPK fertilizers for better growth and higher yield. In fact, there are several studies supporting the positive correlation between the extent of modern technological inputs use and the level of agricultural development (Khan & Khalil, 2013). All these are a testament to the imperative role of NPK fertilizers, enabling farmers to produce higher yields thereby contributing towards improved agricultural development. In the study area, the use of NPK fertilizer during 2018-19 was restricted to only five states with the highest doses in Assam with 74 kg/ha, followed by Mizoram (49 kg/ha), Manipur (33 kg/ha), Tripura (32 kg/ha), and Nagaland (1 kg/ha) of NE India during 2018-19. In fact, the doses of NPK fertilizers in Northeast India are far below the national average (132 kg/ha). This could be due to the gradual transitioning of NE states to organic agricultural practices as a result of Mission Organic Value Chain Development for North-Eastern Region (MOVCD-NER), a centrally funded scheme launched during 2015-16.

Munir (1992) noted a strong linear association between the level of agricultural development and agricultural productivity in the Sub-Himalayan East Region of Uttar Pradesh. This clearly suggests increasing agricultural productivity is key to scaling up the level of agricultural development. In the study area, the yield of food grains during 2019-20 was highest in Tripura (2770 kg/ha) and Meghalaya (2562 kg/ha) compared to the national average (2343 kg/ha). Whereas, it was comparatively lower than the national average in other NE states- Assam (2105 kg/ha), Manipur (2030 kg/ha), Mizoram (1676 kg/ha), Sikkim (1669 kg/ha), Nagaland (1660 kg/ha), and Arunachal Pradesh (1631 kg/ha).

Although paddy is the staple crop and is being widely grown across Northeast India, the rice-based agriculture system has failed to meet the required level of household income-security among the farming community (Barah, 2006). The 2019-20 data showed the highest yield of paddy in Tripura (3031 kg/ha), and on the contrary, the lowest in Nagaland (1675 kg/ha). In fact, the yield in the remaining states namely, Manipur- 2195 kg/ha, Assam- 2176 kg/ha, Sikkim- 1858 kg/ha, Arunachal Pradesh- 1833 kg/ha, Mizoram- 1704 kg/ha, and Nagaland- 1675 kg/ha was far below than the national average (2723 kg/ha).

In recent years, India's agricultural sector has indeed seen notable changes, with shifts in institutional and policy frameworks aimed at boosting productivity. Despite these efforts leading to a rise in overall output, the rate of growth has slowed down. Additionally, persistent differences in agricultural performance between and within states remain a significant concern, with indications of these gaps widening in certain cases. Therefore, a study on disparity in developing countries like India is critically important as the new economic reforms have significantly contributed to the increase in the gap between the rich and the poor states (Singh, 2015). The fruit of accelerated growth in India has not been fairly distributed across different parts of the country, giving rise to an alarming issue of regional disparities. Although various policy initiatives by the government to develop backward areas, inter-state regional inequality has been widening in India (Kurian, 2000). Table 3 presents the estimated composite Z-Score values for each of the NE states based on data presented in Table 2. Based on composite Z-Score values, Rank was assigned to each of the NE states for the purpose of comparative analysis.

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Table 3: Levels of Agricultural Development in North Eastern Region, India

Name of the States	X_1		X_2		X_3		X_4		X_5		X_6			
	Raw Score	Z-Score	Raw Score	Z-Score	Raw Score	Z-Scores	Raw Score	Z-Scores	Raw Score	Z-Scores	Raw Score	Z-Scores	Composite Z-Score	Rank
Arunachal Pradesh	55	-0.43	136	-0.29	30940	-0.45	0.00	-0.84	1631	-0.86	1833	-0.64	**-0.58**	**8**
Assam	357	2.34	149	0.10	663278	2.37	73.99	1.79	2105	0.21	2176	0.05	**+1.14**	**1**
Manipur	73	-0.26	100	-1.35	109611	-0.10	33.15	0.34	2030	0.04	2195	0.09	**-0.21**	**4**
Meghalaya	100	-0.01	122	-0.69	16196	-0.51	0.00	-0.84	2562	1.23	2734	1.17	**+0.06**	**3**
Mizoram	16	-0.78	129	-0.48	3621	-0.57	48.51	0.89	1676	-0.76	1704	-0.90	**-0.43**	**6**
Nagaland	116	0.13	138	-0.22	12668	-0.53	0.64	-0.82	1660	-0.79	1675	-0.96	**-0.53**	**7**
Sikkim	15	-0.79	198	1.57	18198	-0.50	0.00	-0.84	1669	-0.77	1858	-0.59	**-0.32**	**5**
Tripura	80	-0.20	191	1.37	194897	0.28	32.27	0.31	2770	1.70	3031	1.77	**+0.87**	**2**
Mean	**102**	**0.00**	**145**	**0.00**	**131176**	**0.00**	**24**	**0.00**	**2013**	**0.00**	**2151**	**0.00**	**0.00**	
Standard Deviation	**109**	**1.00**	**34**	**1.00**	**224882**	**1.00**	**28**	**1.00**	**445**	**1.00**	**497**	**1.00**	**1**	

Source: Calculated from Table 2.

Note: The standard deviations of the Z-Score for each variable are rounded off.

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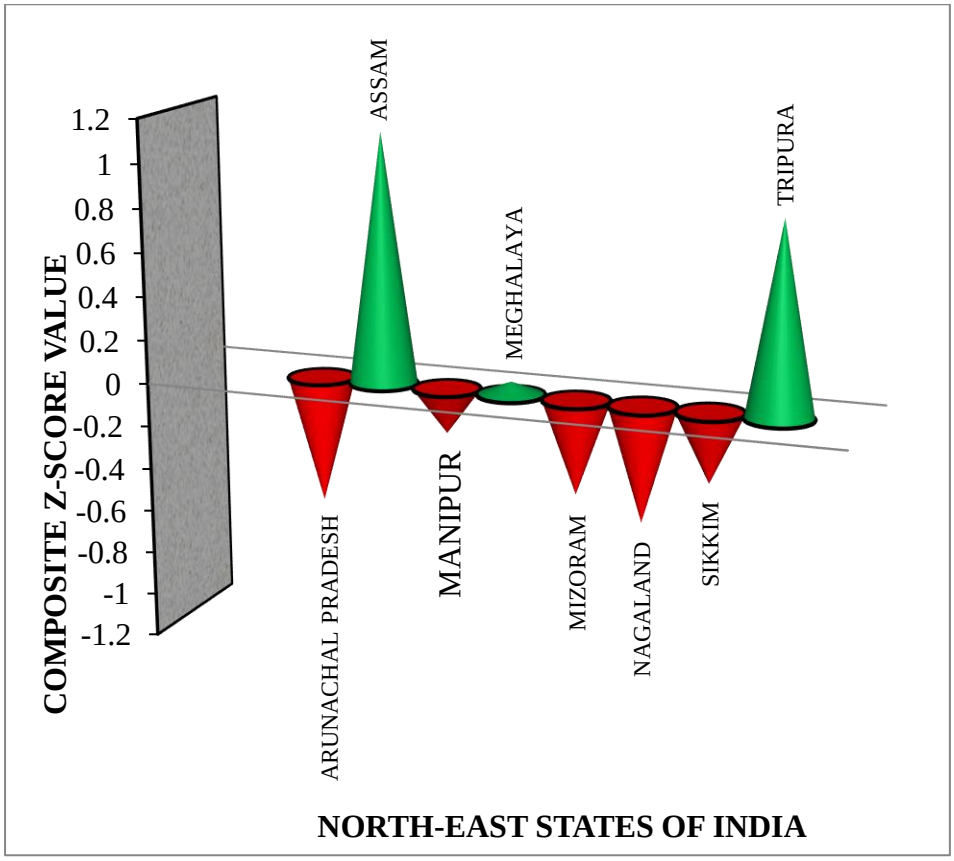
Table 3 shows computed composite Z-Score values ranging between +1.14 above the mean (0) to -0.58 below the mean (0), indicating variation in agricultural development in NE India. Figure 2 reveals the highest level of agricultural development in Assam (Rank 1), followed by Tripura, Meghalaya, Manipur, Sikkim, Mizoram, Nagaland, and Arunachal Pradesh, respectively, demonstrating large inter-state disparity in agricultural development. This finding corroborates the findings of Shee and Maiti (2017), Tanwar et al. (2017), Sau (2018), and Pinki (2020).

Figure 2: Agriculture Development in North Eastern Region, India



Agriculture is not merely a sector but rather a sector of great importance as it feeds other sectors of the economy. As such, the rate of growth of an economy is largely governed by the extent of agricultural development. In fact, the impact of agricultural development is much more substantial in developing economies where there is greater dominance of the agriculture sector (Singh, 1990). The hill agriculture of India's Northeast has immense potential to grow and contribute towards fetching higher farm incomes, ensuring food and nutritional security, reducing rural poverty, and accelerating the pace of overall economic growth. This is owing to the region's resource endowment such as rich land, abundant water, and a favourable climate suitable for growing a wide variety of crops, etc. Yet, due to the lack of system-specific production technologies, poor infrastructure (transport, market, processing, etc.), underdeveloped institutions (credit, extension, information, insurance, etc), difficult terrains, inaccessible habitations, small, scattered and fragmented land holdings, the hill agriculture in this part of the country could not be exploited to its full potential (Birthal, 2010). In NE states, which is lagging far behind the rest in terms of economic development ensuring progressive agriculture is pivotal because progressive agriculture is a boon for economic growth as it not only facilitates development but also helps thriving other prominent sectors (Kaur & Sharma, 2012). Figure

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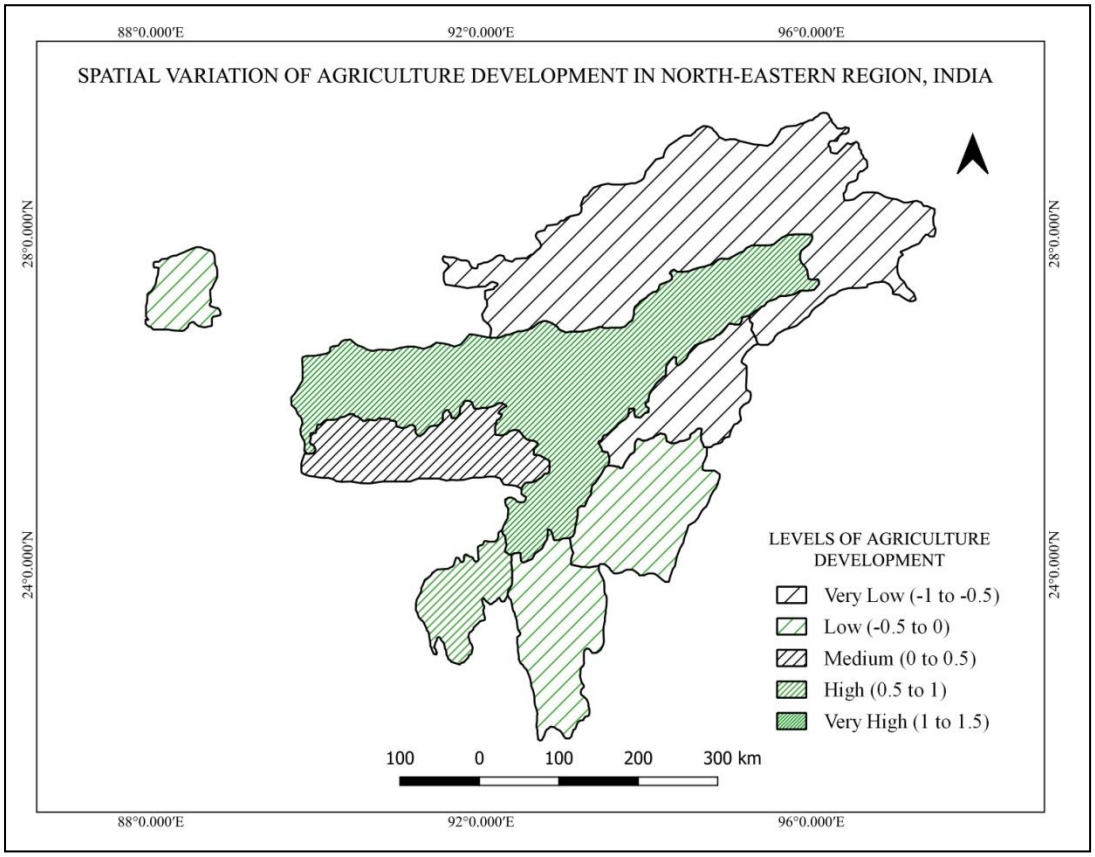
3 reveals that only one sister of NE India falls under the category of very high namely, Assam (+1.14); two states under the category of high namely, Tripura (+0.87) and Meghalaya (+0.06); three states under low namely, Mizoram (-0.43), Sikkim (-0.32), and Manipur (-0.21); and two states under very low namely, Arunachal Pradesh (-0.58), and Nagaland (-0.53), respectively. Thus, agricultural development in NE India varies spatially.

Figure 3: Spatial Pattern of Agricultural Development in Northeast Region, India



CONCLUSION AND RECOMMENDATION

The findings of the present study indicated a significant inter-state disparity in agricultural development between the eight sister states of NE India. While three states namely, Assam, Meghalaya, and Tripura have exhibited high to very high levels of agricultural development, the rest are found under the category of low to very low levels of agricultural development. The poor agricultural development in the majority of the NE states can be directly linked to low productivity of crops, limited usage of NPK fertilizers, and a small share of farm area under irrigation. Therefore, widespread adoption and application of NPK fertilizers, increasing the net irrigated area and cropping intensity in the study area are critical to improving agricultural productivity, which may help create the desired cascading effects to uplift the level of agricultural development. This may be achieved through policy intervention, for instance, by introducing a new agricultural development model in NE India based on its geographical setting, and the area-specific need.

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