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Research Paper

Disparities in Agricultural Development among the Districts- Findings from North East India

Anjoo Yumnam[1*] and N. Deka[2]

[1]ICAR RC for NEH Region, Umiam, Meghalaya, India
[2]Department of Agricultural Economics and Farm Management, Assam Agricultural University, Jorhat, Assam, India

*Corresponding author: anjooyumnam102@gmail.com (**ORCID ID:** 0000-0003-2231-8944)

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ABSTRACT

The present study evaluated the disparities in agricultural development within the NE region of India by computing the composite agricultural development index (CI) for 90 districts from all the 8 states of the region. The study revealed that there was a wide range of variability in the composite index of agricultural development among the districts. States like Mizoram and Arunachal Pradesh were found to have high average CI but the variability within the state was found to be higher than other states. Assam, Manipur and Sikkim were ranked lower in agricultural development but were found to be more symmetrically developed than the rest of the states. To bring uniform development in agricultural sector, the extent of improvements required in different indicators for the poor performing districts were estimated by identifying the model districts. Potential targets were estimated from the model districts. The results from all the states showed that the actual achievements were lower than the potential targets for almost all the development indicators in the low developed districts. A general recommendation for all the districts would be an improvement in the crops and livestock production. Adequate number of veterinary institutions should be set up to provide required services for livestock population. Improvement in the crop sector should be focused on increasing irrigation and more efficient use of area by double cropping. Fertilizers gives the needed plant nutrients when used in recommended doses. However, efforts should be made to provide the needed plant nutrients by organic sources like FYM and to adopt practices which conserve soil nutrients.

HIGHLIGHTS

- Wide range of disparities in agricultural development among the districts of North East India.
- Intra-state variabilities were found to be higher in states having high agricultural development.
- All the low developed districts performed poorer than potential targets in almost all development indicators.

Keywords: Agricultural Development, composite index, north east India

Agriculture development is a multidimensional process of improvement in crop and livestock production affected by a combination of different technological, environmental, financial and physical infrastructural factors. It implies the availability in adequate amounts of these facilities to the maximum number of people. The north eastern region of India as a whole is agriculture led economy which provide 70 per cent of the population with livelihood. Bringing development in the agricultural sector is thus the prerequisite for improving the livelihood and welfare of its people. The NE region missed

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the magic of the Green Revolution as witnessed in other states of India during the 1960s. Subsequently, different location specific agricultural initiatives have been taken up and huge government funds have been diverted to agricultural development in the region. However, the performance of agriculture in the region has been lower as compared to the country level and to other states of India.

One main reason of the region's under performance is the disparities in the level of agricultural development existing among the states of the region. The reasons for the existing disparities are prevalence of a wide variation of topography with difficult terrain, unique socio-cultural systems populated by a mix of different ethnicities with diverse cultural values and cultivation practices. An appropriate policy action has been and always will be to bring uniform development in the agriculture sector by minimising the disparities. To facilitate such policy actions, the present study will evaluate the level of agricultural development of all the states of the region. An assessment of the regional variability in the level of agricultural development will be better explained at district level or at micro block level. Since balanced data for block level is not available for all the states of the region, a district level analysis was conducted in the present study. The specific objectives for the current study are:

1. To evaluate the disparities in agricultural development in north east India.
2. To estimate the extent of improvement required in the poorly developed areas.

MATERIALS AND METHODS

Development indicators: Understanding that development is a multidimensional process, the indicators for agricultural development has been chosen to represent crop and livestock production, physical and technological infrastructures for enhancing agricultural production and banking and credit facilities for agriculture. The reference for choice of indicators have been taken from Ohlan (2013), Singh and Mehala (2016), Shee and Maiti (2017), Srivastava *et al.* (2019), *etc*. The following 12 numbers of indicators have been selected for developing a composite agricultural development index:

Agricultural development indices chosen

Sl. No.	Indicators with units of measurement	Data source and year
1	Percentage of net area sown	Input Survey report, 2016-17
2	Percentage of net sown area irrigated	Input Survey report, 2016-17
3	Percentage of net sown area fertilized	Input Survey report, 2016-17
4	Percentage of area sown more than once	Input Survey report, 2016-17
5	Yield of rice (tonnes per ha)	State statistical report, 2016-17
6	Yield of pulses (tonnes per ha)	State statistical report, 2016-17
7	Yield of oilseeds (tonnes per ha)	State statistical report, 2016-17
8	Cattle population (per 100 persons)	State statistical report, 2018
9	Pig population (per 100 persons)	State statistical report, 2018
10	Poultry population (per 1000 persons)	State statistical report, 2018
11	Number of regional rural bank branches (per lakh persons)	State statistical report, 2018
12	Number of veterinary institutions (per 10,000 livestock)	State statistical report, 2018

The indicators chosen does not form an inclusive list since the choice have been subject to data availability for all the districts of the north-east India states. The analysis was made for the year 2018, however due to non-availability of agricultural input data for the year, the indicators representing crop production were collected for the year 2016-17.

Measuring composite agricultural development index : The statistical procedure to suitably combine the indicators having different measuring scales into a composite index as used by Narain *et al*. (2012), Ohlan (2013) and Srivastava *et al*. (2019), have been used for measuring the composite agricultural development index. The procedure is described as follows:

Let $[X_{ij}]$ be the data matrix giving the values of i^{th} district and j^{th} indicator, where i = 1, 2, 3,…n and j = 1, 2, 3, …..k. Since, the values of the indicators in $[X_{ij}]$ are not recorded in uniform measuring units, the data matrix $[X_{ij}]$ is transformed into the standardized form $[Z_{ij}]$ as follows:

$$\left[Z_{ij}\right] = \frac{X_{ij} - \overline{X}_j}{S_j}$$

Where, $\overline{X}_j$ and S_j are the mean and the standard deviation of the j^{th} indicator respectively. From $[Z_{ij}]$, the optimal value, denoted by Z_{0j}, was selected. The optimal value is the maximum or the minimum value of each indicator depending on the direction of its relation with development. Since each of the indicators chosen has a direct association with the level of agricultural development, maximum value was chosen as the optimal value for each indicator. The pattern of agricultural development for i^{th} district was estimated as follows:

$$P_{ij} = \left(Z_{ij} - Z_{0j}\right)^2$$

The pattern of development was standardized to form a new parameter C_i which was estimated as:

$$C_i = \left[\sum_{j=1}^{k} P_{ij} \Big/ CV_j\right]^{1/2}$$

where, CV_j is the coefficient of variation of the j^{th} indicator in $[X_{ij}]$.

Composite agricultural development index D_i is given by the ratio:

$$D_i = \frac{C_i}{C}$$

Where,

$C = \overline{C} + 3S_{Ci}$

S_{Ci}= Mean of C_i

S_{Ci}= Standard Deviation of C_i

The values of the composite agricultural development index D_i are non-negative and lower value indicate higher development whereas higher value indicate less development.

A suitable fractile classification, as used by Ohlan (2013), was used to classify the districts into four different stages of development viz., highly developed, high middle level developed, low middle developed and low developed.

Identification of model districts: Identification of model districts is useful in fixing potential targets of the development indicators for the low developed districts. To identify model districts, development distance between pairs of districts was calculated. The development distance between districts *i* and *p*, denoted by d_{ip} is calculated as follows:

$$d_{ip} = \left[\sum_{j=1}^{k}\left(Z_{ij} - Z_{pj}\right)^2\right]^{1/2}$$

Where,

i = 1,2,3, 4,….n

p = 1,2,3,4,……n

This give rise to a symmetric matrix called the distance matrix which is of the form as given below:

$$d_{ip} = \begin{bmatrix} d_{11} & d_{12} & . & . & d_{1n} \\ d_{21} & d_{22} & . & . & d_{2n} \\ . & . & . & . & . \\ . & . & . & . & . \\ d_{n1} & d_{n2} & . & . & d_{nn} \end{bmatrix}$$

From the above matrix, the minimum distance in each row was selected and denoted by d_i. Critical Distance (CD) was then calculated using the formula:

$$CD = \overline{d} + 2Sd$$

Where,

$\overline{d}$ = Mean of d_i

Sd = Standard deviation of d_i

The critical distance is used to identify the model districts for a low developed district "*L*". Model districts for district "*L*" will be those districts whose composite agricultural index is less than that of district "*L*" and whose developmental distance from district "*L*" is less than or equal to critical distance (CD). From among the model districts, the best value of each indicator will be the potential target of the respective indicators for district "*L*".

RESULTS AND DISCUSSION

Agricultural Development Indices and stages of development: Composite indices for agricultural development were calculated for 90 districts of the north east India states. The districts were ranked according to the value of the indices and were categorised into different stages of development

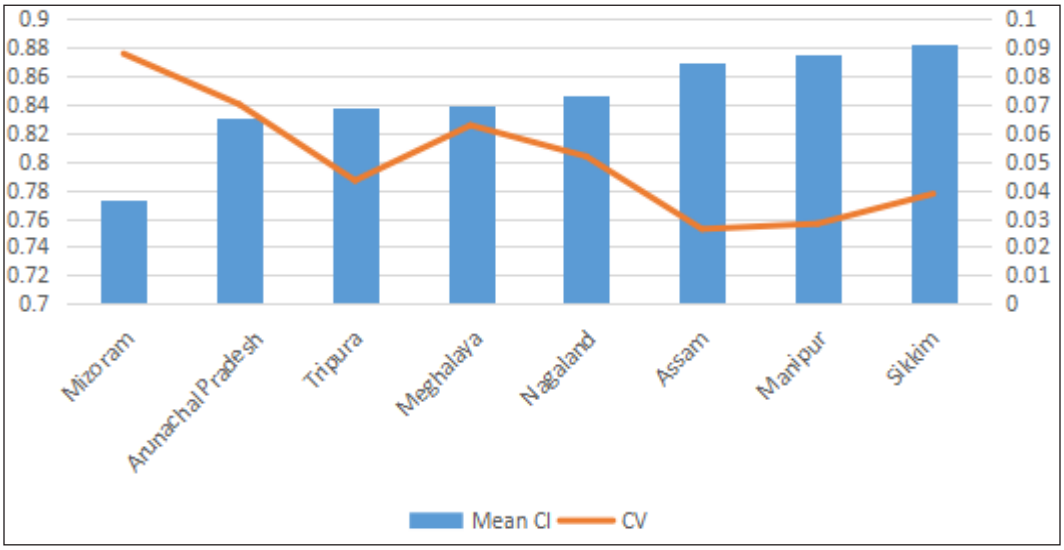

Fig. 1: Mean composite indices of agricultural development

in agriculture sector. The newly formed districts in some states have not been presented separately due to non-availability of all data considered.

The mean composite indices of agricultural development in the eight states of North East India are presented in Fig. 1 along with their respective coefficient of variations, showing inter district variability. It was observed that Mizoram, Arunachal Pradesh and Tripura were ranked highest in agricultural development. However, a high inter district variability in the level of agricultural development were observed in these states. On contrary, Assam, Manipur and Sikkim were three of the least developed in agriculture but a comparatively uniform development was observed among its districts. The results are entirely dependent on the choice of the indicators. To understand the variability of the level of agricultural development among the districts, the model districts were identified. The deviation of the indicators of the low performing districts were analysed and the results are presented in the later sections.

The districts in each state were classified into different stages of development using simple quantile classification of the composite indices of agricultural development (Table 1). The value of the composite indices in Arunachal Pradesh varied between 0.701 and 0.925. Upper Subansiri and Changlang were classified as low developed districts in the state. The composite indices of agricultural development for the districts of Assam ranged between 0.826 and 0.906. The inter district variability in agricultural development was found to be least among the North East states. Five districts, namely, Golaghat, Udalguri, Baksa, Lakhimpur and Sonitpur were classified as low developed in agriculture. In Manipur, the value of the composite indices was highest at 0.843 in Imphal West and 0.915 in Tamenglong. Only Tamenglong district was classified as low developed in the state. The composite indices of agricultural development varied between 0.753 and 0.921. West Garo Hills was the only district in the state classified as highly developed in agriculture while Jaintia Hills was classified as low developed. The composite indices of agricultural development for the districts of Mizoram showed a high level of disparity in agriculture development among the districts. The highest variability was observed in Mizoram. It varied from 0.655 in Siaha to 0.855 in Lawngtlai. Kolasib and Lawngtlai districts were classified as low developed districts. Among the districts of Nagaland, Phek and Kohima were classified as high developed and Peren was classified as low developed. As far as Sikkim was concerned, none of the districts were classified as high developed. East district of Sikkim was classified as low developed, though the variability among the districts were not very high. The value of composite index showed a variability from 0.791 to 0.883 in Tripura. West and South districts were categorised as highly developed and North and Unakoti districts were categorised as low developed districts.

Table 1: Classification of districts into stages of development in agriculture according to the composite index of agricultural development

Sl. No.	States	Highly Developed	High medium developed	Low medium developed	Low developed
1	Arunachal Pradesh	(0.701-0.772)	(0.772 - 0.830)	(0.830 - 0.888)	(0.888 - 0.925)
		Dibang Valley, Anjaw	Upper Siang, Tawang,West Kameng, Lower Dibang Valley, East Kameng	Papum pare, Lower Subansiri, East Siang,West Siang, Kurung Kumey, Tirap, Lohit	Upper Subansiri, Changlang
2	Assam	(0.826 - 0.846)	(0.846 - 0.869)	(0.869 - 0.892)	(0.892 - 0.906)
		Dhubri, Hailakandi, Morigaon, Jorhat, Dhemaji, Chirang	Kamrup Metro, Karbi Anglong, Cachar, Nagaon, Sivasagar, Darrang,	Tinsukia, Kokrajhar, Dima Hasao, Karimganj, Bongaigaon, Kamrup rural, Nalbari, Barpeta, Goalpara, Dibrugarh	Golaghat, Udalguri, Baksa, Lakhimpur, Sonitpur
3	Manipur	(0.843 - 0.851)	(0.851 - 0.875)	(0.875 - 0.900)	(0.900 - 0.915)
		Imphal West, Thoubal, Senapati	Churachandpur, Imphal East	Ukhrul, Chandel, Bishnupur	Tamenglong
4	Meghalaya	(0.753 - 0.786)	(0.786 - 0.839)	(0.839 - 0.891)	(0.891 - 0.921)
		West Garo Hills	South Garo Hills, East Khasi Hills, RiBhoi	East Garo Hills, West Khasi Hills	Jaintia Hills
5	Mizoram	(0.655 - 0.705)	(0.705 - 0.773)	(0.773 - 0.840)	(0.840 - 0.855)
		Siaha	Serchhip, Champhai	Lunglei, Mamit, Aizawl	Kolasib, Lawngtlai
6	Nagaland	(0.748 - 0.802)	(0.802 - 0.846)	(0.846 - 0.890)	(0.890 - 0.891)
		Phek, Kohima	Dimapur, Mokokchung, Zunhebeto	Wokha, Tuensang, Kiphire, Longleng, Mon	Peren
7	Sikkim	(< 0.848)	(0.848 - 0.882)	(0.882 - 0.916)	(0.916 - 0.929)
		—	South district, North District	West District	East district
8	Tripura	(0.791 - 0.802)	(0.802 - 0.838)	(0.838 - 0.874)	(0.874 - 0.883)
		West Tripura, South Tripura	Sepahijilla, Gomati	Khowai, Dhalai	North Tripura, Unakoti

Model Districts for low developed districts: For effecting a uniform development in agriculture, the low performing districts should improve upon its development indicators to its potential level. To estimate the potential level, the development distances between pairs of districts in study were calculated based on the method explained in the earlier section. The development distances are composite measure of all the distances on each of the indicators on which the districts are to be compared. It gives a more sensitive and valid measure of development levels by considering the structural similarity among the districts (Ohlan, 2013). Thus, using the method, the model districts were estimated for each of the low developed districts. The model districts are structurally similar to the low developed districts but are in the higher ladder of agricultural development.

The list of model districts for the low developed districts of each state in North East India are presented in Table 2. Tawang, West Kameng, West Siang, East Siang and Tirap were common model districts for the two low developed districts of Arunachal Pradesh. For the five low developed districts of Assam, Jorhat was a common model district. Manipur, Meghalaya, Nagaland and Sikkim each had one low developed district and the lists of model districts for each of them are shown in the table. For Mizoram, the model districts were common for the two low developed districts. In Tripura, West Tripura, South Tripura and Khowai were common model districts for the two low developed districts.

Table 2: Model districts for low developed districts in the states of North East India

Sl. No.	State	Low developed district	Model Districts
1	Arunachal Pradesh	Upper Subansiri	Tawang, West Kameng, East Kameng, Kurung Kumey, Lower Subansiri, West Siang, East Siang, Lohit, Tirap
		Changlang	Tawang, West Kameng, Papumpare, Kurung Kumey, Upper Subansiri, West Siang, East Siang, Lower Dibang Valley, Tirap
2	Assam	Golaghat	Kokrajhar, Goalpara, Nagaon, Tinsukia, Dibrugarh, Sivasagar, Jorhat, Karbi Anglong, Bongaigaon, Chirang, Kamrup rural, Kamrup metro, Nalbari
		Udalguri	Kokrajhar, Nagaon, Tinsukia, Dibrugarh, Sivasagar, Jorhat, Karbi Anglong, Golaghat, Chirang, Kamrup rural
		Baksa	Goalpara, Nagaon, Tinsukia, Sivasagar, Jorhat, Golaghat, Bongaigaon, Chirang, Darrang, Udalguri
		Lakhimpur	Dhemaji, Jorhat
		Sonitpur	Kokrajhar, Lakhimpur, Dibrugarh, Sivasagar, Jorhat, Golaghat, Kamrup rural, Baksa, Darrang, Udalguri
3	Manipur	Tamenglong	Senapati, Churachandpur, Chandel, Ukhrul
4	Meghalaya	Jaintia Hills	Ribhoi, West Khasi Hills, East Garo Hills
5	Mizoram	Kolasib	Lunglei, Champhai, Aizawl, Mamit
		Lawngtlai	Lunglei, Champhai, Aizawl, Mamit
6	Nagaland	Peren	Kohima, Makokchung, Zunhebeto, Wokha, Tuensang, Kiphire, Longleng, Mon
7	Sikkim	East Sikkim	North Sikkim, South Sikkim, West Sikkim
8	Tripura	North Tripura	West Tripura, South Tripura, Khowai, Dhalai
		Unakoti	West Tripura, South Tripura, North Tripura, Gomati, Khowai, Sephahijilla

Potential Targets for development indicators in low developed districts: The identified model districts for each of the low developed districts for all the states of North East India were used to estimate the potential targets for all the development indicators. The potential targets indicate the extent of improvement in the development indicators required to raise the level of development for the low developed districts. Such information will help the planners and administrators in reorienting the development activities for reducing the disparities among different districts. The best value of each development indicators from among the model districts were taken as the potential targets for the low developed districts. The potential targets and actual achievement in regard to each development indicators for the low developed districts are presented in Table 3.

It is quite evident from the table that the values of the potential targets were better for almost all the indicators in the low developed districts of the North East states. In Arunachal Pradesh, both the low developed districts have hilly landscapes following terrace farming and shifting cultivation which are generally performed under rainfed condition. Understandably the percentage of irrigated area and fertilized area were very low in both the districts. In regards to livestock production too, the two districts underperformed and an improvement in this field will raise its development level by a significant scale. In Assam, Golaghat had the lowest net area sown among the low developed districts and has the least percentage of area sown more than once. It is seen in the table that the potential target for net area irrigated in all the districts were low. One common factor observed for low agricultural development in these districts were the almost nil availability of veterinary services required for the livestock population. An improvement in this field will significantly raise the agricultural development in the state. Tamenglong district in Manipur needs improvement in crops and livestock production. Focus should be made in enhancing irrigation and livestock services. Jaintia

Table 3: Actual Achievements and potential targets of development indicators for low developed districts

State	Low developed Districts	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12
Arunachal Pradesh	Upper Subansiri	70.16 (28.73)	39.03 (28.82)	93.99 (7.63)	26.47 (13.49)	2.24 (2.07)	2.21 (1.51)	1.82 (1.54)	60 (19)	39 (28)	1459 (442)	5 (4)	5 (2)
	Changlang	72.27 (55.26)	44.48 (11.97)	93.98 (17.55)	55.90 (9.76)	2.07 (2.2)*	2.28 (1.26)	1.82 (0.79)	60 (41)	39 (19)	1459 (889)	5 (4)	5 (1)
Assam	Golaghat	64.79 (39.05)	9.46 (4.01)	89.45 (69.20)	32.00 (0.21)	2.60 (2.04)	1.2 (0.95)	1.00 (0.66)	47 (39)	17 (8)	1161 (634)	3 (2)	1 (0)
	Udalguri	58.11 (50.93)	9.46 (15.63)*	89.49 (46.72)	32.00 (1.34)	2.34 (1.9)	1.01 (1.65)*	1 (0.73)	47 (41)	17 (8)	1161 (861)	3 (1)	0 (0)
	Baksa	58.11 (41.21)	15.63 (23.02)*	89.49 (79.22)	23.69 (7.41)	2.34 (1.89)	1.65 (1.14)	0.73 (0.57)	47 (38)	11 (9)	919 (718)	3 (1)	0 (0)
	Lakhimpur	47.73 (43.70)	0.97 (0.64)	63.72 (21.25)	3.67 (10.47)*	2.92 (1.91)	0.86 (0.91)*	0.71 (0.86)*	66 (58)	17 (13)	881 (574)	1 (2)*	0 (0)
	Sonitpur	53.81 (43.42)	23.02 (6.38)	79.21 (24.54)	32 (15.94)	2.3 (2.09)	1.65 (0.82)	1 (0.68)	58 (49)	13 (8)	919 (648)	2 (1)	0 (0)
Manipur	Tamenglong	6.86 (3.70)	0 (0)	99.52 (89.60)	12.97 (13.41)*	1.57 (1.51)	0.95 (0.89)	0.85 (0.85)	16 (13)	15 (18)*	1128 (924)	1 (2)*	2 (2)
Meghalaya	Jaintia Hills	35.56 (9.49)	47.53 (9.39)	10.45 (23.31)*	11.79 (0)	3.36 (2.13)	2.3 (1.1)	1.2 (0.85)	10 (7)	10 (12)*	981 (1100)*	4 (5)*	5 (3)
Mizoram	Kolasib	8.02 (14.63)*	13.03 (14.84)*	28.47 (13.41)	1.71 (0)	1.62 (1.92)*	2.24 (1.34)	0.83 (0.87)*	7 (8)*	30 (28)	1472 (1406)	9 (7)	8 (4)
	Lawngtlai	8.02 (4.57)	13.03 (14.82)*	28.47 (0.38)	1.71 (0)	1.62 (1.65)*	2.24 (1.38)	0.83 (0.65)	7 (3)	30 (25)	1472 (896)	9 (5)	8 (3)
Nagaland	Peren	59.96 (27.79)	32.38 (17.18)	3.48 (6.79)*	43.35 (6.62)	2.53 (2.51)	1.2 (1.17)	1.02 (1.01)	20 (3)	32 (17)	219 (164)	2 (0)	6 (4)
Sikkim	East Sikkim	24.42 (20.97)	17.29 (24.19)*	0 (0)	17.9 (14.14)	1.49 (1.83)*	1.03 (0.98)	0.94 (0.86)	32 (17)	7 (3)	1665 (564)	0 (0)	8 (2)
Tripura	North Tripura	48.25 (15.91)	50.53 (21.02)	84.84 (65.23)	70 (43.29)	3.22 (2.64)	0.97 (0.86)	0.85 (0.85)	29 (19)	13 (5)	1527 (731)	5 (4)	1 (1)
	Unakoti	48.25 (26.99)	50.53 (20.05)	99.18 (61.44)	43.29 (39.24)	3.23 (2.81)	0.94 (0.79)	0.87 (0.77)	29 (22)	7 (3)	1696 (999)	5 (4)	1 (1)

Note: 1. Figures in parentheses are the actual achievement of the developmental indicators

2. denotes that actual achievement is better than the potential target*

***Notations: X1:** Percentage of net area sown; **X2:** Percentage of net sown area irrigated; **X3:** Percentage of net sown area fertilized; **X4:** Percentage of area sown more than once; **X5:** Yield of rice (tonnes per ha); **X6:** Yield of pulses (tonnes per ha); **X7**: Yield of oilseeds (tonnes per ha); **X8**: Cattle population (per 100 persons); **X9**: Pig population (per 100 persons); **X10**: Poultry population (per 1000 persons); **X11:** Number of regional rural bank branches (per 1,00,000 persons); **X12**: Number of veterinary institutions (per 10,000 livestock)*

Hills in Meghalaya recorded higher achievement in net area fertilized, pig and poultry population and number of regional rural banks as compared to the potential target. The district has very low net area sown and area irrigated and no area is recorded as sown more than once. It is seen in the table that the two low developed districts of Mizoram had recorded higher achievements than the target values in regard to some indicators. However, both the districts lagged behind by much larger amount in the rest of the indicators. Double cropping should be encouraged in both the districts and efforts should be made to enhance the productivity of oilseeds, agricultural credit facilities and veterinary services. In Nagaland, the district Peren had higher area fertilized as compared to its model districts and fell below par in the rest of the indicators. Increasing the cattle population will bring a leap in the level of development in the district. Looking at the data for Sikkim, the low developed district had a very low performance in animal sector. Improvement in the livestock sector along with the required facilities

such as veterinary institutions will improve the agricultural development in the district markedly. Finally, for Tripura, improvements are required in all the indicators in both the districts to raise the level of development in agriculture. Focus should be made on improvement in irrigation, double cropping and animal sector. Overall, in all the states agricultural development can be improved by improving the crop and livestock productions through enhancing irrigation and veterinary services.

CONCLUSION

The disparities in agricultural development within the NE region of India was evaluated by computing the composite agricultural development index for 90 districts from all the 8 states of the region. The study revealed that there was a wide range of variability in the composite index of agricultural development among the districts in all the states. To bring uniform development in agricultural sector, the extent of improvements required in different indicators for the poor performing districts were estimated by identifying the model districts. Potential targets were estimated from the model districts and results from all the states showed that the low developed districts needed improvements in almost all the development indicators considered. A general recommendation for all the districts would be an improvement in the crop and livestock production. Adequate number of veterinary institutions should be set up for the livestock population. Improvement in the crop sector should be focused on increasing irrigation and more efficient use of area by double cropping. Fertilizers gives the needed plant nutrients when used in recommended doses. However, efforts should be made to provide the needed plant nutrients by organic sources like FYM and to adopt practices which conserve soil nutrients.

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