

# Agricultural Land Use Transformation in North-East India: A Comparative Analysis of Structural Change, 2014-15 to 2023-24

James Dev Verma\*<sup>1</sup>

<sup>1</sup> Department of Geography, Swami Vivekananda Mahavidyalaya, Mohanpur - 799 211, West Tripura, India

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## Abstract

North-East India exhibits marked diversity in physiography, land resources and farming systems, resulting in distinct agricultural land-use patterns across its eight states. Despite its importance, comprehensive assessment of recent structural changes in agricultural land use remains limited. The present study analyses agricultural land-use transformation in North-East India during 2014-15 to 2023-24 using official data from Land Use Statistics at a Glance. A comparative analysis based on absolute and percentage changes was employed to examine changes in major land-use categories and indicators of agricultural intensification. The results indicate that recorded forest area remained largely stable, whereas land under non-agricultural uses expanded in most states. Other uncultivated land generally declined, although the magnitude of change varied considerably across the region. Changes in fallow land, net sown area, gross cropped area and cropping intensity also revealed pronounced inter-state differences. The findings suggest that agricultural transformation in North-East India has been driven more by changes in land-use composition and the intensity of land utilization than by expansion of the cultivated land base. The study provides recent empirical evidence to support sustainable land-use planning, agricultural resource management and balanced regional development in North-East India.

**Key words:** Agricultural land-use transformation, Land-use change, Cropping intensity, Comparative analysis, Sustainable land management, North-East India

Agricultural land-use transformation is a key indicator of agricultural development, reflecting changes in the utilization of land resources under the combined influence of population growth, economic development, technological progress and environmental change. Changes in land-use patterns directly influence agricultural productivity, food security, rural livelihoods and ecological sustainability. As opportunities for expanding cultivated land have become increasingly limited, agricultural development has relied more on improving the utilization and intensity of existing land resources than on expanding the cultivated area. Consequently, the analysis of agricultural land-use change has become important for understanding agricultural transformation and supporting sustainable land management [5-6], [8].

India has witnessed substantial changes in agricultural land use over recent decades. Rapid urbanization, infrastructure development and changing farming practices have increased competition for land, while technological advancement, irrigation development and multiple cropping have enhanced agricultural intensification in many parts of the country. However, the nature and magnitude of these changes vary considerably across regions because of differences in physiography, climate, resource endowment and socio-economic conditions [11-12]. North-East India presents a distinctive agricultural landscape within the country. Comprising Arunachal Pradesh, Assam, Manipur, Meghalaya,

Mizoram, Nagaland, Sikkim and Tripura, the region is characterized by diverse physiographic conditions, extensive forest resources and contrasting farming systems. While the alluvial plains of Assam support relatively intensive settled agriculture, the predominantly hilly states are characterized by limited cultivable land, rain-fed farming and the continued influence of shifting cultivation. These physical and agricultural contrasts have resulted in marked inter-state variation in agricultural land-use patterns and the pace of agricultural transformation [2-3], [7].

Previous studies have examined agricultural land-use change in North-East India from different perspectives, including shifting cultivation, land degradation, agricultural transformation and land-use/land-cover change. These investigations have demonstrated the considerable spatial diversity of agricultural systems across the region and highlighted the influence of physiography and farming practices on land utilization [2], [7], [9]. However, most studies have focused on individual states or specific aspects of land-use change. Comparative assessments based on recent official agricultural land-use statistics covering all eight North-Eastern states remain limited.

Against this background, the present study examines the structural transformation of agricultural land use in North-East India during 2014-15 to 2023-24 using official land-use statistics published by the Directorate of Economics and

\*Correspondence to: James Dev Verma, E-mail: jameskarma@gmail.com; Tel: +91 9862123220

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Statistics, Department of Agriculture and Farmers Welfare, Government of India [4]. The study analyses changes in the major agricultural land-use categories, including forests, land under non-agricultural uses, other uncultivated land, fallow land, net sown area, gross cropped area, area sown more than once and cropping intensity. Using absolute change, percentage change, and comparative state-wise analysis, the study evaluates the magnitude and direction of agricultural land-use transformation and provides updated evidence to support sustainable agricultural development and land-use planning in North-East India.

## MATERIALS AND METHODS

The study is based entirely on secondary data obtained from Land Use Statistics at a Glance (2023-24) published by the Directorate of Economics and Statistics, Department of Agriculture and Farmers Welfare, Government of India. Wherever necessary, data were cross-verified with the Handbook of Statistics on Indian States published by the Reserve Bank of India. The analysis covers all eight North-Eastern states including Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura for the period 2014-15 to 2023-24. Major land-use categories analyzed include forest area, land under non-agricultural uses, other uncultivated land (excluding fallow land), fallow land, net sown area, gross cropped area, area sown more than once and cropping intensity. Changes in the major land-use categories were assessed using absolute change and percentage change; while cropping intensity was calculated as the ratio of gross cropped area to net sown area and its change was expressed in percentage points. Absolute change was calculated as:

$$\text{Absolute change} = \text{Final Value} - \text{Initial Value}$$

Percentage change was calculated as:

$$\text{Percentage Change (\%)} = \frac{(\text{Final Value} - \text{Initial Value})}{\text{Initial Value}} \times 100$$

Cropping intensity was computed as:

$$\text{Cropping Intensity (\%)} = \frac{(\text{Gross Cropped Area} / \text{Net Sown Area}) \times 100$$

The results are presented through comparative state-wise tables and interpreted to examine the magnitude and direction of agricultural land-use transformation across North-East India.

## RESULTS AND DISCUSSION

### *Structural pattern of agricultural land use in North-East India*

North-East India exhibits considerable diversity in agricultural land use because of marked differences in physiography, forest resources and farming systems. While Assam is characterized by relatively intensive settled agriculture, the predominantly hilly states possess extensive forest cover, limited cultivable land and varying dependence on shifting cultivation. Consequently, the composition of major land-use categories differs substantially across the region. During 2014-15 to 2023-24, the overall land resource base remained broadly stable, although noticeable changes occurred in forest area, land under non-agricultural uses, uncultivated land, fallow land and cultivated land. The magnitude and direction of these changes varied considerably among the eight states, reflecting differences in resource endowment and agricultural development.

### *Changes in forest area and land under non-agricultural uses*

Data depicted in (Table 1) indicates that recorded forest area remained broadly stable across the region during 2014-15 to 2023-24, although inter-state differences were evident. Arunachal Pradesh continued to account for the largest forest area, despite a decline of 89 thousand hectares (1.32%). Meghalaya recorded the highest proportional decline (8.35%), while Mizoram, Nagaland and Tripura showed no change in the reported area. The relatively limited overall variation suggests that changes in the recorded forest category were less pronounced than changes in several agricultural and non-agricultural land-use categories. This broad stability is consistent with the dominant role of forests in the land-use structure of the predominantly hilly states of North-East India [3], [7].

Table 1 Changes in forest area and land under non-agricultural uses in North-East India (2014-15 to 2023-24) (Area in thousand hectares)

| State             | Forest area (2014-15) | Forest area (2023-24) | Change | % Change | Land under non agriculture uses (2014-15) | Land under non agriculture uses (2023-24) | Change | % Change |
|-------------------|-----------------------|-----------------------|--------|----------|-------------------------------------------|-------------------------------------------|--------|----------|
| Arunachal Pradesh | 6732                  | 6643                  | -89    | -1.32    | 25                                        | 25                                        | 0      | 0.00     |
| Assam             | 1853                  | 1829                  | -24    | -1.30    | 1271                                      | 1336                                      | +65    | +5.11    |
| Manipur           | 1699                  | 1660                  | -39    | -2.30    | 26                                        | 26                                        | 0      | 0.00     |
| Meghalaya         | 946                   | 867                   | -79    | -8.35    | 111                                       | 197                                       | +86    | +77.48   |
| Mizoram           | 1585                  | 1585                  | 0      | 0.00     | 69                                        | 79                                        | +10    | +14.49   |
| Nagaland          | 863                   | 863                   | 0      | 0.00     | 93                                        | 124                                       | +31    | +33.33   |
| Sikkim            | 336                   | 334                   | -2     | -0.60    | 10                                        | 28                                        | +18    | +180.00* |
| Tripura           | 629                   | 629                   | 0      | 0.00     | 146                                       | 142                                       | -4     | -2.74    |

Source: Computed from Land Use Statistics at a Glance 2023-24, Directorate of Economics and Statistics, Department of Agriculture and Farmers Welfare, Government of India.

Note: The high percentage increase for Sikkim is attributable to its small initial area under non-agricultural uses.

A contrasting pattern was observed for land under non-agricultural uses, which increased in five states. Meghalaya recorded the largest absolute increase of 86 thousand hectares (77.48%), followed by Assam with 65 thousand hectares (5.11%) and Nagaland with 31 thousand hectares (33.33%).

Mizoram and Sikkim also recorded increases, whereas Arunachal Pradesh and Manipur remained unchanged and Tripura declined by 4 thousand hectares (2.74%). The 180.00% increase reported for Sikkim should be interpreted cautiously because it arose from a very small initial area; the absolute

increase was only 18 thousand hectares. The results indicate that the more noticeable structural change within these two categories occurred through an expansion of land under non-agricultural uses rather than through large-scale changes in the recorded forest category. The expansion of non-agricultural land in several states may be associated with increasing demands for settlements, infrastructure and other non-farm uses

accompanying regional socio-economic development [7], [10]. At the same time, the contrasting state-level patterns demonstrate that agricultural land-use transformation in North-East India is spatially uneven and is shaped by differences in physiography, resource availability and prevailing farming systems [3], [7].

Table 2 Changes in other uncultivated land (Excluding fallow land), 2014-15 to 2023-24 (Area in thousand hectares)

| State             | 2014-15 | 2023-24 | Absolute change | % Change |
|-------------------|---------|---------|-----------------|----------|
| Arunachal Pradesh | 115     | 104     | -11             | -9.57    |
| Assam             | 529     | 527     | -2              | -0.38    |
| Manipur           | 8       | 8       | 0               | 0.00     |
| Meghalaya         | 555     | 536     | -19             | -3.42    |
| Mizoram           | 60      | 54      | -6              | -10.00   |
| Nagaland          | 161     | 125     | -36             | -22.36   |
| Sikkim            | 8       | 20      | +12             | +150.00  |
| Tripura           | 15      | 13      | -2              | -13.33   |

Source: Computed from Land Use Statistics at a Glance 2023-24, Directorate of Economics and Statistics, Department of Agriculture and Farmers Welfare, Government of India

*Note: The exceptionally high percentage increase for Sikkim results from the very small initial area (8 thousand hectares) and should therefore be interpreted cautiously*

#### Changes in uncultivated land resources

Other uncultivated land (excluding fallow land) comprises permanent pastures and other grazing lands, land under miscellaneous tree crops and groves (not included in net sown area), and culturable waste land. Although these lands are not under regular cultivation, they perform important agricultural and ecological functions. Changes in this category therefore provide useful evidence of structural transformation in agricultural land use beyond the cultivated area.

Data presented in (Table 2) indicates that other uncultivated land generally declined across North-East India during 2014-15 to 2023-24, although the magnitude of change varied considerably among the states. Meghalaya and Assam continued to account for the largest areas throughout the study period, while Manipur, Sikkim and Tripura possessed comparatively small areas. Six of the eight states recorded declines, Manipur remained unchanged and Sikkim was the only state to register an increase. The decline was most pronounced in Nagaland, where the area fell by 36 thousand hectares (22.36%). Arunachal Pradesh, Meghalaya, Mizoram and Tripura also recorded reductions, whereas Assam showed

little change over the decade. Sikkim recorded an increase of 12 thousand hectares. Although this represented a rise of 150.00 per cent, the increase was largely due to the small initial area and should therefore be interpreted with caution. The predominance of declining trends suggests a gradual reduction in other uncultivated land across much of North-East India. Similar changes have been associated with shifts in land-use patterns, agricultural expansion and the changing utilization of land resources in the region [7], [9]. However, because this aggregate category includes permanent pastures, miscellaneous tree crops and culturable waste land, the observed changes may reflect different underlying processes in different states. These components are therefore examined separately in the following sections.

#### Changes in permanent pastures and other grazing lands

Permanent pastures and other grazing lands occupy only a small proportion of the reported agricultural land in North-East India. Nevertheless, changes in their extent indicate shifts in the availability of grazing resources and the use of land for livestock-related activities.

Table 3 Changes in permanent pastures and other grazing lands in North-East India, 2014-15 to 2023-24 (Area in thousand hectares)

| State             | 2014-15 | 2023-24 | Absolute change | % Change |
|-------------------|---------|---------|-----------------|----------|
| Arunachal Pradesh | 18      | 18      | 0               | 0.00     |
| Assam             | 167     | 172     | +5              | +2.99    |
| Manipur           | 1       | 1       | 0               | 0.00     |
| Meghalaya         | --      | --      | --              | --       |
| Mizoram           | 11      | 5       | -6              | -54.55   |
| Nagaland          | --      | --      | --              | --       |
| Sikkim            | --      | 9       | --              | --       |
| Tripura           | 1       | 1       | 0               | 0.00     |

Source: Computed from Land Use Statistics at a Glance 2023-24, Directorate of Economics and Statistics, Department of Agriculture and Farmers Welfare, Government of India

*Note: -- indicates that data were not reported in the official land-use statistics; consequently, absolute and percentage changes could not be computed*

Data presented in (Table 3) indicates that permanent pastures and other grazing lands remained almost unchanged in most North-Eastern states during the study period. Assam continued to account for the largest reported area, increasing

slightly from 167 thousand hectares in 2014-15 to 172 thousand hectares in 2023-24, an increase of 5 thousand hectares (2.99%). Arunachal Pradesh remained unchanged at 18 thousand hectares, while Manipur and Tripura each reported

only 1 thousand hectares in both years. Mizoram was the only state to record a substantial decline. The area under permanent pastures fell from 11 thousand hectares to 5 thousand hectares, representing a decrease of 6 thousand hectares (54.55%). This was the largest proportional change among the reporting states and suggests a reduction in land classified under grazing resources during the study period. Inter-state comparison is constrained by incomplete reporting. Official statistics do not provide data for Meghalaya and Nagaland in either year, while Sikkim reported 9 thousand hectares only in 2023-24, making change analysis impossible. The available evidence indicates little structural change in permanent pastures and other grazing lands across North-East India, except in Mizoram. The generally small extent of this category and the absence of data

for several states suggest that grazing land forms only a limited component of the region's agricultural land-use structure. The relatively limited role of grazing land within the broader agricultural land-use structure of the North-Eastern hill states is consistent with the region's predominantly forested and mountainous landscape and diverse farming systems [1-2], [7].

#### *Changes under land under miscellaneous tree crops and groves (not included in net sown area)*

Land under miscellaneous tree crops and groves constitutes one component of other uncultivated land in the official land-use classification. Although its share is relatively small, changes in this category reflect shifts in the utilization of tree-based land resources outside the net sown area.

Table 4 Changes under land under miscellaneous tree crops and groves (not included in net sown area) in North-East India, 2014-15 to 2023-24 (Area in thousand hectares)

| State             | 2014-15 | 2023-24           | Absolute change | % Change |
|-------------------|---------|-------------------|-----------------|----------|
| Arunachal Pradesh | 35      | 31                | -4              | -11.43   |
| Assam             | 220     | 210               | -10             | -4.55    |
| Manipur           | 6       | Data not reported | --              | --       |
| Meghalaya         | 165     | 167               | +2              | +1.21    |
| Mizoram           | 41      | 41                | 0               | 0.00     |
| Nagaland          | 92      | 66                | -26             | -28.26   |
| Sikkim            | 4       | 4                 | 0               | 0.00     |
| Tripura           | 11      | 10                | -1              | -9.09    |

Source: Computed from Land Use Statistics at a Glance 2023-24, Directorate of Economics and Statistics, Department of Agriculture and Farmers Welfare, Government of India

Note: -- indicates that comparable data were not reported in the official statistics for 2023-24; consequently, changes could not be computed

Data in (Table 4) shows that land under miscellaneous tree crops and groves changed only marginally in most North-Eastern states during 2014-15 to 2023-24. Assam continued to report the largest area, although it declined from 220 thousand hectares to 210 thousand hectares, a reduction of 10 thousand hectares (4.55%). Meghalaya was the only state to record an increase, rising slightly from 165 thousand hectares to 167 thousand hectares (1.21%), while Mizoram and Sikkim remained unchanged. Nagaland recorded the largest decline among the reporting states. The area decreased from 92 thousand hectares in 2014-15 to 66 thousand hectares in 2023-24, representing a reduction of 26 thousand hectares (28.26%). Arunachal Pradesh and Tripura also experienced declines of 4 thousand hectares (11.43%) and 1 thousand hectare (9.09%), respectively. Comparable data for Manipur were not available for 2023-24; consequently, changes for the state could not be

assessed. The pattern indicates that this land-use category remained relatively stable across much of North-East India, with the notable decline concentrated mainly in Nagaland. The observed variation forms part of the broader changes in land-use and land-cover patterns documented for the North-East Region [7], [10]. The predominance of small changes suggests that this component contributed only marginally to the broader structural transformation of agricultural land use during the study period.

#### *Changes in culturable waste land*

Culturable waste land is land available for cultivation but remaining uncultivated for a considerable period. Changes in its extent indicate shifts in the utilization of potentially cultivable land and provide an additional measure of structural changes in agricultural land use.

Table 5 Changes in culturable waste land in North-East India, 2014-15 to 2023-24 (Area in thousand hectares)

| State             | 2014-15 | 2023-24           | Absolute change | % Change |
|-------------------|---------|-------------------|-----------------|----------|
| Arunachal Pradesh | 62      | 55                | -7              | -11.29   |
| Assam             | 142     | 145               | +3              | +2.11    |
| Manipur           | 1       | Data not reported | --              | --       |
| Meghalaya         | 390     | 370               | -20             | -5.13    |
| Mizoram           | 7       | 8                 | +1              | +14.29   |
| Nagaland          | 68      | 59                | -9              | -13.24   |
| Sikkim            | 4       | 7                 | +3              | +75*     |
| Tripura           | 3       | 2                 | -1              | -33.33   |

Source: Computed from Land Use Statistics at a Glance 2023-24, Directorate of Economics and Statistics, Department of Agriculture and Farmers Welfare, Government of India

Note: The comparatively high percentage increase for Sikkim reflects the very small initial area under culturable waste land. Data for Manipur were not reported in the official statistics for 2023-24; therefore, changes could not be computed.

Data in (Table 5) reveals considerable interstate variation in culturable waste land during 2014-15 to 2023-24.

Meghalaya had the largest area in both years, although it declined by 20 thousand hectares, from 390 to 370 thousand

hectares (5.13%). Nagaland and Arunachal Pradesh also recorded notable declines of 9 thousand hectares (13.24%) and 7 thousand hectares (11.29%), respectively. Tripura registered a decline of 1 thousand hectare (33.33%), which was the highest proportional reduction among the states with declining values. In contrast, Assam showed a marginal increase of 3 thousand hectares, from 142 to 145 thousand hectares (2.11%). Mizoram recorded an increase of 1 thousand hectare (14.29%), while Sikkim increased from 4 to 7 thousand hectares. Although Sikkim recorded the highest percentage increase (75.00%), the actual change was only 3 thousand hectares because of the small initial base. Data for Manipur were not reported for 2023-24 and therefore no change could be assessed. The data show that culturable waste land declined in four states and increased in

the remaining three states for which comparable data were available. The decline in Meghalaya accounted for the largest absolute reduction, while the increases in Assam, Mizoram and Sikkim were relatively limited in area. The data indicate considerable variation among the states in changes in potentially cultivable land between 2014-15 and 2023-24.

#### *Changes in fallow land*

Fallow land comprises cultivated land that remains temporarily uncultivated and includes current fallows and fallow lands other than current fallows under the official land-use classification. Changes in fallow land provide an indication of variations in the utilization and continuity of agricultural land during the study period.

Table 6 Changes in fallow land in North-East India, 2014-15 to 2023-24 (Area in thousand hectares)

| State             | 2014-15 | 2023-24           | Absolute change | % Change |
|-------------------|---------|-------------------|-----------------|----------|
| Arunachal Pradesh | 101     | 86                | -15             | -14.85   |
| Assam             | 175     | 200               | +25             | +14.29   |
| Manipur           | 0       | Data not reported | -               | -        |
| Meghalaya         | 215     | 203               | -12             | -5.58    |
| Mizoram           | 174     | 144               | -30             | -17.24   |
| Nagaland          | 149     | 177               | +28             | +18.79   |
| Sikkim            | 12      | 9                 | -3              | -25.00   |
| Tripura           | 3       | 2                 | -1              | -33.33   |

Source: Computed from Land Use Statistics at a Glance 2023-24, Directorate of Economics and Statistics, Department of Agriculture and Farmers Welfare, Government of India

Note: Data for Manipur were not reported in the official statistics for 2023-24; therefore, comparable changes could not be computed.

Data in (Table 6) shows considerable variation in the extent and direction of change in fallow land across the North-Eastern states. Meghalaya had the largest area under fallow land in 2014-15 (215 thousand hectares), followed by Assam (175 thousand hectares) and Mizoram (174 thousand hectares). By 2023-24, however, Assam had the largest area at 200 thousand hectares, while fallow land in Meghalaya and Mizoram declined to 203 and 144 thousand hectares, respectively. Five states recorded declines in fallow land. Mizoram registered the largest absolute reduction of 30 thousand hectares (17.24%), followed by Arunachal Pradesh with a decline of 15 thousand hectares (14.85%) and Meghalaya with 12 thousand hectares (5.58%). Sikkim and Tripura recorded smaller absolute reductions of 3 and 1 thousand hectares, respectively. The decline in Tripura was proportionally the highest among the states with comparable data (33.33%), although the actual reduction was only 1 thousand hectares because of its small initial area. Assam and Nagaland, in contrast, recorded

increases. Fallow land increased by 25 thousand hectares (14.29%) in Assam and by 28 thousand hectares (18.79%) in Nagaland. Nagaland therefore recorded the largest absolute increase among the states with comparable data. These contrasting changes indicate differences in the extent to which agricultural land remained under fallow across the states during the study period. The available statistics, however, do not permit the specific factors responsible for these changes to be established.

#### *Agricultural intensification and changes in cultivated land*

Changes in cultivated land can be assessed through net sown area, gross cropped area, area sown more than once, and cropping intensity. Net sown area represents the extent of land cultivated during the agricultural year, while gross cropped area accounts for repeated cultivation. Cropping intensity, expressed as the ratio of gross cropped area to net sown area, provides an indication of the extent of repeated use of cultivated land.

Table 7 Changes in net sown area, gross cropped area and area sown more than once in North-East India, 2014-15 to 2023-24 (Area in thousand hectares)

| State             | Net Sown Area |         | Gross cropped area |         | Area sown more than once |         |
|-------------------|---------------|---------|--------------------|---------|--------------------------|---------|
|                   | 2014-15       | 2023-24 | 2014-15            | 2023-24 | 2014-15                  | 2023-24 |
| Arunachal Pradesh | 225           | 258     | 299                | 348     | 74                       | 90      |
| Assam             | 2,827         | 2,756   | 4,083              | 4,122   | 1,255                    | 1,365   |
| Manipur           | 383           | 215     | 383                | 382     | --                       | 167     |
| Meghalaya         | 286           | 274     | 343                | 330     | 57                       | 56      |
| Mizoram           | 145           | 198     | 145                | 201     | --                       | 3       |
| Nagaland          | 384           | 366     | 500                | 481     | 116                      | 115     |
| Sikkim            | 77            | 83      | 136                | 139     | 59                       | 56      |
| Tripura           | 255           | 255     | 483                | 483     | 228                      | 228     |

Source: Computed by the authors from Land Use Statistics at a Glance 2023-24, Directorate of Economics and Statistics, Department of Agriculture and Farmers Welfare, Government of India.

Note: -- denotes data not reported.

Data in (Table 7) shows considerable interstate variation in the extent and utilization of cultivated land. Assam remained the dominant state in all three indicators in both years. Its net sown area declined from 2,827 to 2,756 thousand hectares, while gross cropped area increased slightly from 4,083 to 4,122 thousand hectares. The area sown more than once also increased from 1,255 to 1,365 thousand hectares. Thus, the increase in gross cropped area occurred despite a decline in net sown area, indicating greater use of the existing cultivated land through repeated cropping.

Arunachal Pradesh recorded increases in all three indicators, with net sown area rising from 225 to 258 thousand hectares, gross cropped area from 299 to 348 thousand hectares, and area sown more than once from 74 to 90 thousand hectares. Mizoram also recorded increases in net sown and gross cropped

areas, although the reported area sown more than once remained very small. Sikkim recorded a modest increase in net sown area and gross cropped area, while its area sown more than once declined from 59 to 56 thousand hectares. Meghalaya and Nagaland, in contrast, recorded declines in all three indicators. Tripura showed no change in any of the three measures.

Manipur presents a distinct pattern. Net sown area declined sharply from 383 to 215 thousand hectares, while gross cropped area remained almost unchanged, falling from 383 to 382 thousand hectares. The reported area sown more than once was 167 thousand hectares in 2023-24. The combination of a substantial reduction in net sown area and a nearly unchanged gross cropped area has important implications for the interpretation of cropping intensity.

Table 8 Changes in cropping intensity in North-East India, 2014-15 to 2023-24 (Cropping intensity in %)

| State             | 2014-15 | 2023-24 | Change (percentage points) |
|-------------------|---------|---------|----------------------------|
| Arunachal Pradesh | 132.9   | 134.9   | +2.0                       |
| Assam             | 144.4   | 149.6   | +5.2                       |
| Manipur           | 100.0   | 177.7   | +77.7                      |
| Meghalaya         | 119.9   | 120.4   | +0.5                       |
| Mizoram           | 100.0   | 101.5   | +1.5                       |
| Nagaland          | 130.2   | 131.4   | +1.2                       |
| Sikkim            | 176.6   | 167.5   | -9.1                       |
| Tripura           | 189.4   | 189.4   | No change                  |

Source: Computed from Land Use Statistics at a Glance 2023-24, Directorate of Economics and Statistics, Department of Agriculture and Farmers Welfare, Government of India.

Note: Cropping intensity (%) = (Gross Cropped Area ÷ Net Sown Area) × 100

The cropping intensity values in (Table 8) further demonstrate the differences among the states. Assam recorded an increase of 5.2 percentage points, from 144.4% to 149.6%, while Arunachal Pradesh, Meghalaya, Mizoram and Nagaland recorded smaller increases. Tripura retained the highest cropping intensity among the states in both years at 189.4%, with no change between the two periods. Sikkim, however, recorded a decline of 9.1 percentage points, from 176.6% to 167.5%. The sharpest change was recorded in Manipur, where cropping intensity increased from 100.0% to 177.7%. This increase needs to be interpreted alongside the underlying components of the indicator. Gross cropped area changed very little, from 383 to 382 thousand hectares, whereas net sown area declined substantially from 383 to 215 thousand hectares. The sharp rise in cropping intensity was therefore largely a consequence of the reduction in reported net sown area rather than a corresponding increase in gross cropped area. This highlights the need to consider both components when interpreting changes in cropping intensity. The data indicate considerable interstate variation in cultivated land use and cropping intensity between 2014-15 and 2023-24. Assam remained the major agricultural state in terms of net sown area, gross cropped area and area sown more than once, while the other states showed divergent changes. The relatively small changes in cropping intensity in most states contrast with the marked change reported for Manipur and the decline in Sikkim. These differences indicate that changes in the extent of cultivated land and changes in the intensity of its use did not follow the same pattern across North-East India.

#### Over all pattern of agriculture land use transformation

The analysis of agricultural land use in North-East India between 2014-15 and 2023-24 indicates considerable interstate variation in both the extent and utilization of land resources. The changes were not marked by a uniform expansion of the cultivated land base; rather, they involved shifts among

different land-use categories and changes in the intensity of land use. The predominance of forest resources, particularly in the hill states, together with differences in physiography and the availability of cultivable land, continued to shape the regional land-use structure.

Recorded forest area remained relatively stable in most states, while land under non-agricultural uses increased in several states. Assam and Meghalaya recorded notable increases in the latter category, with Sikkim and Nagaland showing relatively high proportional changes. Other uncultivated land generally declined, although its individual components; permanent pastures and other grazing lands, miscellaneous tree crops and groves, and culturable waste land etc. showed different patterns across the states. This indicates that changes within the broader uncultivated land category were not uniform [13].

Fallow land also showed contrasting changes. It declined in Arunachal Pradesh, Meghalaya, Mizoram, Sikkim and Tripura, but increased in Assam and Nagaland. These variations indicate differences in the extent of land remaining under fallow across the states. However, a decline in fallow land cannot by itself be taken as evidence of agricultural improvement, as the available data do not establish whether such land was brought under cultivation or shifted to other uses [14-15].

Changes in cultivated land further demonstrate the uneven nature of agricultural transformation. Net sown area increased in Arunachal Pradesh, Mizoram and Sikkim, remained unchanged in Tripura, and declined in Assam, Meghalaya and Nagaland. Manipur recorded the sharpest decline in reported net sown area. At the same time, changes in gross cropped area and area sown more than once indicate differences in the extent of repeated cultivation. Assam continued to account for the largest net sown area, gross cropped area and area sown more than once, while Tripura recorded the highest cropping intensity in 2023-24. Cropping intensity increased in most states, although the magnitude of

change was generally modest. Sikkim recorded a decline, while Tripura remained unchanged. Manipur showed an exceptionally large increase, but this was associated mainly with the sharp reduction in reported net sown area, as gross cropped area changed very little. The Manipur case therefore demonstrates the importance of examining the components of cropping intensity alongside the indicator itself. The data indicate that agricultural land-use transformation in North-East India between 2014-15 and 2023-24 involved substantial interstate differences rather than a common regional trend. Changes in non-agricultural uses, uncultivated land, fallow land and cultivated land occurred in different directions across the states, while changes in repeated cultivation were generally more moderate. The pattern points to a transformation based largely on changes in the utilization and intensity of existing agricultural land rather than on a uniform expansion of the cultivated land base [16].

## CONCLUSION

The study examined the structural changes in agricultural land use across the North-Eastern states of India during 2014-15 to 2023-24 using official land-use statistics. The findings indicate that agricultural land-use transformation in the region has been characterized by gradual changes in land

utilization rather than substantial expansion of cultivated land. Extensive forest cover and the predominance of hilly terrain have continued to constrain horizontal agricultural expansion, making more efficient utilisation of existing agricultural land increasingly important. The analysis reveals considerable interstate variation in land-use dynamics. While land under non-agricultural uses increased in several states, changes in other uncultivated land and fallow land were uneven across the region. Net sown area remained largely stable in most states, whereas improvements in gross cropped area, area sown more than once, and cropping intensity in several states indicate a gradual shift towards agricultural intensification. However, the extent of this transformation differed according to variations in physiography, agricultural infrastructure, and farming practices. The findings suggest that future agricultural development in North-East India should prioritize sustainable intensification rather than expansion of cultivated land. Enhancing irrigation, promoting multiple cropping where suitable, improving land management practices, and adopting state-specific agricultural strategies can contribute to higher productivity while maintaining ecological sustainability. Further research incorporating district-level analysis and geospatial techniques would provide deeper insights into the spatial determinants of agricultural land-use change and support more informed policy formulation.

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