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# Spatio-temporal Changes of Land Use and Land Cover in Purba Medinipur District: A Geospatial Approach

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**Abstract**

The current study analyses the spatio-temporal patterns of land use and land cover in Purba Medinipur District, West Bengal. To achieve the aims, employ Landsat 5 TM (1991-2001, 2011) and Landsat OLI/TIRS (2021) data from the USGS portal. The supervised classification approach is employed for picture classification. The results indicate that the district's general land use pattern has significantly and unpredictably transformed over the past 30 years in response to the demands of population growth. Nevertheless, the district has encroached upon and devastated agricultural regions adjacent to populated areas. The woods and shrublands have been eradicated. Resources have been appropriated from others through contemporary investments in hydropower facilities, industrial sectors, and transportation infrastructures.

**Keywords:** Land Use and Land Cover, Purba Medinipur, GIS-RS, Landsat

## 1. Introduction

The type of land cover and pattern of its use has a great impact on indigenous dwellers of a specific region (Munsi et al., 2010). Land cover is the more physical phenomenon that explains the kind of natural covering of a specific land surface (Batar et, al., 2017). On the other hand, land use means the modified nature of the land; humans are kept practicing such kinds of activities that are suitable to the land and local system (Patra & Gavsker, 2021)). After removal of the primary natural cover from land, they do suitable use of specific parts of the land. The regional habit of population, types of economic activities and their reciprocal dependency on nature have been understood by seeing the LULC pattern of a region (Ramachandran & Reddy, 2017). Urban land use pattern is different from the rural; mainly high concentration of congested skyscrapers with lowering gradient from center to periphery is the key land use pattern of the urban landscape (Rawat & Kumar, 2015). Understanding the distinction between land use and use is crucial. The direct usage of certain land is referred to as land use (Rawat & Kumar, 2015). The terms residential, manufacturing, and agricultural refer to a system of land utilisation that includes parks, neighbourhood retail and service facilities, industrial locations, and agricultural pursuits. The terms residential, manufacturing, and agricultural refer to this system of land utilisation. In a rural location, orcharding, truck planting and grazing would imply a land-use scheme, whereas tree crops or row crops would indicate a land use (MSPI, India-1988-99). According to Salter's definition, "land utilization research can be described as coping with problem situations in which people in a given locality are transitioning from activities with certain land requirements to activities with different land requirements."

Rather than a single farmer, land use focuses on problems that concern society and the country as a whole. Among the different main types of land use, land use refers to the most productive use of finite land.

**Study Area**

Purba Medinipur district is a part of the Lower Ganga Plain (Coastal Belt on the Bay of Bengal), West Bengal,India and its geographically location laying between 21° 36' 35"N to 22° 02' 23"N and 87° 22' 48"E to 88° 01' 12"E, and its covering an area of 4295.00 sq km. Purba Medinipur district is surrounded by Paschim Medinipur and Howrah in north , Bay of Bengal in the south , South24 Parganas and Howrah in east and also Orissa state in the west (Fig. 1). Total population is 5,094,238. Population density 1076 km2(census, 2011). This district formed by the 25 block and 5 municipality area.

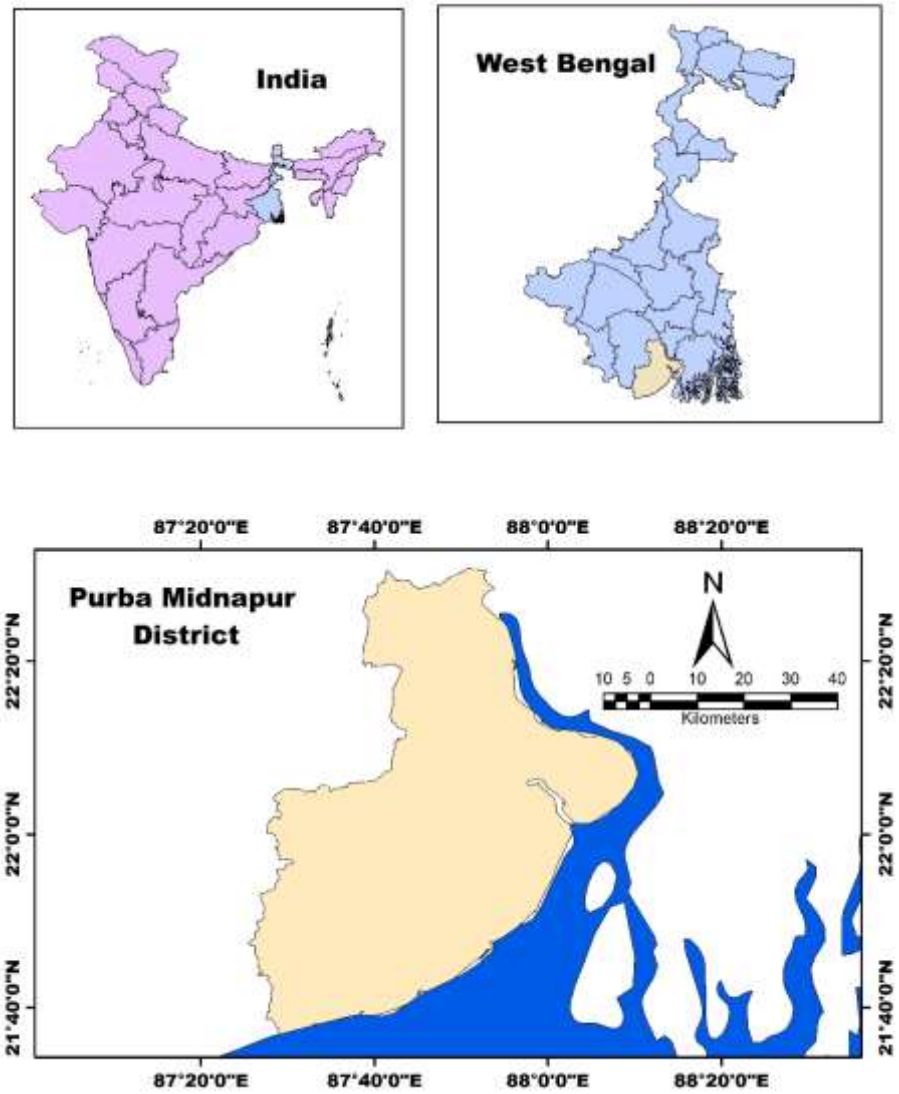


**Fig. 1 Location map of the study area**

**Result and Discussion**

**Spatio Temporal Change of Land Use and Land Cover at District Level:** The coastal district of Purba Medinipur has a vast plain topography. The Eastern part of the district is separated by a river network. Rivers are entered with their lower course upon the district and deposited a huge quantity of sediment;

naturally silted fertile alluvium soil is famous for agricultural activities. Basically, five broad land use and land cover facilities were investigated during the study. Agricultural land, waterbody, fallow land, settlement, and vegetation have occupied around all land under the district. The General configuration of LULC of Purba Medinipur district from 1991 to 2021 has given below in figure 3.1 and table 3.1. Overall LULC status of urban centers of Purba Medinipur district has shown below the figure 3.2. Agricultural land is the major land-use practice by the people of the district. In each decade sharing of agricultural land to districts' total land has increased significantly.

**Table: 3.1 Spatio Temporal Change of Land Use and Land Cover**

| LULCs | Area in (Sq. km) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1991 | % | 2001 | % | Change | 2011 | % | Change | 2021 | % | Change |
| Settlement | 41.47 | 1.06 | 115.13 | 2.95 | 178 | 230.45 | 5.9 | 100.16 | 386.12 | 9.88 | 67.55 |
| Vegetation | 1539.45 | 39.4 | 1398.58 | 35.8 | -9.15 | 1196.81 | 30.6 | -16.85 | 740.82 | 19 | -45.76 |
| Water body | 71.21 | 1.82 | 107.87 | 2.76 | 51.48 | 181.64 | 4.64 | 68.39 | 423.04 | 10.8 | 132.9 |
| Fallow land | 922.23 | 23.6 | 670.52 | 17.2 | -27.29 | 228.52 | 5.84 | -193.42 | 92.46 | 2.36 | -147.15 |
| Agriculture land | 1334.83 | 34.1 | 1617.12 | 41.4 | 21.15 | 2071.75 | 53 | 28.11 | 2266.72 | 58 | 9.46 |

In 1991, one-third of the land had been used for agricultural purposes; it has continuously increased and the share increased to 41.36 in 2001, 52.98 percent in 2011, and 57.99 in 2021. Congestion of the human population in that particular coastal district and growing demand for food supply are responsible for increasing agricultural land in that given district. Initially, 1539.45 sq km area of the district was covered with natural vegetation which constitutes 39.38 percent of total land. It has decreased continuously – only 1398.58 square km of land with natural vegetation was found in 2001, 1196.81 square km in 2011 and finally, 740.82 km² lands were covered with vegetation in 2021. The percentage share of vegetation lost also produced a vulnerable condition of vegetation lost in the district – 39.38 percent vegetation in 1991 reduced to 18.95 percent in 2021 and it keeps continuing. Lost vegetation cover registered in the year 2001, 2011, and 2021 were -9.15, -16.85, and -45.76 percent respectively. The cultural landscape of human dwellers is effectively known as settlements. Settlement of Purba Medinipur district bearing the greatest significance of human concentration. Initially, 1.06 percent of the land of the district was covered by human settlement and it has increased at rapid progression consequently; the share of human dwellers increased so rapidly that 9.88 percent of the land of the district is occupied by settlement in the year 2021. About 1000 percent growth has been registered in human habitat from 1991 to 2021. Although the share of the settlement to total area is relatively low it contains a significant change to the “population boom” of the district.

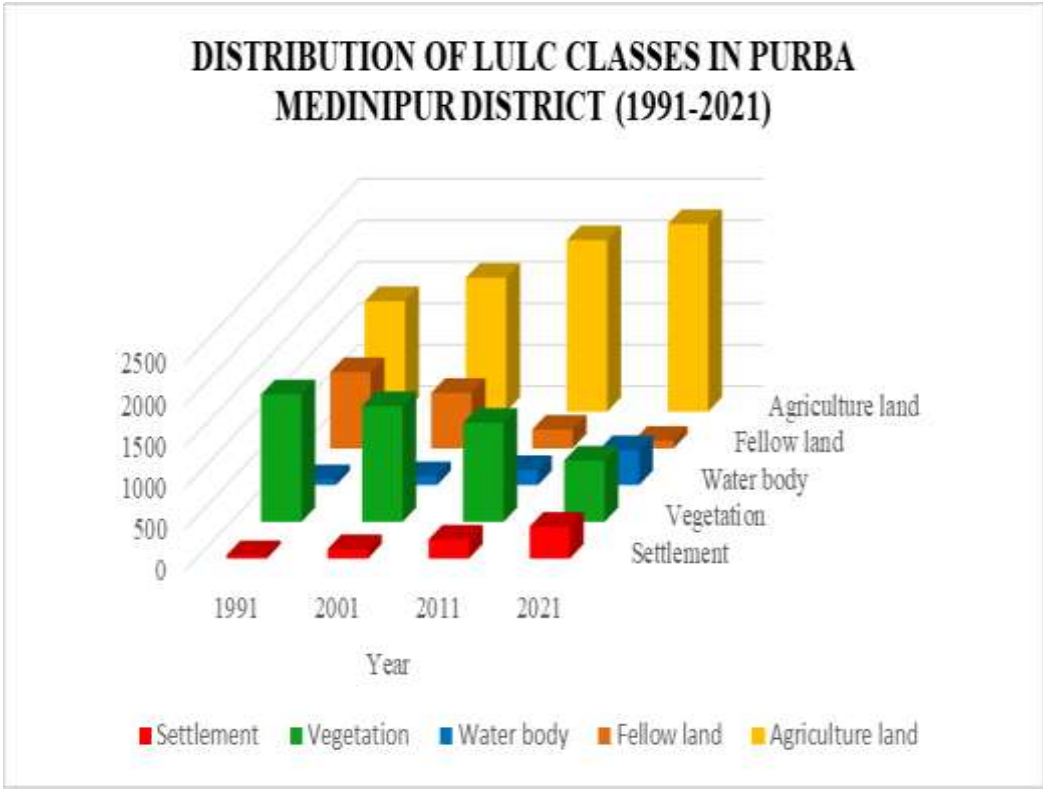


**Figure: 3.1: Distribution of Major LULC**

Rivers, small canals, and ponds are the major sources of lentic and lotic water in the district. Around 10 percent of the land is identified as water bodies. Canals and rivers are worked as major irrigation sources during cultivation. Major sources of water are different peninsular river systems. The four major rivers of the district are Kelaghai, Kansabati, Hoogly, and Haldi. Kasai is the longest river in the district. These rivers are perennial and produced inundation during the rainy season and flood plain topography is waterlogged in rainy seasons. Besides these rivers, many canals flow inside this district and carry the water of the basin area. Major canals in the district are the Midnapore canal and Hijli tidal canal.

Fallow land is a symbol of unproductive characteristics of land which may be created by either physical or anthropogenic influences. The physical factors like steep slope, salty nature of the soil, availability of water below the wilting point, etc are responsible for making a land unproductive while shifting cultivation, abandoned land also enhances the area of unproductive land by human intervention. The district managed to reduce its fallow land in each decade and transformed into well-managed different LULC classes. In 2021 only 2.36 percent of the land of the district is occupied by fallow land.

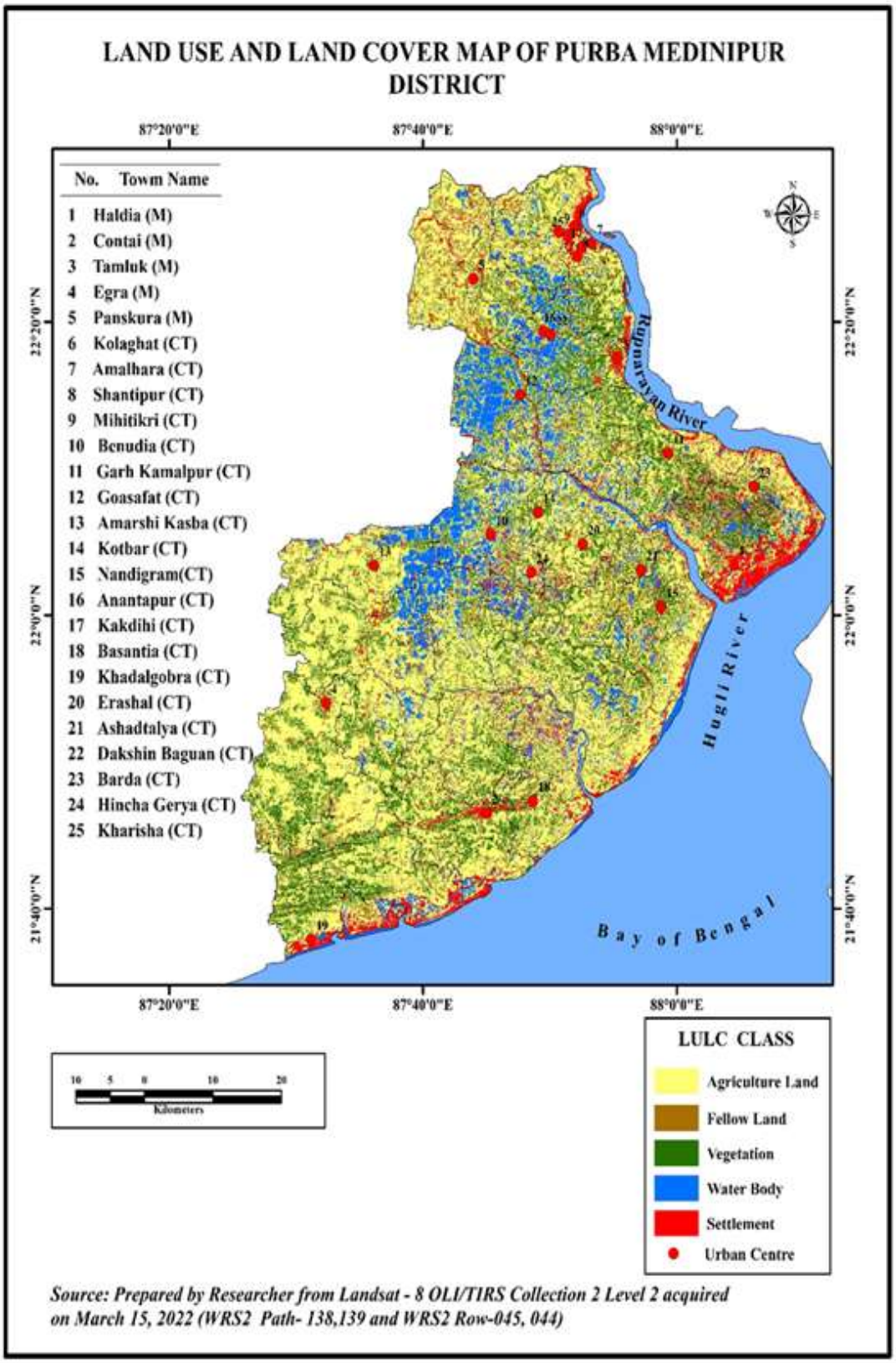


**Figure: 3.2: LULC Map of Purba Medinipur District (2021)**

**3.3 LULC conversion at district level:** Emphasis on the topic of LULC conversion gives a broader idea of sequential change in landscape matrix in a specific region over a particular period. Table 3.2 demonstrates LULC conversion of different blocks during 1991 to 2021.

**Table: 3.2 LULC Change from 1991 to 2021 (Area in sq km)**

| Year | 2001 | | | | | |
|---|---|---|---|---|---|---|
| **1991** | **LULC Classes** | **Settlement** | **Vegetation** | **Waterbody** | **Fallow land** | **Agricultural land** |
| | **Settlement** | 8.59 | 5.47 | 4.17 | 4.67 | 18.50 |
| | **Vegetation** | 7.61 | 998.64 | 7.94 | 133.96 | 167.07 |
| | **Water body** | 1.20 | 3.28 | 50.49 | 1.07 | 14.77 |
| | **Fallow land** | 33.20 | 148.94 | 29.35 | 218.39 | 211.11 |
| | **Agricultural land** | 64.46 | 241.84 | 15.74 | 312.22 | 243.83 |
| **2001** | **2011** | | | | | |
| | **Settlement** | 38.38 | 7.64 | 7.30 | 9.45 | 52.27 |
| | **Vegetation** | 15.97 | 834.62 | 17.29 | 42.27 | 142.06 |
| | **Water body** | 10.10 | 5.47 | 70.33 | 0.82 | 20.55 |
| | **Fallow land** | 28.80 | 59.48 | 27.84 | 57.80 | 496.46 |
| | **Agricultural land** | 137.08 | 289.37 | 58.40 | 118.12 | 368.48 |
| **2011** | **2021** | | | | | |
| | **Settlement** | 55.81 | 13.67 | 21.83 | 6.85 | 132.18 |
| | **Vegetation** | 102.81 | 462.91 | 26.72 | 10.82 | 237.92 |
| | **Water body** | 29.14 | 4.20 | 70.01 | 2.46 | 72.54 |
| | **Fallow land** | 22.54 | 26.13 | 21.11 | 11.64 | 147.03 |
| | **Agricultural land** | 175.46 | 233.84 | 279.70 | 60.80 | 603.80 |

***Source: Prepared by Researcher***

**3.3.1 LULC conversion (1991-2001):** Land Cover and Land use (LULC) categories and conversion of it between 1991 to 2001 give a holistic idea about the transformation of major land categories. Among five major LULC categories agricultural land occupied 60 percent of total land. Major conversion found in vegetation cover to agricultural land around 167 sq. km. of natural land cover (vegetation) had depleted between 1991 to 2001 and converted to agricultural land. 7.61 sq. km. of vegetation had been wiped out for making human settlement. Conversion of settlement from other LULC classes is also carried out immense significant of this region; about 64.46 sq. km. of agricultural land is occupied and converted to settlement. Although settlement occupied relatively less area of the total land of the district but an exponential growth has been observed in case of the settlement area during 1991 to 2021. The district is consisting of 90 percent or more rural population thus, sometimes settlement structures are left out due to canopy cover. Responsible authorities and human consciousness did a great job towards the restoration of fallow land. 33.20 sq. km. area has been directly converted to settlement land, 148.94 sq. km. area

managed to recover from fallow categories and used by human dwellers for settlement purposes. In the case of water bodies, it was almost stable for these decades, 14.77 sq. km. of water bodies had transformed into agricultural land

**3.3.2 LULC conversion (2001-2011):** These decades has been characterized with rapid growth of the human population with in the district. Genuinely, additional land is required for fulfilling the scarcity of land for settlement – thus conversion to settlement from other LULC classes is a notable incident of the decade. Around 137.08 sq. km. of agricultural land was occupied by human dwellers only between 2001 to 2011; 15.97 sq. km. of vegetational land and 28.80 sq. km. of fallow land had been converted to settlement land. Most depletion has been found in vegetation classes; around 142.06 sq. km. of vegetation cover destroyed to fulfill upgrowing needs of food for humans. Massive amount of fallow land recovered from its own category – 496.46 sq. km. of fallow land transformed from fallow categories to productive agricultural land. A reverse instance also found that 118.12 sq. km. of agricultural land lost its fertile characteristics and became fallow land. Mostly coastal lands are becoming considered unproductive and fertile due to tidal activities of the sea. "AILA" cyclone in 2009 was holistically responsible for the deteriorating nature of land in the coastal part of the district.

**3.3.3 LULC conversion (2011-2021):** Latest conversion between 2011 and 2021 depicts huge depletion of natural vegetation. About 46 percent of vegetation cover has been lost in the last decades this shows the environmental vulnerability of the Purba Medinipur district. 102.81 sq. km. of vegetation covers destroyed for making human settlement which is a massive one. Lack of governmental control and less human consciousness is reflected in such incident. The overall picture of these decades can be summarized as settlement areas increased at a rapid progression, and the massive amount of new agricultural land and settlement areas came into existence after larger depletion of vegetation cover. Water bodies' conversion is very negligible.

**3.4 Year-Wise Change of LULC at Block Level:** Block-level analysis of LULC provides a more thorough view of the studied area's intrinsic state. It is highly helpful to compare an intra block study of LULC analysis for a given time period since each block has a unique composition of a certain LULC class that does not intercept with other blocks (s). We have discussed LULC pattern of 7 blocks under Tamluk subdivision.

**Table No. 3.3 Status of Agricultural Land and Waterbodies in Tamluk Sub-division (1991-2021)**

| Year | Block | Area of Block (ha) | Block area to district ar | Settlement | Share | Decadal C | Vegetation (ha) | Share | Decadal C | Water Bodies (ha) | Share | Decadal C | Fallow Land | Share | Decadal C | Agricultural land (ha) | Share | Decadal C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| | | | ea (%) | (ha) | total land (%) | hange (%) | | total land (%) | hange (%) | | total land (%) | hange (%) | | total land (%) | hange (%) | | total land (%) | hange (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1991 | Chandipur | 13758.00 | 2.88 | 786.72 | 5.72 | - | 2691.46 | 19.56 | - | 661.55 | 4.81 | - | 2312.77 | 16.81 | - | 7305.50 | 53.10 | - |
| | Moyna | 15451.00 | 3.23 | 1488.89 | 9.64 | - | 3819.41 | 24.72 | - | 1561.06 | 10.10 | - | 4116.30 | 26.64 | - | 4465.34 | 28.90 | - |
| | Kolaghat | 14791.00 | 3.09 | 1954.79 | 13.22 | - | 3735.03 | 25.25 | - | 509.83 | 3.45 | - | 2098.10 | 14.18 | - | 6493.25 | 43.90 | - |
| | Panskura-I | 24692.00 | 5.16 | 1943.83 | 7.87 | - | 4789.71 | 19.40 | - | 431.14 | 1.75 | - | 4736.86 | 19.18 | - | 12790.46 | 51.80 | - |
| | Sahid Matangini | 9782.00 | 2.04 | 992.60 | 10.15 | - | 2971.08 | 30.37 | - | 209.48 | 2.14 | - | 1392.80 | 14.24 | - | 4216.04 | 43.10 | - |
| | Tamluk | 12350.00 | 2.58 | 1031.69 | 8.35 | - | 3056.82 | 24.75 | - | 687.52 | 5.57 | - | 2065.87 | 16.73 | - | 5508.10 | 44.60 | - |
| | Nandakumar | 16570.00 | 3.46 | 1899.92 | 11.47 | - | 5244.89 | 31.65 | - | 1269.96 | 7.66 | - | 1046.70 | 6.32 | - | 7108.53 | 42.90 | - |
| 20 | Chandipur | 1375 | 2.88 | 1045.81 | 7.60 | 32.93 | 1907.56 | 13. | -29 | 902.53 | 6.56 | 36.43 | 2720 | 19. | 17.63 | 7181.68 | 52. | -1.69 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | | 8.00 | | | | | | 87 | .13 | | | | .42 | 77 | | | 20 | |
| | Moyna | 15451.00 | 3.23 | 1892.73 | 12.25 | 27.12 | 2742.66 | 17.75 | -28.19 | 2115.26 | 13.69 | 35.50 | 4173.21 | 27.01 | 1.38 | 4527.14 | 29.30 | 1.38 |
| | Kolaghat | 14791.00 | 3.09 | 2455.27 | 16.60 | 25.60 | 2570.02 | 17.38 | -31.19 | 639.69 | 4.32 | 25.47 | 2455.28 | 16.60 | 17.02 | 6670.74 | 45.10 | 2.73 |
| | Panskura-I | 24692.00 | 5.16 | 2540.07 | 10.29 | 30.67 | 3211.97 | 13.01 | -32.94 | 593.86 | 2.41 | 37.74 | 4395.12 | 17.80 | -7.21 | 13950.98 | 56.50 | 9.07 |
| | Sahid Matangini | 9782.00 | 2.04 | 1214.91 | 12.42 | 22.40 | 2111.31 | 21.58 | -28.94 | 265.16 | 2.71 | 26.58 | 1221.36 | 12.49 | -12.31 | 4969.26 | 50.80 | 17.87 |
| | Tamluk | 12350.00 | 2.58 | 1437.11 | 11.64 | 39.30 | 2218.57 | 17.96 | -27.42 | 946.99 | 7.67 | 37.74 | 2535.63 | 20.53 | 22.74 | 5211.70 | 42.20 | -5.38 |
| | Nandakumar | 16570.00 | 3.46 | 2776.49 | 16.76 | 46.14 | 3167.29 | 19.11 | -39.61 | 1781.14 | 10.75 | 40.25 | 1040.61 | 6.28 | -0.58 | 7804.47 | 47.10 | 9.79 |
| 2011 | Chandipur | 13758.00 | 2.88 | 1346.46 | 9.79 | 28.75 | 1603.78 | 11.66 | -15.93 | 1369.54 | 9.95 | 51.74 | 2641.77 | 19.20 | -2.89 | 6796.45 | 49.40 | -5.36 |
| | Moyna | 15451.00 | 3.23 | 2411.26 | 15.61 | 27.40 | 2113.93 | 13.68 | -22.92 | 3537.23 | 22.89 | 67.22 | 1934.38 | 12.52 | -53.65 | 5454.20 | 35.30 | 20.48 |
| | Kolaghat | 14791.00 | 3.09 | 2823.84 | 19.09 | 15.01 | 1949.98 | 13.18 | -24.13 | 1136.22 | 7.68 | 77.62 | 2313.76 | 15.64 | -5.76 | 6567.20 | 44.40 | -1.55 |
| | Panskura - I | 2469 | 5.16 | 2912.63 | 11. | 14.67 | 2729.27 | 11. | -15 | 890.34 | 3.61 | 49.92 | 5097 | 20. | 15.99 | 13062.07 | 52. | -6.37 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2.00 | | | 80 | | | 05 | .03 | | | | .69 | 65 | | | 90 | |
| | Sahid Matangini | 9782.00 | 2.04 | 1460.00 | 14.93 | 20.17 | 1689.85 | 17.28 | -19.96 | 608.17 | 6.22 | 129.36 | 868.87 | 8.88 | -28.86 | 5155.11 | 52.70 | 3.74 |
| | Tamluk | 12350.00 | 2.58 | 1636.66 | 13.25 | 13.89 | 1717.71 | 13.91 | -22.58 | 2415.80 | 19.56 | 155.10 | 1602.78 | 12.98 | -36.79 | 4977.05 | 40.30 | -4.50 |
| | Nandakumar | 16570.00 | 3.46 | 3062.45 | 18.48 | 10.30 | 2334.68 | 14.09 | -26.29 | 2822.73 | 17.04 | 58.48 | 827.36 | 4.99 | -20.49 | 7522.78 | 45.40 | -3.61 |
| 2021 | Chandipur | 13758.00 | 2.88 | 1514.51 | 11.01 | 12.48 | 1309.78 | 9.52 | -18.33 | 2957.97 | 21.50 | 115.98 | 2582.61 | 18.77 | -2.24 | 5393.13 | 39.20 | -20.65 |
| | Moyna | 15451.00 | 3.23 | 2876.06 | 18.61 | 19.28 | 1577.27 | 10.21 | -25.39 | 7308.32 | 47.30 | 106.61 | 1016.30 | 6.58 | -47.46 | 2673.02 | 17.30 | -50.99 |
| | Kolaghat | 14791.00 | 3.09 | 2897.43 | 19.59 | 2.61 | 1488.88 | 10.07 | -23.65 | 2751.12 | 18.60 | 142.13 | 1973.82 | 13.34 | -14.69 | 5679.74 | 38.40 | -13.51 |
| | Panskura - I | 24692.00 | 5.16 | 3376.14 | 13.67 | 15.91 | 2221.46 | 9.000 | -18.61 | 2987.73 | 12.10 | 235.57 | 3044.60 | 12.33 | -40.27 | 13062.07 | 52.90 | 0.00 |
| | Sahid Matangini | 9782.00 | 2.04 | 1596.55 | 16.32 | 9.35 | 1103.22 | 11.28 | -34.71 | 1936.83 | 19.80 | 218.47 | 577.21 | 5.90 | -33.57 | 4568.19 | 46.70 | -11.39 |
| | Tamluk | 12350.00 | 2.58 | 1917.43 | 15.53 | 17.16 | 1348.72 | 10.92 | -21.48 | 4532.45 | 36.70 | 87.62 | 512.95 | 4.15 | -68.00 | 4038.45 | 32.70 | -18.86 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Nandakumar | 1657 0.00 | 3.46 | 3247.78 | 19.60 | 6.05 | 1783.49 | 10.76 | -23.61 | 5600.66 | 33.80 | 98.41 | 735.09 | 4.44 | -11.15 | 5202.98 | 31.40 | -30.84 |

*Source: Prepared by Scholar*

**3.4.1. Blockwise Change in LULC (1991-2001):**

Block-by-block decadal change over the years 1991 to 2001 highlighted the current state and changing situation of the land use and land cover classes in the study area. The current study demonstrates that between 1991 and 2001 considerable shifting among all LULC classes in the study area. Significant Proportion of agricultural land has been observed in each block under Tamluk sub-division in 1991. Around 53.10 and 51.80 percent land had been used for agricultural purposes for Chandipur and Panskura–I blocks. Moyna block registered lowest proportion of land under agricultural uses (28.90 percent) among all seven blocks under the sub-division. Almost each block had substantial number of vegetation covert till 1991. Most proportion of vegetation cover was found in Nandakumar (31.65 percent) & Sahid Matangini block (30.37%); While, Nandakumar & Panskura – I had highest amount of aerial coverage (5244.89 hectare& 4789.71 ha). Settlement under all seven blocks has maintained almost common pattern for last three decades. Around 5 to13 percent land was utilized for settlement purposes. Kolaghat block has highest amount of land under settlement (13.22 percent & 1954.79 ha); while Chandipur block had least amount of land under same category (5.72 percent, 786.72 ha). Water bodies and Fallow land both are other two major categories under 5 major LULC classes; Moyna block has highest proportion of Water bodies (10.10 percent, 1561.06 ha) and fallow land 26.64 percent in 1991. Highest amount of fallow land was found in Panskura -I block (4736.86 ha.). Least amount of fallow land and water bodies were found in Nandakumar and Sahid Matangini block respectively.

**3.4.2. Block wise Change in LULC (2001-2011):**

All blocks under Tamluk Sub-division registered steady growth in settlement category. Chandipur block experienced highest growth rate in settlement category (28.75percent) between 2001 to 2011. Kolaghat and Nandakumar block occupied most proportion of land in settlement category among all 7 blocks under Tamluk sub-division in 2011. Just reverse situation found in temporal change in vegetation cover; all the blocks are significantly loosed vegetation cover between 2001-2011. Nandakumar, Panskura- I, Kolaghat and Moyna blocks were continuously losing more than 20% vegetation cover from its previous decades. Panskura-I and Chandipur registered 15.03 percent and 15.93 percent vegetation cover in between 2001-2011 which was lowest among all the blocks under Tamluk sub-division. A perfectly inverse relationship has been found between settlement and vegetation category; where vegetation cover losses its ground and settlement has increased its ground distribution. Moyna and Nandakumar block had highest number of water bodies (3537.23 hectare and 2822.73 ha) in the sub-division. In case of Moyna block about 22.89 percent land was covered with water bodies. Lowest distribution and proportional share of water bodies was found in Panskura-I (890.34 hectare and 3.61 percent) block. Fallow land is one of the major LULC clans for all the blocks of the sub-division. Conversion of fallow land to other land use land cover clearly visible in figure 3.4. Panskura-I block has highest aerial distribution of land under fallow category (5097.69 ha) and Nandakumar has least amount of land under same category in the year 2011. Around 53.65 percent fallow land has been reclaimed and used for other four major LULC categories in Moyna

block (2001-2011) which was highest among other blocks under the Tamluk sub- division. Majority of fallow land reclaimed for making big fisheries in Moyna block. Beside Moyna, Tamluk has also registered 36.79 percent reduction of fallow land during 2001-2011. Agricultural land is the major land use clans for the sub-division till 2011. It is clearly found from Table (3.4) that Panskura-I block has highest proportion of land for agricultural used (52.90 percent followed by Sahid Matangini (52.70 percent), Chandipur (49.40 percent), Kolaghat (44.40 percent), Nandakumar (45.40 percent), Tamluk (40.30 percent), Moyna (35.20 percent) respectively. The detail description of LULC between 2001-2011 is shown in the Table 3.4.

**3.4.3. Block wise Change in LULC (2011-2021):**

The share of settlement area to block area during 2021 increased in Nandakumar block (19.60 percent) followed by Kolaghat (19.59 percent), Moyna (18.61 percent), Sahid Matangini (16.32 percent), Tamluk (15.53 percent), Panskura-I (1367 percent) and Chandipur (11.01 percent) respectively. Around 19.28 percent and 17.16 percent settlement area increased between the decade 2011-2021 in Moyna and Tamluk block which is highest in the sub- division. In case of vegetation cover a common sequence prevails almost all the blocks - most Vegetation cover found in Panskura-I block (2221.46 ha) while lowest aerial coverage of natural vegetation found in Sahid Matangini Block (1103.22 ha). Sahid Matangini also registered highest amount of forest depletion (-34.71 percent) among all the blocks under Tamluk sub- division followed by Moyna (-25.39 percent) Kolaghat (-23.65 percent), Nandakumar (23.61 percent), Tamluk (-21.48 percent), Panskura-I (-18.61 percent) and Chandipur (-18.33 percent). Most promising and drastic change found in water bodies; Moyna has both highest amount of waterbodies (7308.32 ha) as well as largest proportion of land to total land under waterbodies (47.30 percent). Around 106.61 percent increase in waterbodies registered by Moyna block between 2011-2021. All blocks under Tamluk sub-division registered positive growth in waterbodies. Panskura-I registered 235.57 percent growth in waterbodies followed by Sahid Matangini (218.47 percent), Kolaghat (142.13 percent), Chandipur (115.98 percent), Moyna (106.6 percent), Nandakumar (98.41 percent), and Tamluk (87.62 percent) respectively. It is essential to mention that most changes in waterbodies found in those blocks which have either small land area or relatively small share of land in water bodies in previous decades.

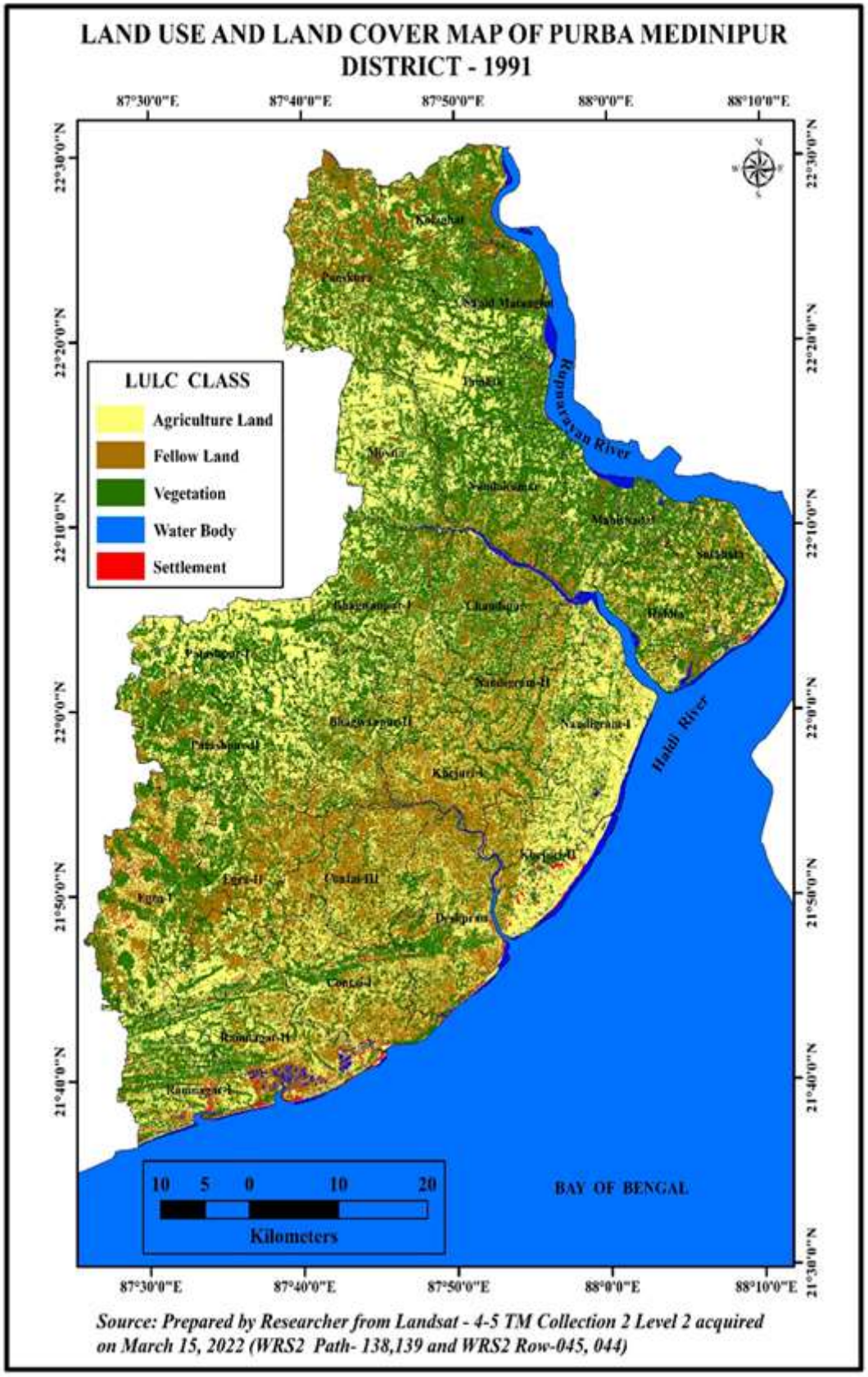
LAND USE AND LAND COVER MAP OF PURBA MEDINIPUR DISTRICT - 1991
87°30'0"E
87°40'0"E
87°50'0"E
88°0'0"E
88°10'0"E
22°30'0"N
22°20'0"N
22°10'0"N
22°0'0"N
21°50'0"N
21°40'0"N
LULC CLASS
Agriculture Land
Fellow Land
Vegetation
Water Body
Settlement
Rupnarayan River
Haldi River
BAY OF BENGAL
10 5 0 10 20
Kilometers
Source: Prepared by Researcher from Landsat - 4-5 TM Collection 2 Level 2 acquired on March 15, 2022 (WRS2 Path- 138,139 and WRS2 Row-045, 044)

**Figure: 3.3:**

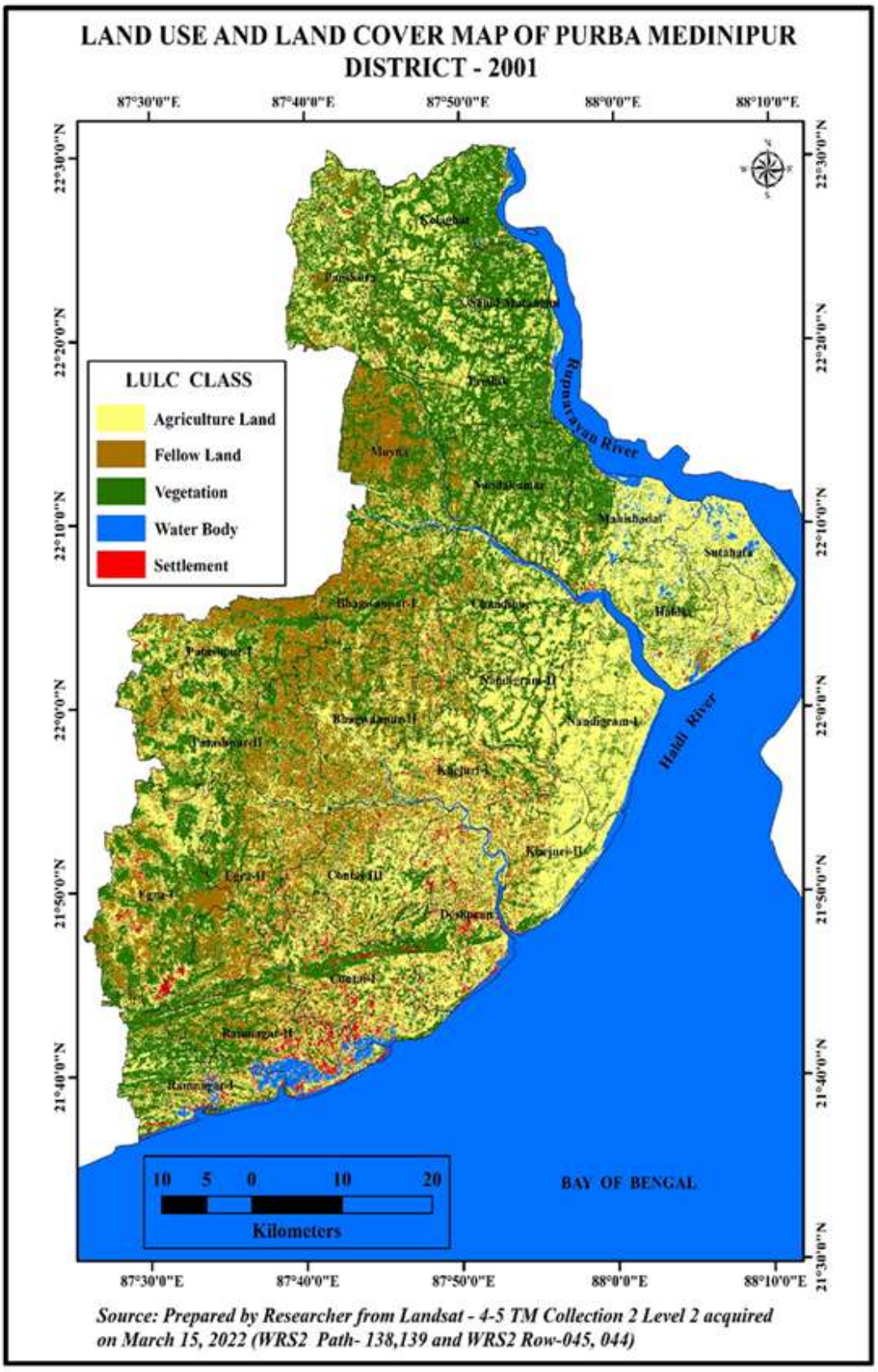
LAND USE AND LAND COVER MAP OF PURBA MEDINIPUR DISTRICT - 2001
87°30'0"E
87°40'0"E
87°50'0"E
88°0'0"E
88°10'0"E
22°30'0"N
22°20'0"N
22°10'0"N
22°0'0"N
21°50'0"N
21°40'0"N
LULC CLASS
Agriculture Land
Fellow Land
Vegetation
Water Body
Settlement
Kolaghat
Panskura
Moyna
Nandakumar
Mahishadal
Sutahata
Haldia
Nandigram-I
Nandigram-II
Khejuri-I
Khejuri-II
Contai-I
Contai-II
Ramnagar-I
Ramnagar-II
Rupnarayan River
Haldi River
BAY OF BENGAL
10 5 0 10 20
Kilometers
Source: Prepared by Researcher from Landsat - 4-5 TM Collection 2 Level 2 acquired on March 15, 2022 (WRS2 Path- 138,139 and WRS2 Row-045, 044)

**Figure 3.4:**

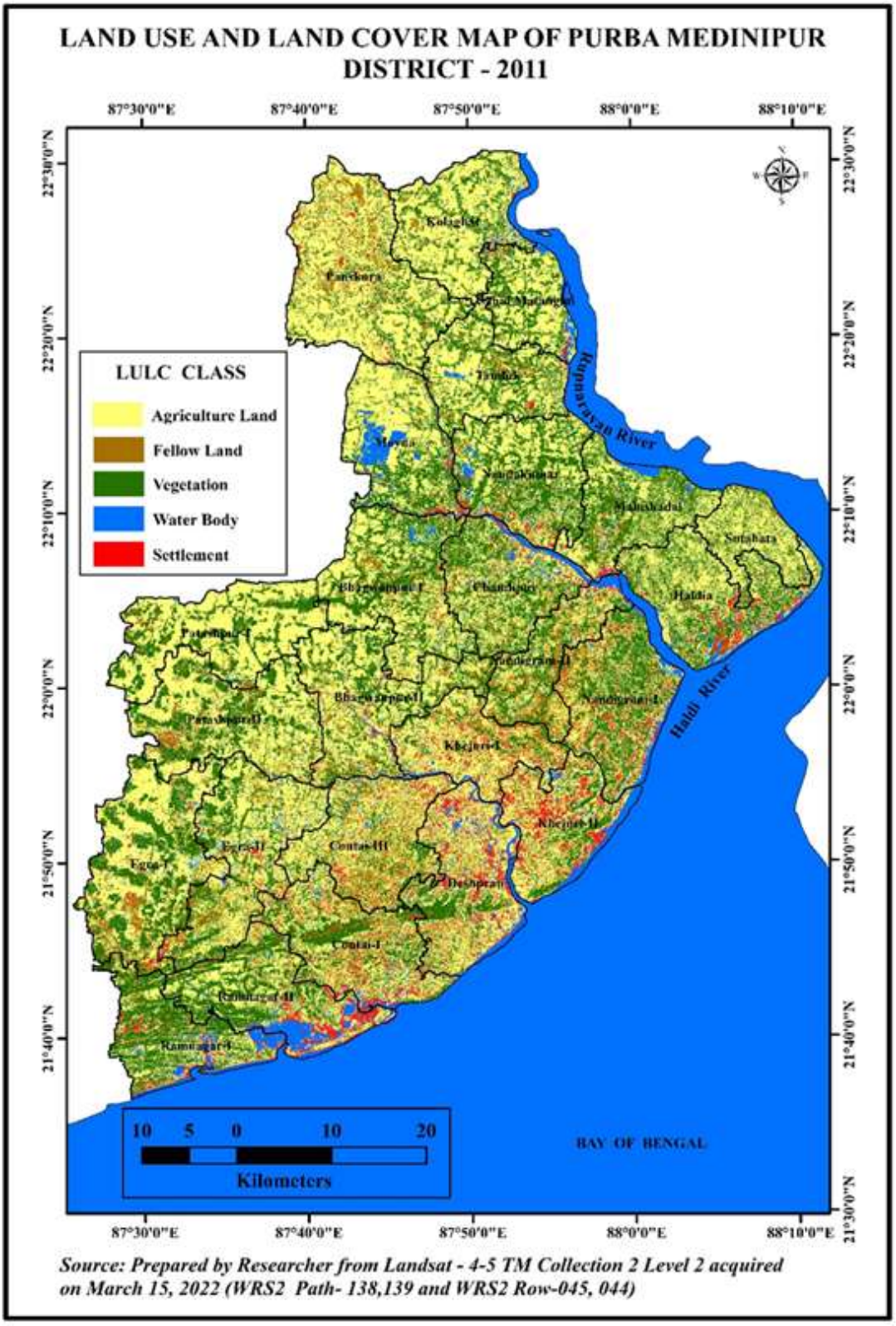
LAND USE AND LAND COVER MAP OF PURBA MEDINIPUR DISTRICT - 2011
87°30'0"E
87°40'0"E
87°50'0"E
88°0'0"E
88°10'0"E
22°30'0"N
22°20'0"N
22°10'0"N
22°0'0"N
21°50'0"N
21°40'0"N
21°30'0"N
LULC CLASS
Agriculture Land
Fellow Land
Vegetation
Water Body
Settlement
Rupnarayan River
Haldi River
BAY OF BENGAL
10 5 0 10 20
Kilometers
Source: Prepared by Researcher from Landsat - 4-5 TM Collection 2 Level 2 acquired on March 15, 2022 (WRS2 Path- 138,139 and WRS2 Row-045, 044)

**Figure 3.5:**

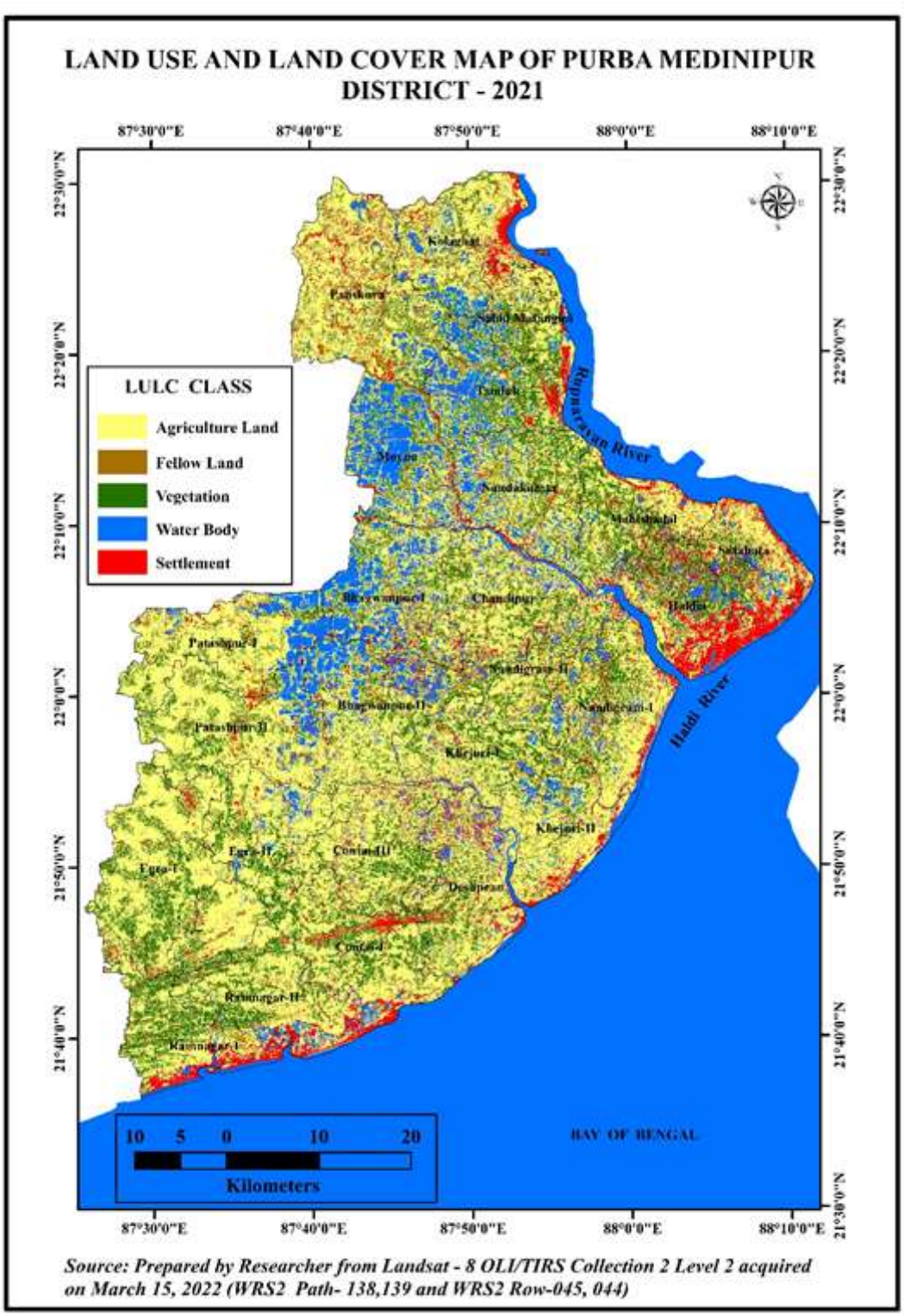


**Figure 3.6:**

### 3.5 Conversion of LULC at block level:

Discussion of LULC conversion at lower administrative level (Block level) gives a detail and more precise view of current situation of existing landscape pattern.

| Table: 3.4 LULC Change from 1991 to 2021 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Name of Block | Year | 2001 | | | | | |
| Chandipur | | LULC Classes | Settlement | Vegetation | Waterbody | Fallow land | Agricultural land |
| | 1991 | Settlement | 784 | 0 | 2 | 0 | 0 |
| | | Vegetation | 86 | 1844 | 91 | 127 | 544 |
| | | Water body | 29 | 17 | 562 | 11 | 42 |
| | | Fallow land | 17 | 44 | 52 | 2127 | 82 |
| | | Agricultural land | 129 | 2 | 195 | 455 | 6489 |
| | | 2011 | | | | | |
| | 2001 | Settlement | 1041 | 0 | 1 | 0 | 2 |
| | | Vegetation | 42 | 1502 | 8 | 16 | 39 |
| | | Water body | 59 | 9 | 757 | 57 | 20 |
| | | Fallow land | 47 | 33 | 396 | 2037 | 207 |
| | | Agricultural land | 157 | 19 | 207 | 531 | 6528 |
| | | 2021 | | | | | |
| | 2011 | Settlement | 1341 | 0 | 4 | 0 | 1 |
| | | Vegetation | 35 | 1127 | 124 | 81 | 236 |
| | | Water body | 16 | 1 | 1331 | 7 | 14 |
| | | Fallow land | 5 | 12 | 349 | 1947 | 328 |
| | | Agricultural land | 117 | 169 | 1150 | 547 | 4811 |
| | 2001 | | | | | | |
| Moyna | 1991 | Settlement | 1480 | 0 | 4 | 1 | 4 |
| | | Vegetation | 57 | 2352 | 216 | 326 | 868 |
| | | Water body | 43 | 29 | 1318 | 126 | 45 |
| | | Fallow land | 64 | 112 | 184 | 3343 | 413 |
| | | Agricultural land | 248 | 250 | 393 | 377 | 3197 |
| | | 2011 | | | | | |
| | 2001 | Settlement | 1882 | 1 | 5 | 2 | 2 |
| | | Vegetation | 26 | 1887 | 146 | 191 | 496 |
| | | Water body | 58 | 41 | 1722 | 102 | 192 |
| | | Fallow land | 72 | 169 | 1026 | 1538 | 1368 |
| | | Agricultural land | 373 | 15 | 638 | 101 | 3399 |
| | | 2021 | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2011 | Settlement | 2398 | 1 | 6 | 2 | 4 |
| | | Vegetation | 13 | 1362 | 23 | 267 | 448 |
| | | Water body | 67 | 36 | 3119 | 169 | 146 |
| | | Fallow land | 84 | 58 | 858 | 739 | 195 |
| | | Agricultural land | 314 | 120 | 3302 | 51 | 1667 |
| | Kolaghat (1991-2021) | | | | | | |
| Kolaghat | 1991 | Settlement | 1954 | 0 | 0 | 0 | 0 |
| | | Vegetation | 19 | 2027 | 117 | 456 | 1117 |
| | | Water body | 61 | 44 | 385 | 7 | 12 |
| | | Fallow land | 53 | 155 | 186 | 1648 | 56 |
| | | Agricultural land | 368 | 344 | 49 | 345 | 5455 |
| | | 2011 | | | | | |
| | 2001 | Settlement | 2437 | 2 | 2 | 11 | 3 |
| | | Vegetation | 7 | 1670 | 35 | 285 | 573 |
| | | Water body | 40 | 15 | 532 | 18 | 34 |
| | | Fallow land | 59 | 107 | 165 | 1942 | 183 |
| | | Agricultural land | 280 | 155 | 402 | 57 | 5774 |
| | | 2021 | | | | | |
| | 2011 | Settlement | 2820 | 1 | 0 | 2 | 0 |
| | | Vegetation | 5 | 1166 | 103 | 246 | 429 |
| | | Water body | 13 | 8 | 997 | 75 | 57 |
| | | Fallow land | 3 | 52 | 482 | 1610 | 166 |
| | | Agricultural land | 56 | 261 | 1169 | 40 | 5027 |
| | Panskura-I (1991-2021) | | | | | | |
| Panskura-I | 1991 | Settlement | 1937 | 1 | 0 | 0 | 5 |
| | | Vegetation | 462811 | 82 | 607 | 1243 | |
| | | Water body | 25 | 13 | 303 | 60 | 30 |
| | | Fallow land | 75 | 327 | 78 | 3573 | 683 |
| | | Agricultural land | 457 | 59 | 130 | 255 | 11989 |
| | | 2011 | | | | | |
| | 2001 | Settlement | 2530 | 2 | 0 | 1 | 7 |
| | | Vegetation | 34 | 2420 | 63 | 269 | 425 |
| | | Water body | 34 | 26 | 408 | 67 | 58 |
| | | Fallow land | 81 | 150 | 48 | 3950 | 166 |
| | | Agricultural land | 233 | 131 | 371 | 810 | 12406 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2021 | | | | | |
| | 2011 | Settlement | 2899 | 2 | 1 | 3 | 7 |
| | | Vegetation | 9 | 1937 | 114 | 199 | 470 |
| | | Water body | 19 | 3 | 796 | 24 | 48 |
| | | Fallow land | 69 | 154 | 590 | 2049 | 2235 |
| | | Agricultural land | 380 | 125 | 1486 | 769 | 10302 |
| | Sahid Matangini (1991 – 2021) | | | | | | |
| Sahid Matangini | 1991 | Settlement | 990 | 0 | 1 | 0 | 1 |
| | | Vegetation | 42 | 1853 | 50 | 358 | 668 |
| | | Water body | 27 | 35 | 96 | 14 | 37 |
| | | Fallow land | 37 | 92 | 80 | 990 | 193 |
| | | Agricultural land | 108 | 131 | 38 | 141 | 4070 |
| | | 2011 | | | | | |
| | 2001 | Settlement | 1210 | 0 | 0 | 0 | 4 |
| | | Vegetation | 15 | 1376 | 70 | 223 | 427 |
| | | Water body | 30 | 6 | 200 | 14 | 15 |
| | | Fallow land | 47 | 68 | 257 | 698 | 151 |
| | | Agricultural land | 158 | 240 | 81 | 67 | 4558 |
| | | 2021 | | | | | |
| | 2011 | Settlement | 1452 | 1 | 1 | 3 | 3 |
| | | Vegetation | 10 | 906 | 30 | 235 | 509 |
| | | Water body | 16 | 9 | 527 | 22 | 34 |
| | | Fallow land | 24 | 70 | 303 | 257 | 214 |
| | | Agricultural land | 94 | 117 | 1075 | 60 | 3811 |
| | Tamluk (1991-2021) | | | | | | |
| Tamluk | 1991 | Settlement | 1024 | 2 | 0 | 0 | 5 |
| | | Vegetation | 23 | 1871 | 65 | 345 | 752 |
| | | Water body | 29 | 48 | 486 | 67 | 57 |
| | | Fallow land | 16 | 113 | 120 | 1870 | 53 |
| | | Agricultural land | 345 | 184 | 276 | 71 | 4344 |
| | | 2011 | | | | | |
| | 2001 | Settlement | 1434 | 0 | 0 | 0 | 3 |
| | | Vegetation | 21 | 1431 | 79 | 289 | 398 |
| | | Water body | 33 | 4 | 811 | 73 | 26 |
| | | Fallow land | 12 | 95 | 1387 | 1345 | 839 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | Agricultural land | 136 | 187 | 138 | 105 | 3711 |
| | | 2021 | | | | | |
| | 2011 | Settlement | 1619 | 2 | 0 | 1 | 14 |
| | | Vegetation | 17 | 1154 | 62 | 119 | 365 |
| | | Water body | 23 | 24 | 2142 | 77 | 149 |
| | | Fallow land | 14 | 37 | 761 | 365 | 425 |
| | | Agricultural land | 244 | 131 | 1567 | 49 | 3082 |
| | Nandakumar (1991-2021) | | | | | | |
| Nandakumar | 1991 | Settlement | 1891 | 0 | 3 | 0 | 6 |
| | | Vegetation | 16 | 2625 | 243 | 157 | 2203 |
| | | Water body | 126 | 8 | 1001 | 64 | 70 |
| | | Fallow land | 35 | 30 | 58 | 810 | 114 |
| | | Agricultural land | 708 | 304 | 476 | 9 | 5508 |
| | | 2011 | | | | | |
| | 2001 | Settlement | 2759 | 1 | 1 | 4 | 11 |
| | | Vegetation | 28 | 2027 | 53 | 222 | 837 |
| | | Water body | 26 | 4 | 1599 | 40 | 112 |
| | | Fallow land | 38 | 67 | 225 | 579 | 131 |
| | | Agricultural land | 211 | 236 | 943 | 94 | 6441 |
| | | 2021 | | | | | |
| | 2011 | Settlement | 3043 | 1 | 5 | 2 | 11 |
| | | Vegetation | 7 | 1572 | 14 | 286 | 456 |
| | | Water body | 18 | 15 | 2448 | 182 | 159 |
| | | Fallow land | 46 | 23 | 117 | 534 | 107 |
| | | Agricultural land | 133 | 172 | 3017 | 269 | 3931 |

### 3.5.1 Block level conversion (1991 -2001)

The general configuration of LULC conversion during the decade 1991-2001 reveals that about 544 hectare +natural cover has been depleted for the purpose of agricultural land expansion in Chandipur block. 129 hectare agricultural land had been transformed to settlement category. Around 455 hectare agricultural land was abandoned and remained as fallow category while 195 hectare waterbody expanded after converting from agricultural category. Major conversion of LULC under Moyna block found in Vegetation cover; 868 ha, 326 hectare vegetation cover losses its ground and transformed to agricultural and fallow category. Significant amount of fallow land reclaimed and used as agricultural and allied activities (413ha), water bodies (184 ha), vegetation regeneration (112 ha) and settlement (64 ha). Kolaghat block experienced lots of land transformation (conversion) between the period 1991-2001.

Around 1117 hectare vegetation cover lost its existing ground for agricultural land expansion; another 456 hectare and 117 hectare vegetation cover wiped out and converted to fallow category and waterbodies. Enormous amount of agricultural land (365 ha) converted and used for development purposes (settlement). Panskura-I block has highest share of land among all the blocks under Tamluk sub-division; major conversion of the block registered during 1991-2001; around 1243 hectare new land was introduced for agricultural land use after converting from vegetation category, another 607hectareland converted to fallow category as vegetation cover losses its ground. Significant amount (653 ha) of fallow land was reclaimed for agricultural practices (457 ha).

Sahid Matangini is relatively small block under the Tamluk sub-division in term of area of land available. Agricultural practices are the major land use category of the block. Like other block of the sub-division this block also experiences rapid rate of forest land conversion to other four land use category. Detail description of LULC conversion among 5 major LULC for the decade 1991-2001 depicted in the table 3.4. Major conversion of land in Tamluk block found in vegetation, agricultural and fallow land category. 345 hectare agricultural land has been converted to settlement category; while 184 and 276 hectare agricultural land transformed to vegetation cover regeneration and waterbody creation. Huge amount of vegetation cover (2619) depleted in Nandakumar block between 1991-2001. Most amount of vegetation cover initially found in Nandakumar block; unfortunately, more than 50 percent vegetation cover was undergone through rapid land transformation.

**3.5.2 Block level conversion (2001 -2011)**

Significant amount of water body has increased in Chandipur block between 2001-2011. A total of 611 hectare land converted from other three major LULC classes (except settlement) to waterbody that depicted huge surge of demand for inland fisheries. Other major changes are 207 hectare fallow land had been reclaimed for agricultural purposes while 531 hectare existing agricultural land transformed to fallow category which is almost 2.5 times than the previous reclamation amount. Moyna block experienced rapid conversion of land during 2001-2011. Around 1026 hectare and 638 hectare fallow land and agricultural land converted to regenerate in land waterbodies. The entire scenario showed rapid transformation of socio-economic activities across the block. Other significant changes registered in rapid reclamation of fallow land to other LULC categories especially agricultural land (1368ha) and water bodies. Kolaghat followed almost same pattern of land conversion as it experienced in previous decades (1997-2001). Notable changes are visible in vegetation and agricultural categories. Around 573 hectare land under vegetation depleted for creation of new agricultural land. 280 hectare agricultural land came under conversion for making new settlement. Panskura-I block is famous for its agricultural activities. Agricultural land slightly increases between 2001-2011; major conversion to agricultural land found from vegetation (425ha) followed by fallow land reclamation (1666 ha) and waterbody (58 ha). About 1600 hectare agricultural land was transformed to other four land use categories – fallow land (810 ha) followed by waterbodies (371 ha), settlement (233 ha) and vegetation (131 ha). Sahid Matangini had least amount of land available under waterbodies till 1991, but it was increased two consecutive decades; share of waterbodies to total block area of Sahid Matangini in 2001 increased 2.5 times than its previous occurrence. Detail description of land conversion in Sahid Matangini block depicts in table 3.4. Huge surge of water bodies between 2001-2011 is one of the major characteristics of Tamluk sub-division. Around 761 hectare fallow land had undergone the reclamation process and transformed as water bodies; 1567 hectare agricultural land also converted to waterbodies in the given decades. Nandakumar block had significant amount of vegetation cover (3200 ha) in 2001, around 837 hectare vegetation cover depleted

as a result of agricultural land expansion. The major conversion scenario of LULC of Nandakumar block during 2001-2011 shown in the table 3.4.

**3.5.3 Block level conversion (2011 -2021)**

Block level conversion of LULC in different blocks of Tamluk sub-division (2001-2011) depicts following scenario. Decent amount of land converted to agricultural land from fallow category (328 ha) in Chandipur block. About 349 hectare land recovered from fallow category and made it suitable for aqua cultural practices during 2011-2021. 124 and 236 hectare vegetation covers entirely carved out into water bodies and agricultural land. Another notable broad conversion found in conversion of agricultural land to settlement (117ha). Although substantial amount of agricultural land transformed from fallow category but 547 hectare fresh agricultural land has been identified as fallow land during the decade 2011-2021 in Chandipur block. Enormous amount of agricultural land has been converted to waterbody in Moyna block during 2011-2021. 3302 hectare land was additionally added to water bodies between 2011-2021; which is around 20 percent land of entire block. Rapid changes in agricultural land and water bodies depicted major shifting of economic activities in the given block. 858 hectare fallow land has also been transformed to waterbodies. This enormous and major LULC changes superimposed the other LULC categories beneath the water bodies. Large amount of vegetation cover (429 ha) has been lost by Nandakumar block for the purpose of agricultural land expansion during 2011-2021.482 hectare and 1169 hectare fallow land and agricultural land has been also transformed into waterbodies. The major LULC conversion of Kolaghat block for the decade 2011-2021 shown in the table 3.4. Panskura-I is considered as largest agricultural predominated block in Tamluk sub-division; around 50% of the land under this block is used for agriculture and allied purposes. This block has experienced slight shifting of economic activities from agriculture to aquaculture during the phrase 2011-2021 as 1486 hectare and 590 hectare agricultural and fallow land converted to waterbodies. The other major changes of LULC registered by the blocks were 380 hectare settlement newly expand after losing agricultural activities, 470-hectare vegetation cover depleted foe producing new agricultural land. Around 2049-hectare fallow land has been reclaimed and made it useful for agricultural uses.

**Conclusion**

The goal of land-use categorization is to describe and recognise the unique utilities of different types of land in order to serve people's requirements consistently and intelligently. It is a hierarchical grouping of different types of land based on some comparable qualities. The study region is a prime illustration of how men's economic behaviours significantly affect the local climate. It is necessary to consider the district's overall land-use pattern in light of its shifting socioeconomic and environmental circumstances. Physical characteristics like as relief, soil type, and the southwest monsoon all have an impact on the land-use pattern in the studied region. Regarding changes in crop land-use, several variances and unique characteristics of the monsoonal environment are relevant. Different agricultural land-use patterns are impacted by rainfall amount and distribution. On the other side, the pattern of forest land use is significantly influenced by relief and rainfall. Cotton, coconuts, and evergreen forests are connected with the wet zone under the influence of soil and climate, whereas high to moderate rainfall regions have supported more complicated crop production and agricultural economies centred on rice, millets, and fruit gardens.

The region's general structure, topography, geology, geography, and soils have all had an impact on the development of various land-use zones, such as fertile land, barren and unusable land, forest land, pastures,

and so on. The extent of settlement areas, transportation routes, fallow land, and the stage, pace, and intensity of agricultural growth have all been impacted by human and economic variables. The district's overall land use pattern has evolved extensively and unpredictably during the previous 30 years due to the needs of increased population expansion. However, farmlands close to population locations have also been encroached upon and destroyed. Woods and scrub fields have been removed. Resources have been taken from other people by current investments in hydropower plants, industry, and transportation networks. The spatial aspect of agricultural structure in particular and land use in general in the Purba Medinipur District have both been significantly impacted by the extent and direction of land-use changes as a result of government policies and development activities. The pattern of land use is intricate, changing, and widely varying in space. The competitive land-use pattern in the area is the consequence of thousands of years of land-use experiments and failures. The district's current land-use pattern is the result of a prolonged period including a wide variety of environmental factors, yet it has frequently been impacted by these factors.

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