ELEPHANT RESERVES OF INDIA

LAND USE – LAND COVER CLASSIFICATION

भारतीय वन्यजीव संस्थान
Wildlife Institute of India

आज़ादी का अमृत महोत्सव

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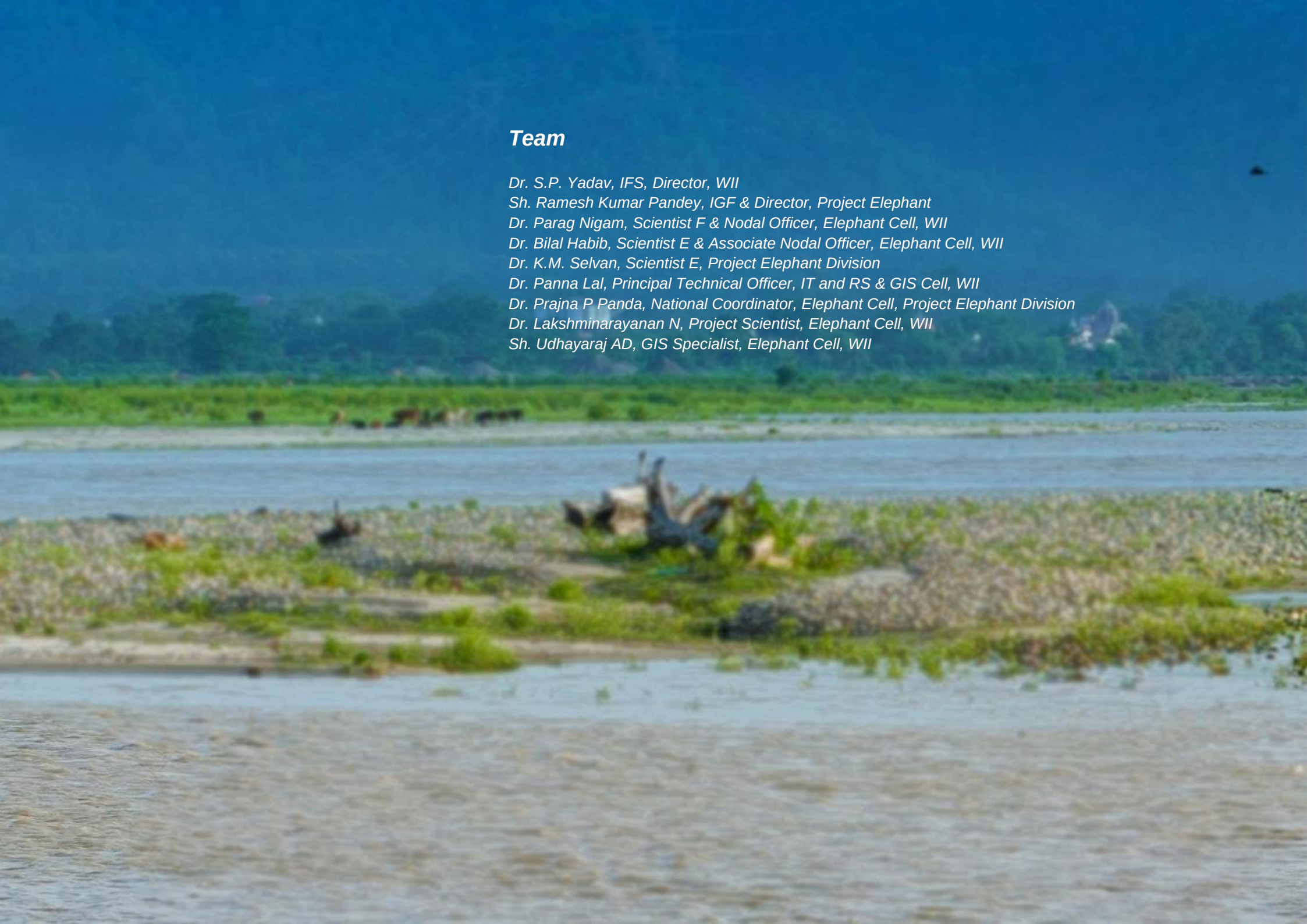

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Land-use and Land-cover Classification in the Elephant Reserves of India

Introduction

Elephant populations occur in 13 range countries in Asia as disjunct populations (Leimgruber et al 2003). The current distribution of Asian elephants however represents only a small fraction of their historic range (Sukumar, 2003). As India holds more than 50% of the wild Asian elephant populations in four major elephant-bearing regions of the country namely Southern, North-Western, East Central, and North-Eastern (Rangarajan et al, 2010) it plays a crucial role in the long-term conservation of the species. Taking cognizance of elephant conservation priorities, the Government of India, with a stated objective of ensuring long-term conservation of viable elephant populations and their natural habitats, launched Project Elephant in 1992. To bring uniformity in management practices across the country; provide technical and financial support to elephant range states and address issues of human-elephant conflict, Elephant Reserves (ERs) have been created across the four elephant-holding regions. Presently, there are 31 ERs in India.

Elephants are long-ranging animals and move across landscapes not just limited to forest areas therefore, the declaration of ERs, in general, follows a landscape approach to elephant conservation by including human-elephant conflict mitigation zones as well corridors that may occur outside the forests. In such zones outside of forest habitats, elephant movement between habitats could be needed to maintain elephant meta-populations. The elephant task force report (Gajah report) of the Government of India (Rangarajan et al, 2010) recommended that ERs should be the basic management unit for elephant conservation and management in India. The report further called for a declaration of ERs as ecologically sensitive areas (ESA) under the Environmental (Protection) Act, 1986. In such ESAs, the rights of local communities that fall within ERs would be amply recognized and facilitated as partners in elephant conservation (Rangarajan et al, 2010). The rationale for including non-forest areas in ERs was also based on the recognition that major environmental changes such as mineral mining and associated activities, industrial development, and linear infrastructure development occurring both inside the forests and in the immediate vicinity outside of forests can potentially affect elephant habitats as well as populations due to increasing in isolation of habitats, edge effects, and site-specific insidious threats. As an example, major roads and other linear infrastructure could act as major barriers to elephant movement if the developmental activities do not adequately consider elephant habitat needs. Given this, an understanding of the present land-use land-cover (LULC) describing the proportion of different land-use categories within the ERs would be essential to have. Further, a broad comparison assessing whether the LULC of the ERs has drastically changed or remained static would be essential to make.

Scope of the Report

In this report, the present status of the LULC of the ERs in India classified based on the BHUVAN LULC layer of NRSC for the year 2018 is provided. Only five major LULC classes have been provided for the ERs, which include forests, agriculture, water, fallow and human built-up areas. Further sub-classification of forests into different forest types and tree density, and agriculture Kharif*harif* and *rabi* crops was not done. Further, using geospatial layers for the years 1985, 1995, 2005, and 2018 broad comparisons between the years were made for all the five major LULC categories of the ERs to assess any major potential disparity between the years. Additionally, the linear infrastructure comprising major roads (National and State Highways) and the Indian Railway network were mapped based on 2018 (Bhuvan LULC data).

Analytical Approach

Digitization of Elephant Reserve: The geospatial layers (boundary polygons) of ERs were created using two sources: For thirty ERs, the boundary polygons were directly obtained from the State Forest Departments. For Shiwalik ER (Uttarakhand), the boundary polygons were drawn in GIS based on gazette notifications. The latter, however, requires revalidation of the boundaries by the respective states. The ER boundary that requires revalidation was communicated to the respective states by the Project Elephant division of the MoEF&CC. Validation of boundary polygons is required for the state of Uttarakhand (Shiwalik ER).

Extraction of LULC information: To extract LULC information for each ER, raster layers of LULC about the period 1985, 1995, 2005 (Roy et.al, 2016) and 2018 (BHUVAN, NRSC, GOI) were used. The resolution and source of the data have been provided in Table 1.

Table 1: Details of imagery used for LULC classification of the Elephant Reserves in India

S. No.	Year	Source	Resolution (m)
01	1985	Roy et al., 2016	100
02	1995	Roy et al., 2016	100
03	2005	Roy et al., 2016	100
04	2018	BHUVAN, NRSC, Government of India	30

i. The land use and land cover (LULC) classification products at 100-m resolution for India at decadal intervals for 1985, 1995, and 2005 were acquired from Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC) (1985, 1995 and 2005) which was developed by Roy et, al. (2016). The data were derived from Landsat 4 and 5 Thematic Mapper (TM), Enhanced Thematic Mapper Plus (ETM+), and Multispectral (MSS) data, India Remote Sensing satellites (IRS) Resourcesat Linear Imaging Self-Scanning Sensor-1 or III (LISS-I, LISS-III) data, ground truth surveys, and visual interpretation. An overall mapping accuracy of all the three decadal data was found to be 94.46% and the Kappa accuracy of 0.9445.

ii. The LULC data for the year 2018 was acquired freely from the BHUVAN – Thematic services website which facilitates LULC data for the entire country at the scale of 1:250000 with 19 LULC classes (http://bhuvannoeda.nrsc.gov.in/theme/thematic/theme.php). The LULC data were derived from Resourcesat-1 satellite Linear Imaging Self Scanning Sensor (LISS) - III data.

Methodology: The workflow of the methodology adopted for the integrated decadal land use changes in the ERs is as follows.

Step 1	**Acquisition of the pre-classified freely available data from various sources.**
Step 2	Sub-setting the acquired raster images based on the area of interest (geospatial layer of the ERs).
Step 3	The acquired datasets were pre-classified into 19 LULC classes based on the IGBP (International Geosphere-Biosphere Programme) classification scheme, which was broadly classified into five classes as mentioned in the scope of the report.
Step 4	The creation of the decadal LU/LC maps was based on the subset images of the different time periods to visualize the overall changes
Step 5	Vectorization of the raster datasets to estimate the statistical area of various feature classes for further comparison and change detection.

Summary of LULC of ERs

The combined area of the 31 ERs is about 76,508.38 km^2, which constitutes about 70% of the distributional range (1,25,000 km^2) of elephants. The average size of the ER in the country is 2,468.01 km^2 (SD = 2677.82, Range = 23.5 to 13,440). The 31 ERs are spread across 14 states in India. The LULC details of the ERs across four regions in India, in terms of percentage of different land uses, have been provided in Table 2. The average forest cover in the ERs of the country is around 76.9% (SD = 17.5, Range = 38.5 to 99.1). The average area under agriculture in the ERs is 20.1% (SD = 14.9, Range = 0.5 to 57.7). The average human built-up area

in the ERs is 0.3% (SD = 0.7, Range = 0 to 3.2). The average forest cover and agricultural areas in the ERs did not differ significantly between the four elephant-bearing regions suggesting uniformity in the approach followed for declaration (Fig-1).

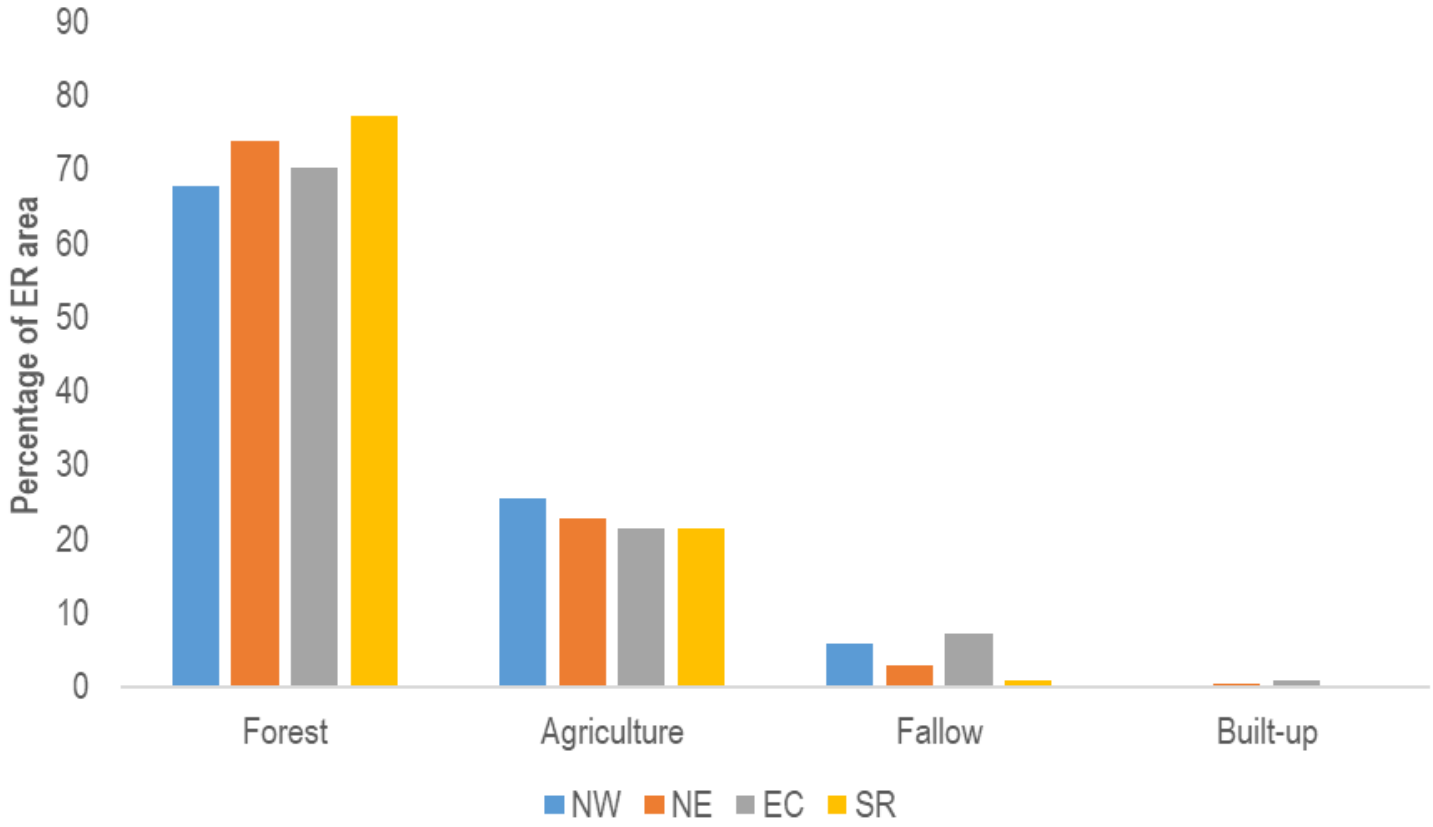


Figure 1: Extent of area (in percentages) of different LULC in the Elephant Reserves across four elephant-bearing regions (2018). NW-North-west region, NE-North-east region, EC – East-central region, and SR – Southern region

Table 2: LULC classification of the Elephant Reserves. Classification is based on 2018 imagery of BHUVAN, NRSC.

S. No	Elephant Reserve	Region	State	Area (km^2)	% Forest + Water	% Agriculture	% Fallow	% Built-up
North Western Region								
1	Shivalik*	NW	Uttarakhand	5405.0*	80.9	16.1	2.2	0.0
2	Uttar Pradesh		Uttar Pradesh	744.0	54.9	35.2	9.6	0.2
Region-wise averages					**67.9**	**25.6**	**5.9**	**0.1**
North Eastern Region								
3	South Arunachal	NE	Arunachal Pradesh	1957.5	85.5	12.0	1.8	0.0
4	Kameng		Arunachal Pradesh	1892.0	99.1	0.5	0.2	0.0
5	Chirang-Ripu		Assam	2600.0	66.9	28.3	2.4	0.1
6	Dihing Patkai		Assam	937.0	83.5	15.2	0.0	0.1
7	Dhansiri Lungding		Assam	2740.0	89.3	10.6	0.0	0.0
8	Kaziranga Karbi Anglong		Assam	3270.0	84.2	7.0	1.3	1.3
9	Sonitpur		Assam	1420.0	38.5	57.7	0.7	0.0
10	Garo Hills		Meghalaya	3500.0	86.9	10.6	0.0	0.7
11	Intanki		Nagaland	202.0	96.7	2.2	0.2	0.0
12	Singphan		Nagaland	23.5	92.6	6.5	0.0	0.3
13	Eastern Dooars		West Bengal (north)	978.0	81.4	11.0	4.5	0.0
Region-wise averages					**74.0**	**22.9**	**3.0**	**0.6**
East Central Region								
14	Sarguja Jashpur	EC	Chhattisgarh	1143.3	80.1	15.4	4.3	0.0
15	Lemru		Chhattisgarh	1995	85.7	13.0	1.1	0.0
16	Singhbhum		Jharkhand	13440.0	38.2	40.0	19.6	1.0
17	Mahanadi		Odisha	1038.0	85.6	8.1	3.2	3.2
18	Mayurbhanj		Odisha	3213.8	54.8	23.9	18.6	2.5
19	Sambalpur		Odisha	427.0	96.2	3.2	0.5	0.0
20	Mayurjharna		West Bengal (south)	414.0	52.0	43.8	4.1	0.0
Region-wise averages					**70.3**	**21.5**	**7.3**	**0.9**

S. No	Elephant Reserve	Region	State	Area (km^2)	% Forest + Water	% Agriculture	% Fallow	% Built-up
Southern Region								
20	Rayala	SR	Andhra Pradesh	766.0	92.5	4.9	2.6	0.0
21	Dandeli		Karnataka	2321.0	58.6	39.9	1.3	0.0
22	Mysuru		Karnataka	8055.9	84.4	14.8	0.8	0.0
23	Anamudi		Kerala	3728.0	74.0	25.5	0.3	0.0
24	Nilambur		Kerala	1419.0	82.2	17.3	0.4	0.4
25	Periyar		Kerala	3742.0	87.6	12.1	0.2	0.0
26	Wayanad		Kerala	1200.0	80.4	16.0	2.5	1.0
27	Anamalai		Tamil Nadu	1457.0	78.4	21.2	0.2	0.0
28	Coimbatore		Tamil Nadu	566.0	45.4	53.6	0.9	0.0
29	Nilgiri		Tamil Nadu	4663.0	75.7	23.6	0.5	0.0
30	Srivilliputtur – Periyar		Tamil Nadu	1249.0	92.5	5.7	1.3	0.0
Region-wise averages				**76,058.38**	**77.4**	**21.5**	**1.0**	**0.1**
Overall averages				**2468.01**	**76.9**	**20.1**	**2.7**	**0.3**

* For these ERs, validation of the reserve polygons by the respective State Forest Departments is pending. NW-North-west region, NE-North-east region, EC – East-central region ,and SR – Southern region

Disclaimer

The data in this report has been compiled in good faith by WII, but no illustration is made or assurance is given (either express or obscure) as to the completeness or precision of the data, as data has been collated from various sources including the Forest Department websites, state government gazette notifications and online sources, etc. The user of this information agrees that WII will not be liable for any direct or indirect loss arising from the use of the information.

The geospatial layers of the Elephant Reserves in India used for land-use & land-cover classification pertain to two sources: (i) For 30 ERs, the geospatial layers were directly obtained from the respective state forest departments (ii) for 1 ER, the Elephant Cell of the Wildlife Institute of India used the gazette notifications to create ER boundaries. The one ER created using gazette notifications is in the process of validation by the respective state. As the validation of ER boundaries is not complete yet, the latter can be prone to spatial errors, sometimes of even high magnitude.

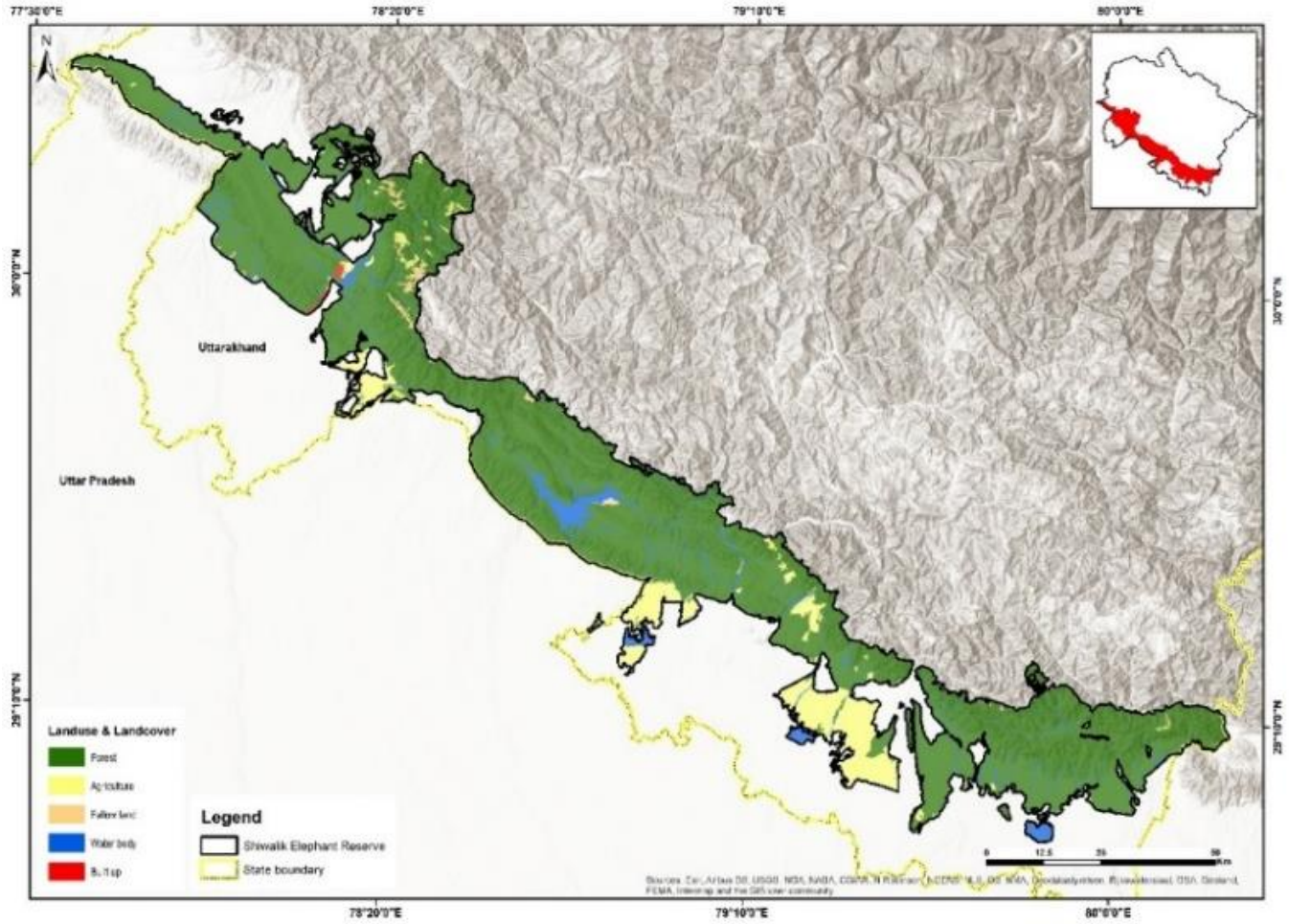
For extracting land-use land-cover classification of the ERs, pre-classified geospatial layers were obtained for 1985, 1995, 2005, and 2018. The layers obtained were used as such and no re-classification was done. The resolution of geospatial layers pertaining to the years 1985, 1995, and 2005 was 100-m, whereas, for the year 2018, the resolution was 30-m. Since pre-classified layers were used as such without ground evaluation, there could be discrepancies in the land-use land-cover information provided for the individual ERs in the report.

User Feedback

The Elephant Cell, WII requests the user to pass on any new information or amendment in the given information to elephantcell@wii.gov.in whenever available. WII would be happy to update the database upon verification of the authenticity of the source of data.


ELEPHANT RESERVES OF
North-Western Region

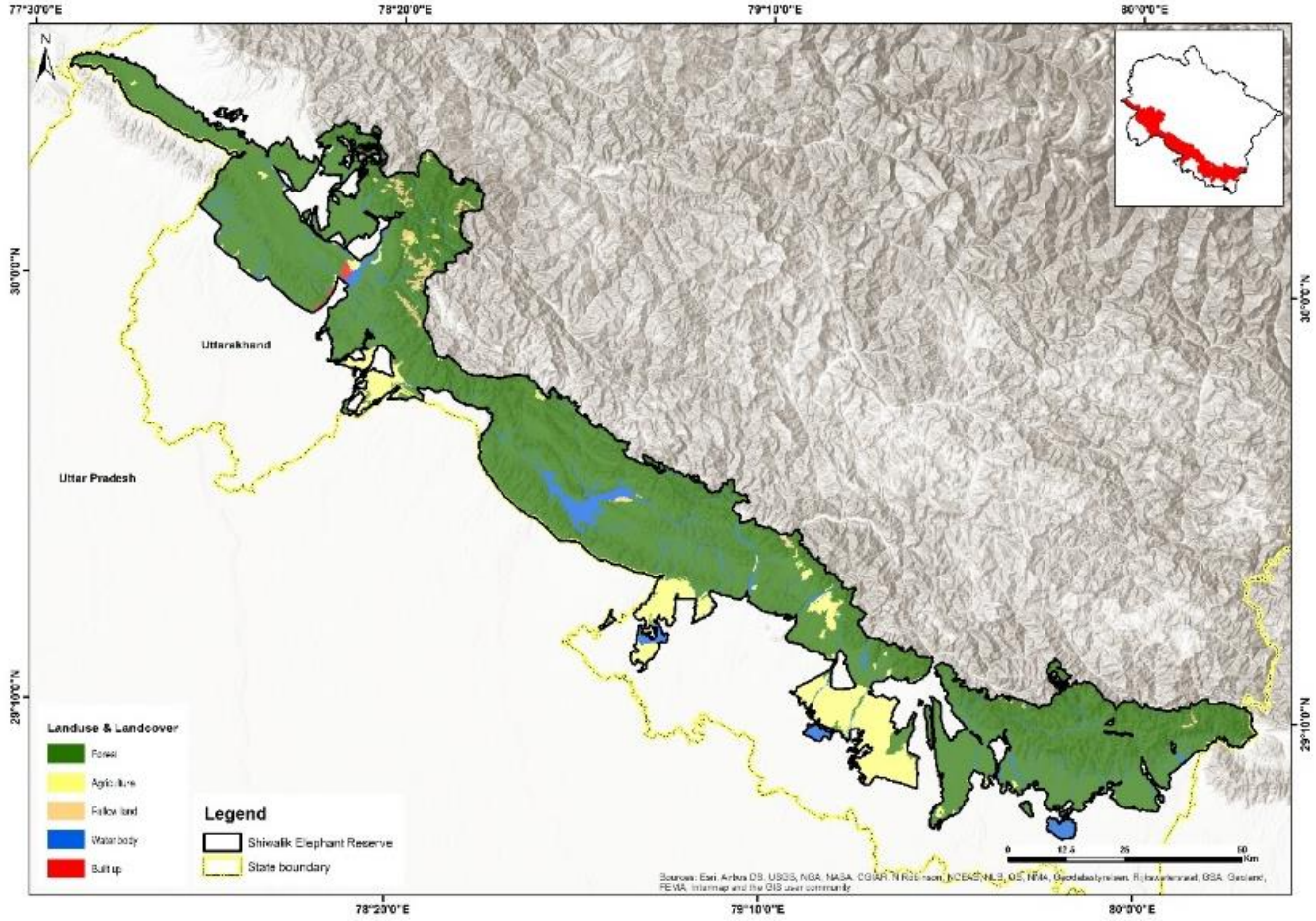
Shivalik Elephant Reserve, Uttarakhand 1985



LULC Type	*1985 (%)*
Forest	*83.15*
Agriculture	*10.07*
Fallow land	*0.95*
Built up	*0.19*
Waterbody	*5.63*

LULC Map of Shivalik Elephant Reserve for the Year 1985 – Roy et al., 2016

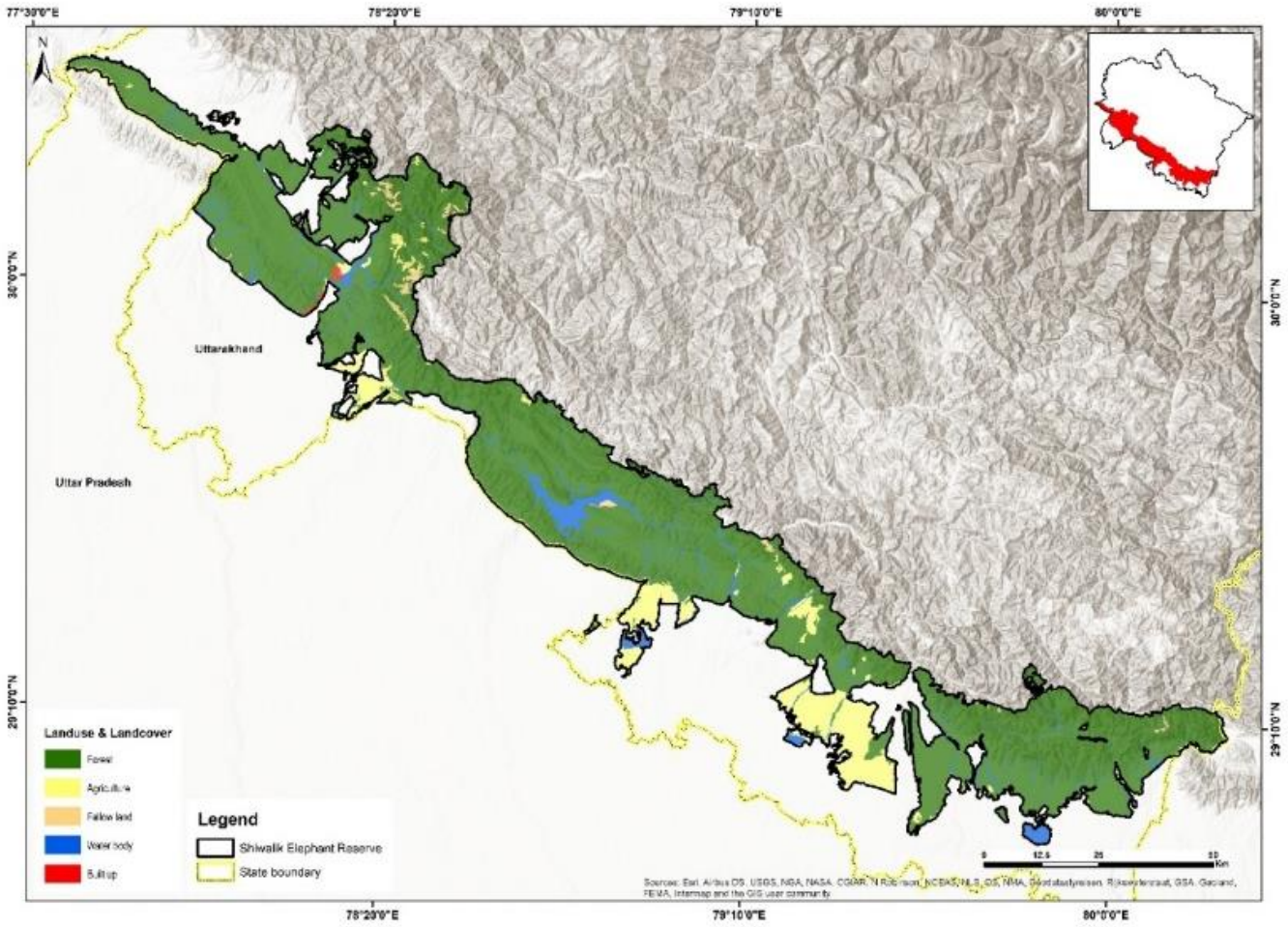
Shivalik Elephant Reserve, Uttarakhand 1995



LULC Type	*1995 (%)*
Forest	*83.11*
Agriculture	*10.01*
Fallow land	*1.08*
Built up	*0.22*
Waterbody	*5.58*

LULC Map of Shivalik Elephant Reserve for the Year 1995 – Roy et al., 2016

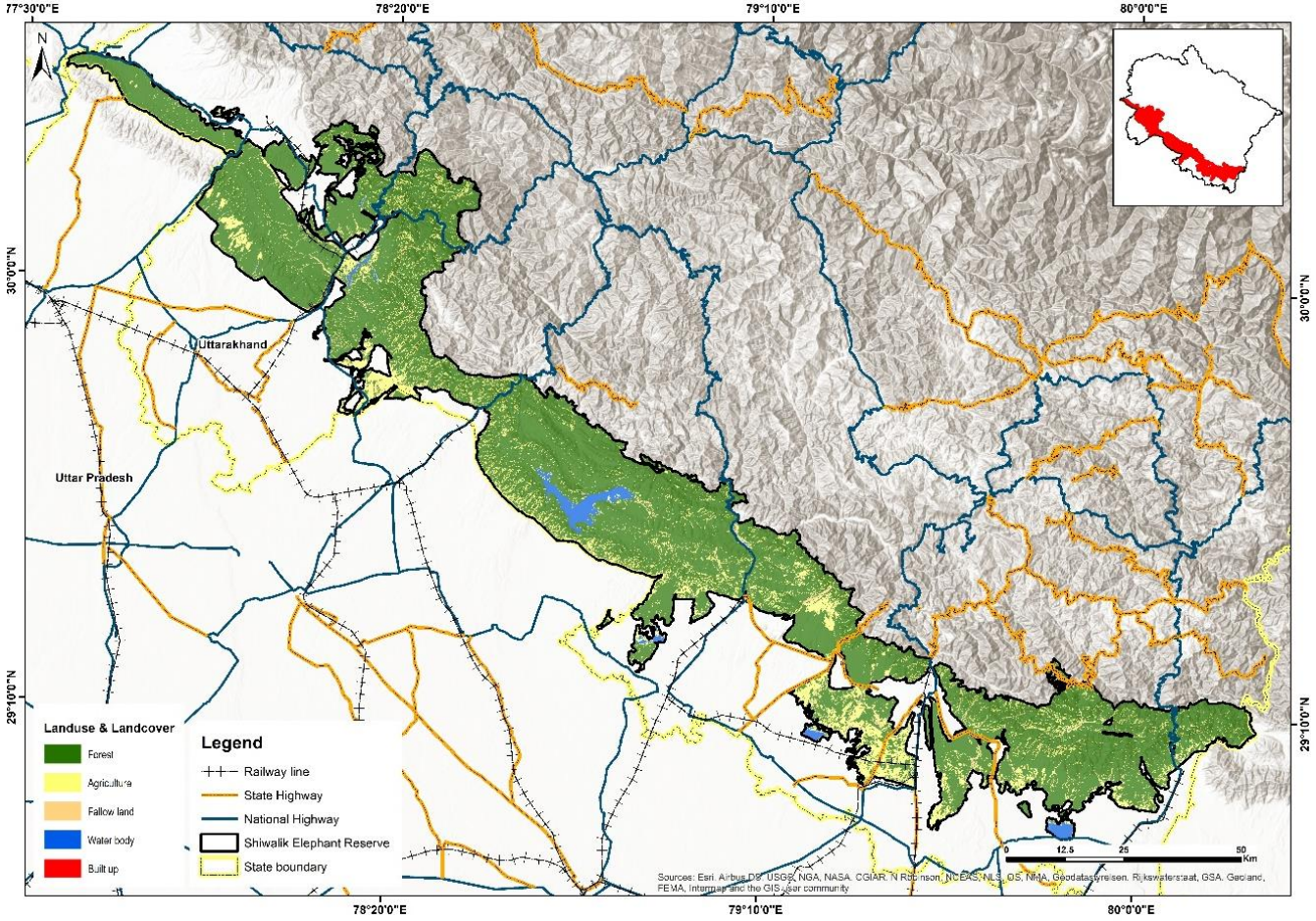
Shivalik Elephant Reserve, Uttarakhand 2005



LULC Type	*2005 (%)*
Forest	*83.12*
Agriculture	*9.68*
Fallow land	*1.30*
Built up	*0.26*
Waterbody	*5.63*

LULC Map of Shivalik Elephant Reserve for the Year 2005 – Roy et al., 2016

Shivalik Elephant Reserve, Uttarakhand 2018



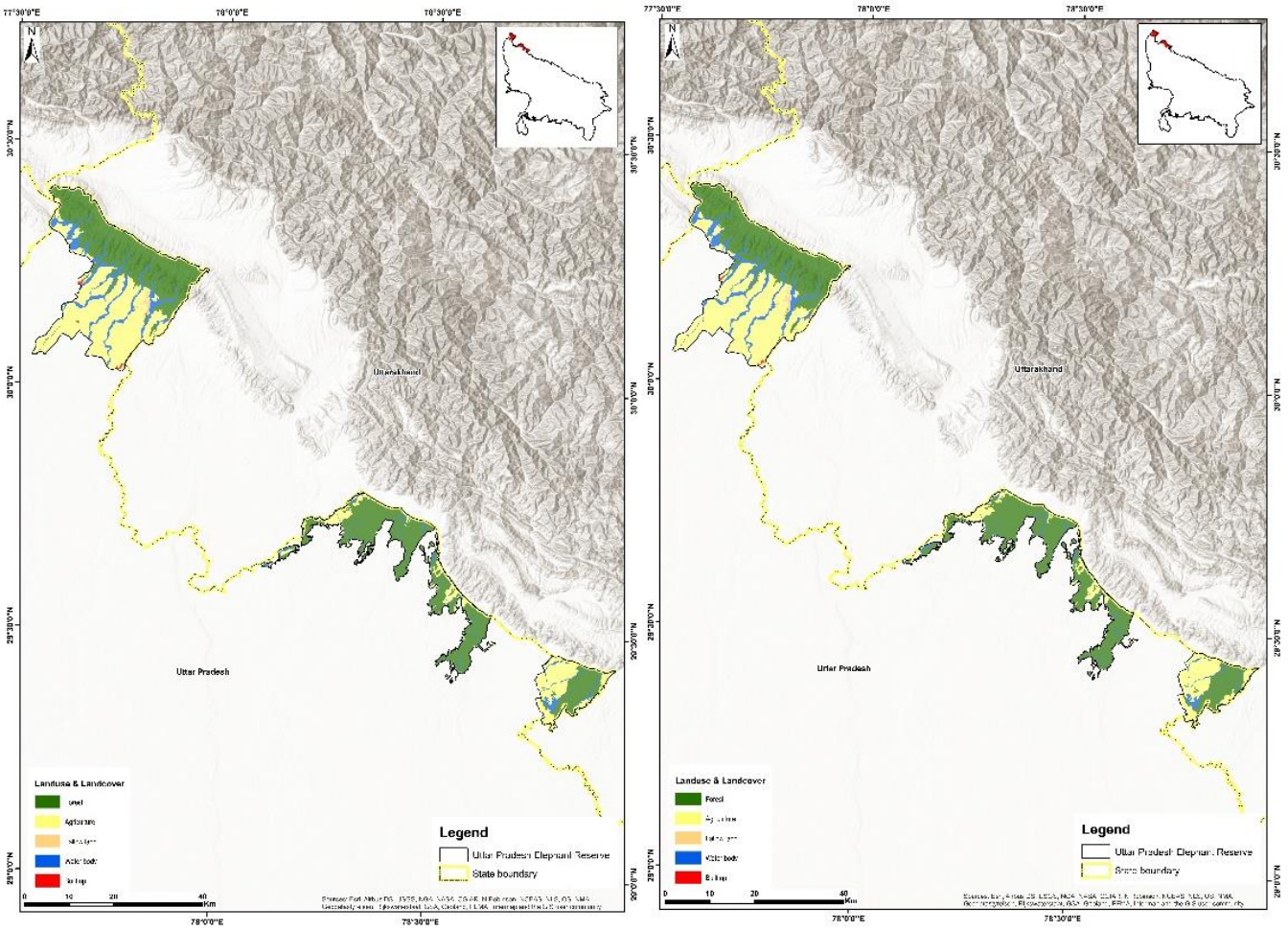
LULC Type	*2018 (%)*
Forest	*79.72*
Agriculture	*16.09*
Fallow land	*2.22*
Built up	*0.03*
Waterbody	*1.93*

LULC Map of Shivalik Elephant Reserve for the Year 2018 with linear infrastructure – Bhuvan (NRSC)

The land-use land-cover of Shivalik ER shows a marginal decrease in the overall forest cover over the years with marginal increase in agriculture. To understand the changes in the landscape ground validation would be required with use of high resolution satellite imagery for over the years. The trend of change in LULC over the years could not be assessed due to variation in the resolution.

The geospatial layer of Shivalik ER was created using gazette notifications and it is in the process of validation by the respective state. As the validation of ER boundaries is not complete yet, the latter can be prone to spatial errors, sometimes of even high magnitude.

Uttar Pradesh Elephant Reserve, Uttar Pradesh 1985 & 95

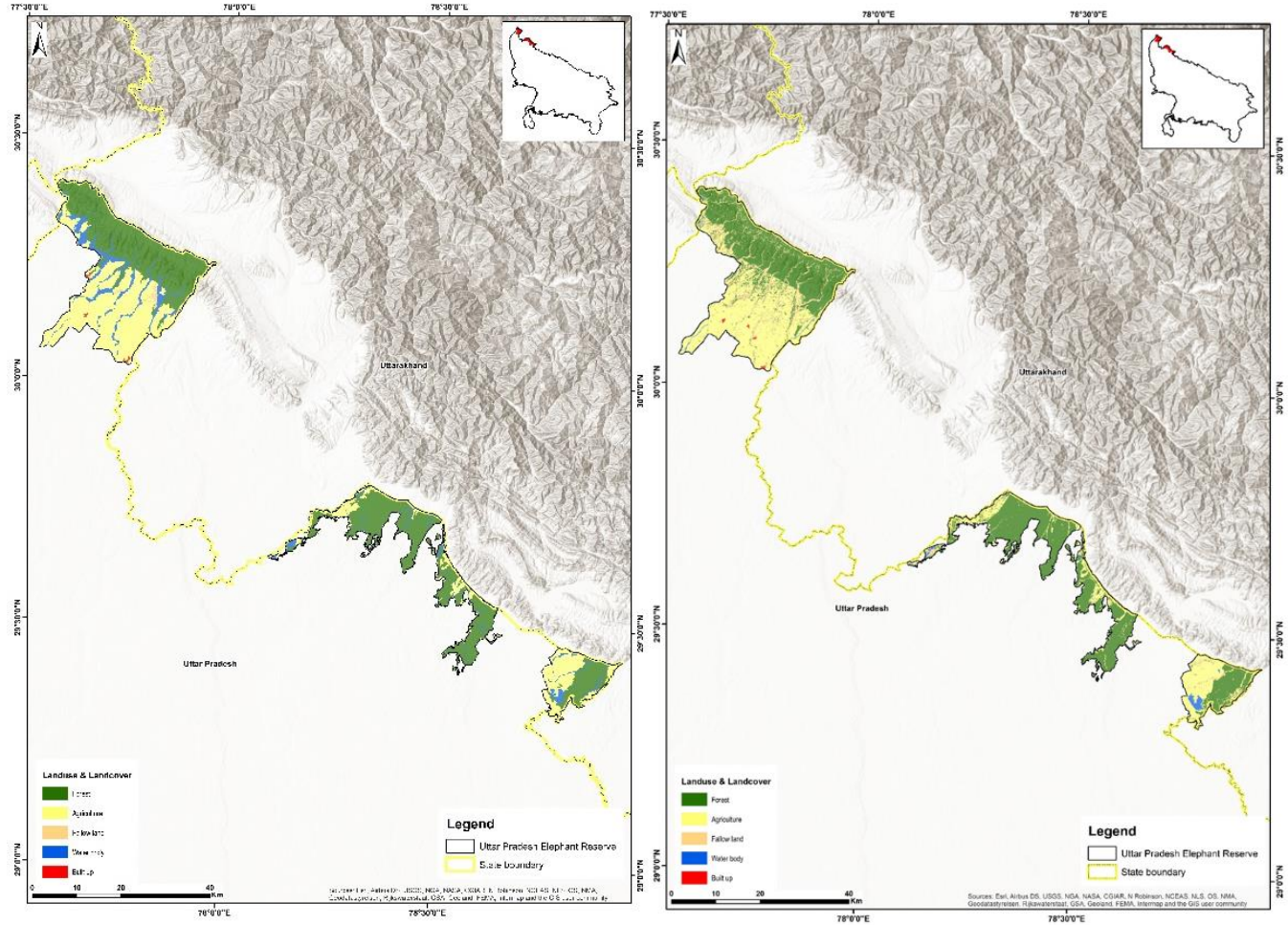


LULC Type	***1985 (%)***
Forest	*53.07*
Agriculture	*36.77*
Fallow land	*0.16*
Built up	*0.55*
Waterbody	*9.45*

LULC Type	***1995 (%)***
Forest	*52.88*
Agriculture	*36.80*
Fallow land	*0.23*
Built up	*0.52*
Waterbody	*9.58*

LULC Map of Uttar Pradesh Elephant Reserve for the Year 1985 & 95 – Roy et al., 2016

Uttar Pradesh Elephant Reserve, Uttar Pradesh 2005 & 18



LULC Type	***2005 (%)***
Forest	*53.47*
Agriculture	*36.81*
Fallow land	*0.24*
Built up	*0.66*
Waterbody	*8.82*

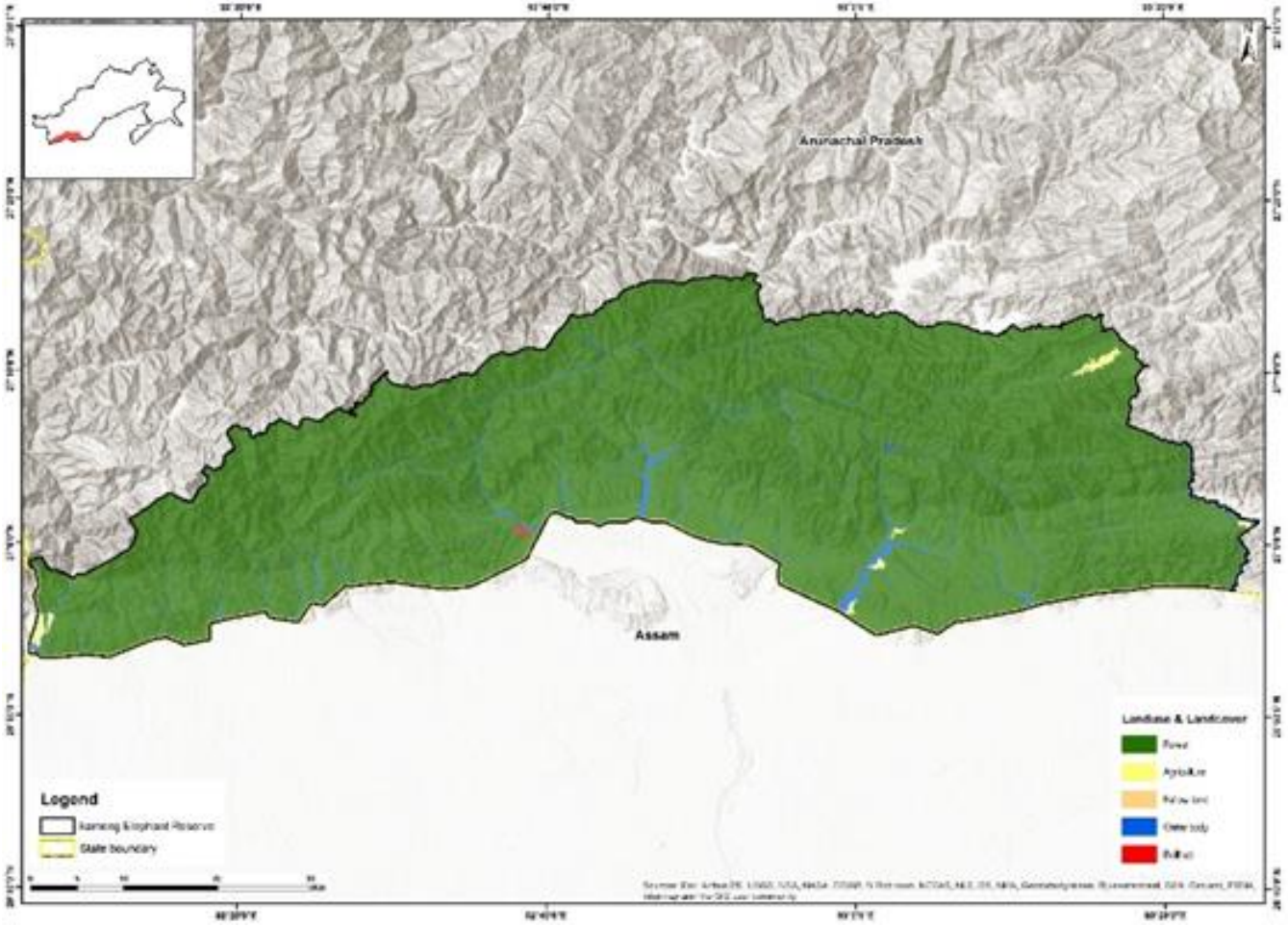
LULC Type	***2018 (%)***
Forest	*53.8*
Agriculture	*35.2*
Fallow land	*0.2*
Built up	*9.6*
Waterbody	*1.2*

LULC Map of Uttar Pradesh Elephant Reserve for the Year 2005 – Roy at al., 2016 & Year 2018 – Bhuvan (NRSC)

The Uttar Pradesh ER has a forest cover of 53.8% and a large agricultural buffer around the ER. Between 2005 and 2018, there were observed differences in LULC classes, which would require further comparison using high-resolution imagery and recent supervised classification to rule out miss-classification and adequate ground-truthing.


ELEPHANT RESERVES OF
North-Eastern Region

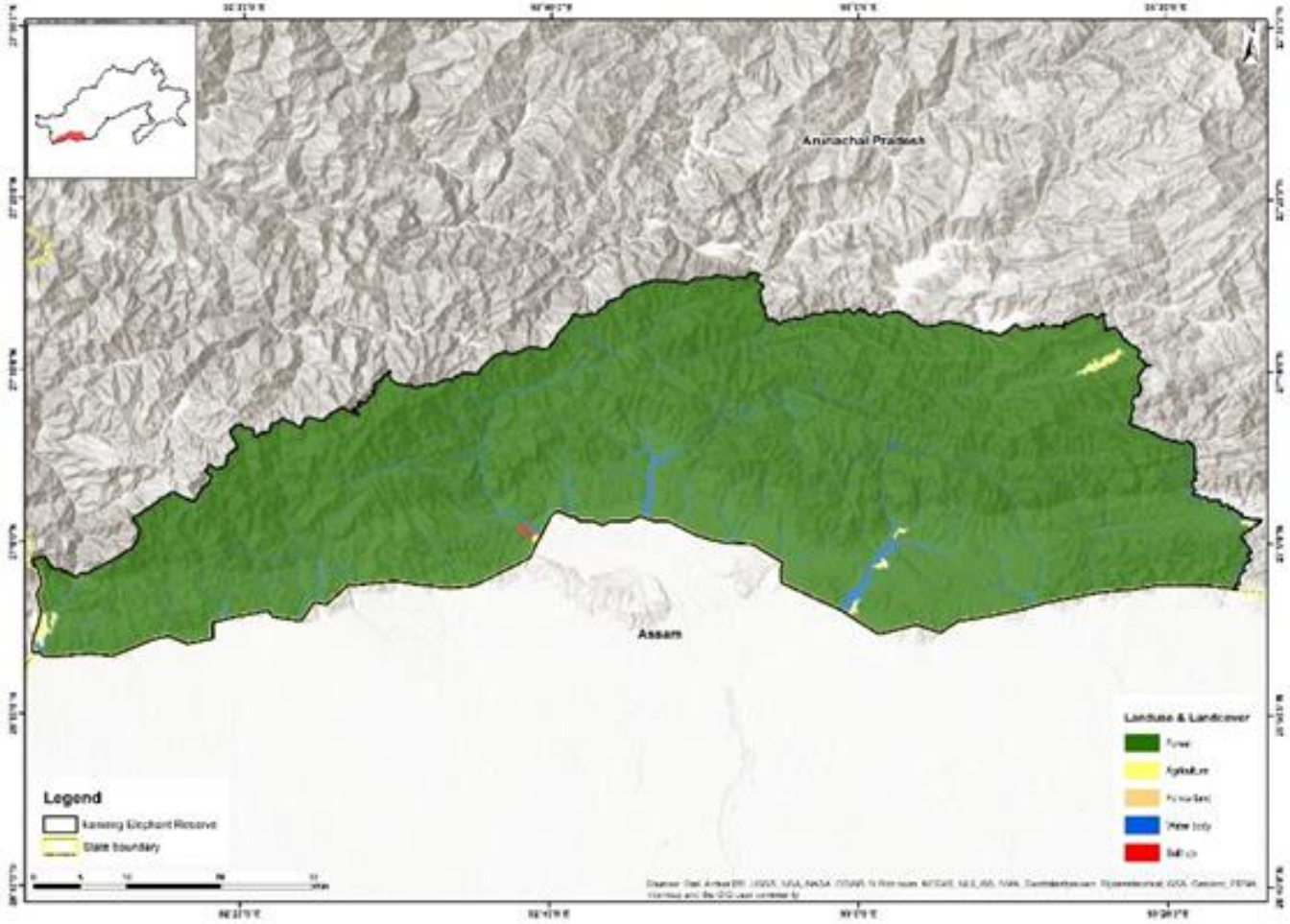
Kameng Elephant Reserve, Arunachal Pradesh 1985



LULC Type	*1985 (%)*
Forest	*96.95*
Agriculture	*0.38*
Fallow land	*0.00*
Built up	*0.04*
Waterbody	*2.63*

LULC Map of Kameng Elephant Reserve for the Year 1985 – Roy et al., 2016

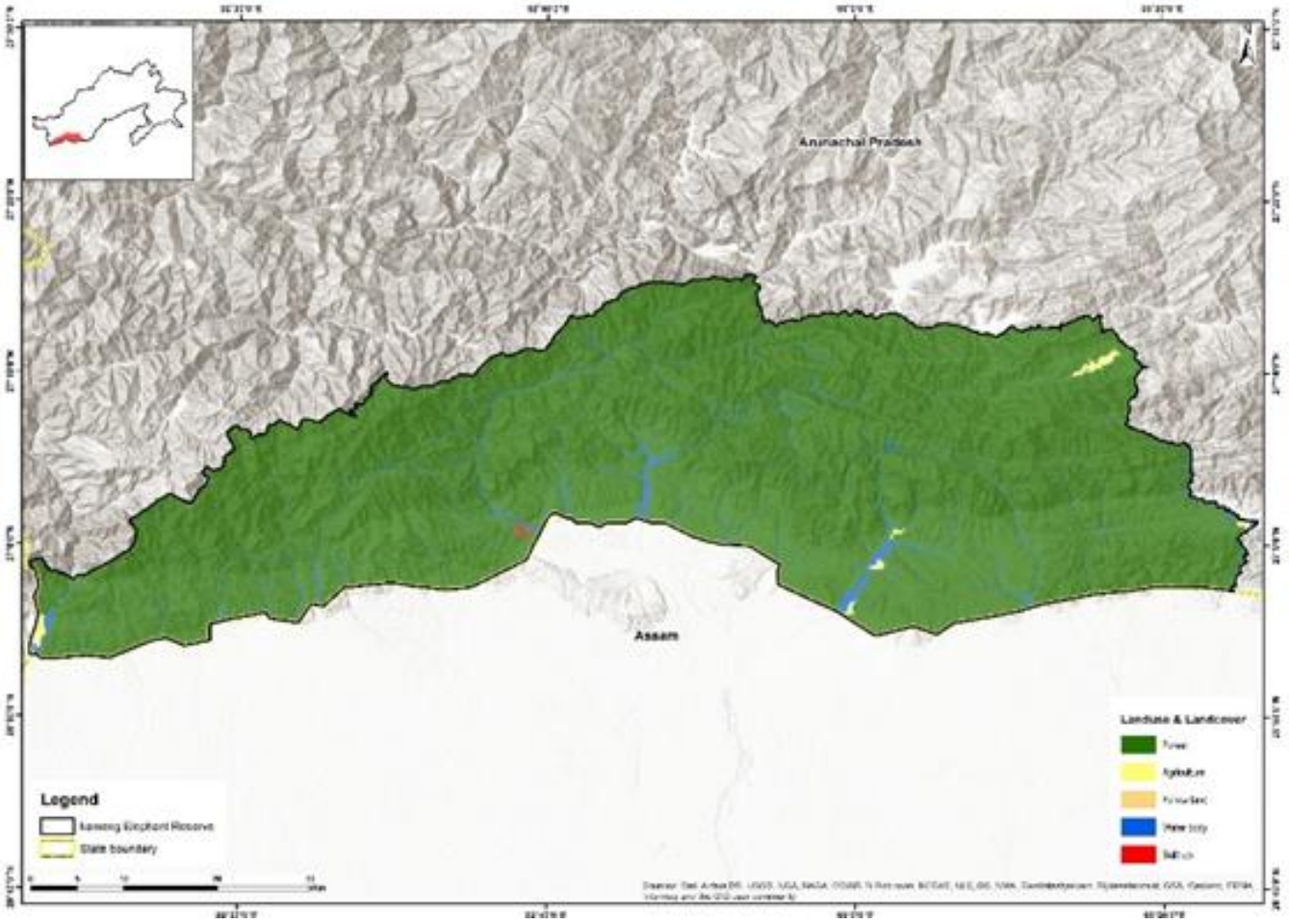
Kameng Elephant Reserve, Arunachal Pradesh 1995



LULC Type	*1995 (%)*
Forest	*96.93*
Agriculture	*0.36*
Fallow land	*0.00*
Built up	*0.04*
Waterbody	*2.67*

LULC Map of Kameng Elephant Reserve for the Year 1995 – Roy et al., 2016

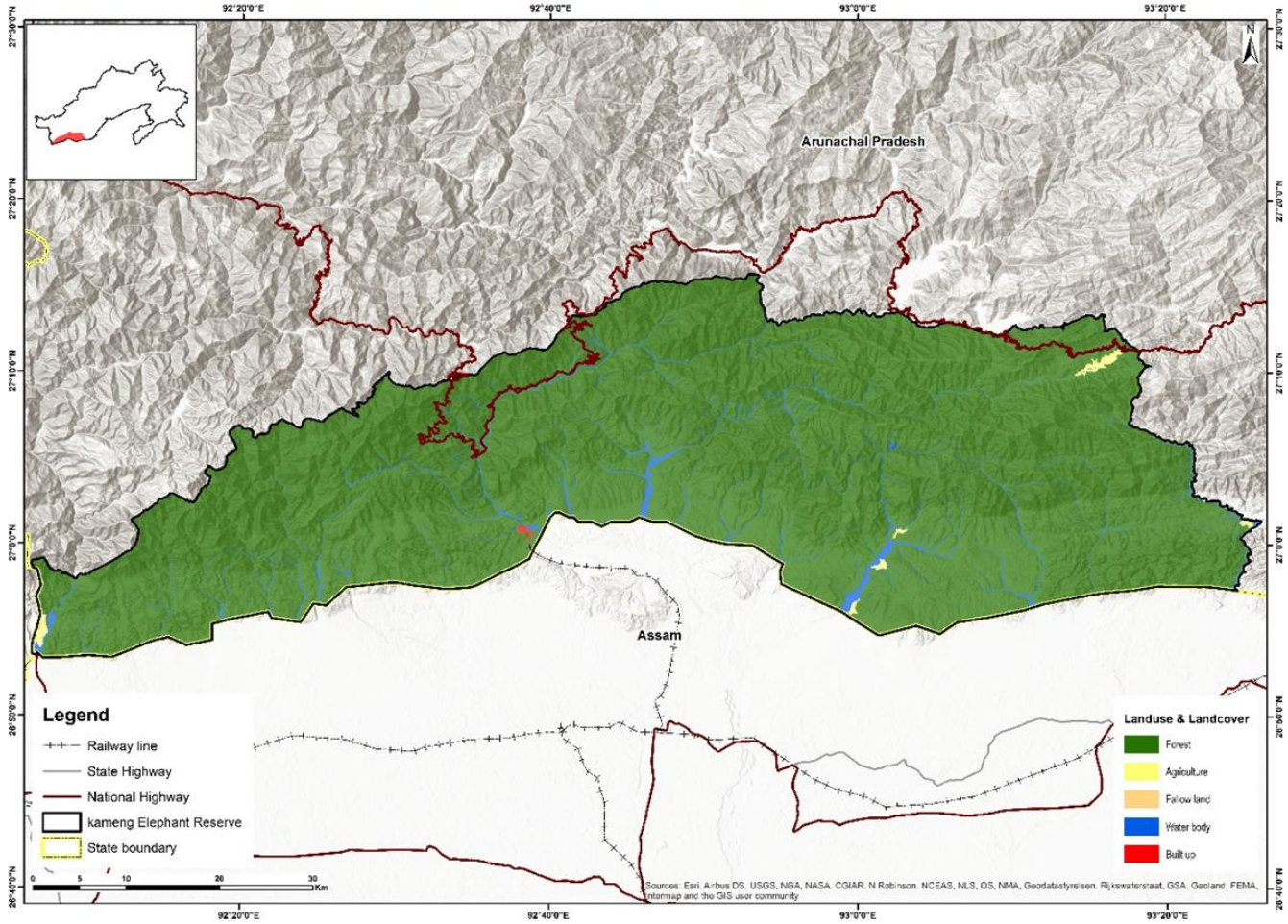
Kameng Elephant Reserve, Arunachal Pradesh 2005



LULC Type	*2005 (%)*
Forest	*96.87*
Agriculture	*0.42*
Fallow land	*0.00*
Built up	*0.04*
Waterbody	*2.68*

LULC Map of Kameng Elephant Reserve for the Year 2005 – Roy et al., 2016

Kameng Elephant Reserve, Arunachal Pradesh 2018

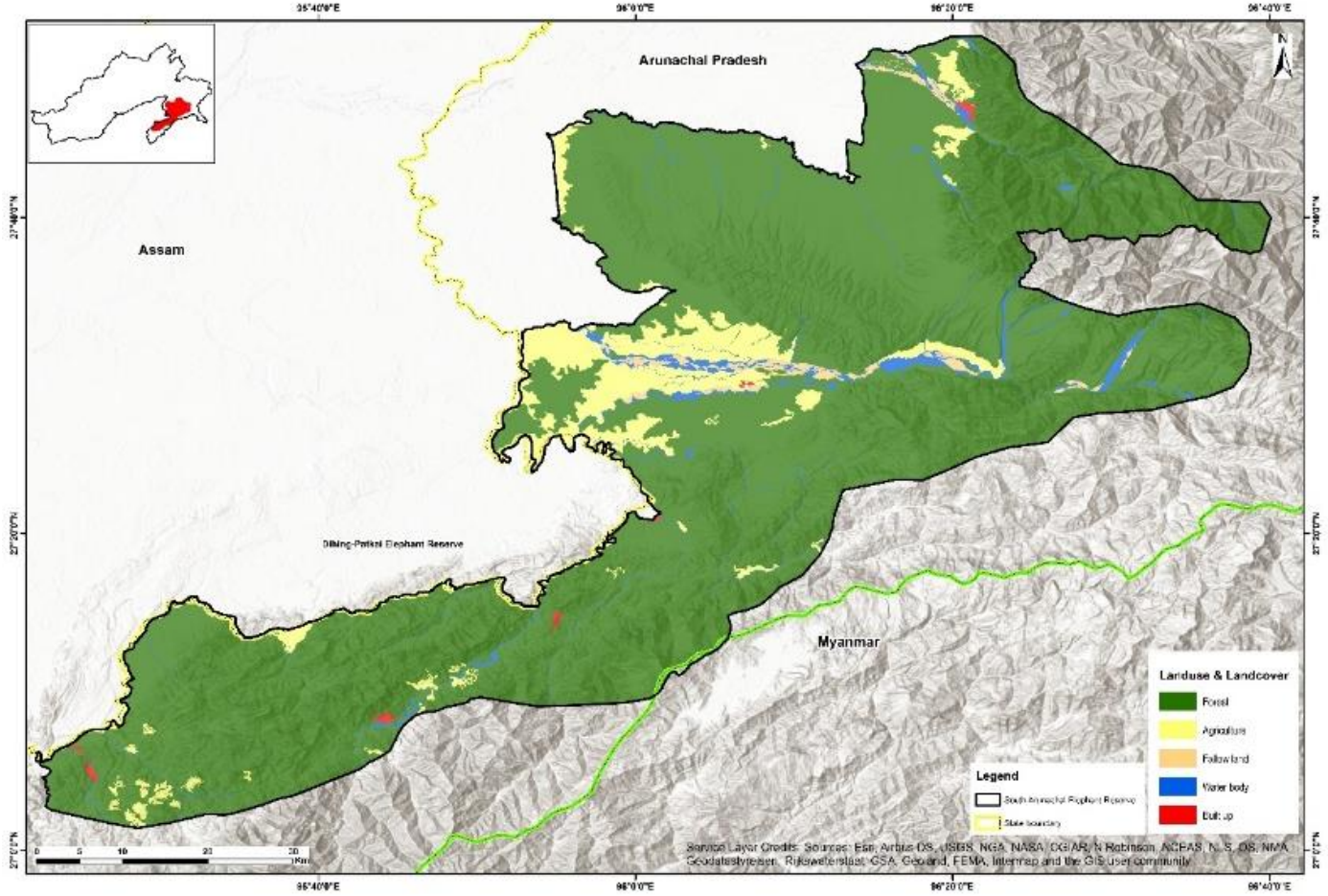


LULC Type	*2018 (%)*
Forest	*99.06*
Agriculture	*0.46*
Fallow land	*0.16*
Built up	*0.01*
Waterbody	*0.32*

The Kameng ER is mostly forested with minimal agricultural areas. The resolution of the layers 2005 and 2018 are different to make fine-level comparisons to elucidate on the minimal changes observed in the forest cover and water body.

LULC Map of Kameng Elephant Reserve for the Year 2018 with linear infrastructure – Bhuvan (NRSC)

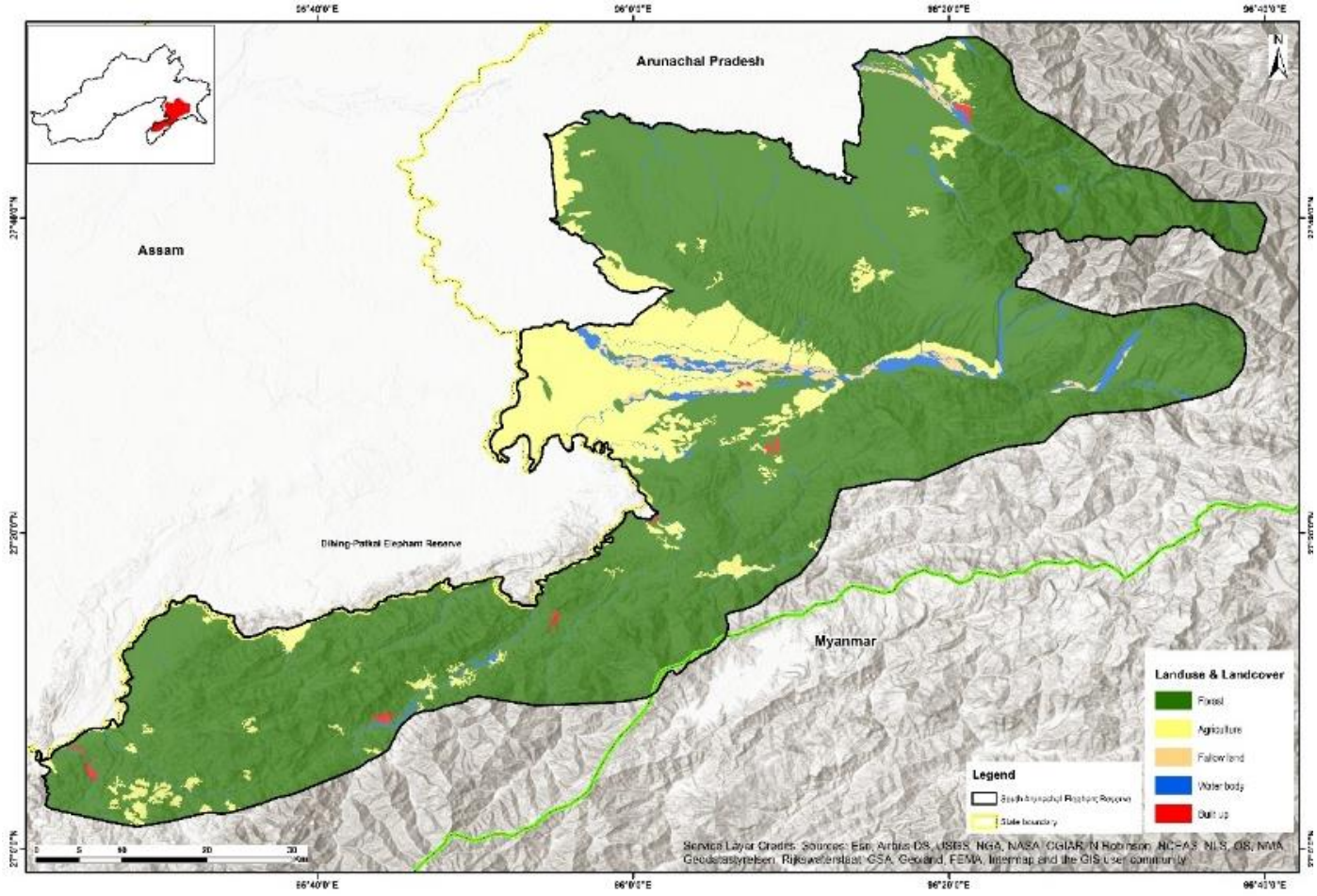
South Arunachal Elephant Reserve, Arunachal Pradesh 1985



LULC Type	*1985 (%)*
Forest	*89.1*
Agriculture	*7.2*
Fallow land	*1.03*
Built up	*0.19*
Waterbody	*2.35*

LULC Map of South Arunachal Elephant Reserve for the Year 1985 – Roy et al., 2016

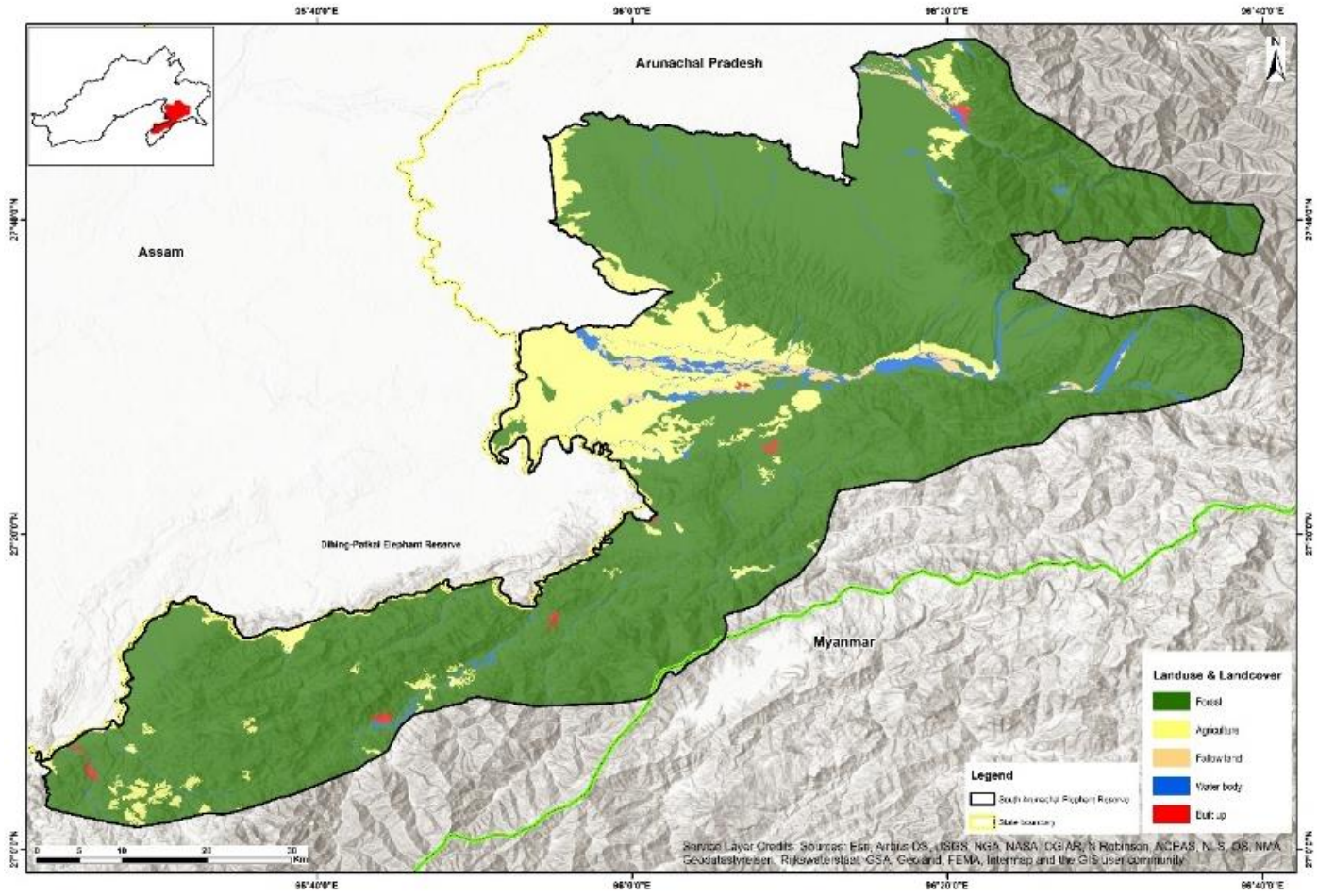
South Arunachal Elephant Reserve, Arunachal Pradesh 1995



LULC Type	*1995 (%)*
Forest	*85.3*
Agriculture	*10.9*
Fallow land	*1.03*
Built up	*0.22*
Waterbody	*2.3*

LULC Map of South Arunachal Elephant Reserve for the Year 1995 – Roy et al., 2016

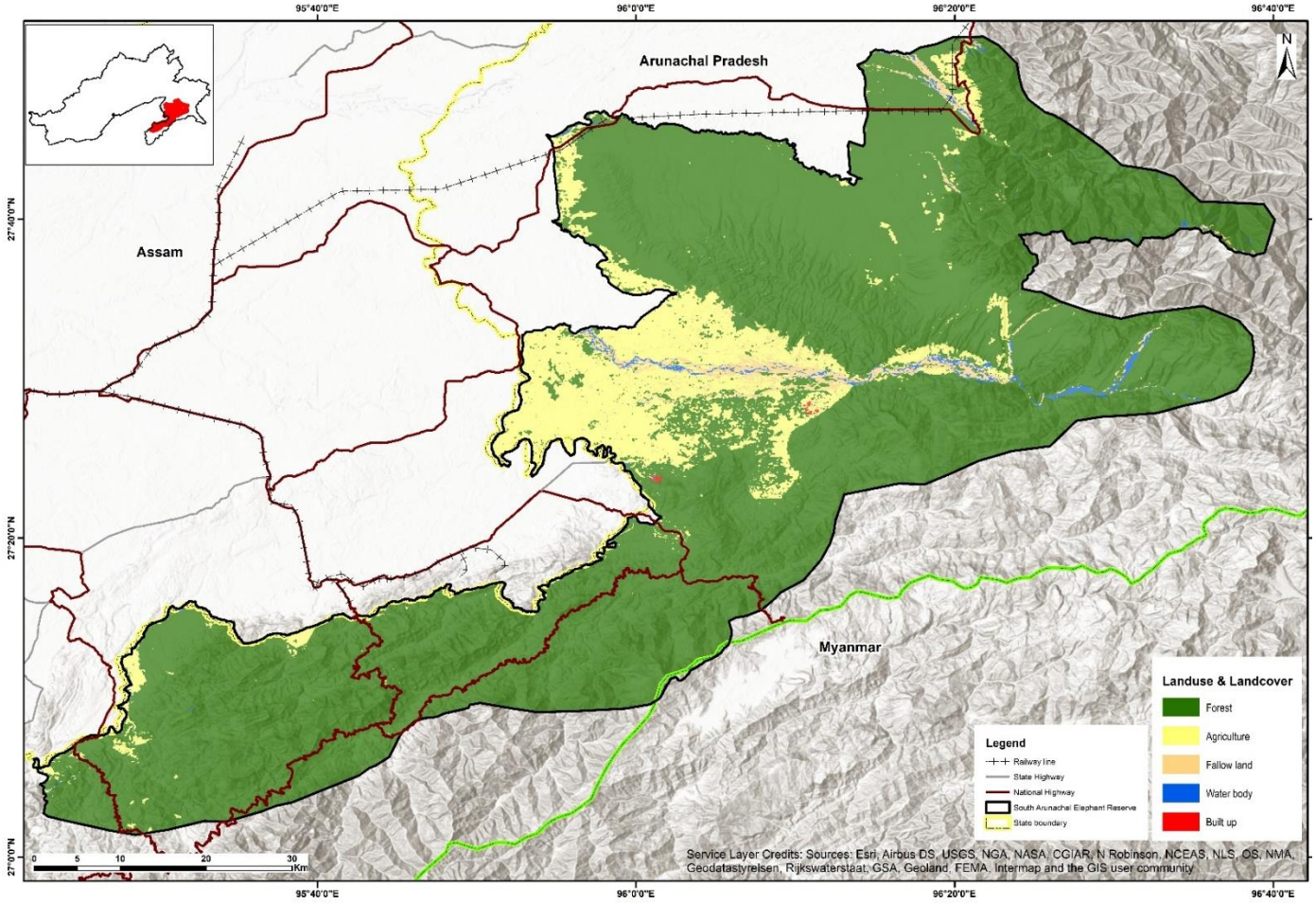
South Arunachal Elephant Reserve, Arunachal Pradesh 2005



LULC Type	*2005 (%)*
Forest	*84.2*
Agriculture	*12.04*
Fallow land	*1.03*
Built up	*0.22*
Waterbody	*2.42*

LULC Map of South Arunachal Elephant Reserve for the Year 2005 – Roy et al., 2016

South Arunachal Elephant Reserve, Arunachal Pradesh 2018

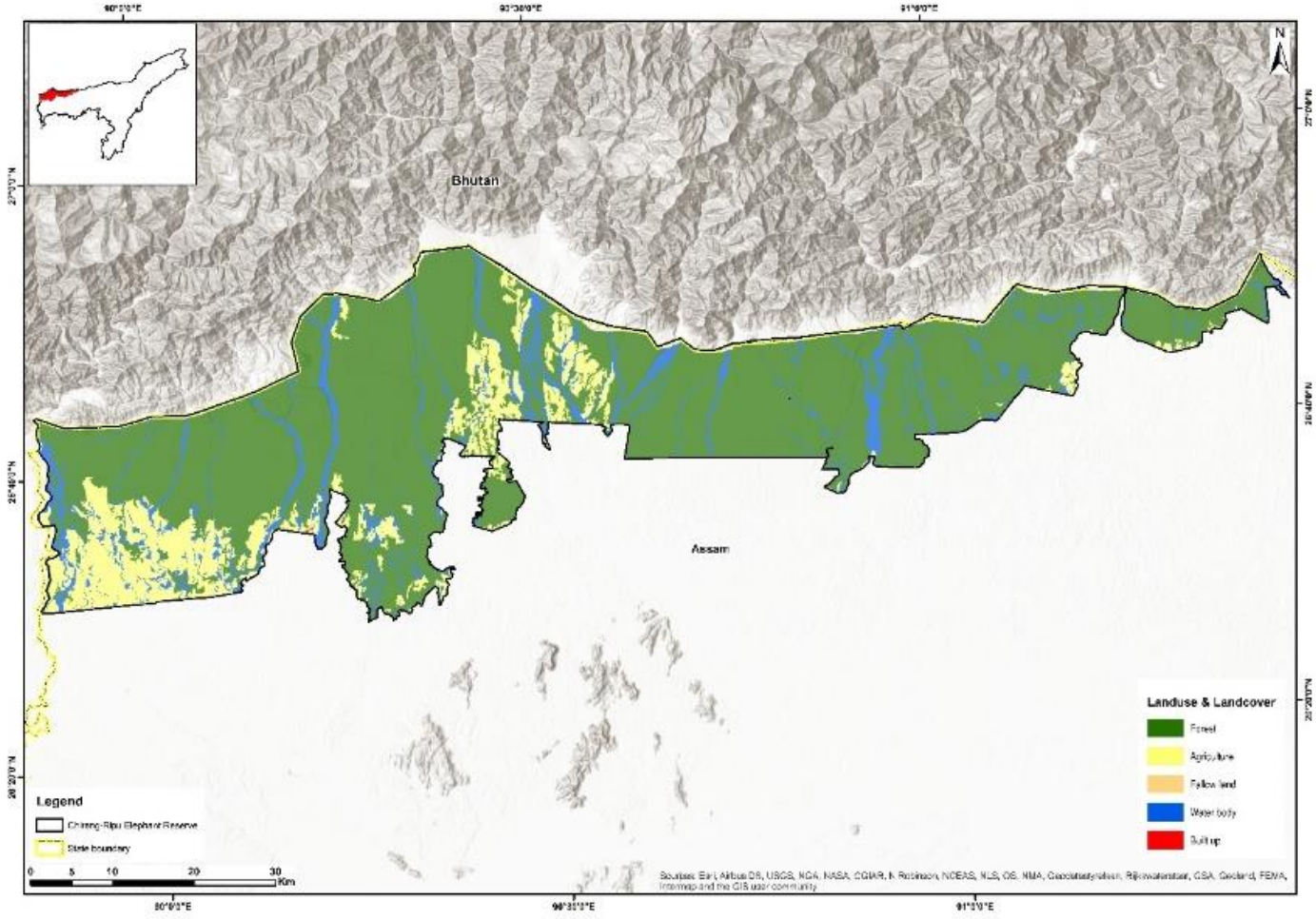


LULC Type	***2018 (%)***
Forest	*85.49*
Agriculture	*11.98*
Fallow land	*1.81*
Built up	*0.03*
Waterbody	*0.68*

Over 85% of the South Arunachal ER is forested. Between 1985 and 1995, there was a decline in the forest cover and increase in the agricultural areas. It may be noted that the resolution of the geospatial layers for 1985 and 1995 was the same. From the year 1995 onwards, the forest cover appears steady.

LULC Map of South Arunachal Elephant Reserve for the Year 2018 with linear infrastructure – Bhuvan (NRSC)

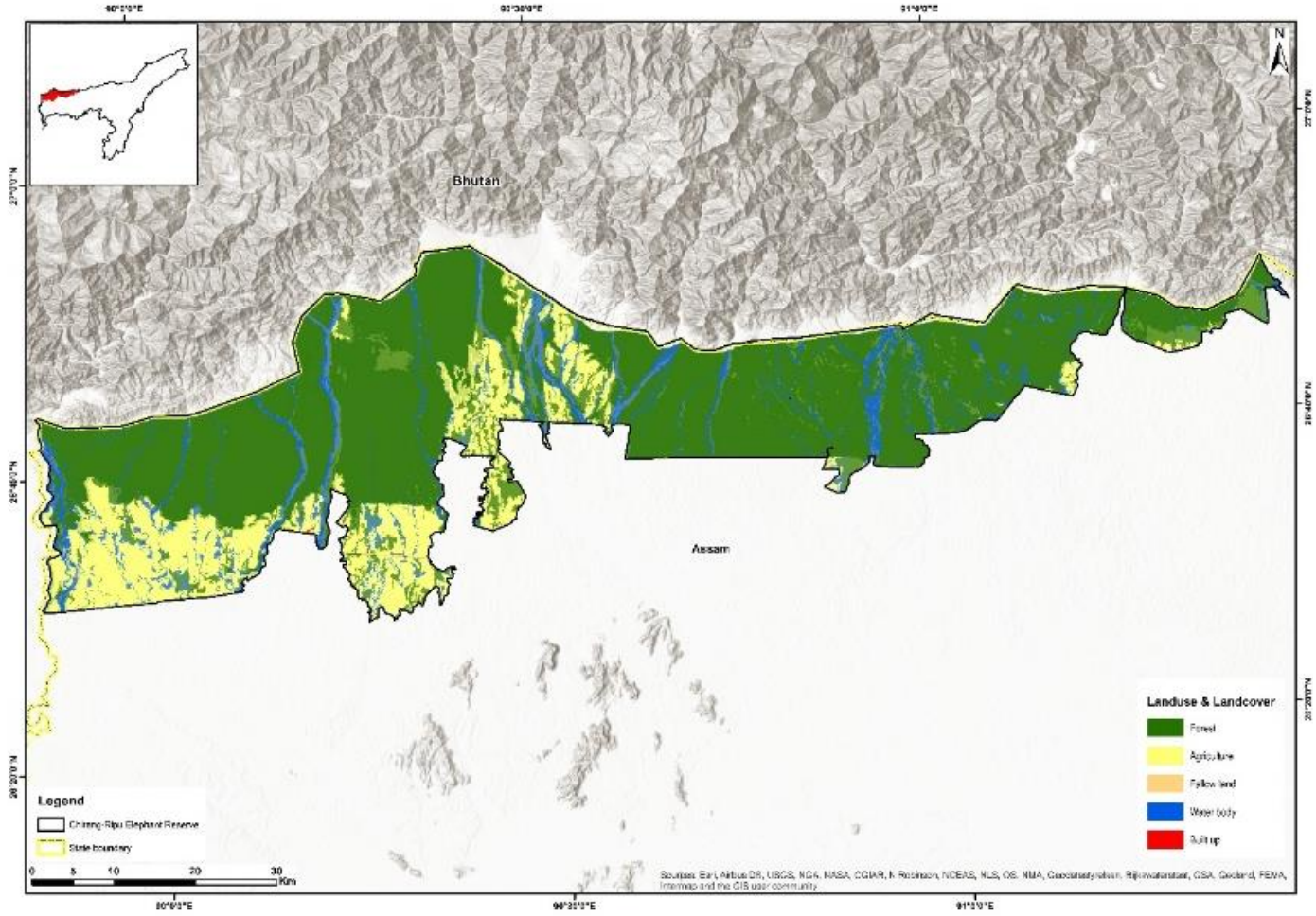
Chirang - Ripu Elephant Reserve, Assam 1985



LULC Type	*1985 (%)*
Forest	*75.48*
Agriculture	*14.28*
Fallow land	*0.00*
Built up	*0.01*
Waterbody	*10.23*

LULC Map of Chirang - Ripu Elephant Reserve for the Year 1985 – Roy et al., 2016

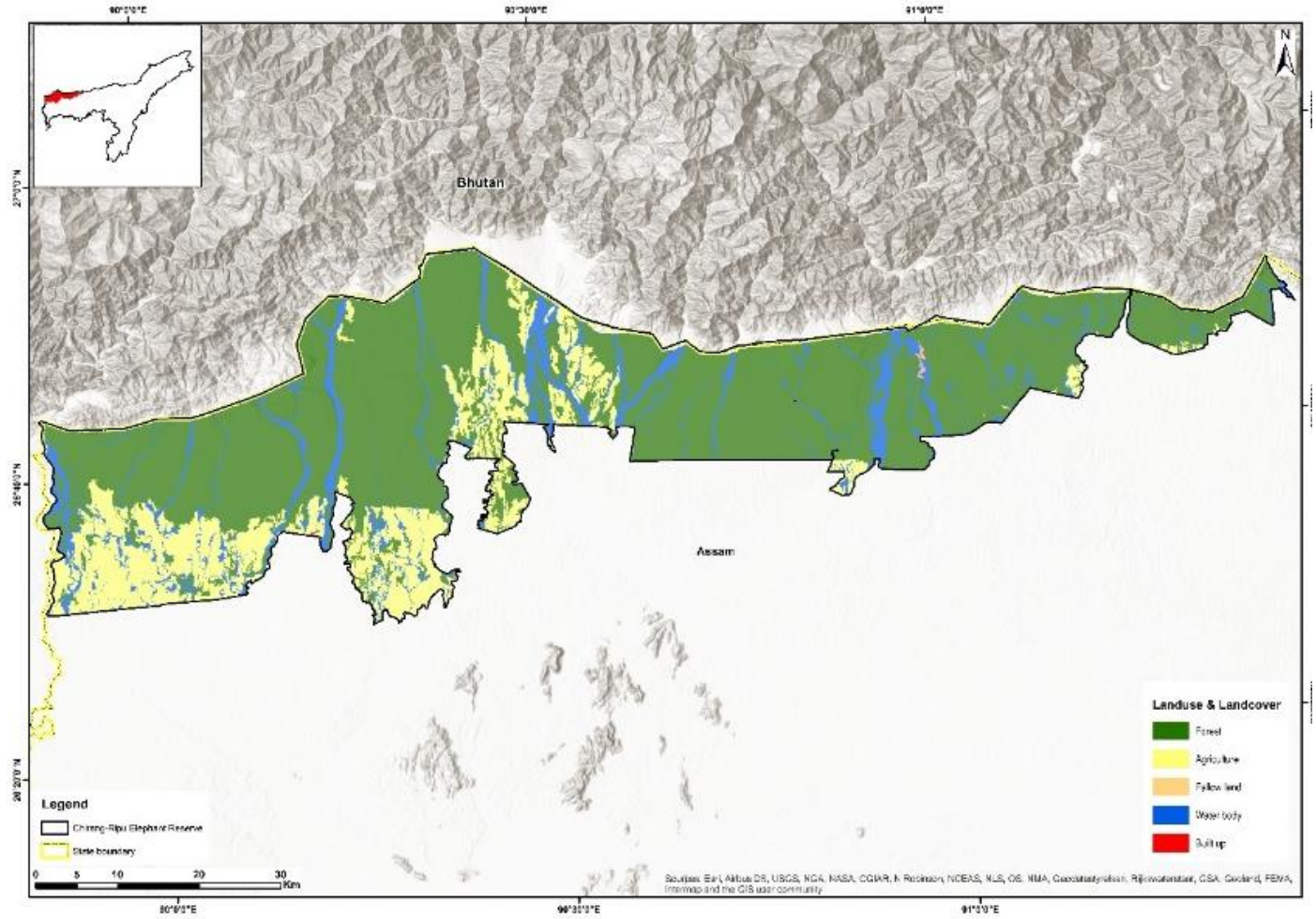
Chirang - Ripu Elephant Reserve, Assam 1995



LULC Type	*1995 (%)*
Forest	*70.40*
Agriculture	*19.05*
Fallow land	*0.00*
Built up	*0.01*
Waterbody	*10.52*

LULC Map of Chirang - Ripu Elephant Reserve for the Year 1995 – Roy et al., 2016

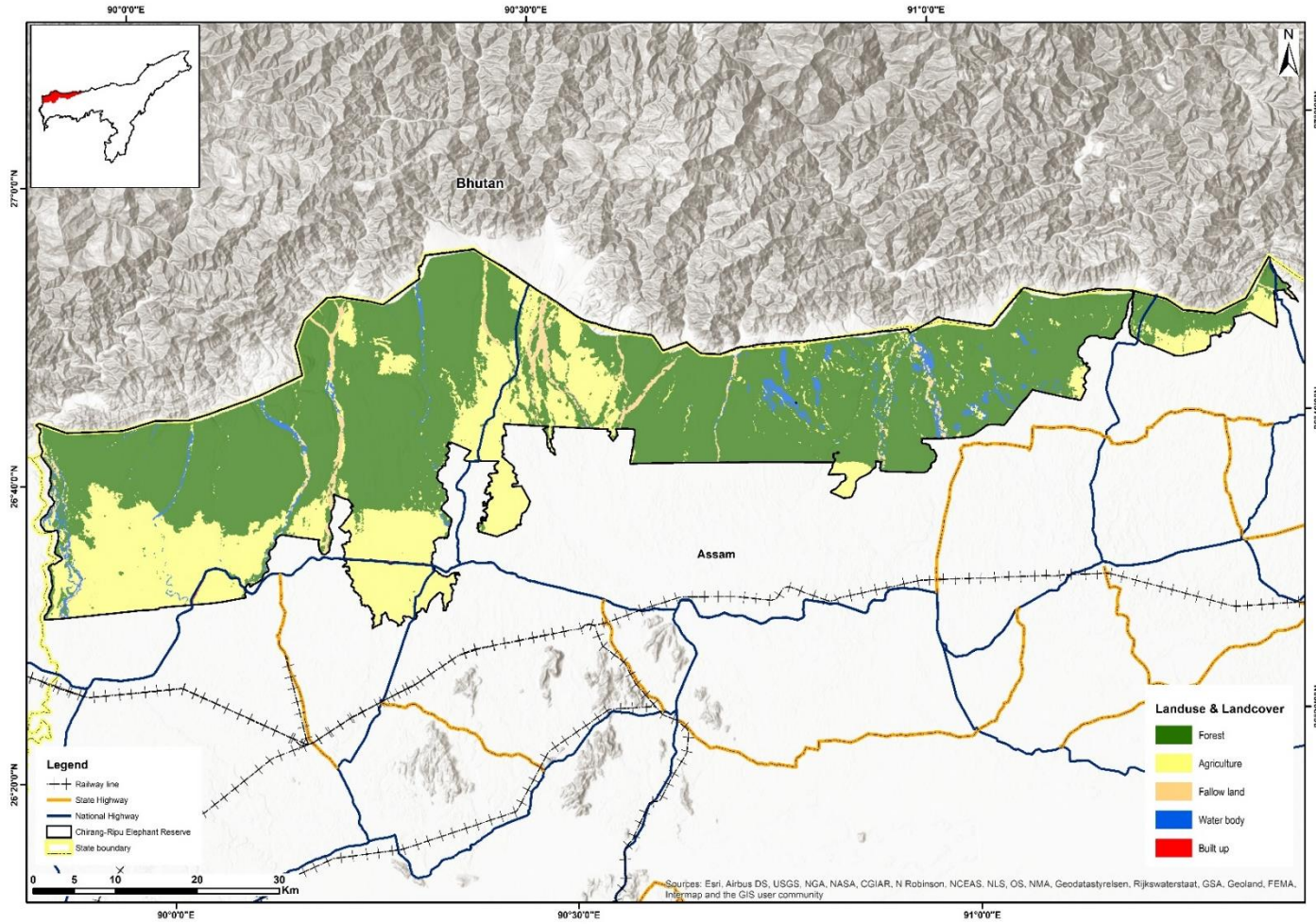
Chirang - Ripu Elephant Reserve, Assam 2005



LULC Type	*2005 (%)*
Forest	*69.41*
Agriculture	*19.41*
Fallow land	*0.07*
Built up	*0.01*
Waterbody	*11.10*

LULC Map of Chirang - Ripu Elephant Reserve for the Year 2005 – Roy et al., 2016

Chirang - Ripu Elephant Reserve, Assam 2018

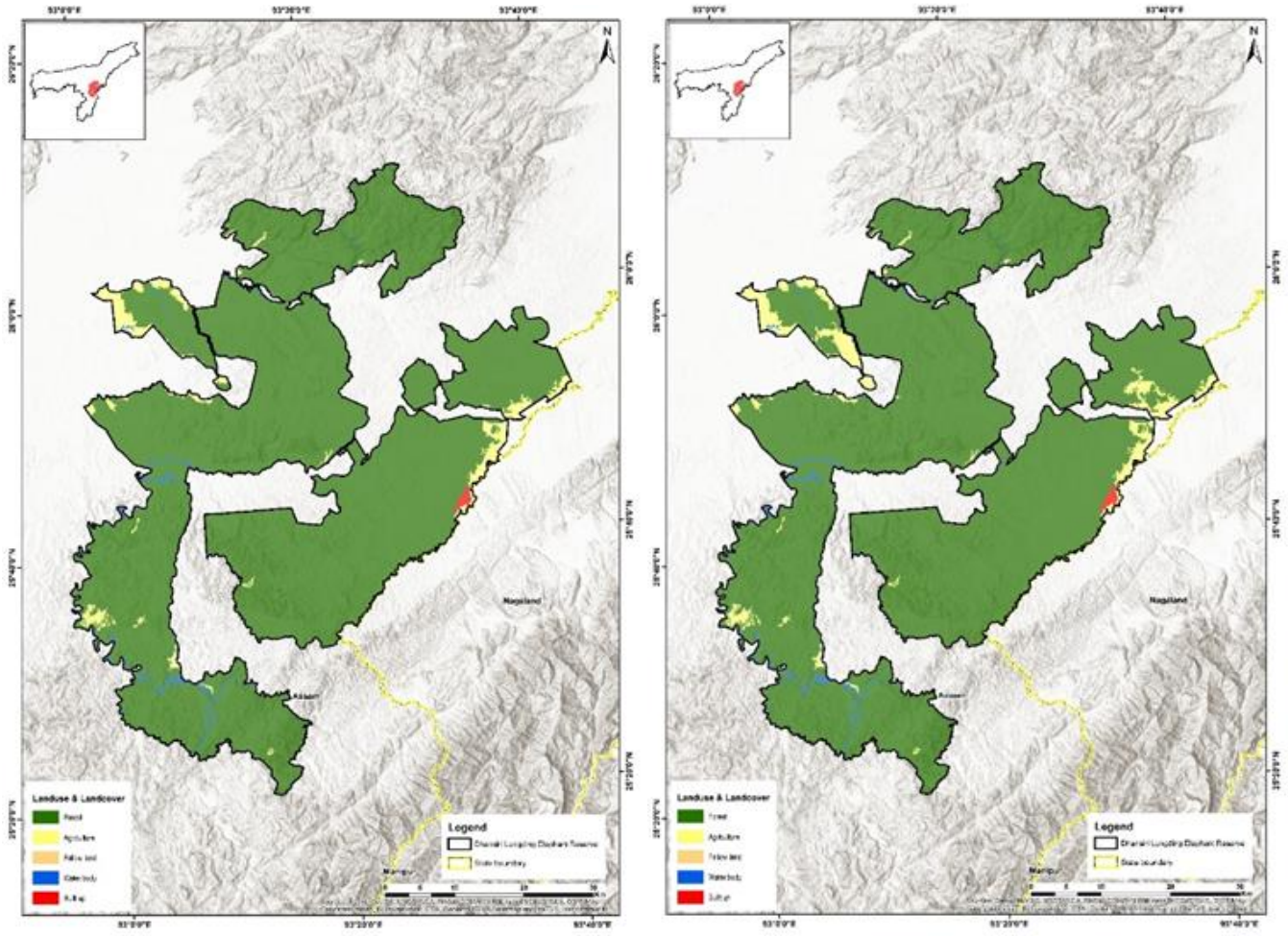


LULC Type	*2018 (%)*
Forest	*66.89*
Agriculture	*28.28*
Fallow land	*2.41*
Built up	*0.08*
Waterbody	*2.34*

About 66.9% of Chirag Ripu ER under forests. Decline in the forest cover was observed during the period 1985 to 1995). Even for the period 1995 to 2005, there was a marginal decrease. For the period 2005 to 2018 to a decline in forest cover was observed. However, the resolution of the layers 2005 and 2018 are not comparable.

LULC Map of Chirang - Ripu Elephant Reserve for the Year 2018 with linear infrastructure – Bhuvan (NRSC)

Dhansiri Lungding Elephant Reserve, Assam 1985 & 95

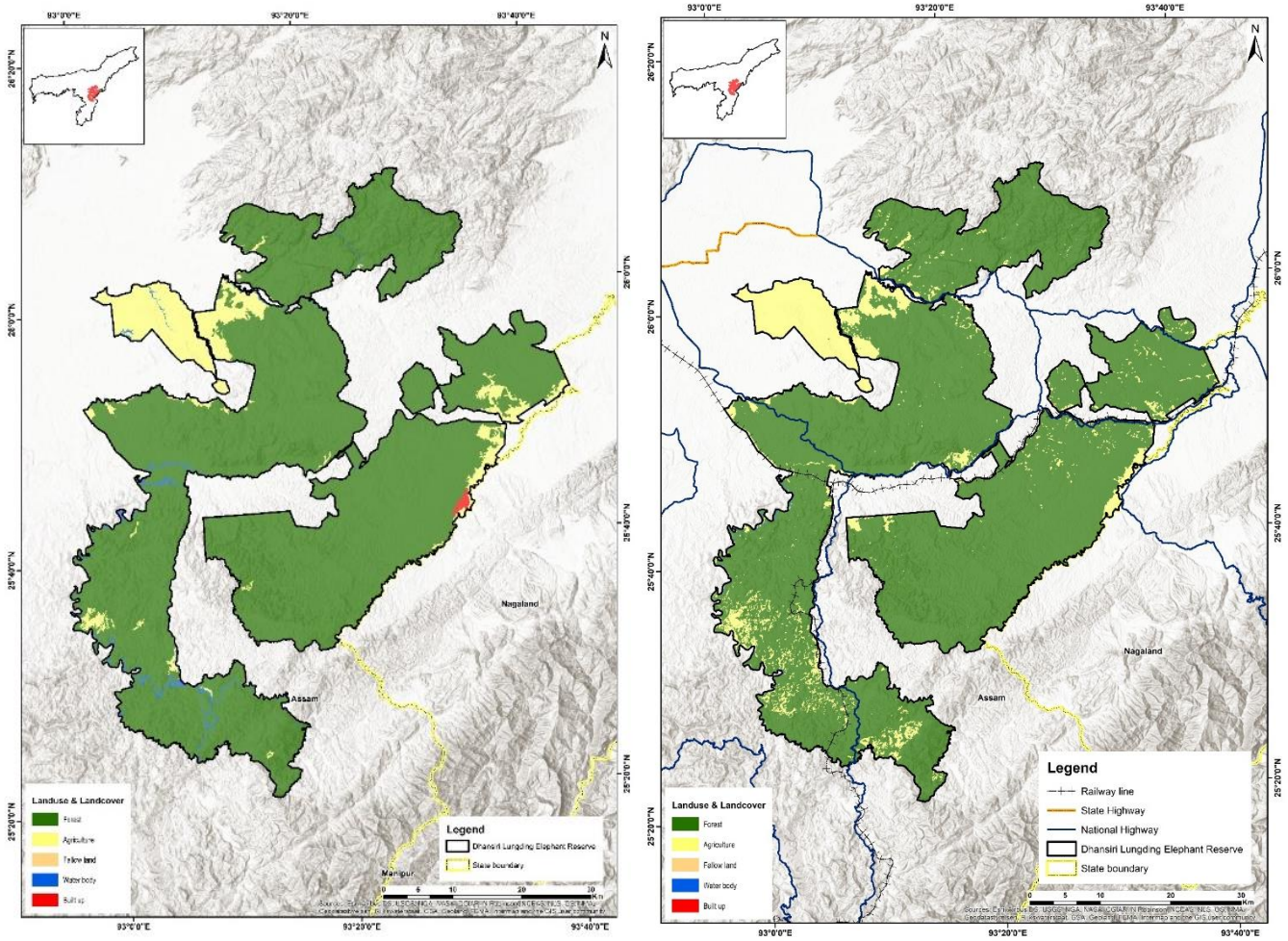


LULC Type	***1985 (%)***
Forest	*95.07*
Agriculture	*3.47*
Fallow land	*0.00*
Built up	*0.16*
Waterbody	*1.29*

LULC Type	***1995 (%)***
Forest	*94.02*
Agriculture	*4.52*
Fallow land	*0.00*
Built up	*0.16*
Waterbody	*1.29*

LULC Map of Dhansiri Lungding Elephant Reserve for the Year 1985 & 95 – Roy et al., 2016

Dhansiri Lungding Elephant Reserve, Assam 2005 & 18



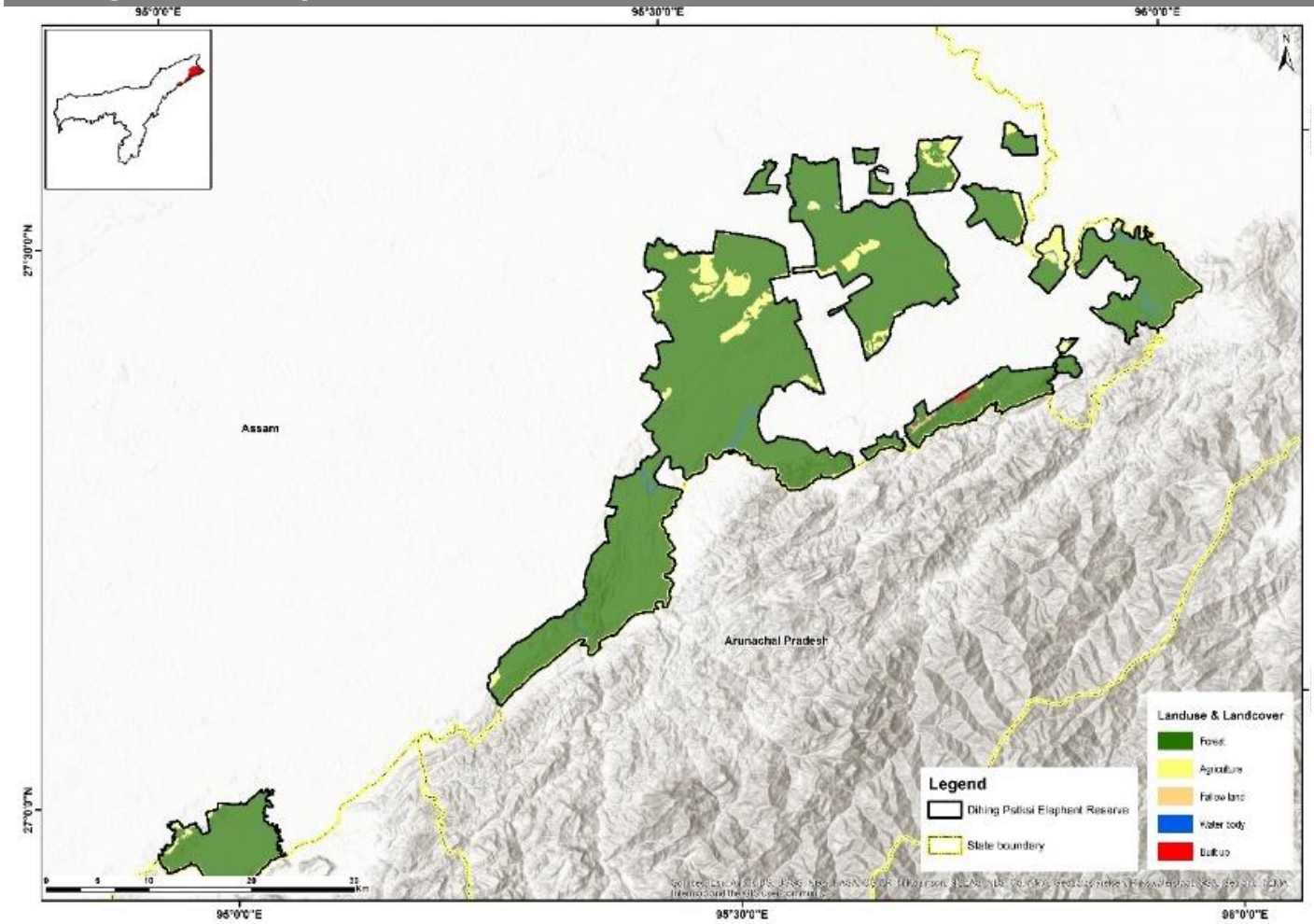
LULC Type	2005 (%)
Forest	90.11
Agriculture	8.45
Fallow land	0.00
Built up	0.16
Waterbody	1.29

LULC Type	2018 (%)
Forest	89.27
Agriculture	10.57
Fallow land	0.01
Built up	0.01
Waterbody	0.15

LULC Map of Dhansiri Lungding Elephant Reserve for the Year 2005 – Roy at al., 2016 & Year 2018 – Bhuvan (NRSC)

About 89.27% of Dhansiri Lungding ER under forests. A marginal decline in the forest cover was observed during the period 1985 to 1995. For the period 1995 to 2005, there was a relatively high decline in the forest cover. For the period 2005 to 2018 decline in forest cover was observed. However, the resolution of the layers 2005 and 2018 are not comparable.

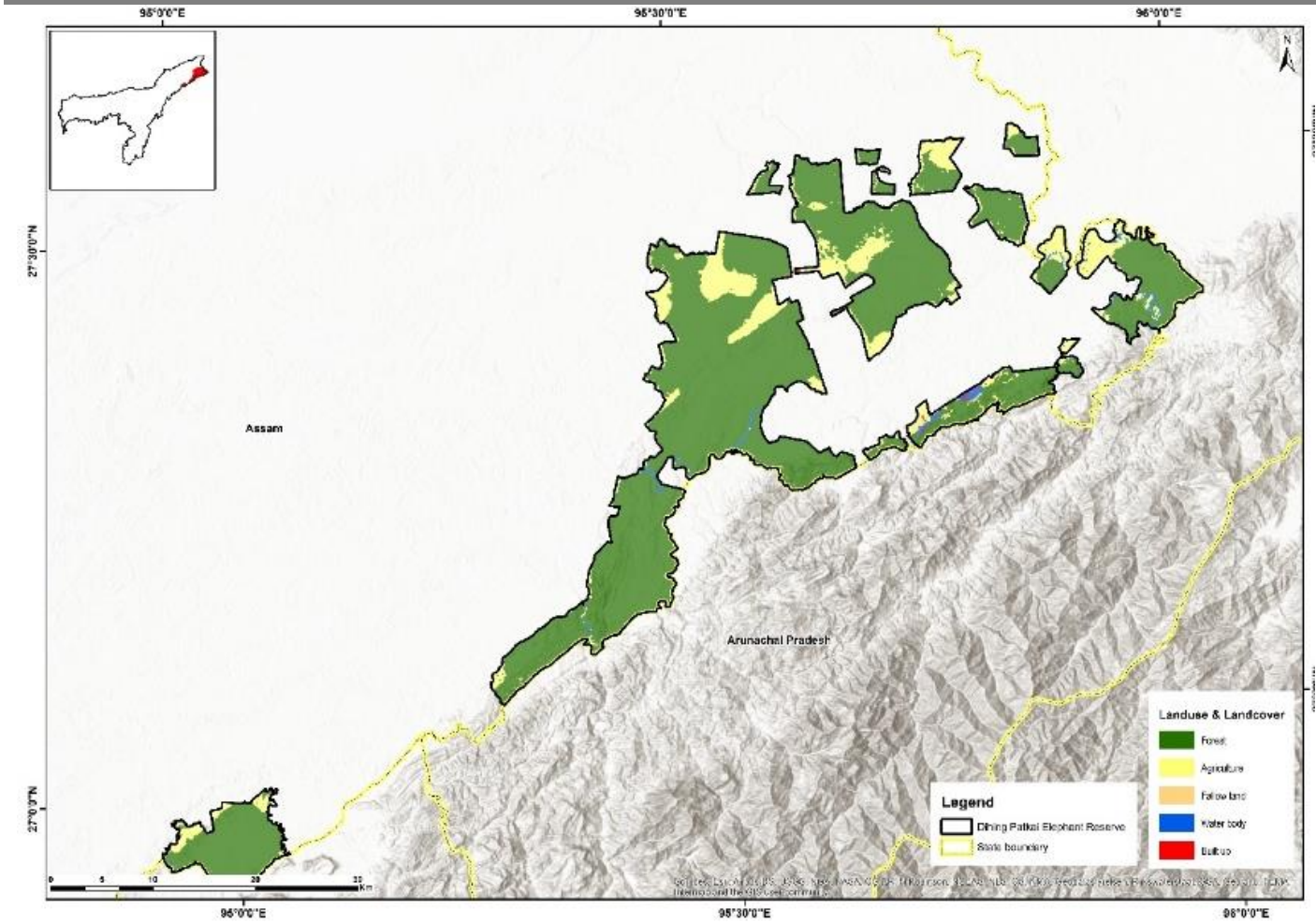
Dihing Patkai Elephant Reserve, Assam 1985



LULC Type	*1985 (%)*
Forest	*91.25*
Agriculture	*7.40*
Fallow land	*0.14*
Built up	*0.13*
Waterbody	*1.07*

LULC Map of Dihing Patkai Elephant Reserve for the Year 1985 – Roy et al., 2016

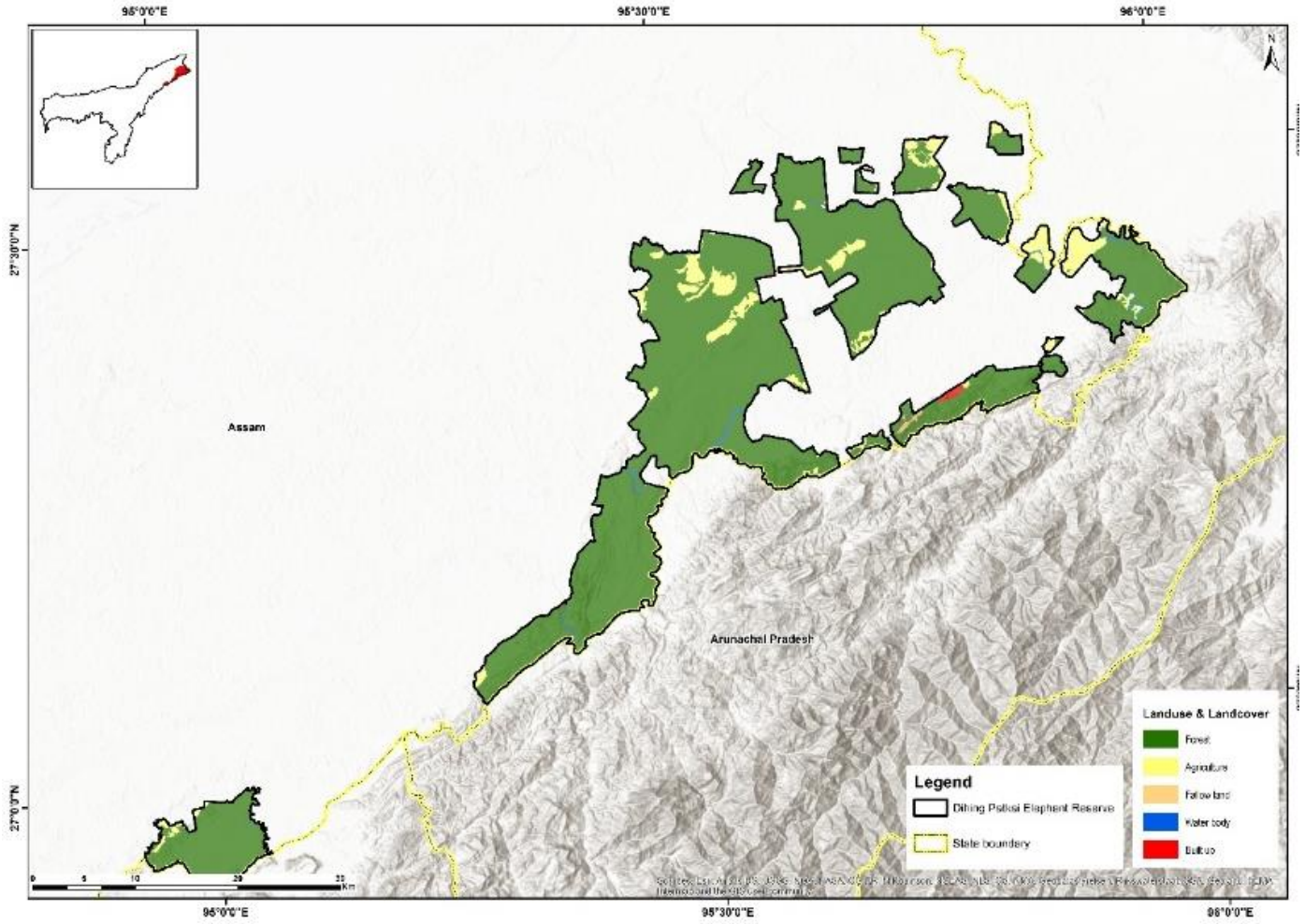
Dihing Patkai Elephant Reserve, Assam 1995



LULC Type	*1995 (%)*
Forest	*89.84*
Agriculture	*8.78*
Fallow land	*0.14*
Built up	*0.17*
Waterbody	*1.07*

LULC Map of Dihing Patkai Elephant Reserve for the Year 1995 – Roy et al., 2016

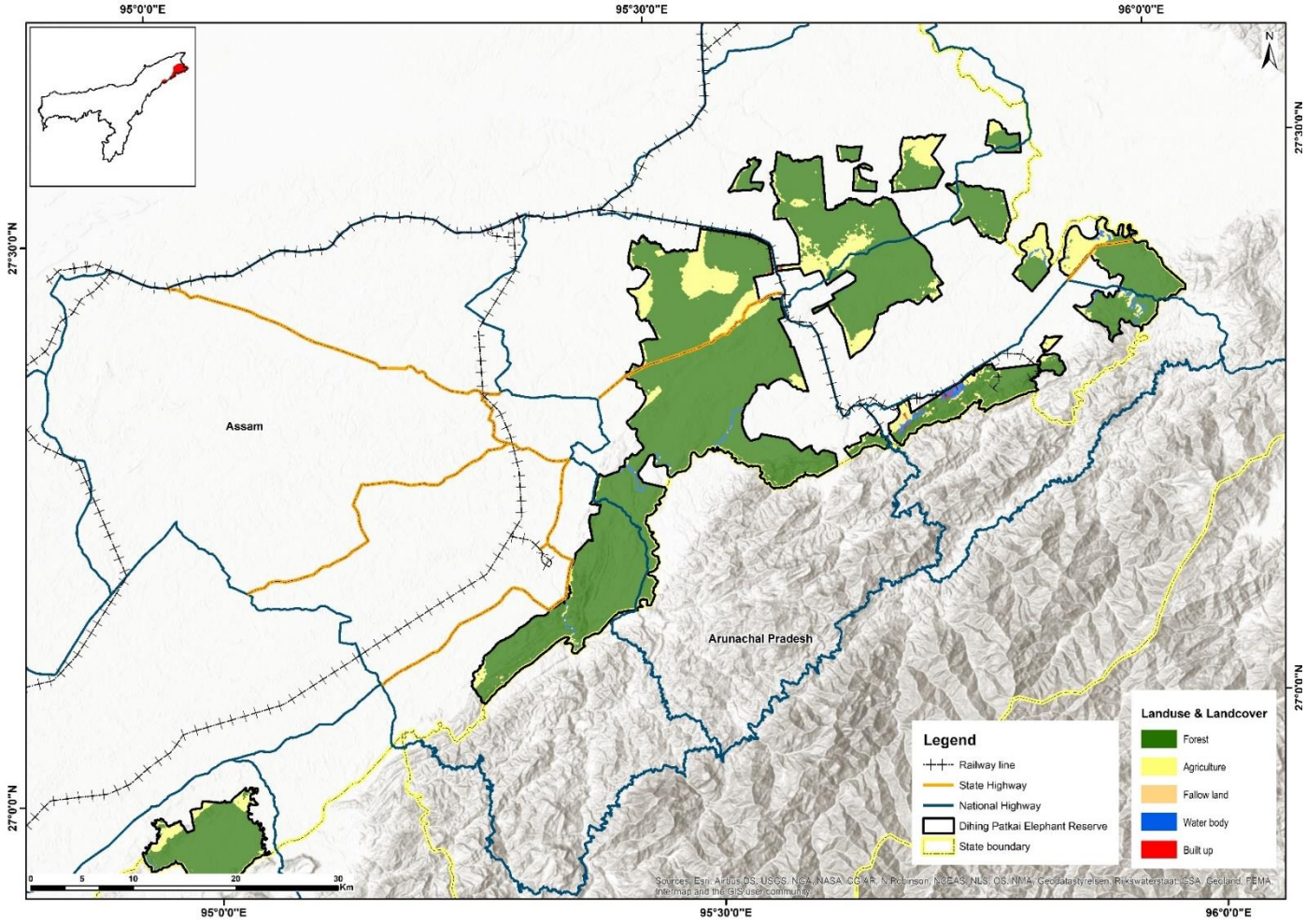
Dihing Patkai Elephant Reserve, Assam 2005



LULC Type	*2005 (%)*
Forest	*89.72*
Agriculture	*8.90*
Fallow land	*0.15*
Built up	*0.25*
Waterbody	*0.98*

LULC Map of Dihing Patkai Elephant Reserve for the Year 2005 – Roy et al., 2016

Dihing Patkai Elephant Reserve, Assam 2018

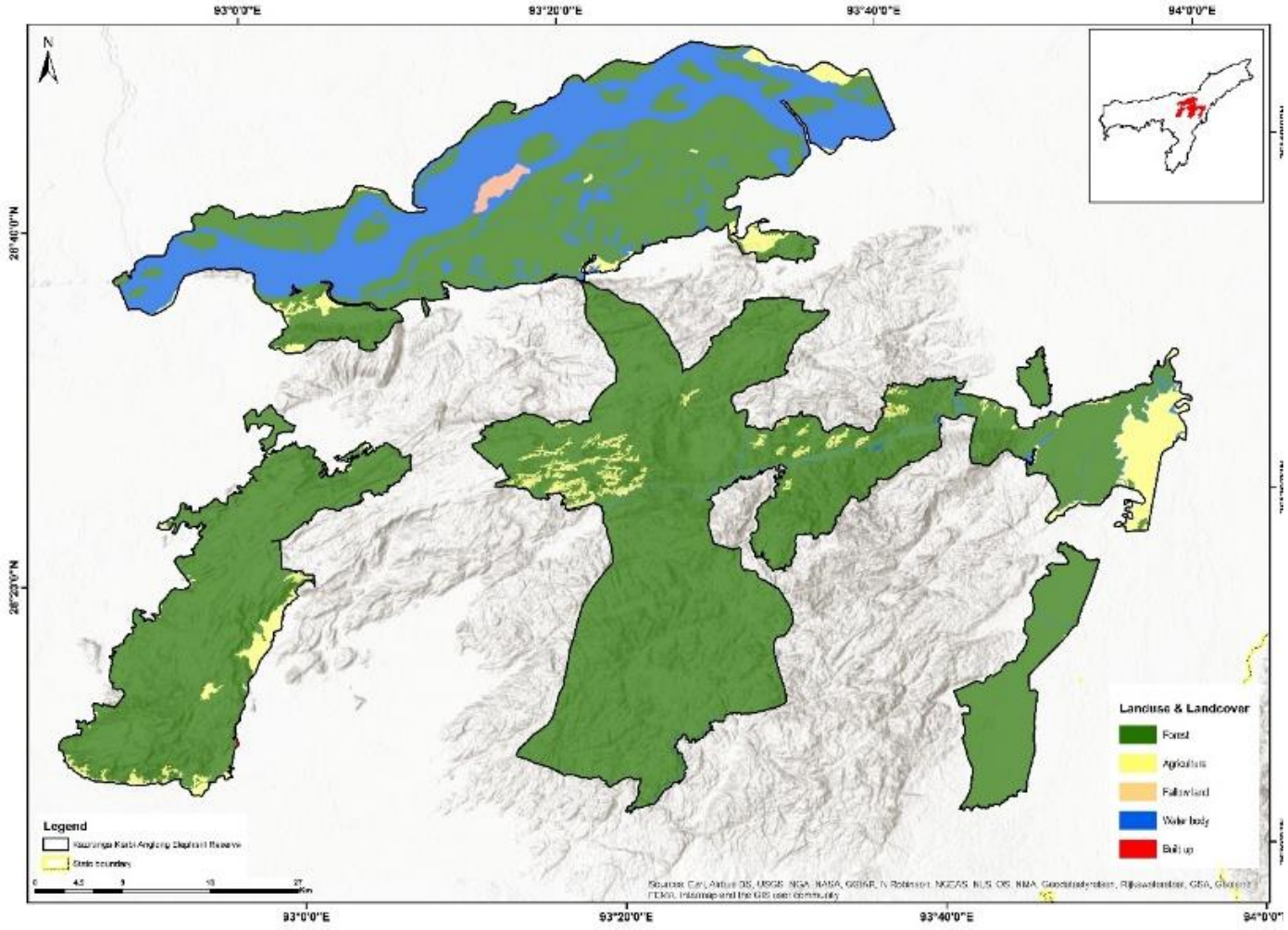


LULC Type	*2018 (%)*
Forest	*83.49*
Agriculture	*15.18*
Fallow land	*0.01*
Built up	*0.13*
Waterbody	*1.19*

About 83.5 % of Dihing Patkai ER under forests. Decrease in forest cover is evident between 1985 and 1995. Similarly, a decline in the forest cover was observed between 2005 and 2018. However, the resolution of the layers 2005 and 2018 are not comparable.

LULC Map of Dihing Patkai Elephant Reserve for the Year 2018 with linear infrastructure – Bhuvan (NRSC)

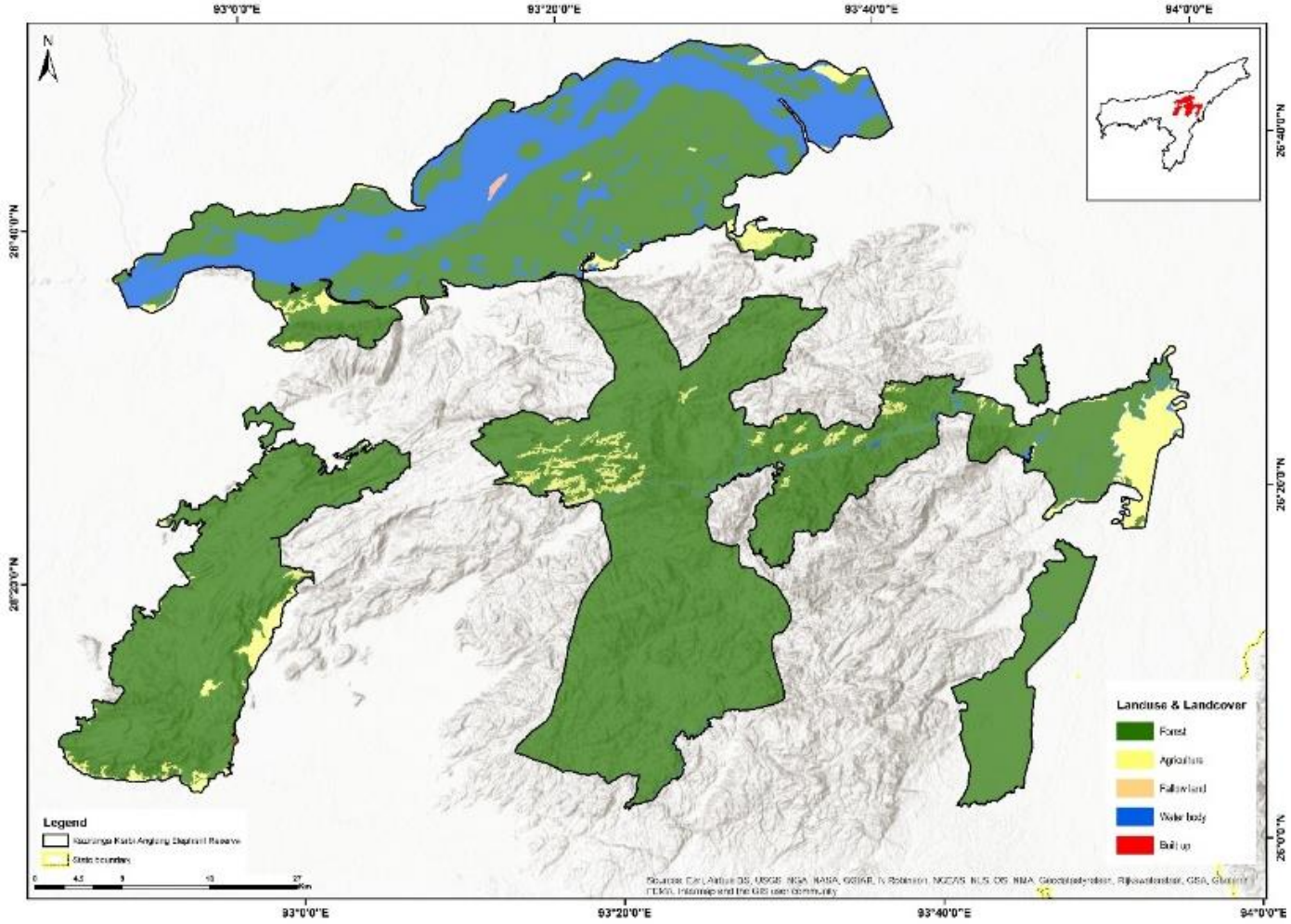
Kaziranga Karbi Anglong Elephant Reserve, Assam 1985



LULC Type	*1985 (%)*
Forest	*79.34*
Agriculture	*5.39*
Fallow land	*0.34*
Built up	*0.01*
Waterbody	*14.92*

LULC Map of Kaziranga Karbi Anglong Elephant Reserve for the Year 1985 – Roy et al., 2016

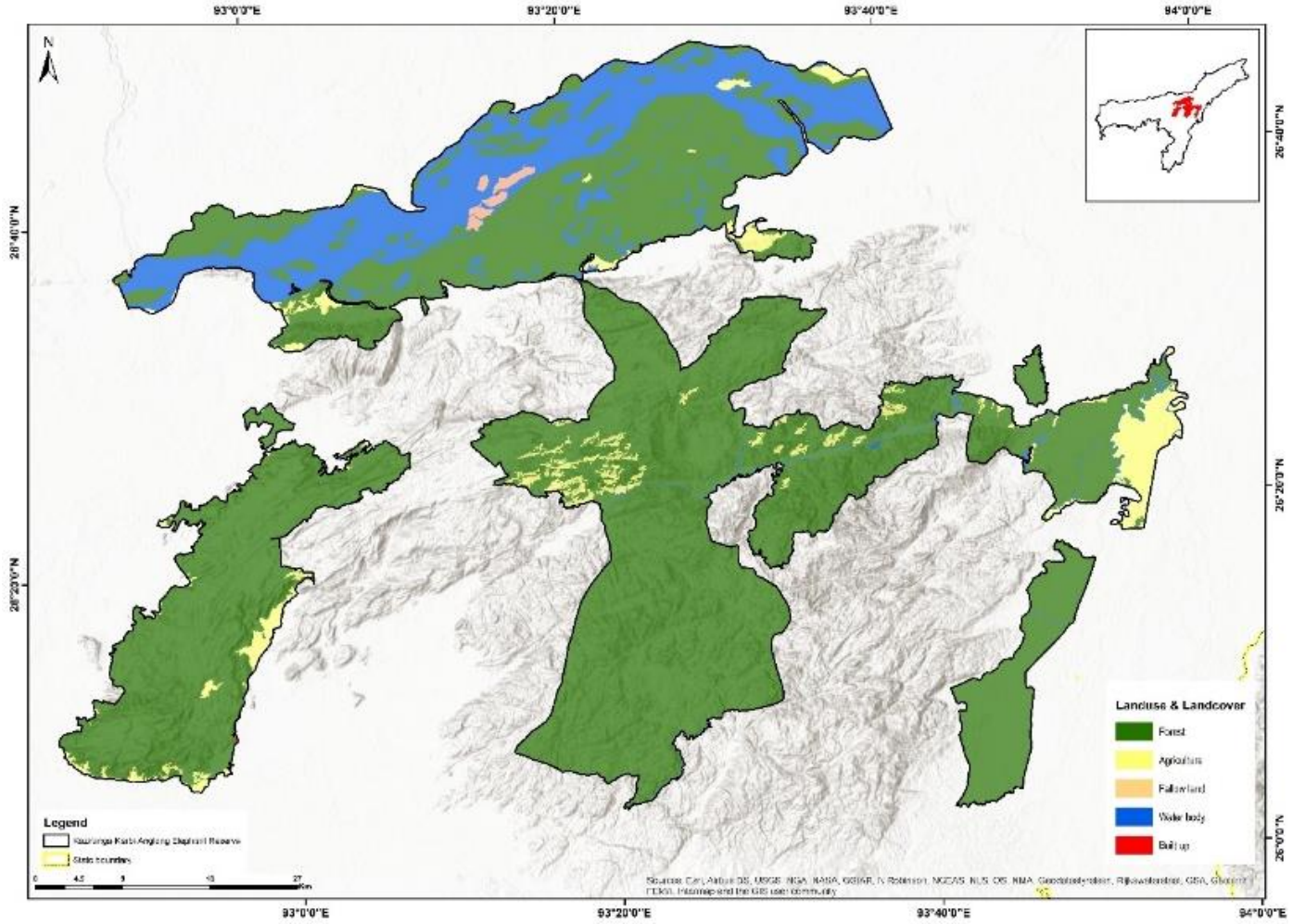
Kaziranga Karbi Anglong Elephant Reserve, Assam 1995



LULC Type	***1995 (%)***
Forest	*80.19*
Agriculture	*5.29*
Fallow land	*0.06*
Built up	*0.01*
Waterbody	*14.45*

LULC Map of Kaziranga Karbi Anglong Elephant Reserve for the Year 1995 – Roy et al., 2016

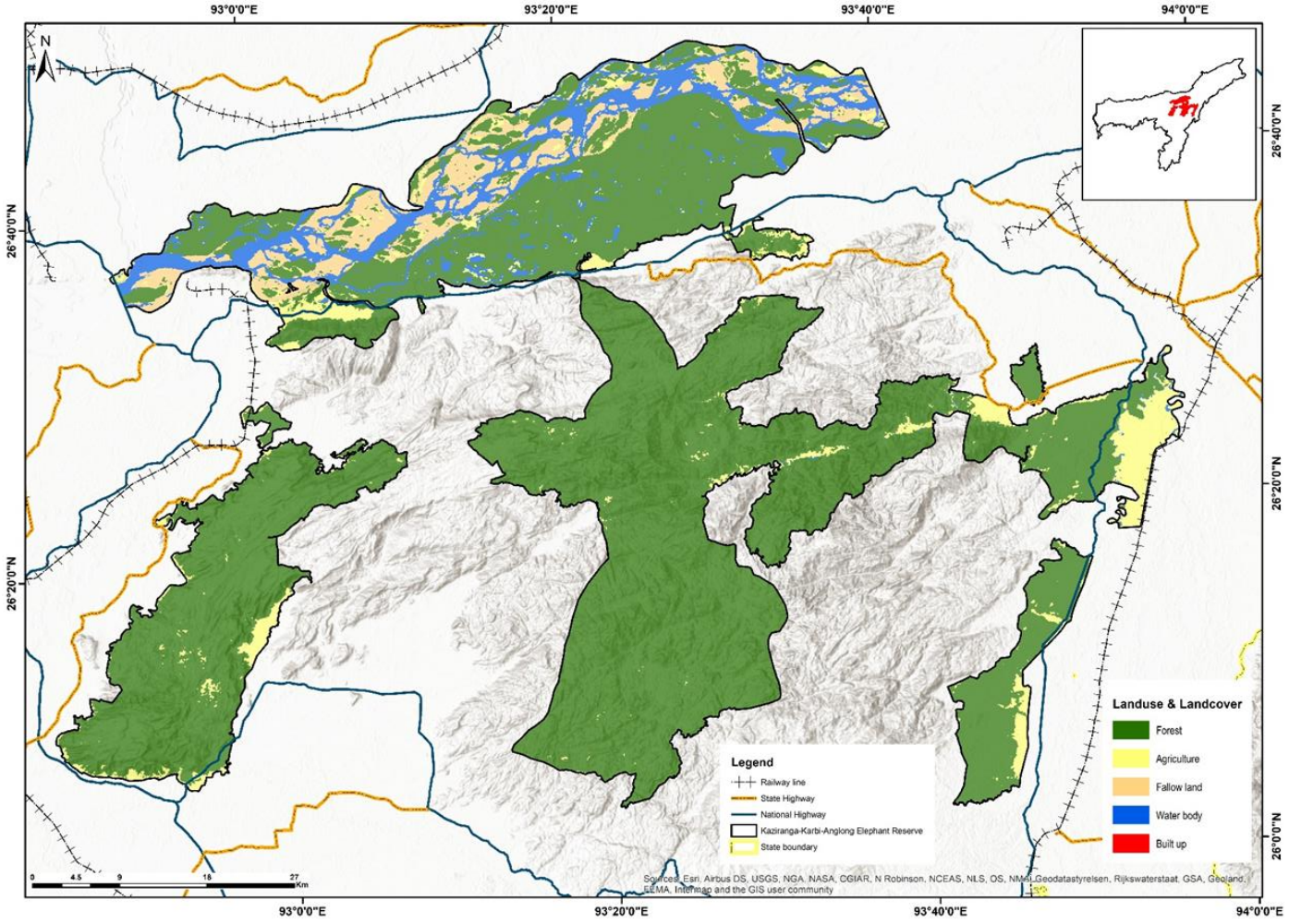
Kaziranga Karbi Anglong Elephant Reserve, Assam 2005



LULC Type	*2005 (%)*
Forest	*79.19*
Agriculture	*5.20*
Fallow land	*0.39*
Built up	*0.01*
Waterbody	*15.21*

LULC Map of Kaziranga Karbi Anglong Elephant Reserve for the Year 2005 – Roy et al., 2016

Kaziranga Karbi Anglong Elephant Reserve, Assam 2018

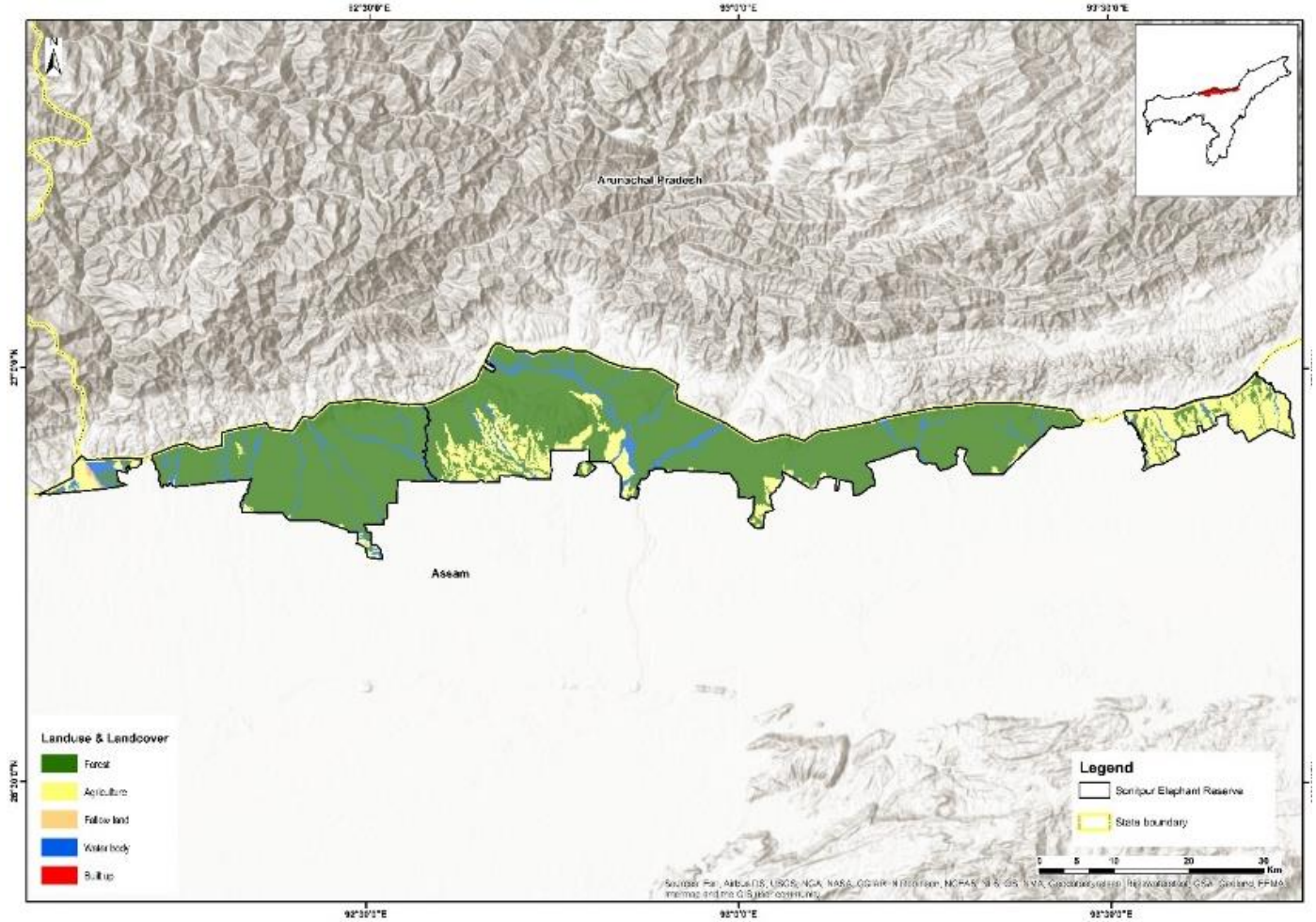


LULC Type	*2018 (%)*
Forest	*84.17*
Agriculture	*6.99*
Fallow land	*1.27*
Built up	*0.00*
Waterbody	*7.57*

About 84.7 % of Kaziranga Karbi-Anglong ER is under forests. An increase in the forest cover as evident between 2005 and 2018. During the same period, there was a decline in the water body (primarily Brahmaputra River). Since the resolution of the two layers was not comparable, it would require intensive assessment using a combination of ground information and high-resolution satellite imagery-based classification.

LULC Map of Kaziranga Karbi Anglong Elephant Reserve for the Year 2018 with linear infrastructure – Bhuvan (NRSC)

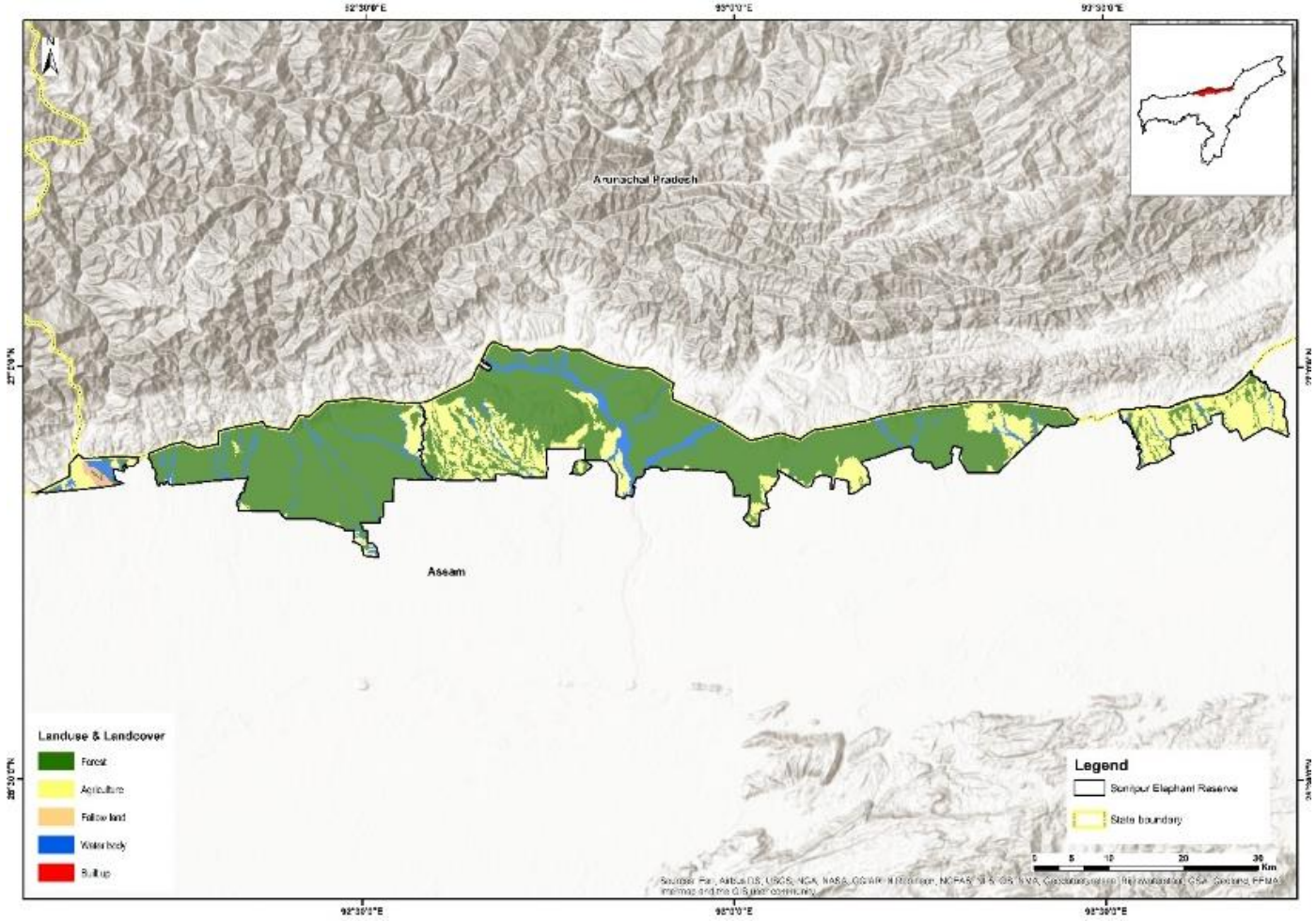
Sonitpur Elephant Reserve, Assam 1985



LULC Type	*1985 (%)*
Forest	*77.98*
Agriculture	*15.34*
Fallow land	*0.12*
Built up	*0.00*
Waterbody	*6.55*

LULC Map of Sonitpur Elephant Reserve for the Year 1985 – Roy et al., 2016

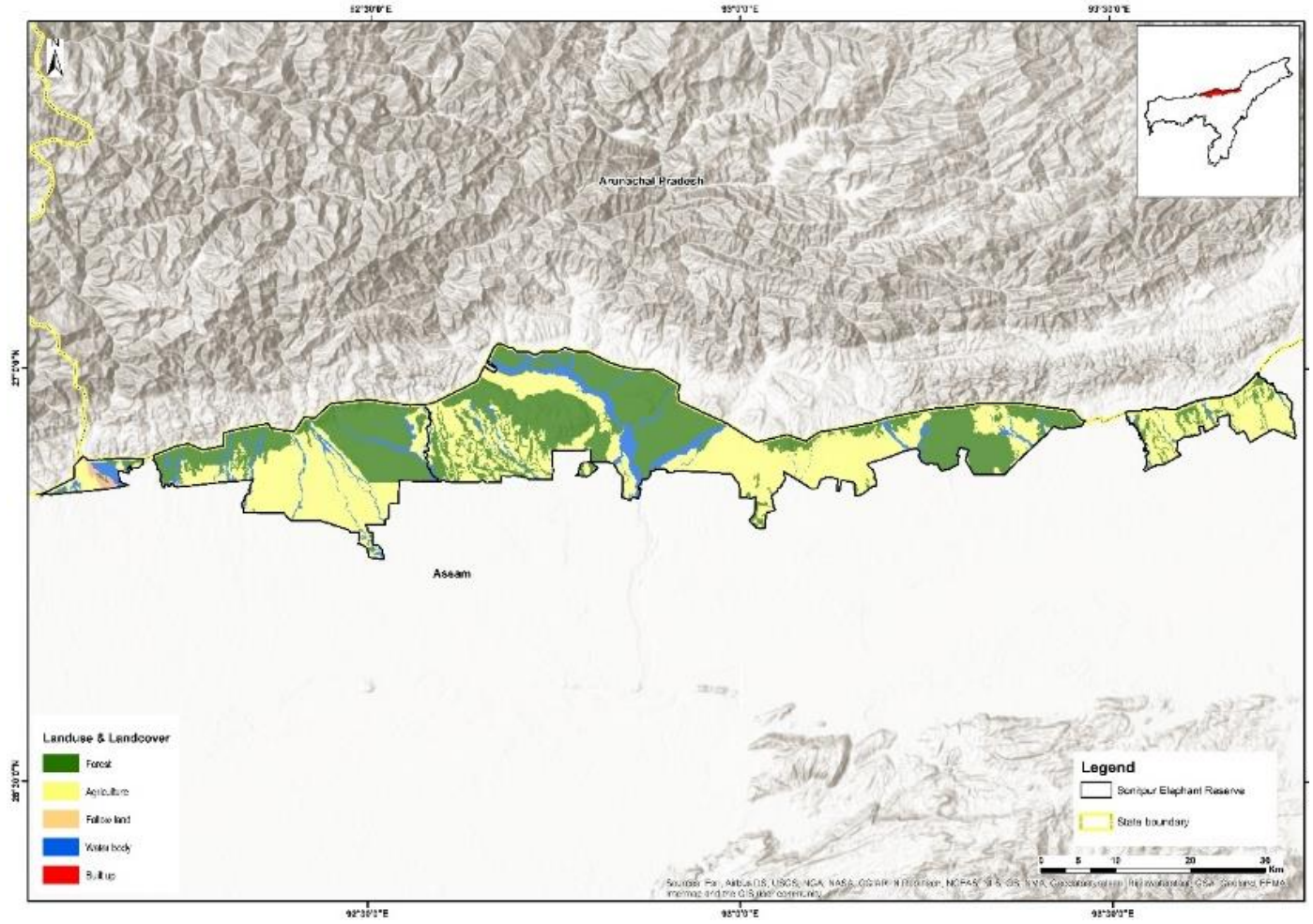
Sonitpur Elephant Reserve, Assam 1995



LULC Type	*1995 (%)*
Forest	*70.98*
Agriculture	*21.16*
Fallow land	*0.39*
Built up	*0.03*
Waterbody	*7.44*

LULC Map of Sonitpur Elephant Reserve for the Year 1995 – Roy et al., 2016

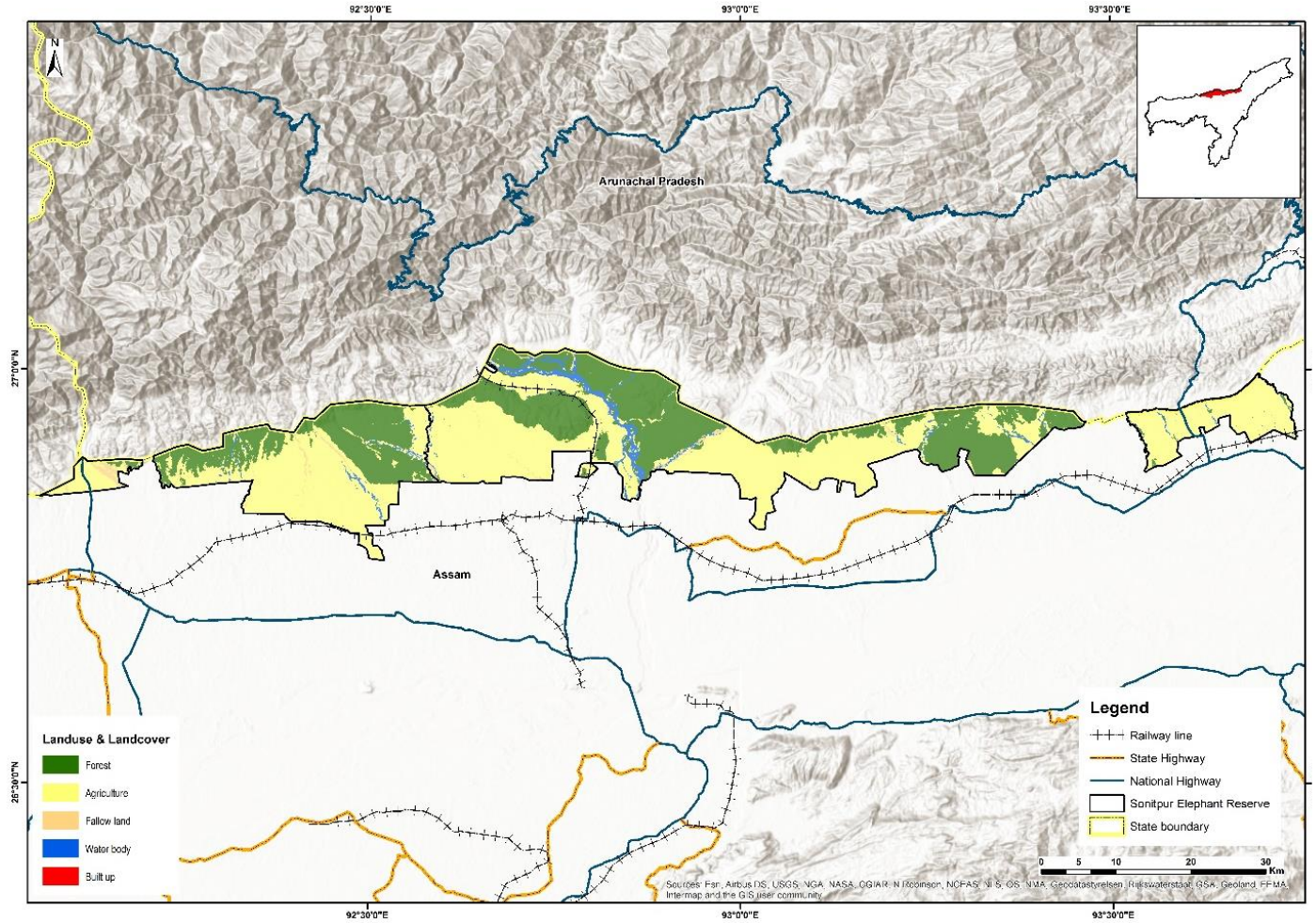
Sonitpur Elephant Reserve, Assam 2005



LULC Type	*2005 (%)*
Forest	*71.03*
Agriculture	*21.12*
Fallow land	*0.39*
Built up	*0.03*
Waterbody	*7.42*

LULC Map of Sonitpur Elephant Reserve for the Year 2005 – Roy et al., 2016

Sonitpur Elephant Reserve, Assam 2018

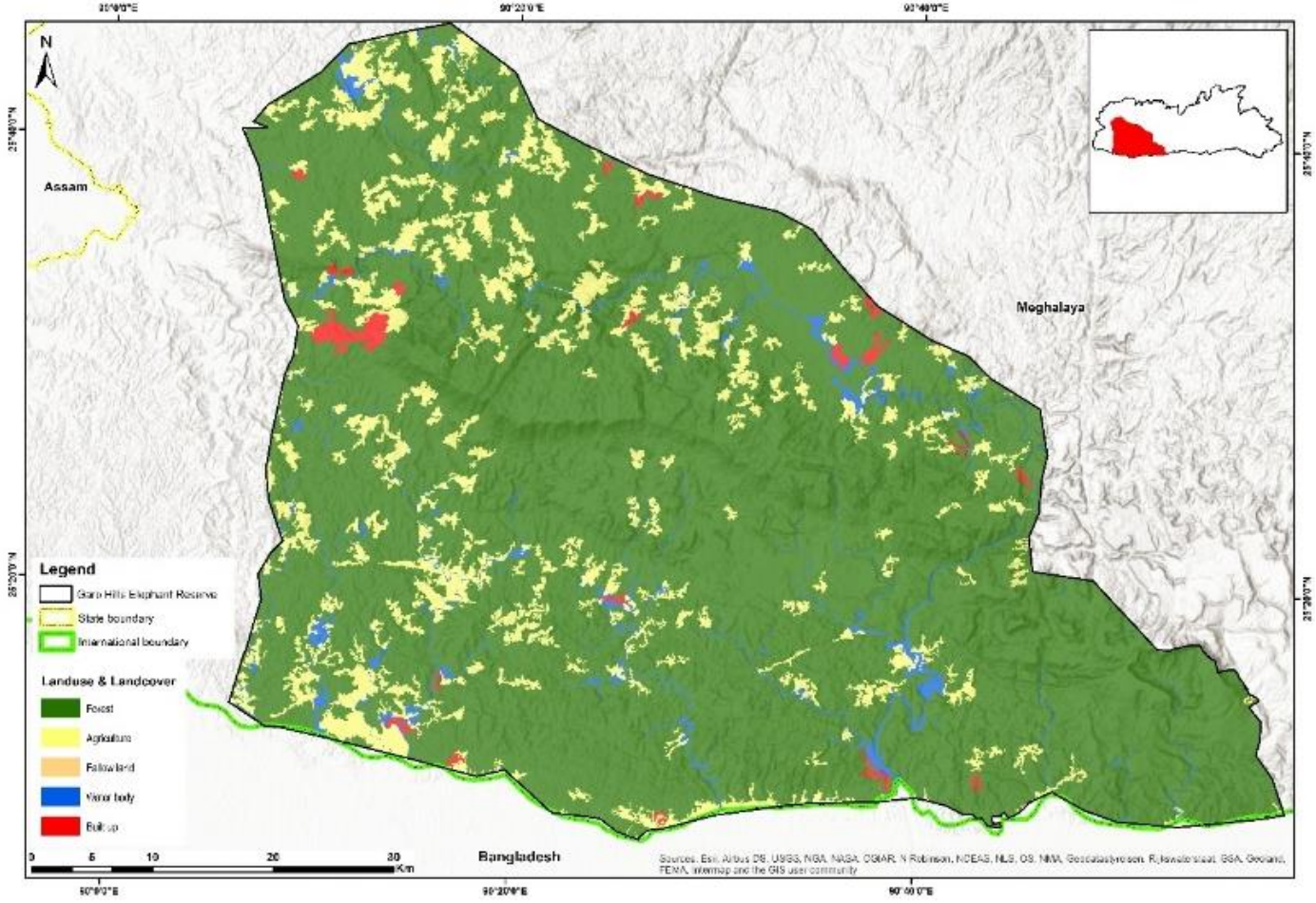


LULC Type	*2018 (%)*
Forest	*38.5*
Agriculture	*57.7*
Fallow land	*0.7*
Built up	*0.00*
Waterbody	*3.1*

In the Sonitpur ER, around 38.5% of the reserve is under forest cover. A major decline in the forest cover was observed between the years 2005 and 2018. This calls for a detailed assessment using a combination of ground information as well as recent high-resolution imagery with which fine-scale supervised classification of land-use can be done.

LULC Map of Sonitpur Elephant Reserve for the Year 2018 with linear infrastructure – Bhuvan (NRSC)

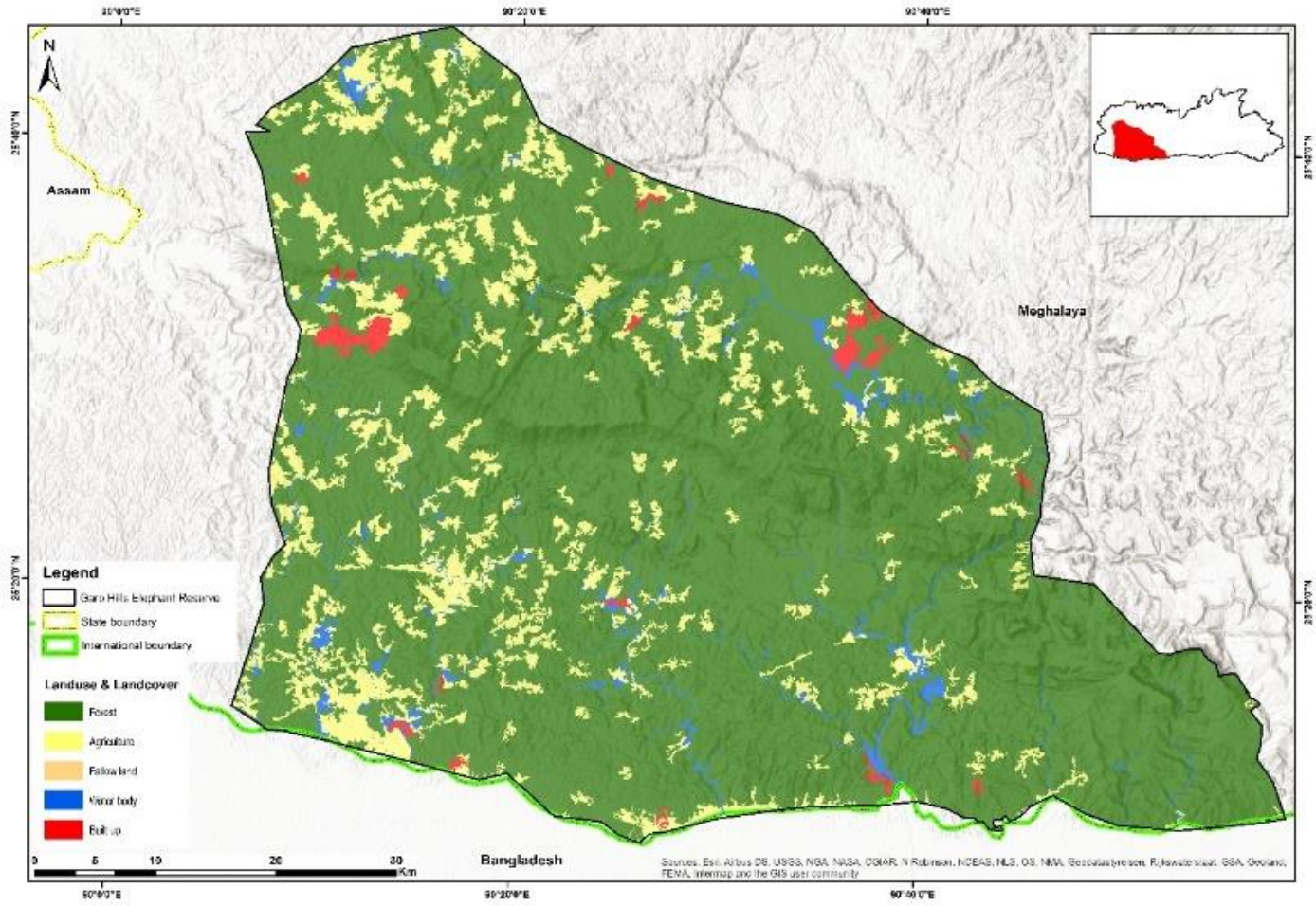
Garo Hills Elephant Reserve, Meghalaya 1985



LULC Type	***1985 (%)***
Forest	*85.38*
Agriculture	*11.24*
Fallow land	*0.00*
Built up	*0.87*
Waterbody	*2.51*

LULC Map of Garo Hills Elephant Reserve for the Year 1985 – Roy et al., 2016

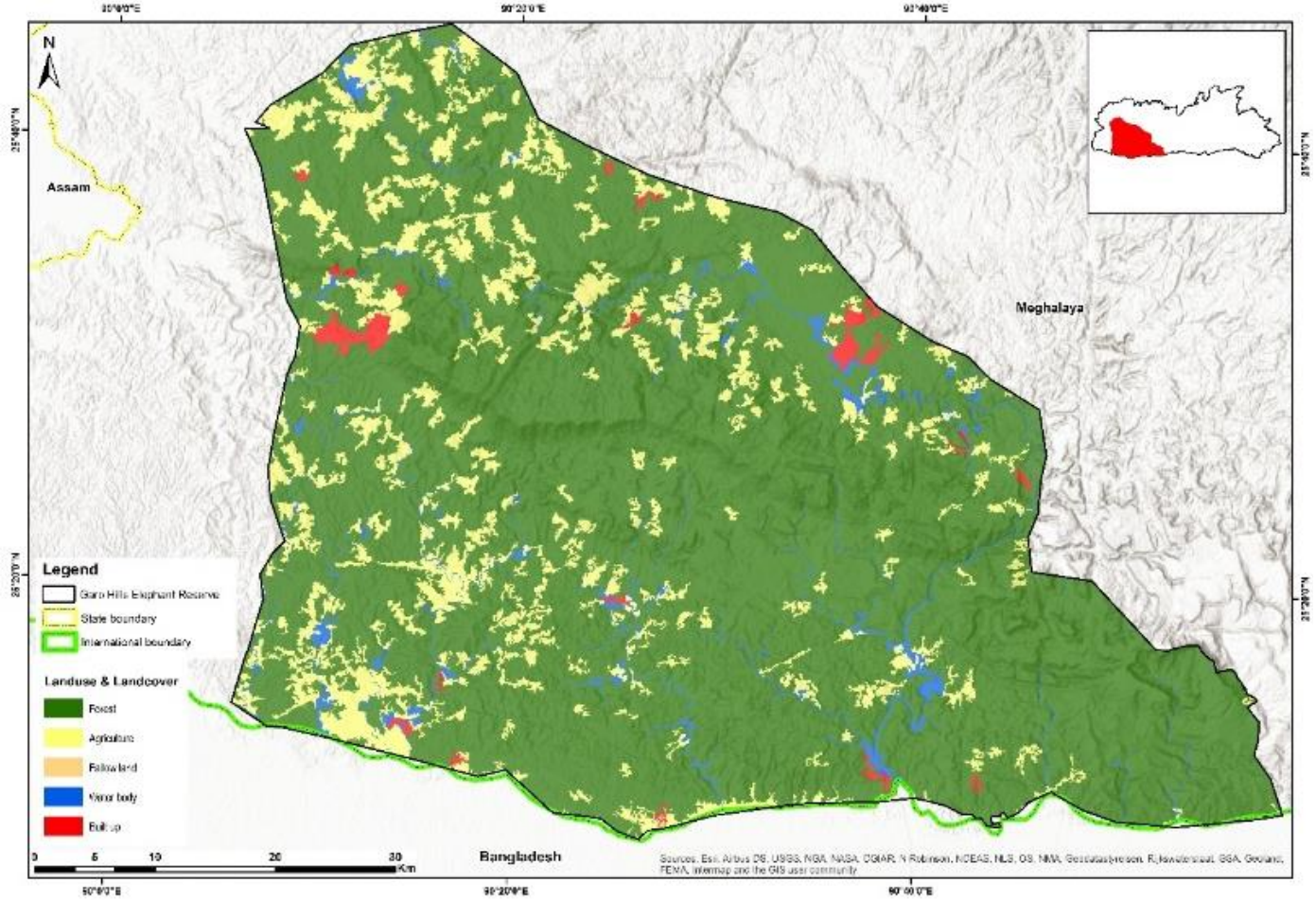
Garo Hills Elephant Reserve, Meghalaya 1995



LULC Type	*1995 (%)*
Forest	*84.12*
Agriculture	*12.36*
Fallow land	*0.00*
Built up	*1.01*
Waterbody	*2.51*

LULC Map of Garo Hills Elephant Reserve for the Year 1995 – Roy et al., 2016

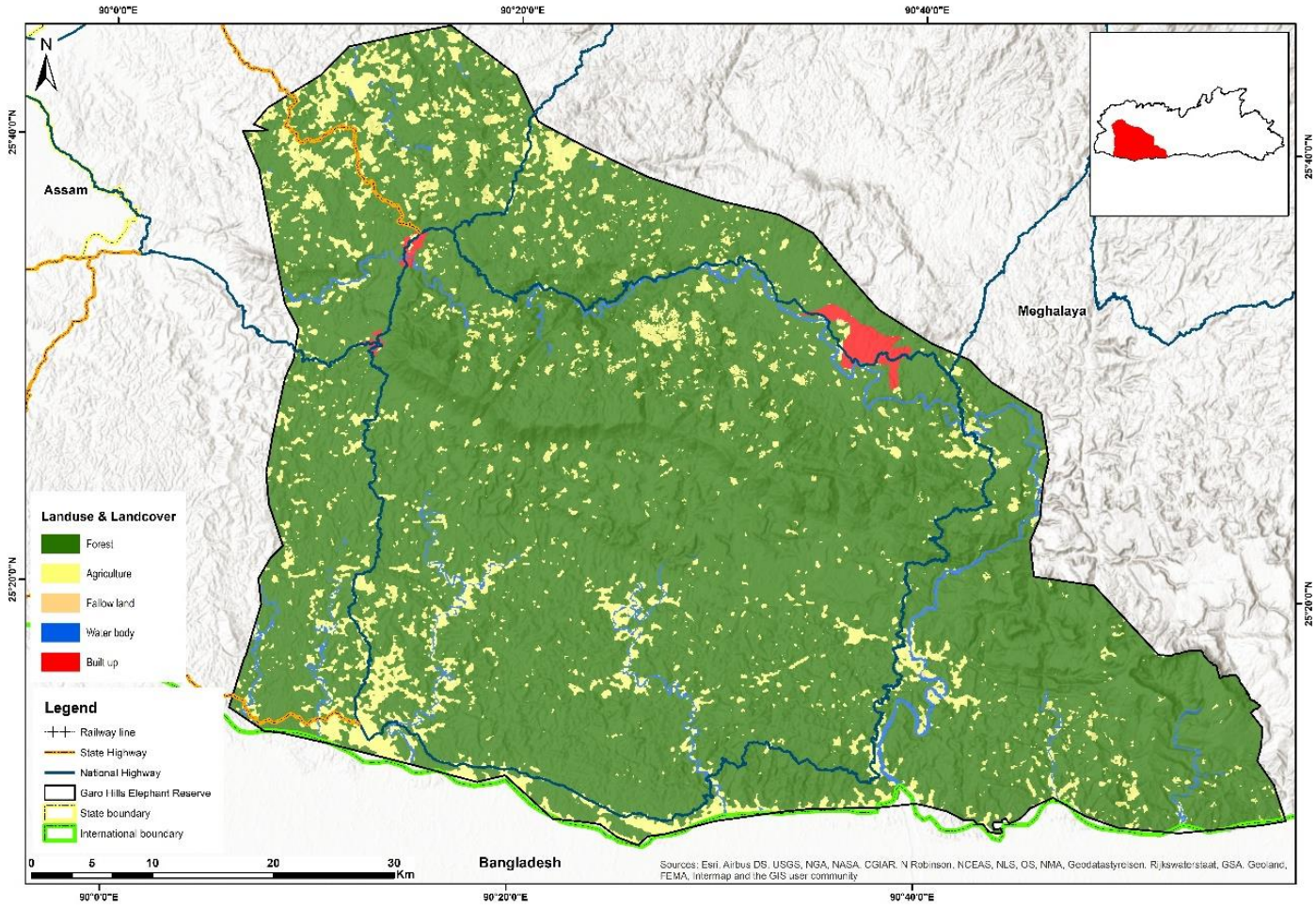
Garo Hills Elephant Reserve, Meghalaya 2005



LULC Type	*2005 (%)*
Forest	*83.83*
Agriculture	*12.67*
Fallow land	*0.00*
Built up	*1.01*
Waterbody	*2.50*

LULC Map of Garo Hills Elephant Reserve for the Year 2005 – Roy et al., 2016

Garo Hills Elephant Reserve, Meghalaya 2018

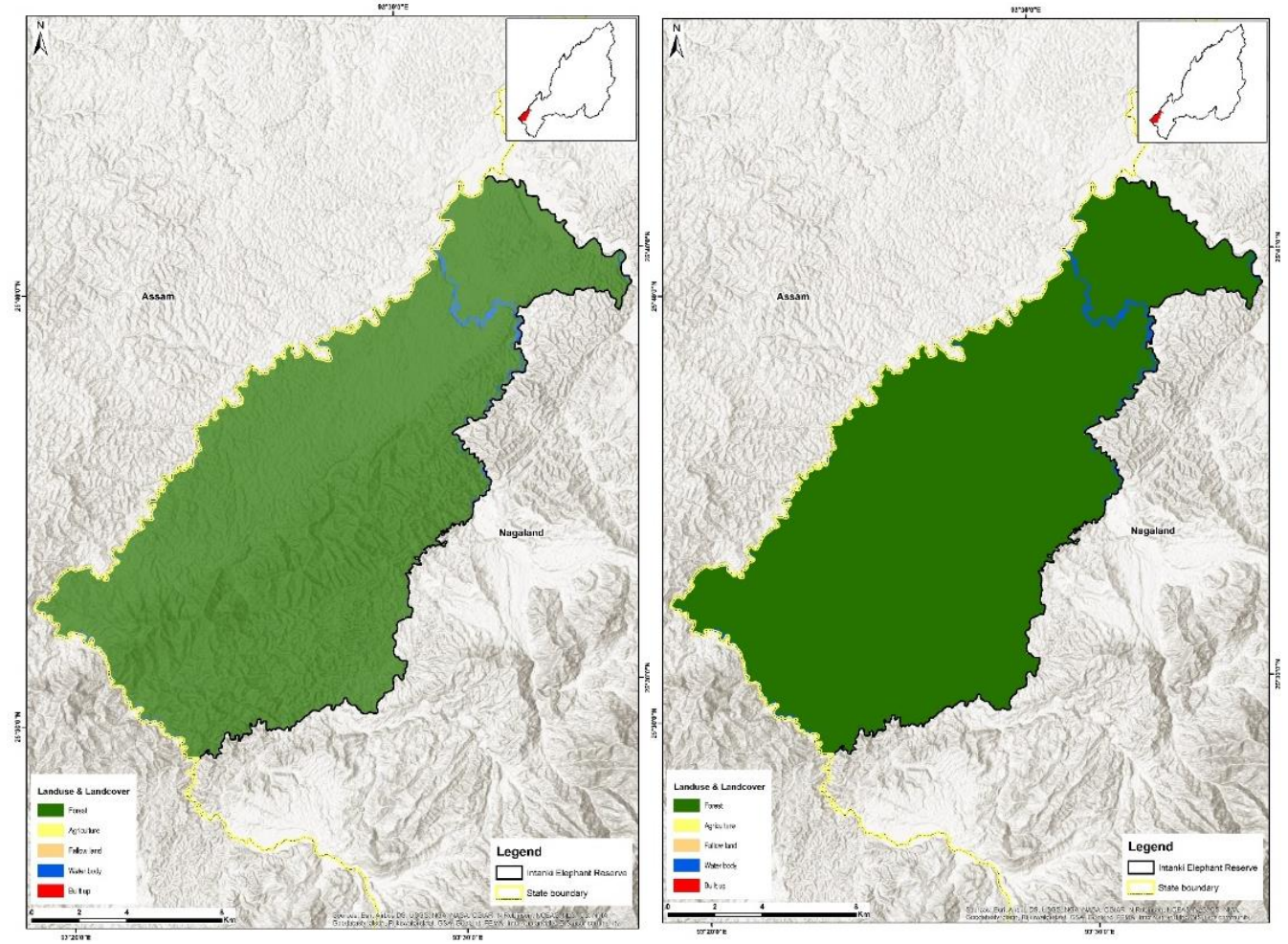


LULC Type	*2018 (%)*
Forest	*86.91*
Agriculture	*10.68*
Fallow land	*0.02*
Built up	*0.66*
Waterbody	*1.74*

In the Garo Hills ER, over 86.9% of the ER is forested. There was a marginal increase in the forest cover for the period 2005 and 2018 and corresponding marginal decrease in the agricultural areas. However, the resolution of the layers used during 2005 and 2018 are different for making fine-scale comparisons.

LULC Map of Garo Hills Elephant Reserve for the Year 2018 with linear infrastructure – Bhuvan (NRSC)

Intanki Elephant Reserve, Nagaland 1985 & 95

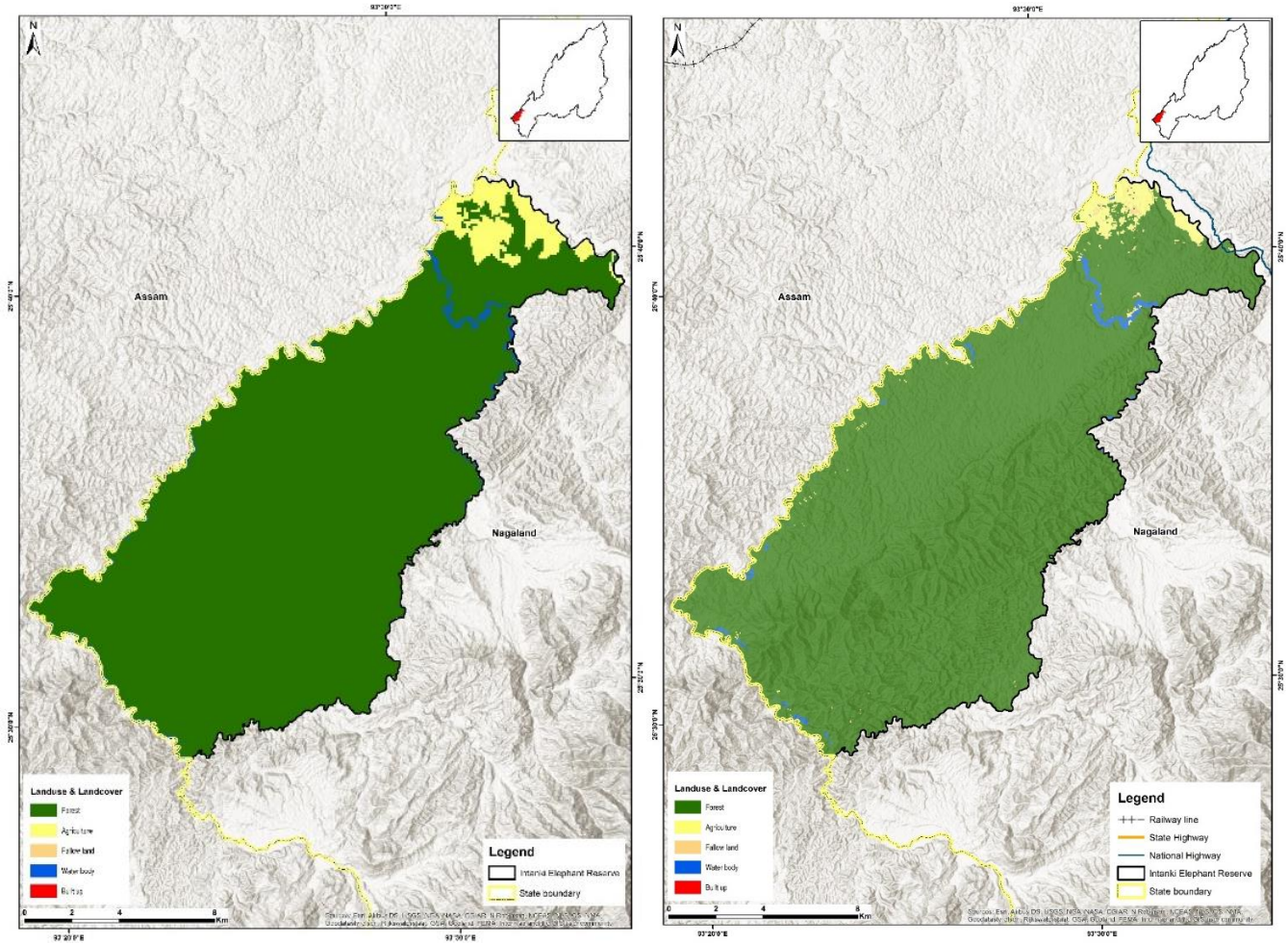


LULC Type	***1985 (%)***
Forest	*98.54*
Agriculture	*0.01*
Fallow land	*0.00*
Built up	*0.00*
Waterbody	*1.45*

LULC Type	***1995 (%)***
Forest	*98.54*
Agriculture	*0.01*
Fallow land	*0.00*
Built up	*0.00*
Waterbody	*1.45*

LULC Map of Intanki Elephant Reserve for the Year 1985 & 95 – Roy et al., 2016

Intanki Elephant Reserve, Nagaland 2005 & 18



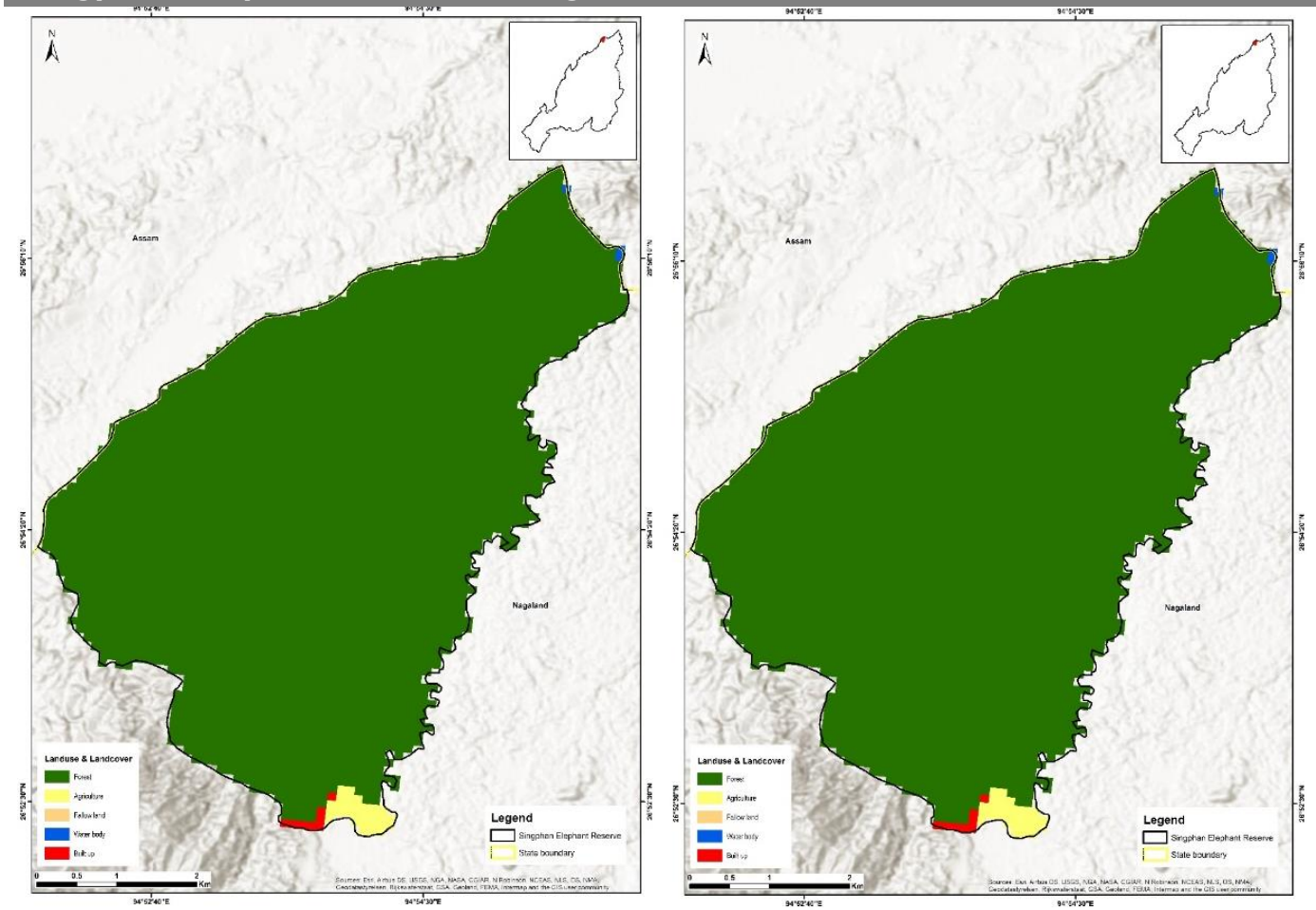
LULC Type	***2005 (%)***
Forest	*93.95*
Agriculture	*4.05*
Fallow land	*0.00*
Built up	*0.00*
Waterbody	*2.0*

LULC Type	***2018 (%)***
Forest	*96.66*
Agriculture	*2.21*
Fallow land	*0.24*
Built up	*0.00*
Waterbody	*0.89*

LULC Map of Intanki Elephant Reserve for the Year 2005 – Roy at al., 2016 & Year 2018 – Bhuvan (NRSC)

In the Intanki ER, over 96.66% of the ER is forested. There was a marginal increase in the forest cover for the period 2005 and 2018 and corresponding marginal decrease in the agricultural areas. However, the resolution of the layers used during 2005 and 2018 are different for making fine-scale comparisons.

Singphan Elephant Reserve, Nagaland 1985 & 95

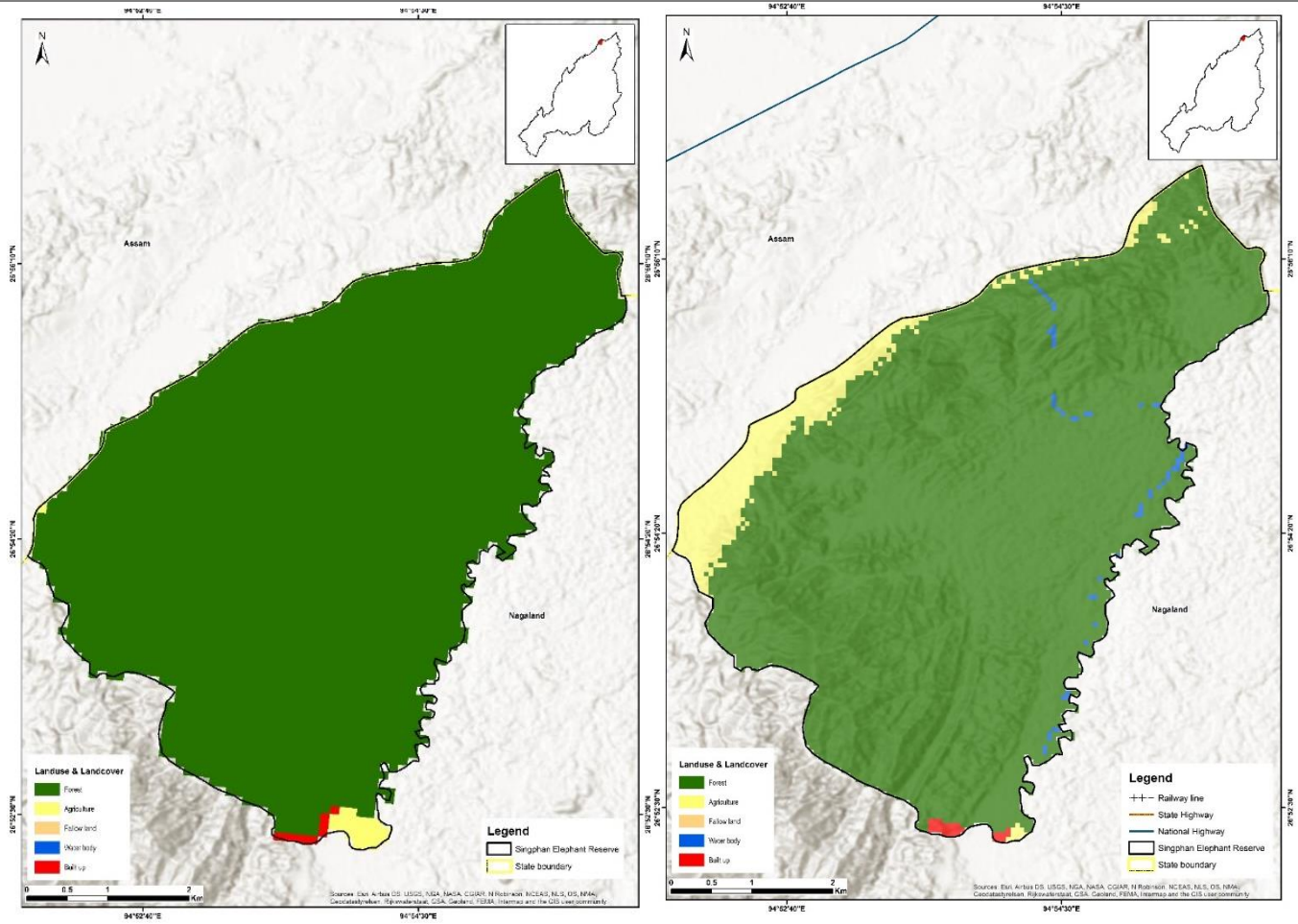


LULC Type	***1985 (%)***
Forest	*98.62*
Agriculture	*1.00*
Fallow land	*0.00*
Built up	*0.28*
Waterbody	*0.10*

LULC Type	***1995 (%)***
Forest	*98.62*
Agriculture	*1.00*
Fallow land	*0.00*
Built up	*0.28*
Waterbody	*0.10*

LULC Map of Singphan Elephant Reserve for the Year 1985 & 95 – Roy et al., 2016

Singphan Elephant Reserve, Nagaland 2005 & 18



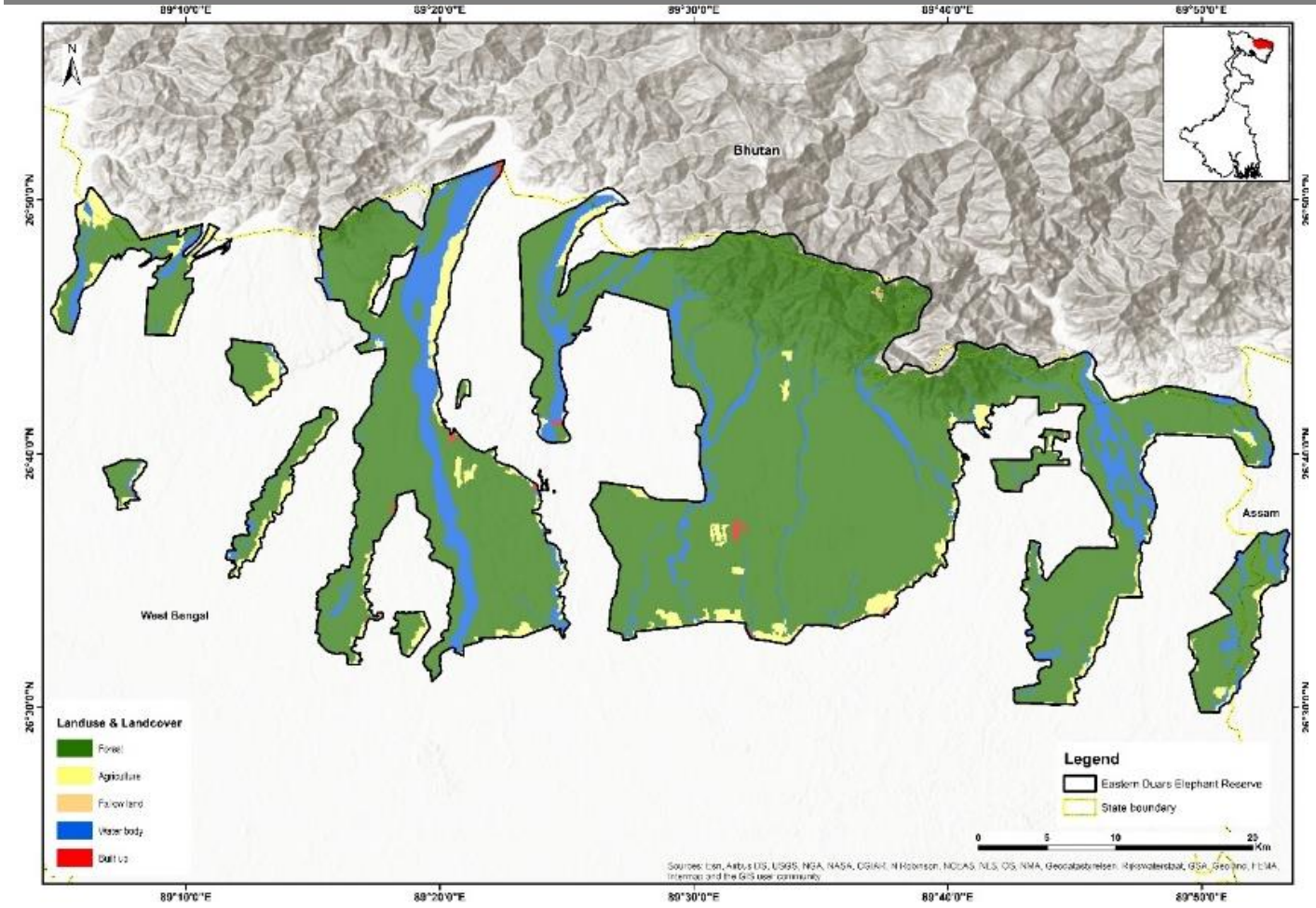
LULC Type	***2005 (%)***
Forest	*98.86*
Agriculture	*0.83*
Fallow land	*0.00*
Built up	*0.31*
Waterbody	*0.00*

LULC Type	***2018 (%)***
Forest	*98.13*
Agriculture	*0.96*
Fallow land	*0.00*
Built up	*0.31*
Waterbody	*0.60*

LULC Map of Singphan Elephant Reserve for the Year 2005 – Roy at al., 2016 & Year 2018 – Bhuvan (NRSC)

In the Singhapan Hills ER, over 98.1 % of the ER is forested. No major changes in the LULC classes were observed.

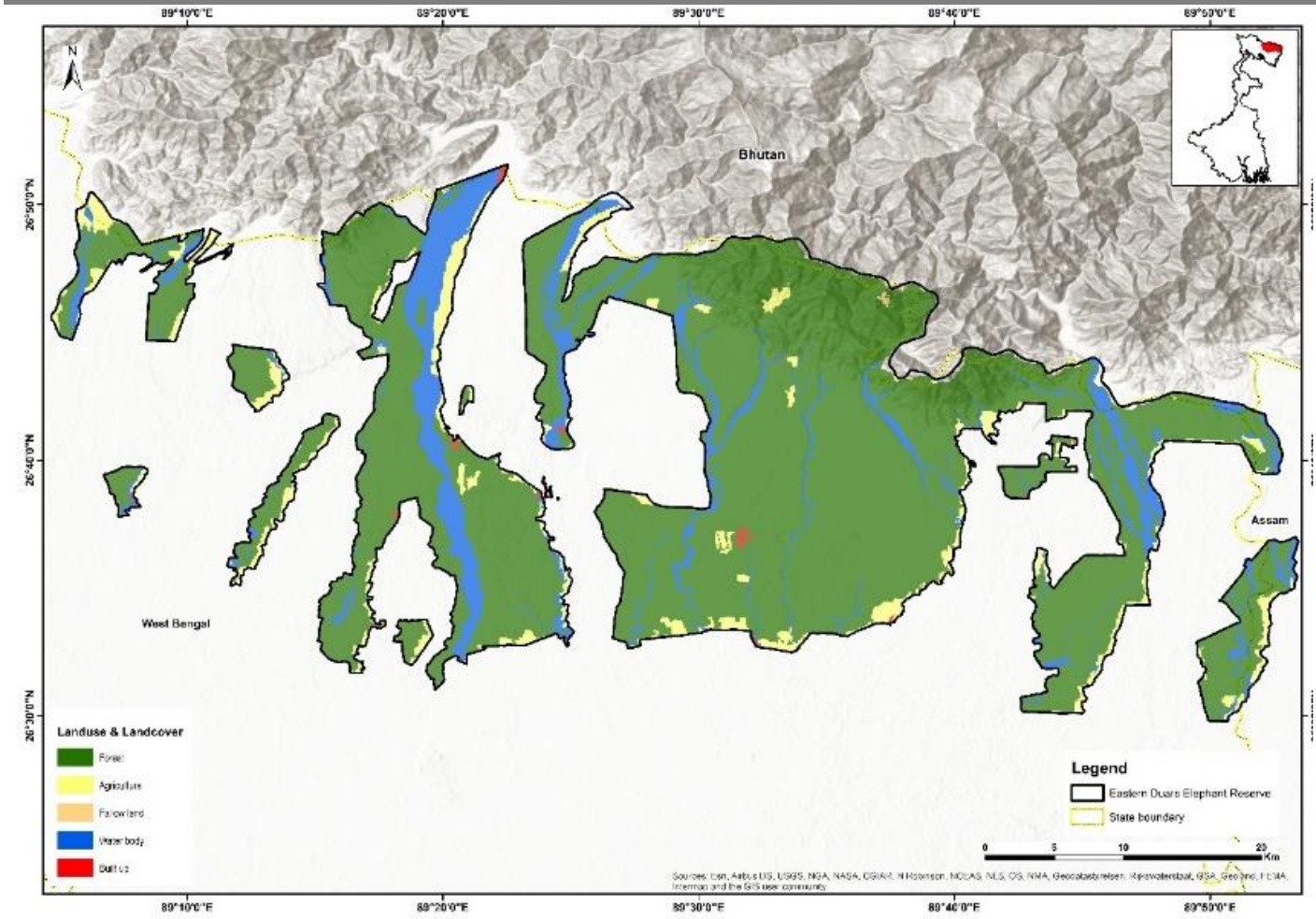
Eastern Dooars Elephant Reserve, Nagaland 1985



LULC Type	*1985 (%)*
Forest	*81.54*
Agriculture	*6.58*
Fallow land	*0.04*
Built up	*0.29*
Waterbody	*11.55*

LULC Map of Eastern Dooars Elephant Reserve for the Year 1985 – Roy et al., 2016

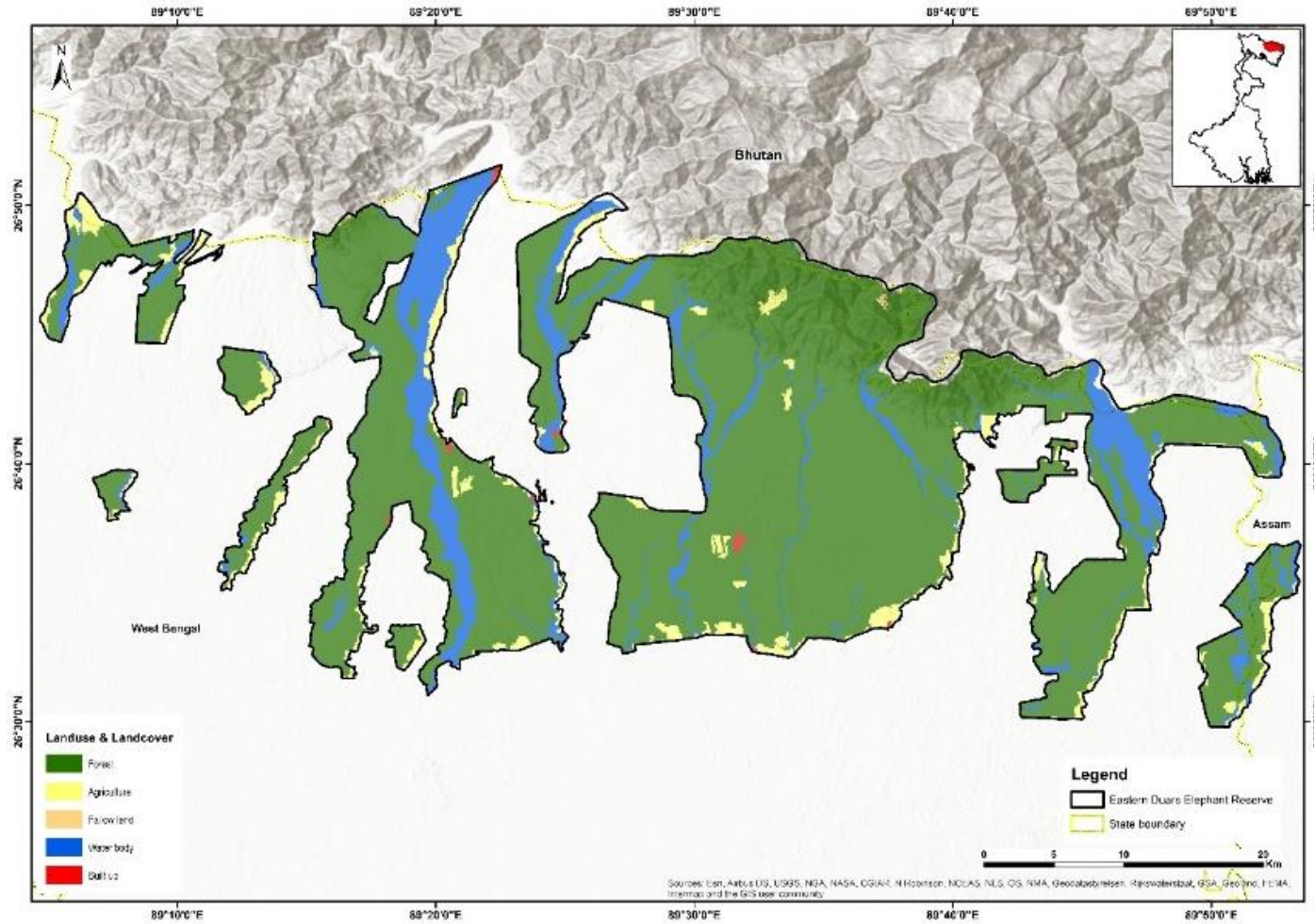
Eastern Dooars Elephant Reserve, Nagaland 1995



LULC Type	*1995 (%)*
Forest	*80.49*
Agriculture	*6.98*
Fallow land	*0.04*
Built up	*0.29*
Waterbody	*12.19*

LULC Map of Eastern Dooars Elephant Reserve for the Year 1995 – Roy et al., 2016

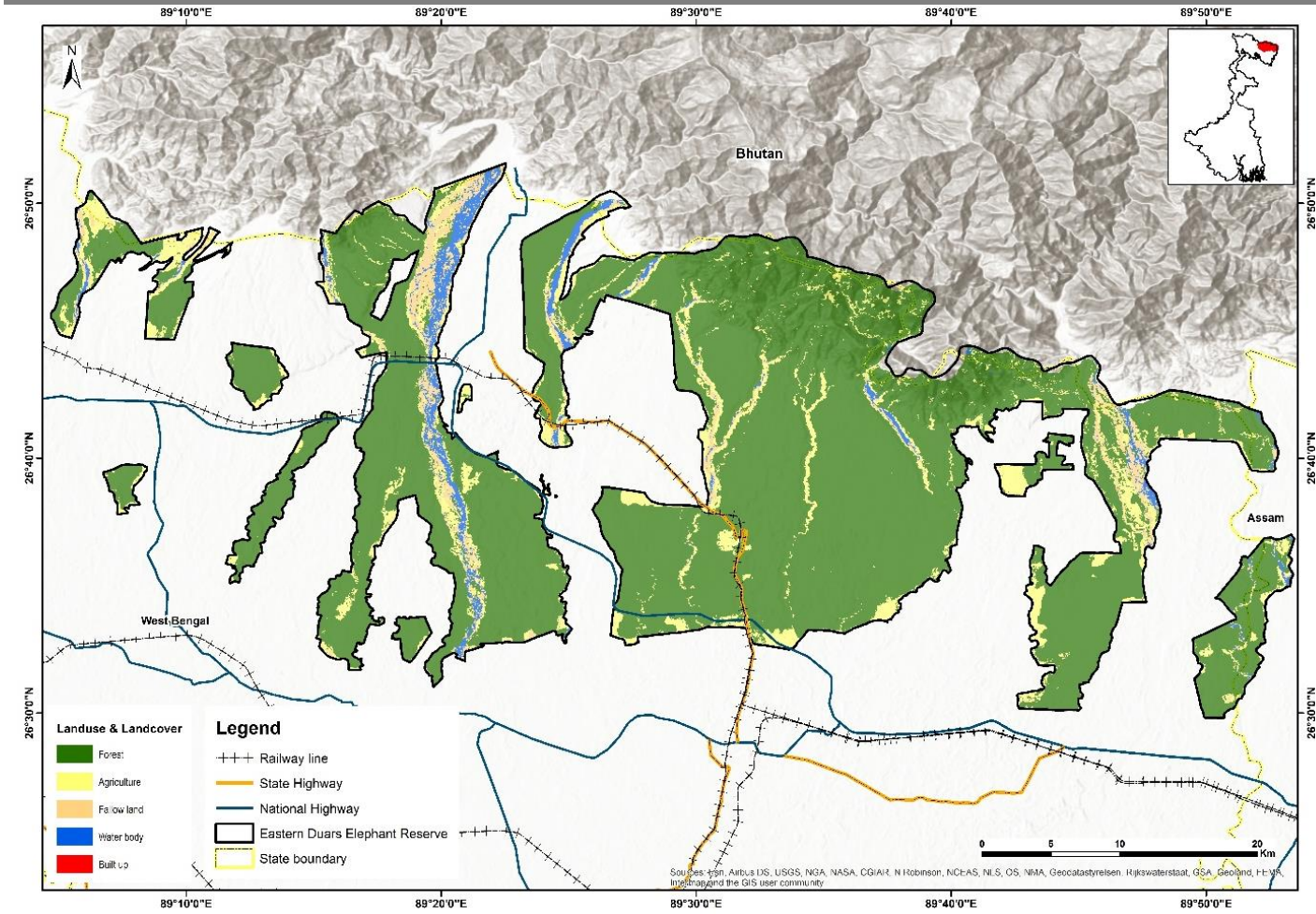
Eastern Dooars Elephant Reserve, Nagaland 2005



LULC Type	*2005 (%)*
Forest	*79.93*
Agriculture	*6.34*
Fallow land	*0.04*
Built up	*0.28*
Waterbody	*13.41*

LULC Map of Eastern Dooars Elephant Reserve for the Year 2005 – Roy et al., 2016

Eastern Dooars Elephant Reserve, Nagaland 2018



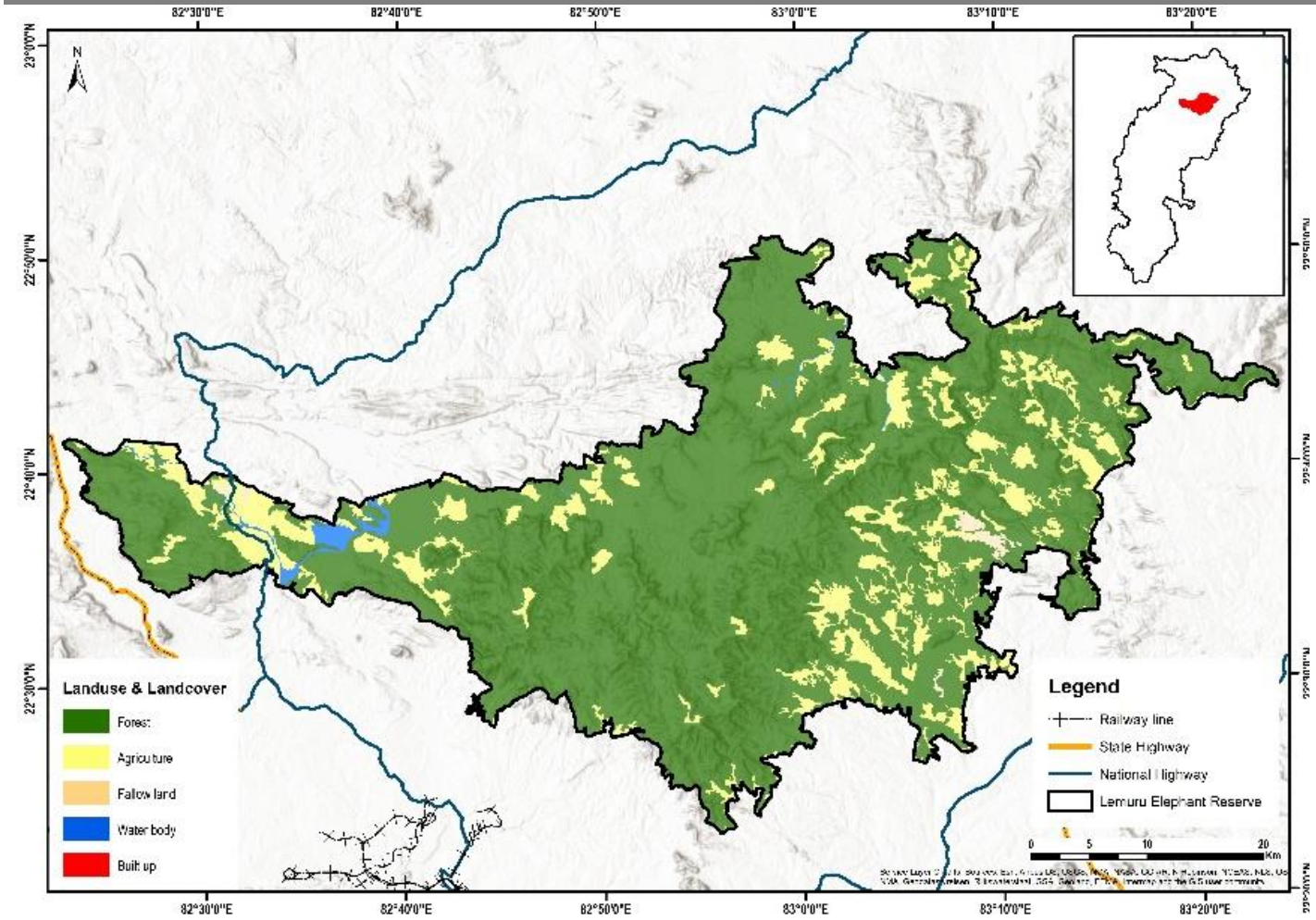
LULC Type	*2018 (%)*
Forest	*81.44*
Agriculture	*10.96*
Fallow land	*4.52*
Built up	*0.00*
Waterbody	*3.08*

In the Eastern Dooars ER, over 81.4 % of the ER is forested. There was a marginal increase in the forest cover for the period 2005 and 2018. Area under agriculture had increased too. However, the area under waterbody had drastically reduced. The resolution of the layers used during 2005 and 2018 are different for making fine-scale comparisons.

LULC Map of Eastern Dooars Elephant Reserve for the Year 2018 with linear infrastructure – Bhuvan (NRSC)

ELEPHANT RESERVES OF
East Central Region

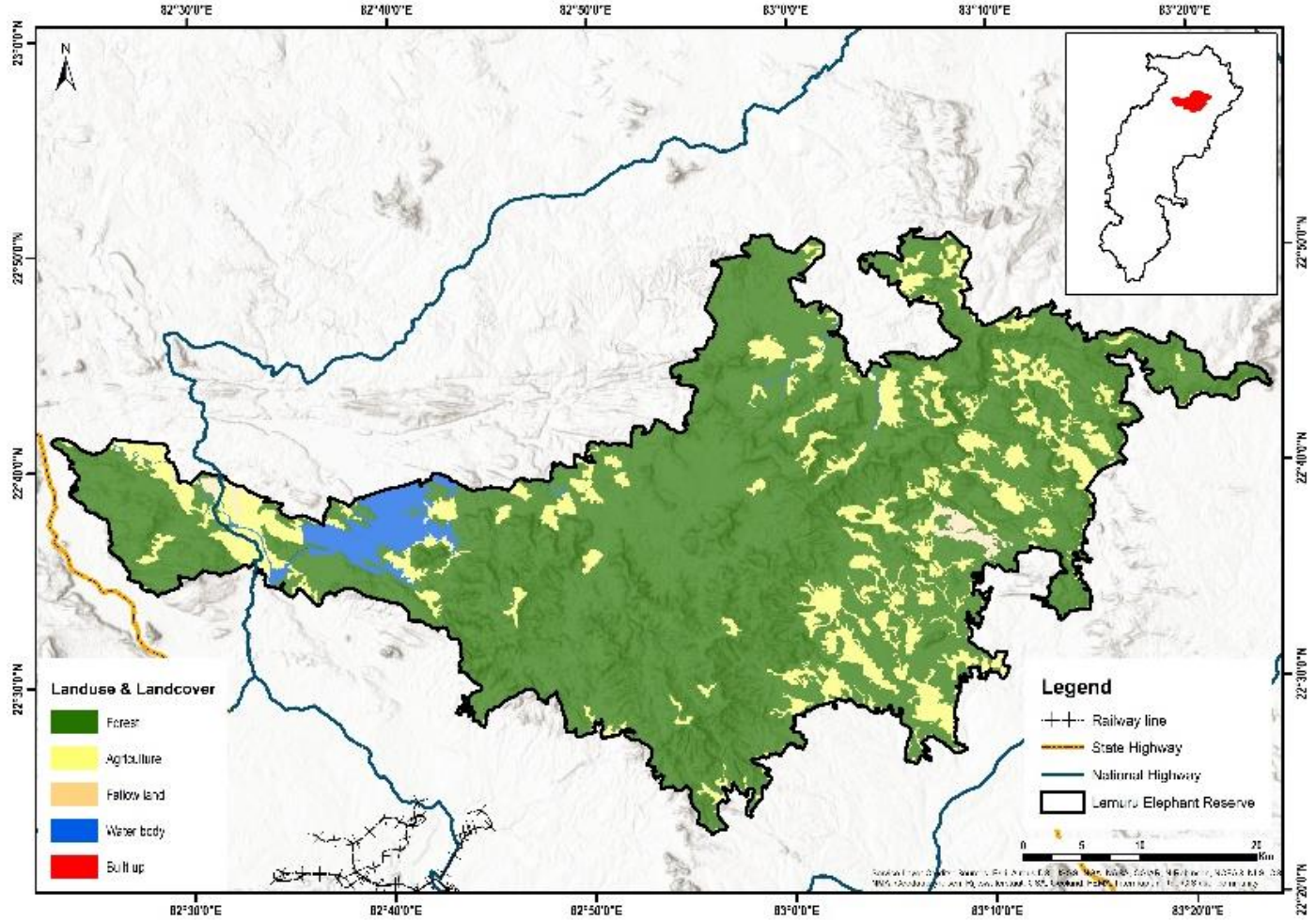
Lemru Elephant Reserve, Chhattisgarh 1985



LULC Type	*1985 (%)*
Forest	*83.91*
Agriculture	*14.73*
Fallow land	*0.53*
Built up	*0.00*
Waterbody	*0.82*

LULC Map of Lemru Elephant Reserve for the Year 1985 – Roy et al., 2016

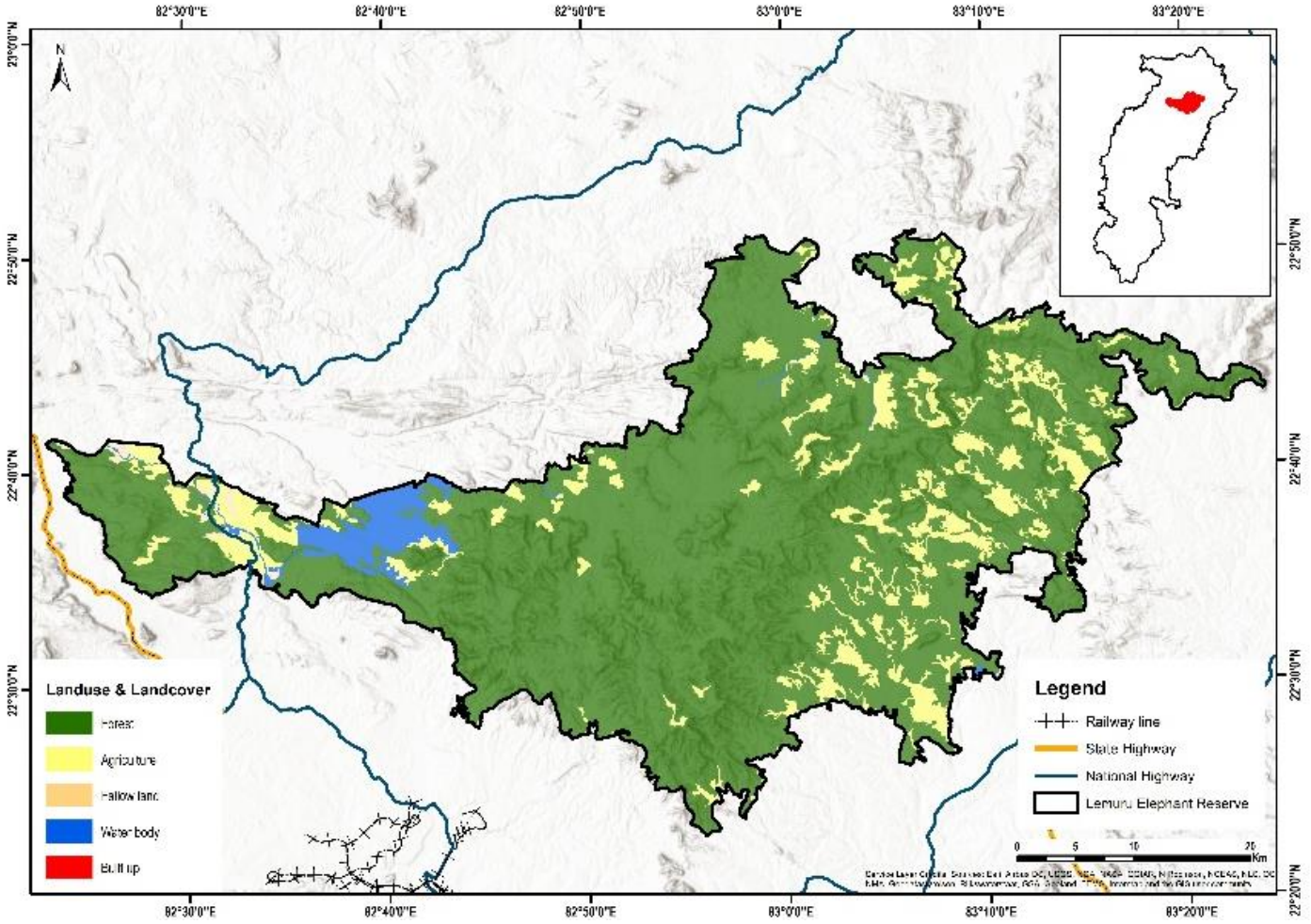
Lemru Elephant Reserve, Chhattisgarh 1995



LULC Type	*1995 (%)*
Forest	*81.98*
Agriculture	*14.50*
Fallow land	*0.68*
Built up	*0.00*
Waterbody	*2.84*

LULC Map of Lemru Elephant Reserve for the Year 1995 – Roy et al., 2016

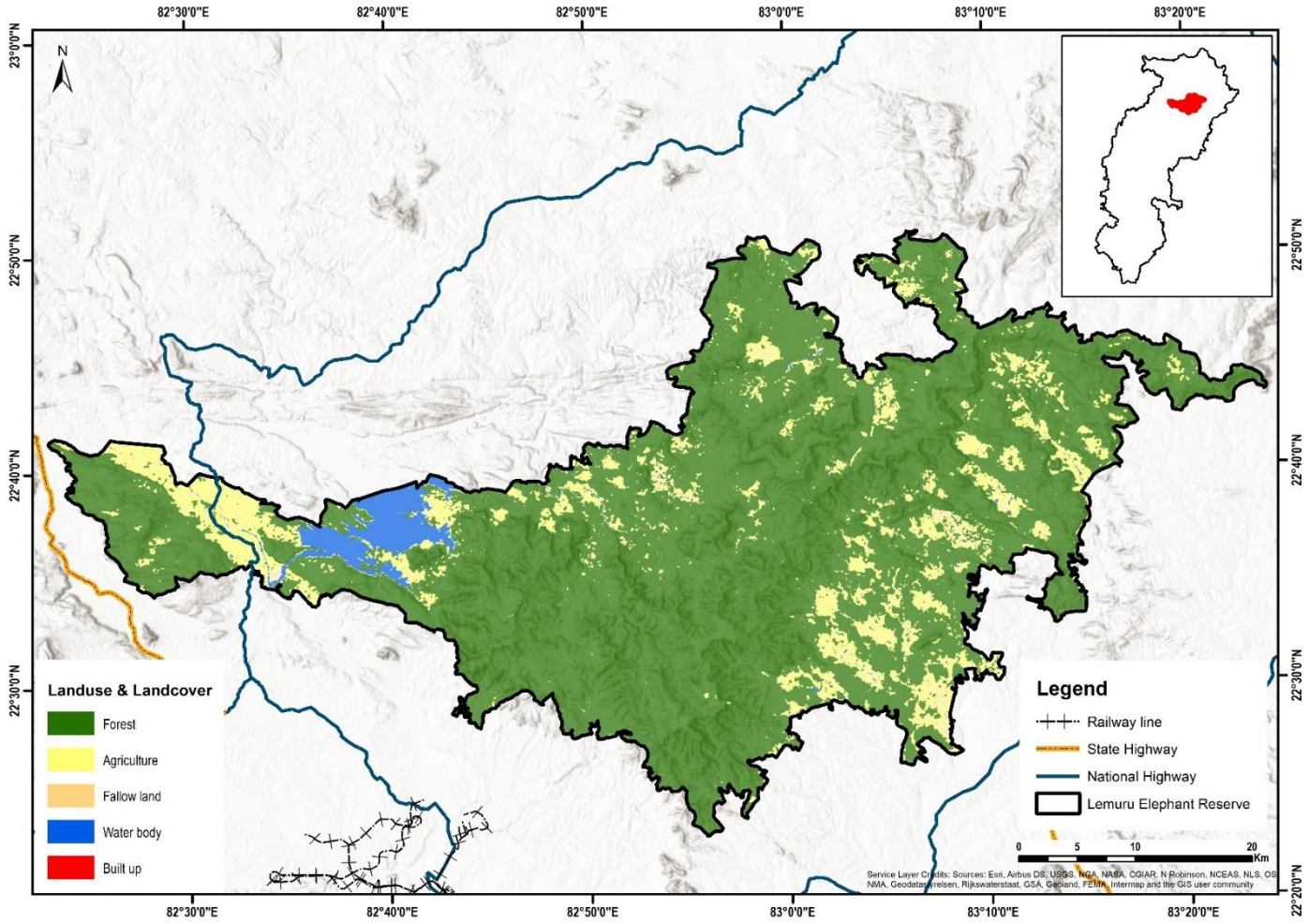
Lemru Elephant Reserve, Chhattisgarh 2005



LULC Type	*2005 (%)*
Forest	*81.44*
Agriculture	*12.45*
Fallow land	*0.45*
Built up	*0.00*
Waterbody	*2.96*

LULC Map of Lemru Elephant Reserve for the Year 2005 – Roy et al., 2016

Lemru Elephant Reserve, Chhattisgarh 2018

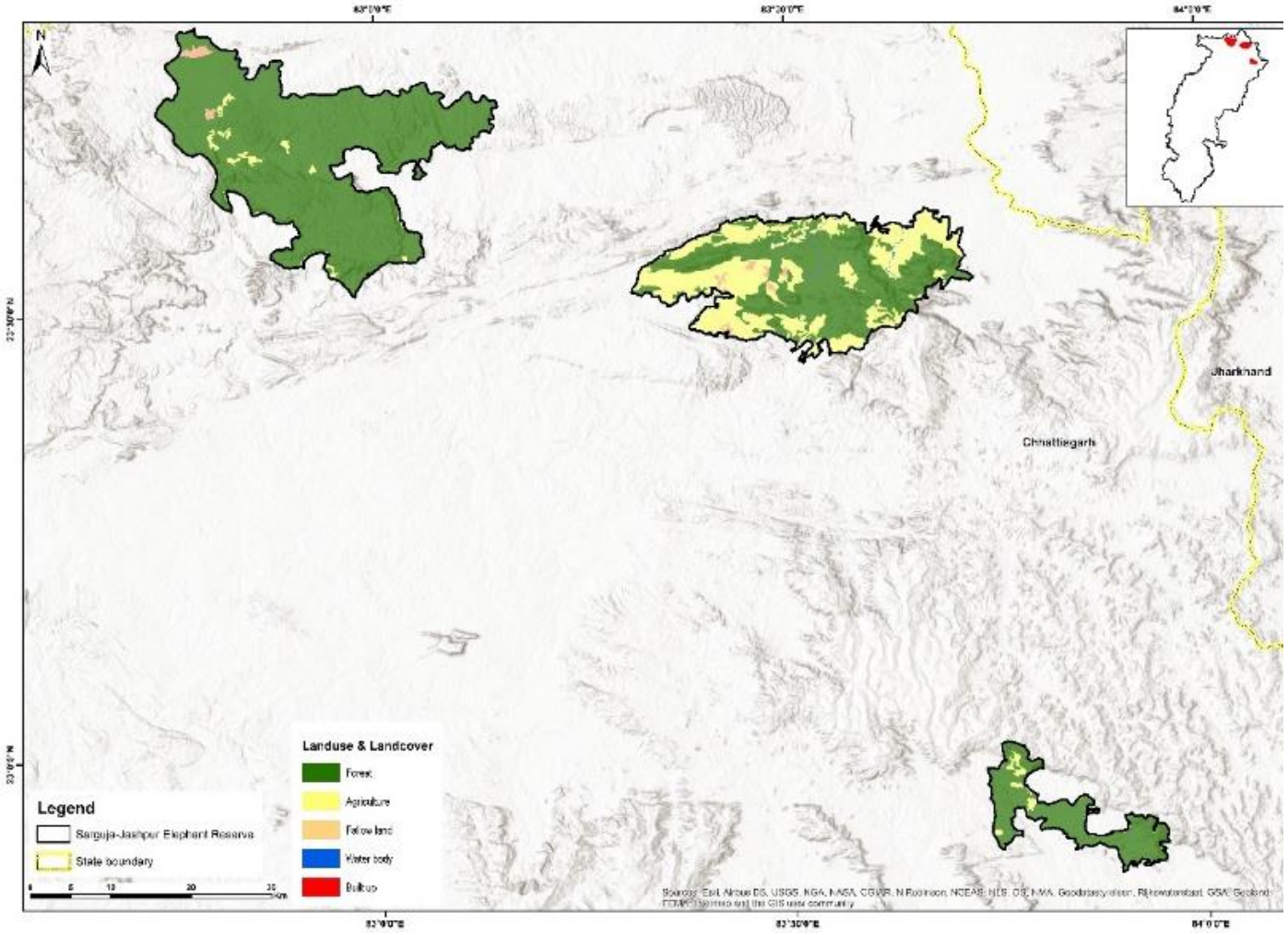


LULC Type	*2018 (%)*
Forest	*83.06*
Agriculture	*13.06*
Fallow land	*1.15*
Built up	*0.01*
Waterbody	*2.73*

In the Lemuru ER, over 83.06% of the ER is forested. No major changes were observed in the LULC between the four years of imagery that were compared.

LULC Map of Lemru Elephant Reserve for the Year 2018 with linear infrastructure – Bhuvan (NRSC)

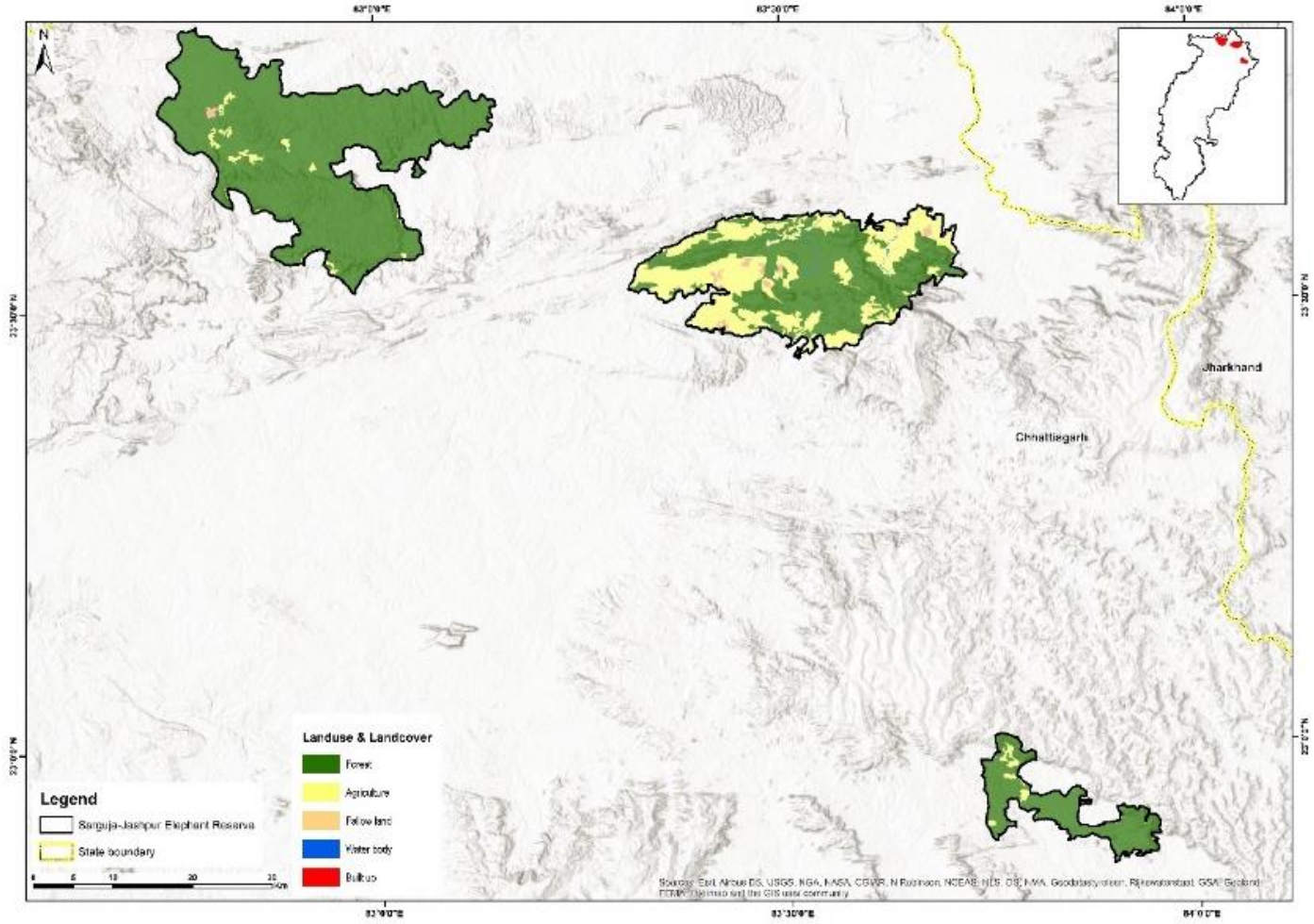
Sarguja – Jashpur Elephant Reserve, Chhattisgarh 1985



LULC Type	*1985 (%)*
Forest	*79.51*
Agriculture	*19.07*
Fallow land	*0.90*
Built up	*0.00*
Waterbody	*0.52*

LULC Map of Sarguja – Jashpur Elephant Reserve for the Year 1985 – Roy et al., 2016

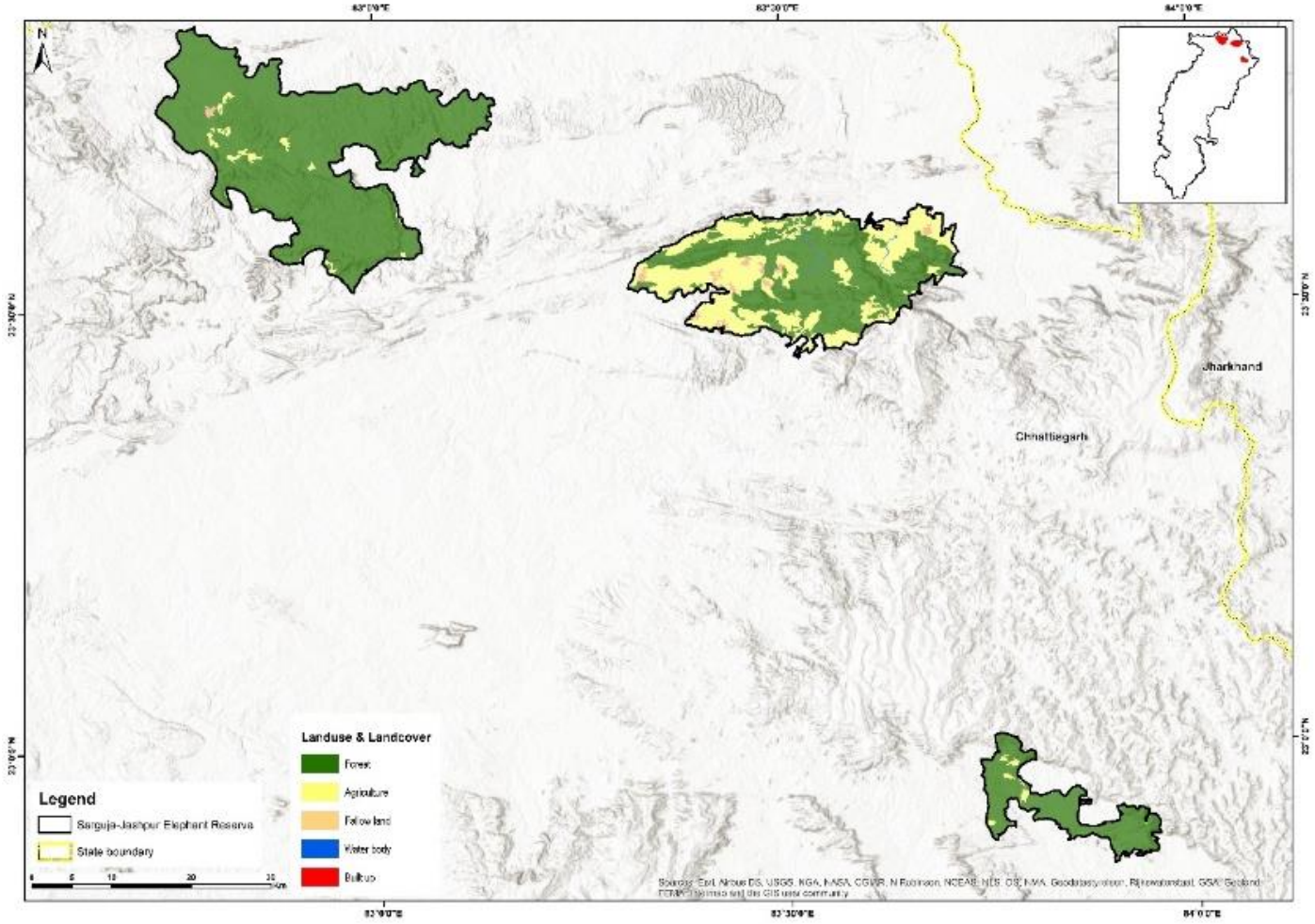
Sarguja – Jashpur Elephant Reserve, Chhattisgarh 1995



LULC Type	*1995 (%)*
Forest	*79.83*
Agriculture	*18.93*
Fallow land	*0.71*
Built up	*0.00*
Waterbody	*0.52*

LULC Map of Sarguja – Jashpur Elephant Reserve for the Year 1995 – Roy et al., 2016

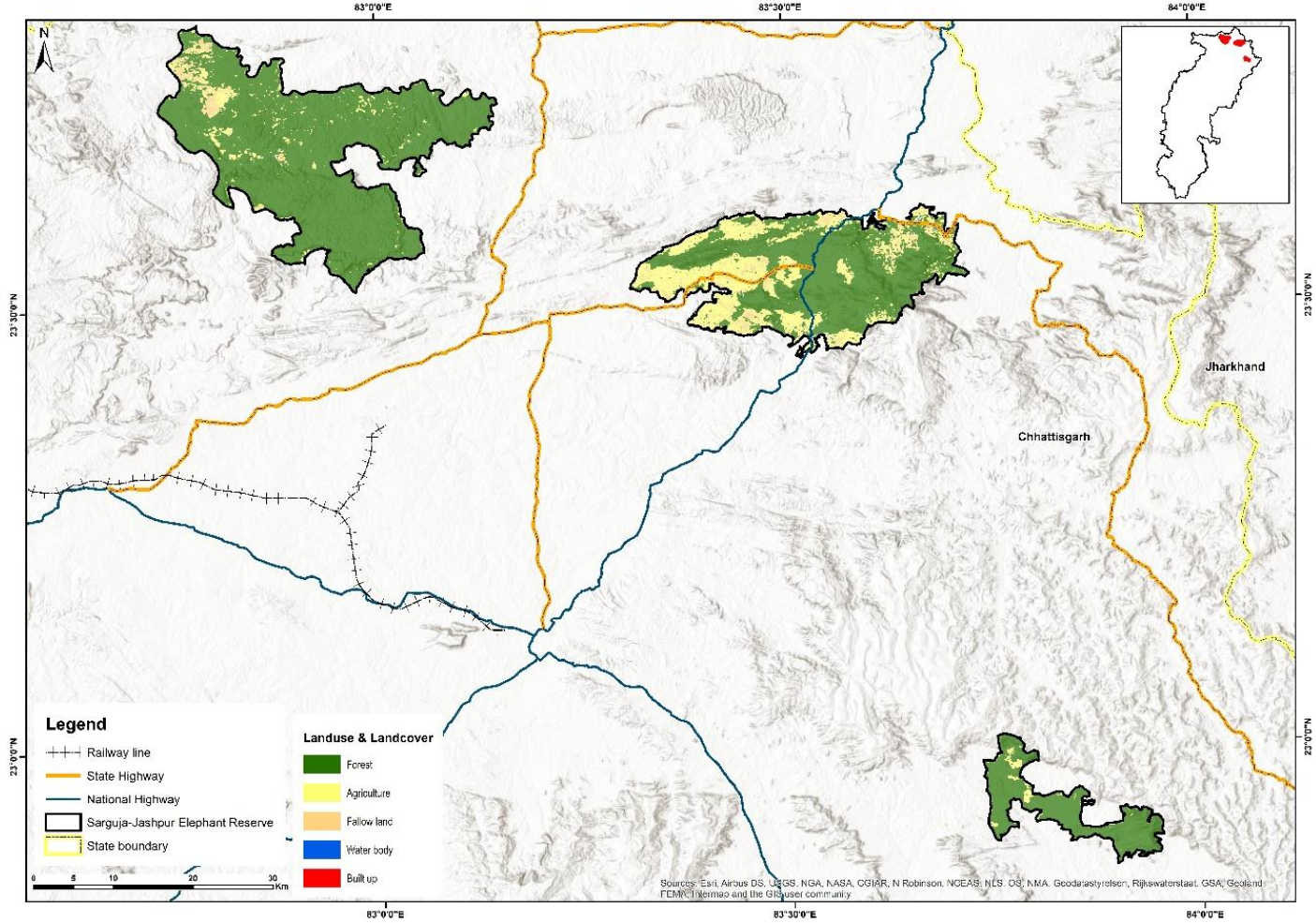
Sarguja – Jashpur Elephant Reserve, Chhattisgarh 2005



LULC Type	*2005 (%)*
Forest	*80.11*
Agriculture	*18.43*
Fallow land	*0.93*
Built up	*0.00*
Waterbody	*0.53*

LULC Map of Sarguja – Jashpur Elephant Reserve for the Year 2005 – Roy et al., 2016

Sarguja – Jashpur Elephant Reserve, Chhattisgarh 2018

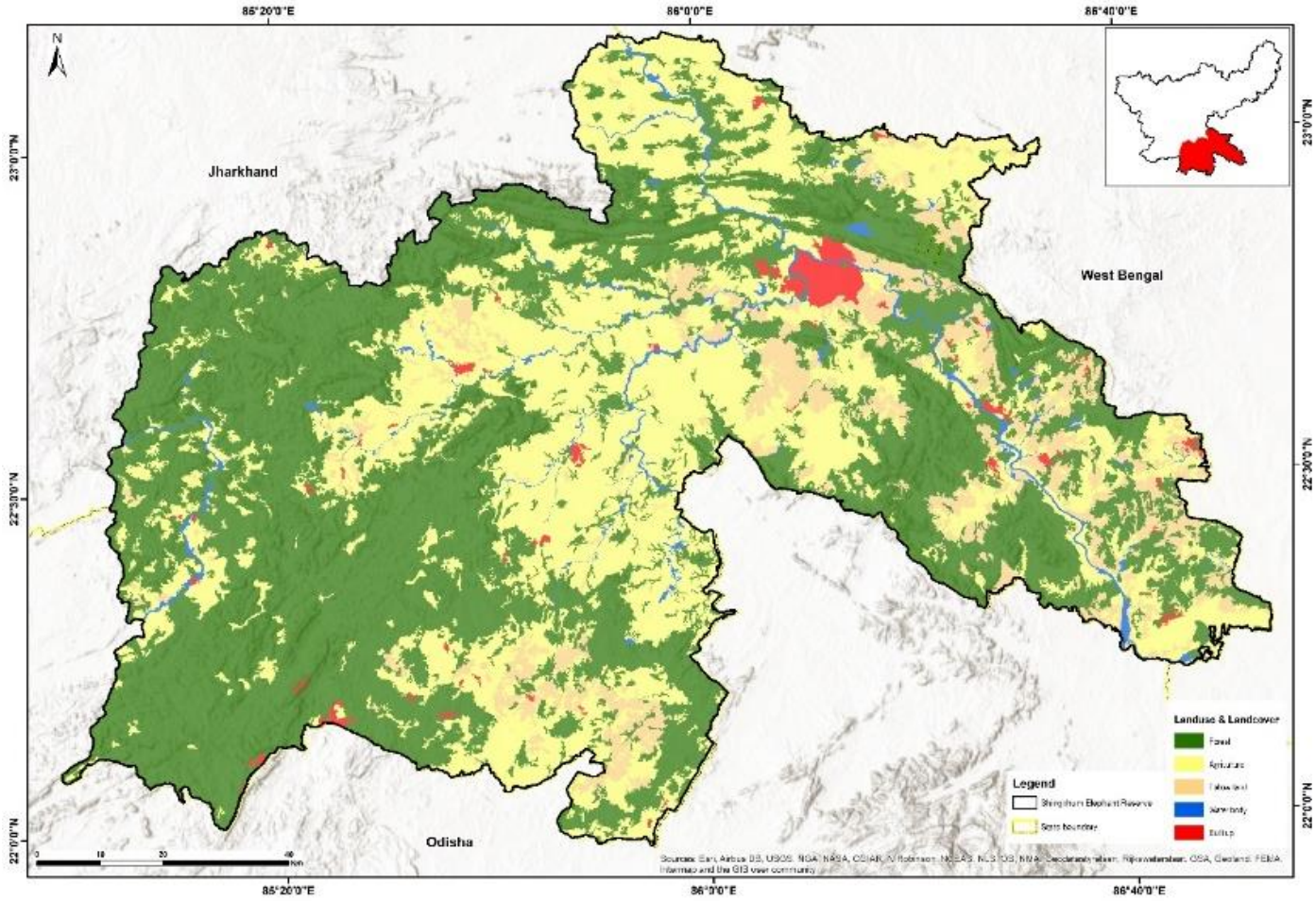


LULC Type	*2018 (%)*
Forest	*80.12*
Agriculture	*15.36*
Fallow land	*4.32*
Built up	*0.001*
Waterbody	*0.19*

In the Sarguja Jashpur ER, over 80.1% of the ER is forested. No major changes were observed in the LULC between the four years of imagery that were compared.

LULC Map of Sarguja – Jashpur Elephant Reserve for the Year 2018 with linear infrastructure – Bhuvan (NRSC)

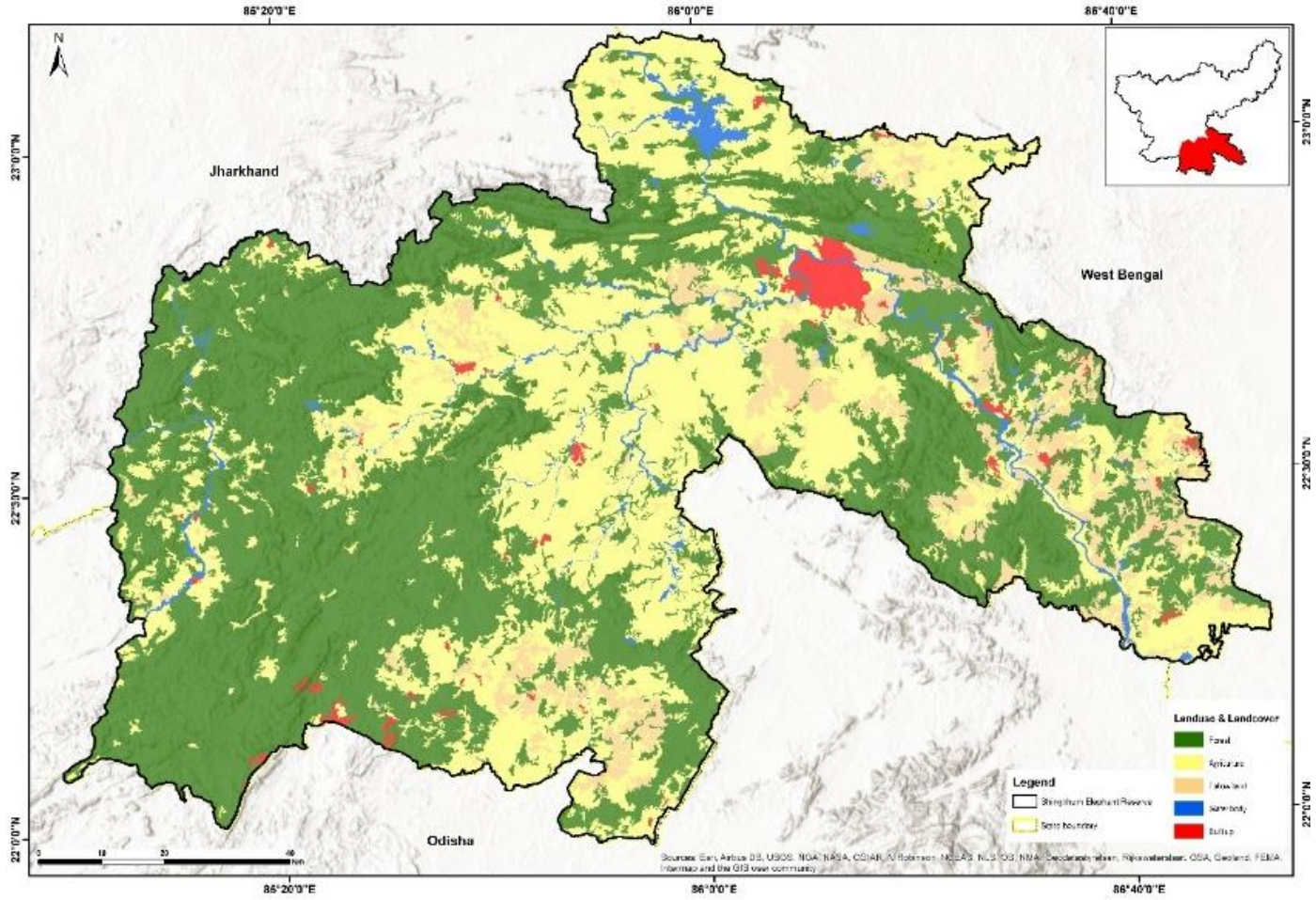
Singhbhum Elephant Reserve, Jharkhand 1985



LULC Type	*1985 (%)*
Forest	*52.07*
Agriculture	*36.61*
Fallow land	*8.27*
Built up	*1.31*
Waterbody	*1.73*

LULC Map of Singhbhum Elephant Reserve for the Year 1985 – Roy et al., 2016

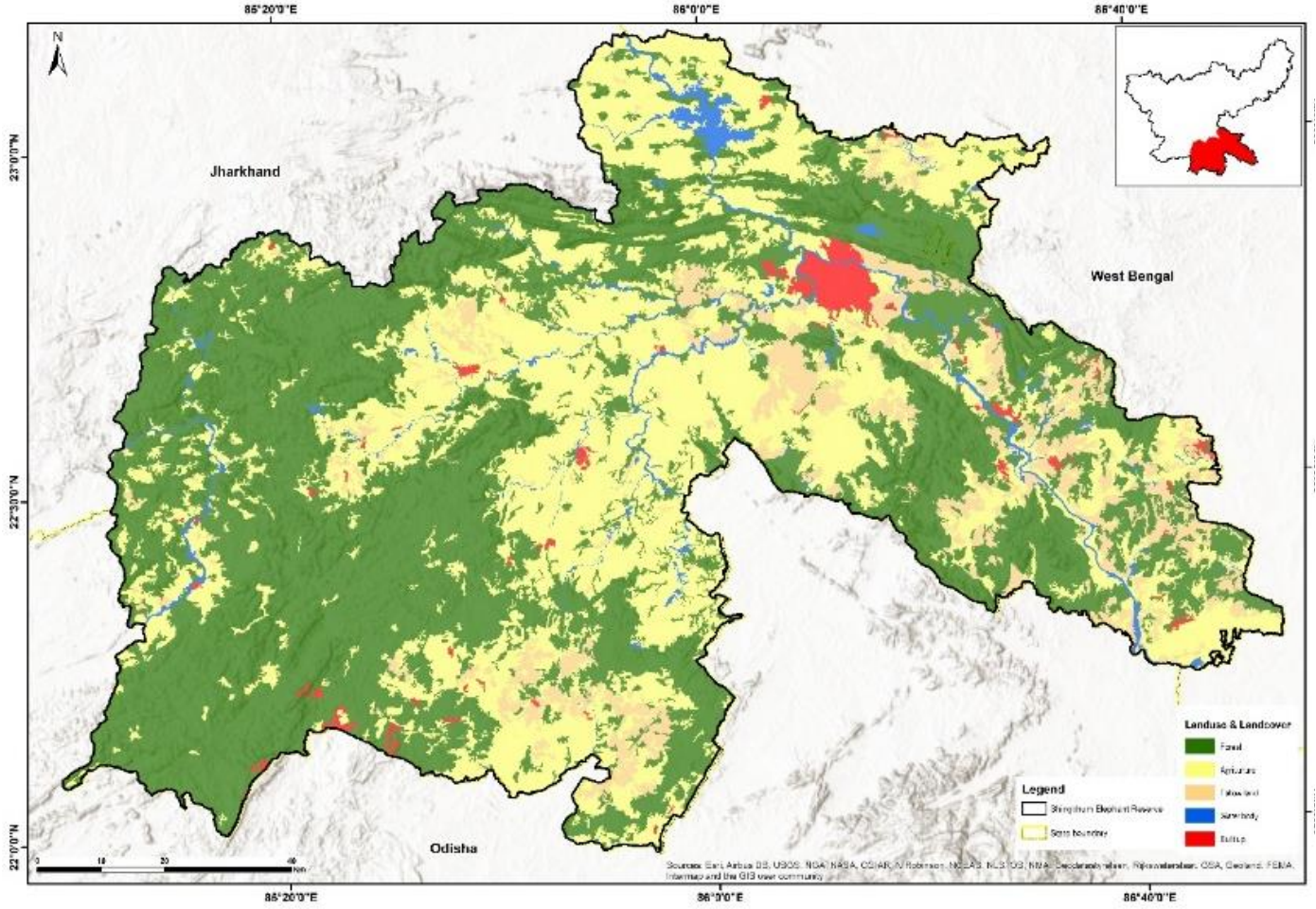
Singhbhum Elephant Reserve, Jharkhand 1995



LULC Type	*1995 (%)*
Forest	*51.48*
Agriculture	*37.06*
Fallow land	*7.81*
Built up	*1.49*
Waterbody	*2.16*

LULC Map of Singhbhum Elephant Reserve for the Year 1995 – Roy et al., 2016

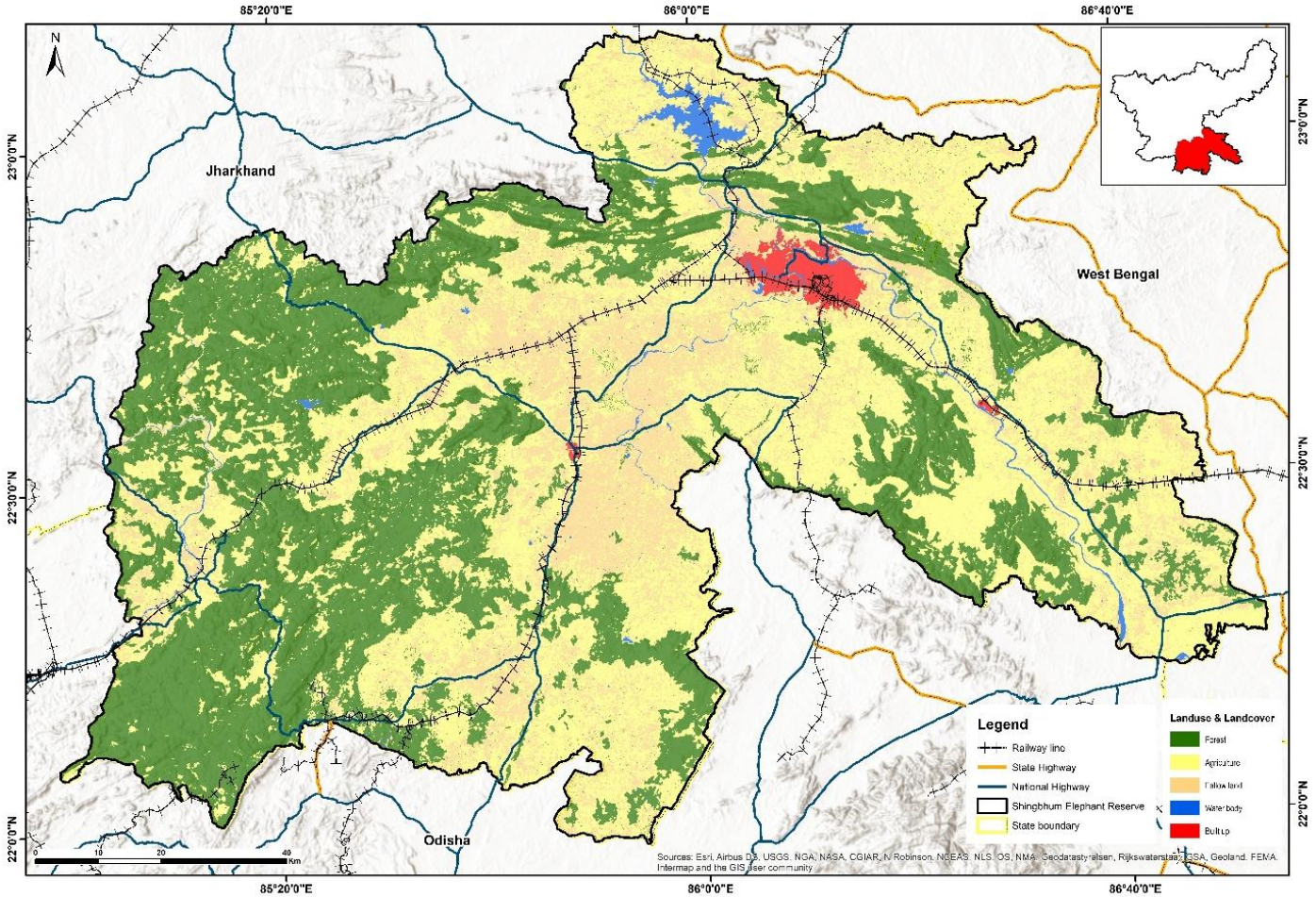
Singhbhum Elephant Reserve, Jharkhand 2005



LULC Type	*2005 (%)*
Forest	*51.48*
Agriculture	*37.06*
Fallow land	*7.81*
Built up	*1.49*
Waterbody	*2.16*

LULC Map of Singhbhum Elephant Reserve for the Year 2005 – Roy et al., 2016

Singhbhum Elephant Reserve, Jharkhand 2018

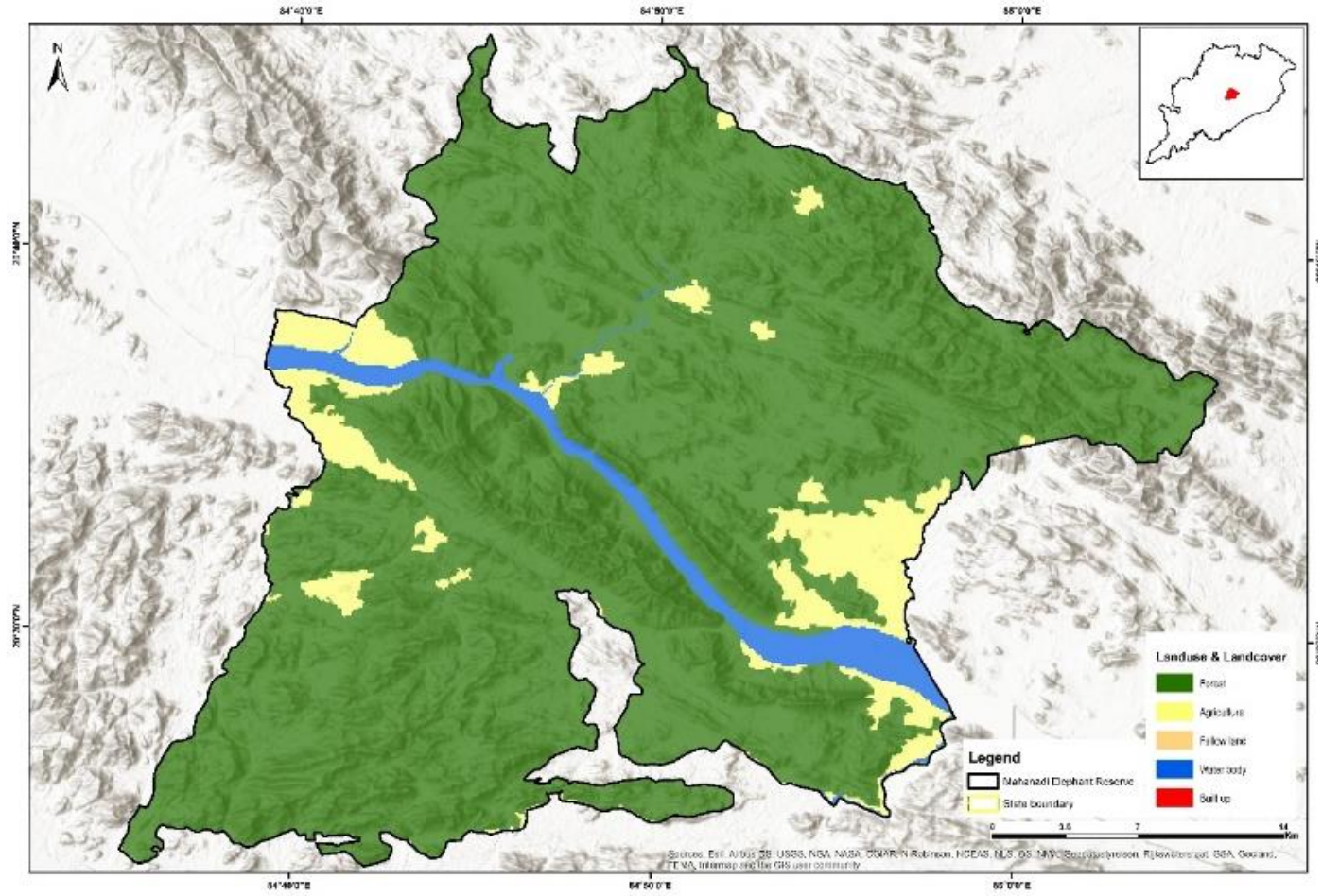


LULC Type	*2018 (%)*
Forest	*38.24*
Agriculture	*39.96*
Fallow land	*19.56*
Built up	*1.09*
Waterbody	*1.15*

In the Singhbhum ER, about 38.2% of the reserve is forested. Major decline in the forest cover was observed between 2005 to 2018 which calls for a detailed assessment using a combination of ground data and high-resolution satellite layers that can be used for reclassification of the LULC for the reserve.

LULC Map of Singhbhum Elephant Reserve for the Year 2018 with linear infrastructure – Bhuvan (NRSC)

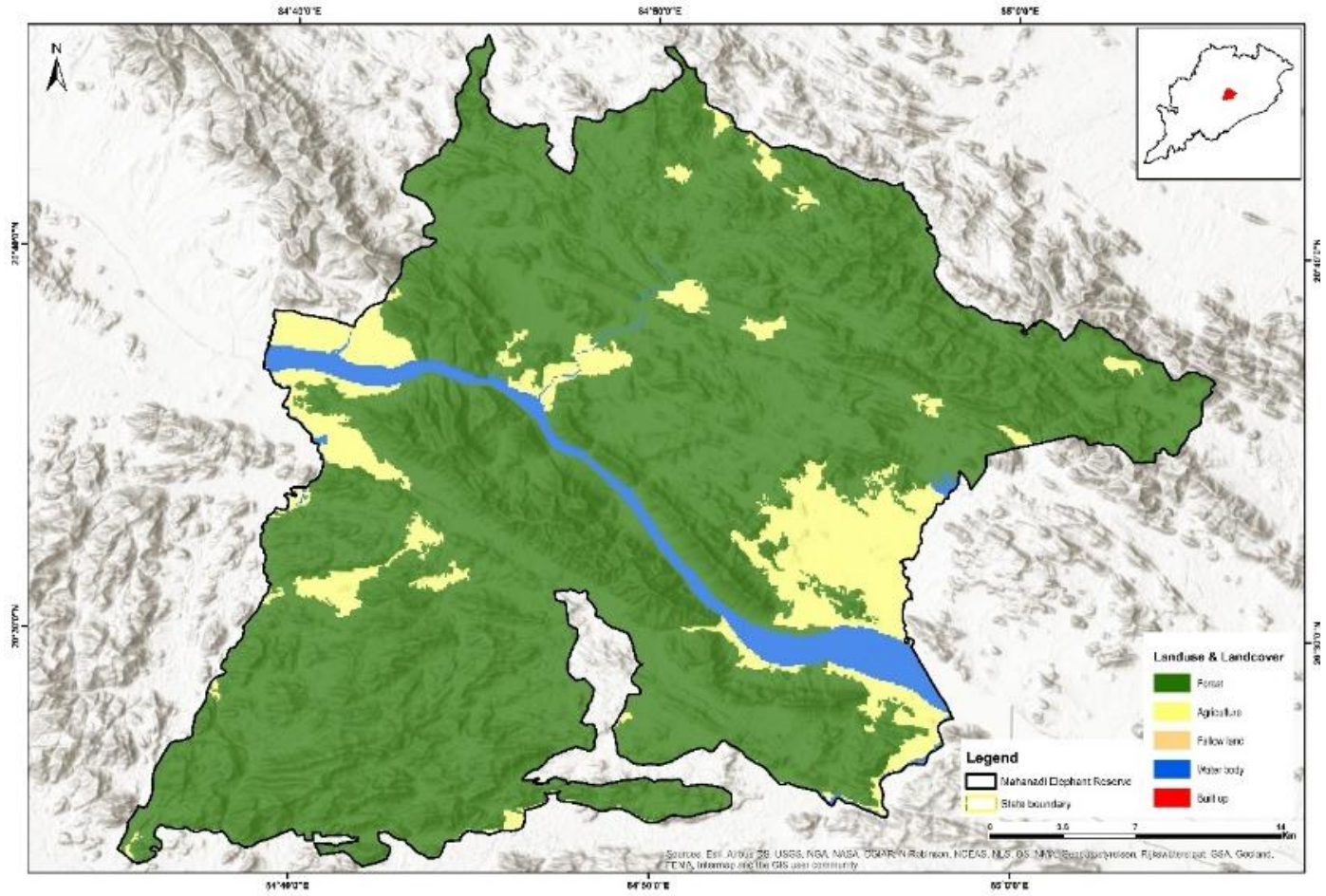
Mahanadi Elephant Reserve, Odisha 1985



LULC Type	*1985 (%)*
Forest	*88.31*
Agriculture	*7.95*
Fallow land	*0.00*
Built up	*0.00*
Waterbody	*3.74*

LULC Map of Mahanadi Elephant Reserve for the Year 1985 – Roy et al., 2016

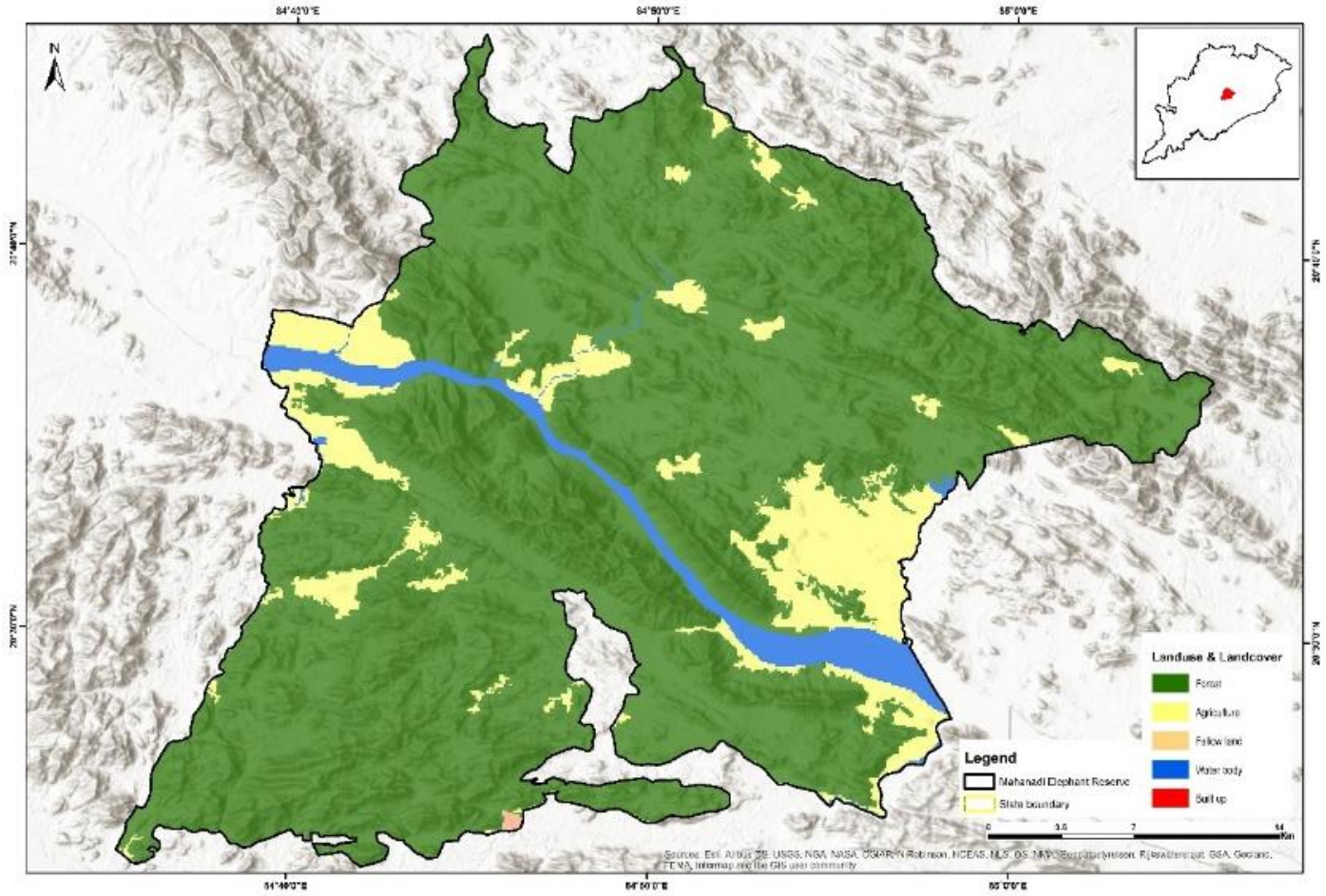
Mahanadi Elephant Reserve, Odisha 1995



LULC Type	*1995 (%)*
Forest	*88.31*
Agriculture	*7.95*
Fallow land	*0.00*
Built up	*0.00*
Waterbody	*3.74*

LULC Map of Mahanadi Elephant Reserve for the Year 1995 – Roy et al., 2016

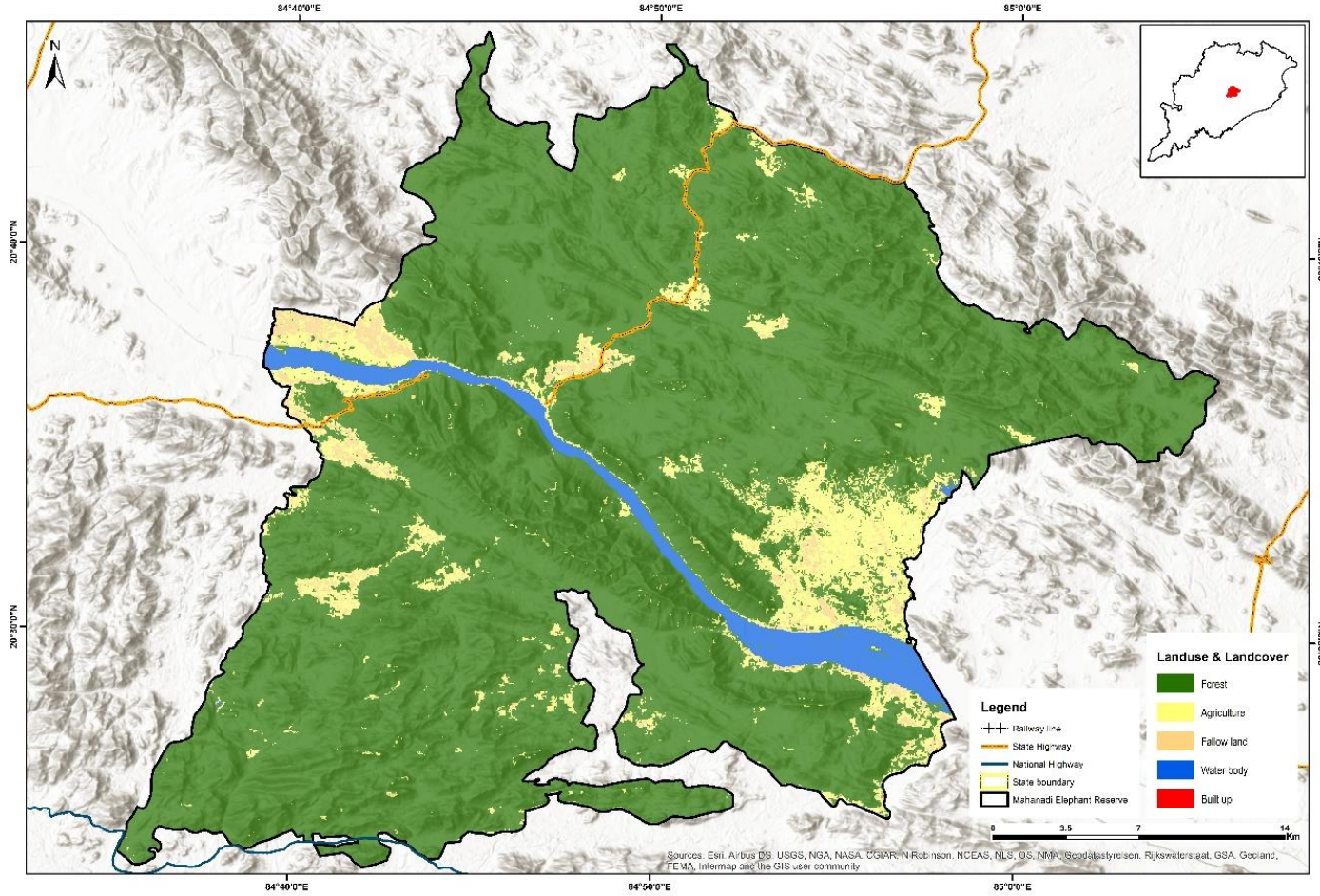
Mahanadi Elephant Reserve, Odisha 2005



LULC Type	*2005 (%)*
Forest	*85.70*
Agriculture	*10.61*
Fallow land	*0.07*
Built up	*0.00*
Waterbody	*3.62*

LULC Map of Mahanadi Elephant Reserve for the Year 2005 – Roy et al., 2016

Mahanadi Elephant Reserve, Odisha 2018

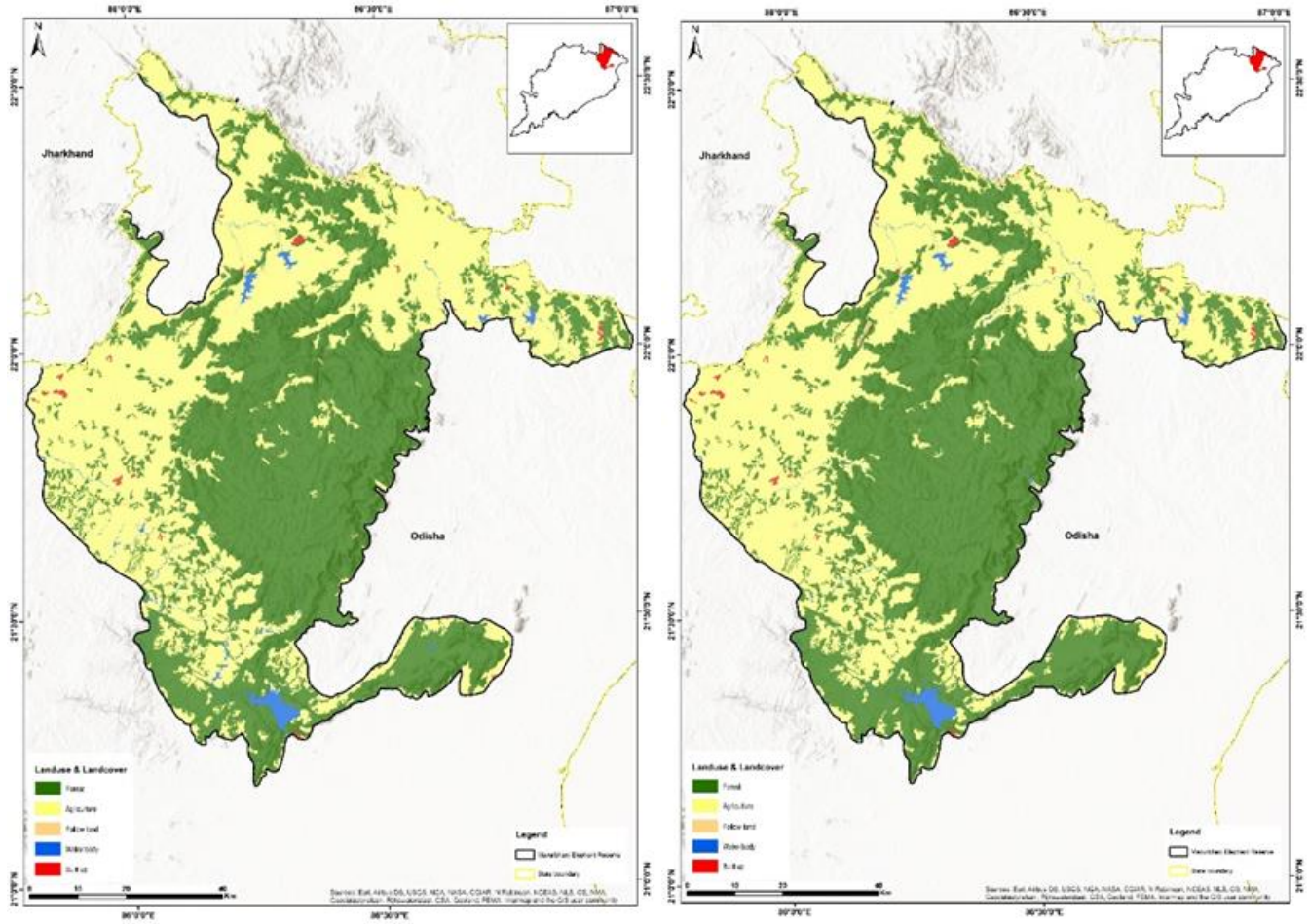


LULC Type	*2018 (%)*
Forest	*85.57*
Agriculture	*8.06*
Fallow land	*3.18*
Built up	*0.00*
Waterbody	*3.20*

In the Mahanadi ER, about 85.5% of the area is forested (Fig 17). No major changes in the LULC classes pertaining to forest cover was noticed between 1985 to 2018 (Table 18).

LULC Map of Mahanadi Elephant Reserve for the Year 2018 with linear infrastructure – Bhuvan (NRSC)

Mayurbhanj Elephant Reserve, Odisha 1985 & 95

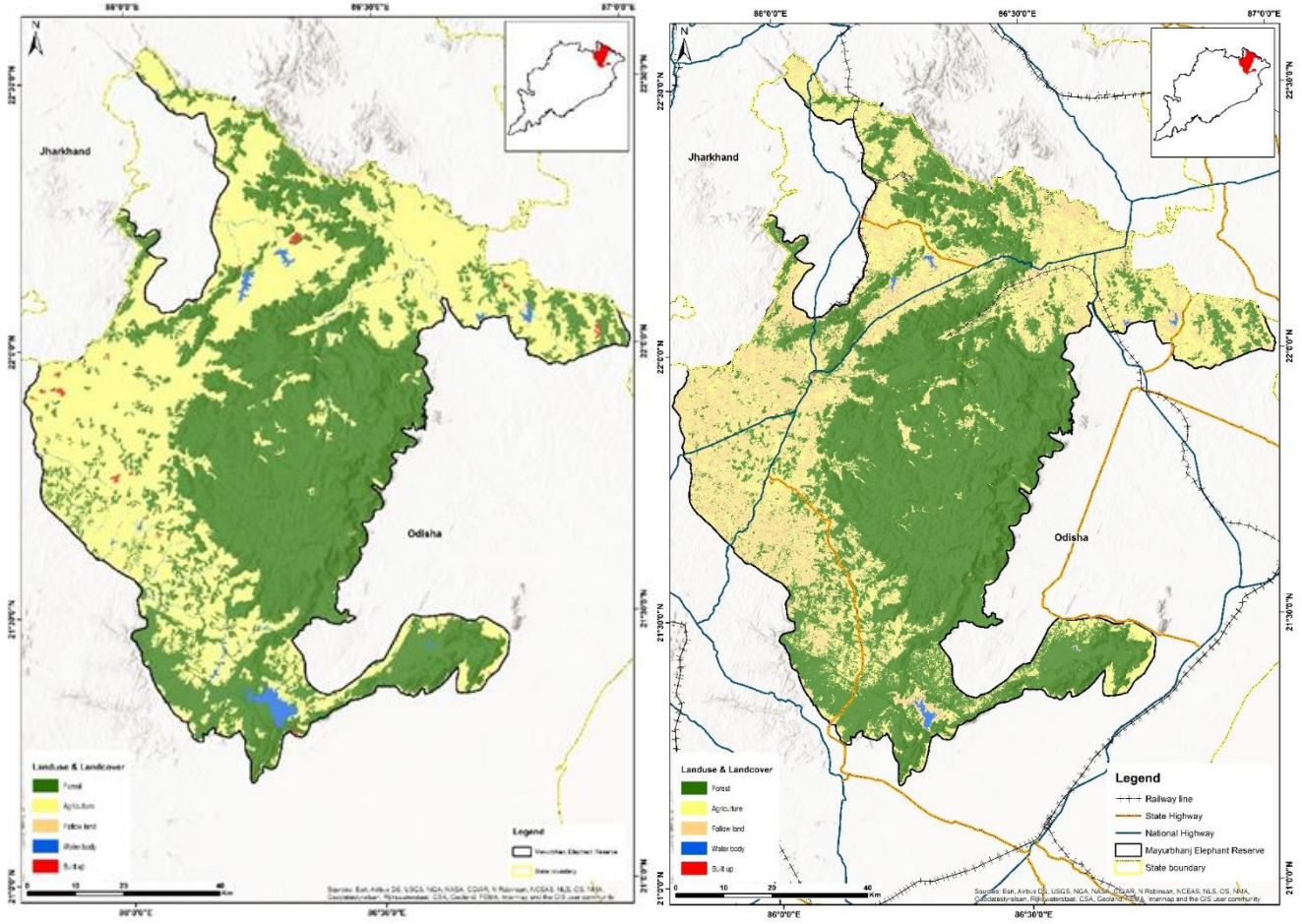


LULC Type	***1985 (%)***
Forest	*53.64*
Agriculture	*44.83*
Fallow land	*0.22*
Built up	*0.26*
Waterbody	*1.05*

LULC Type	***1995 (%)***
Forest	*52.73*
Agriculture	*45.63*
Fallow land	*0.19*
Built up	*0.25*
Waterbody	*1.17*

LULC Map of Mayurbhanj Elephant Reserve for the Year 1985 & 95 – Roy et al., 2016

Mayurbhanj Elephant Reserve, Odisha 2005 & 18



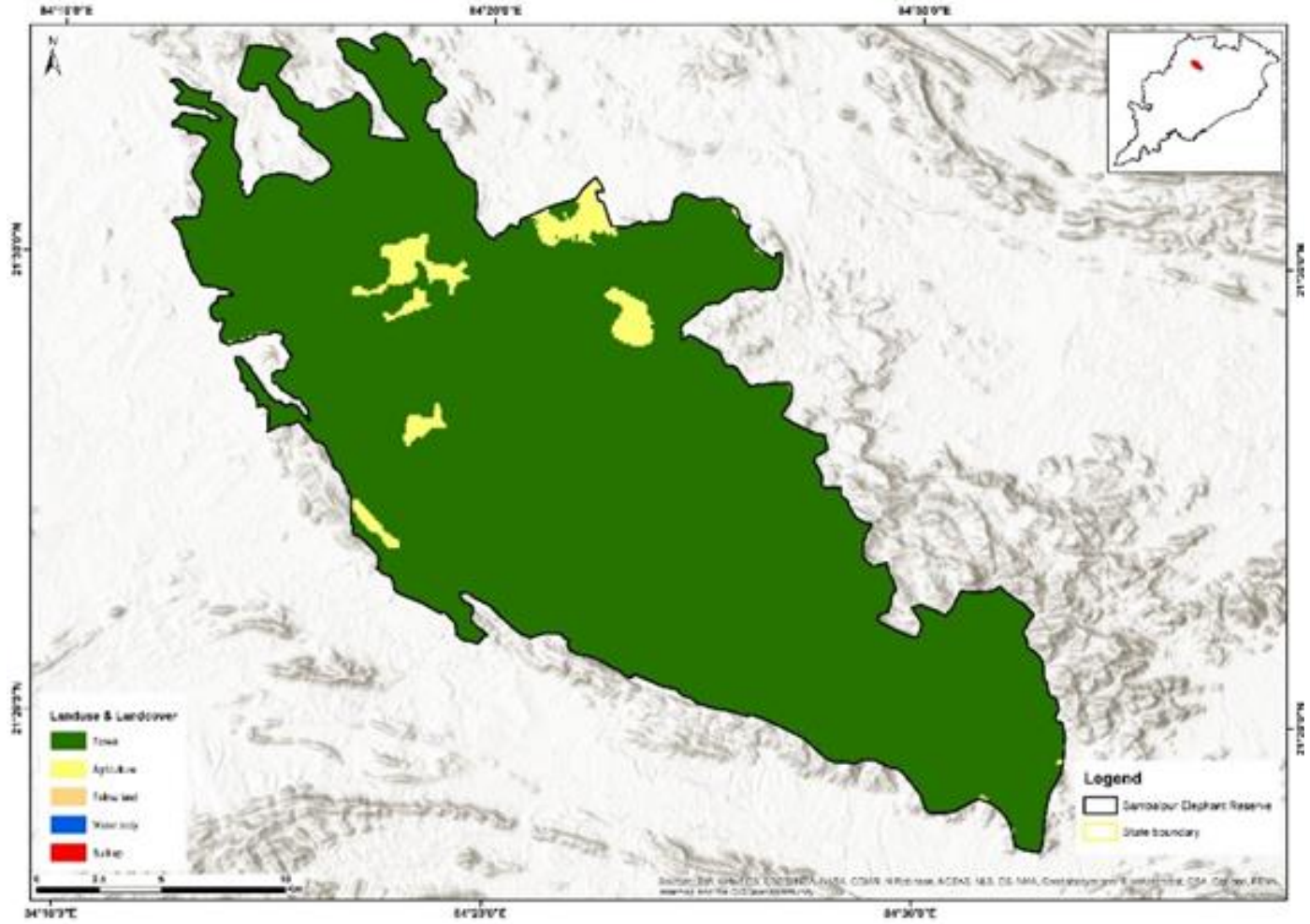
LULC Type	2005 (%)
Forest	52.37
Agriculture	45.09
Fallow land	0.19
Built up	0.25
Waterbody	1.26

LULC Type	2018 (%)
Forest	54.8
Agriculture	23.9
Fallow land	18.6
Built up	2.5
Waterbody	0.3

LULC Map of Mayurbhanj Elephant Reserve for the Year 2005 – Roy at al., 2016 & Year 2018 – Bhuvan (NRSC)

About 54.8% of the Mayurbhanj ER is forested. There was a marginal increase in the forest cover for the period 2005 and 2018 and corresponding decrease in the agricultural areas. However, the resolution of the layers used during 2005 and 2018 are different for making fine-scale comparisons.

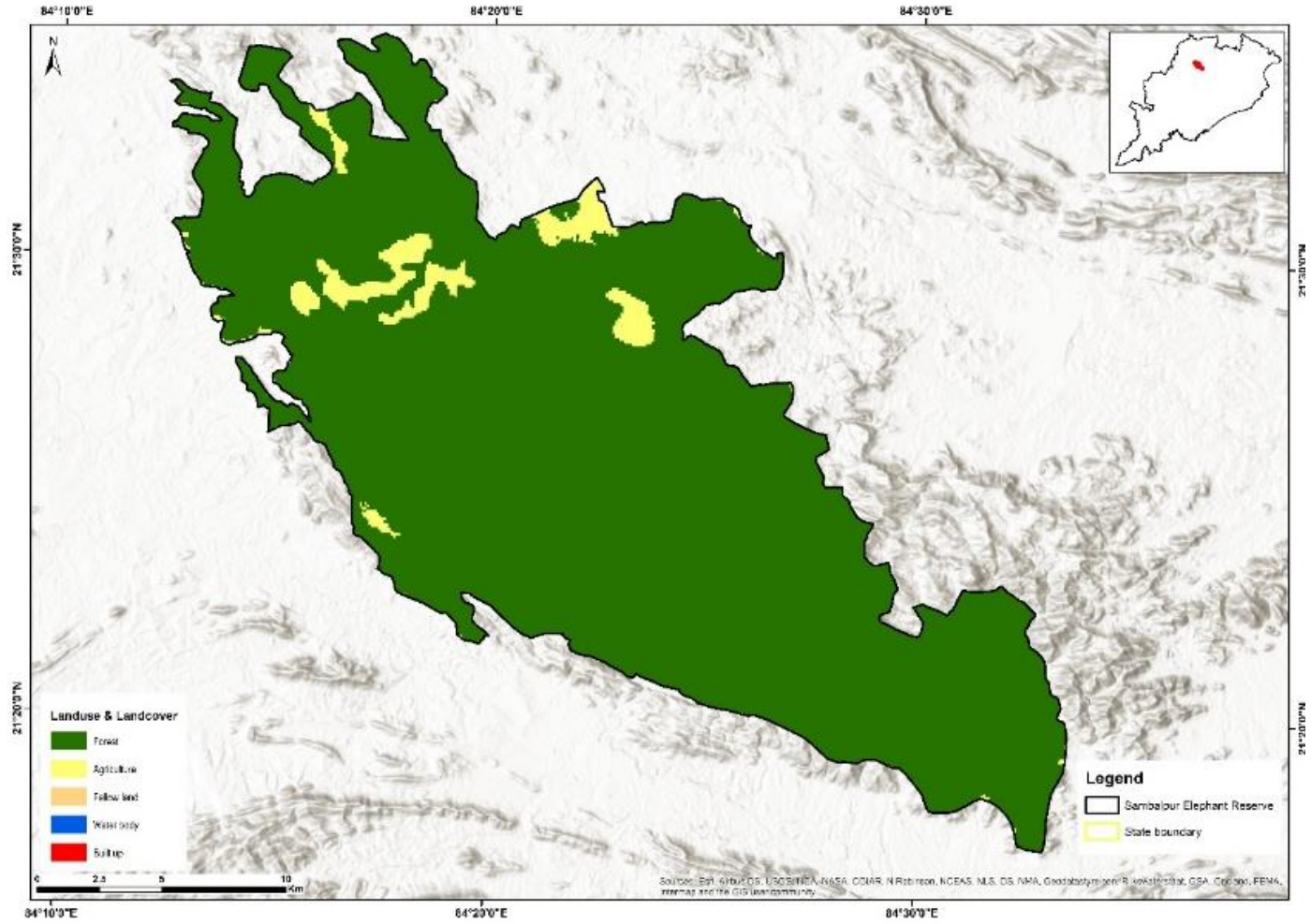
Sambalpur Elephant Reserve, Odisha 1985



LULC Type	*1985 (%)*
Forest	*96.91*
Agriculture	*3.09*
Fallow land	*0.00*
Built up	*0.00*
Waterbody	*0.00*

LULC Map of Sambalpur Elephant Reserve for the Year 1985 – Roy et al., 2016

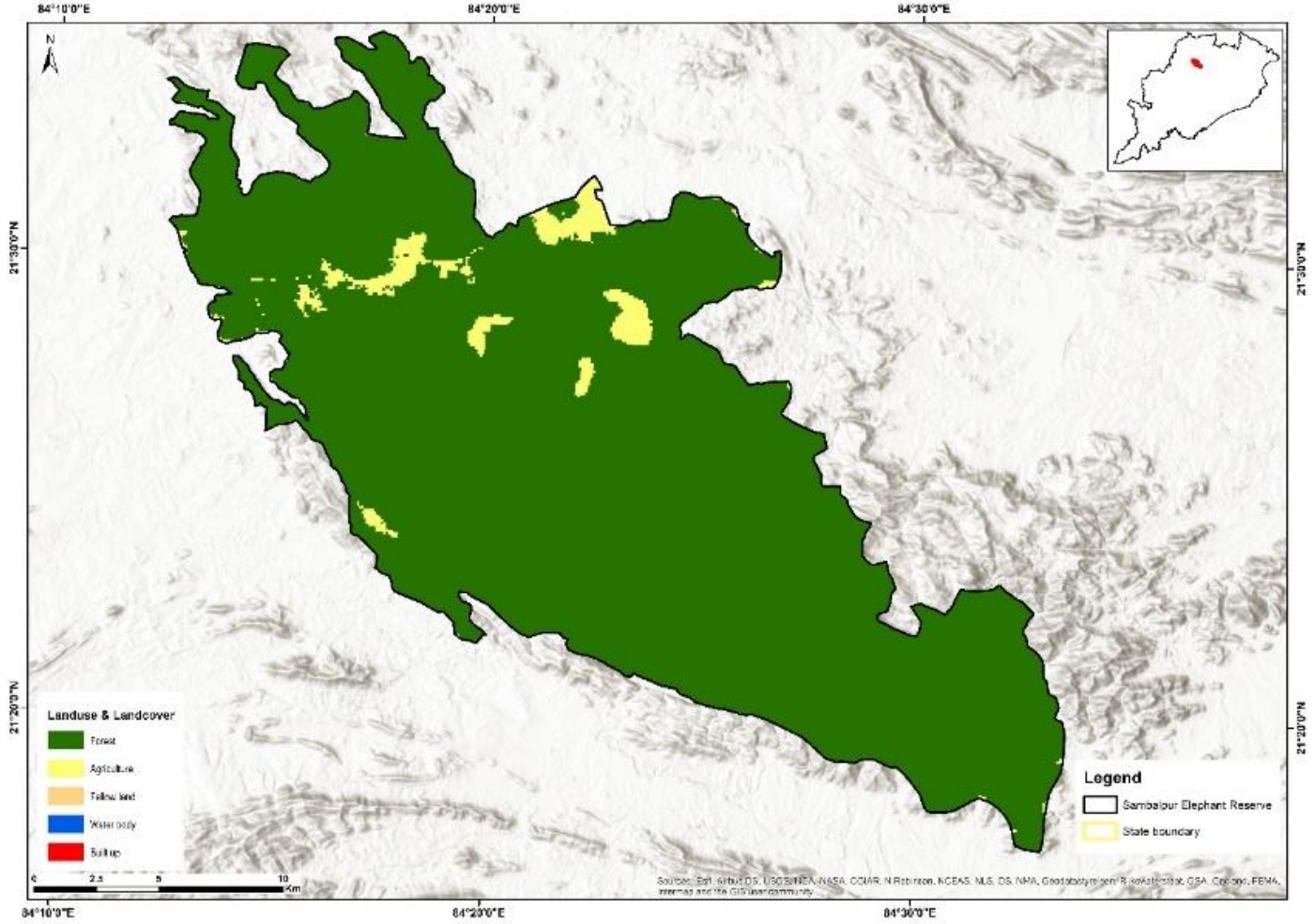
Sambalpur Elephant Reserve, Odisha 1995



LULC Type	***1995 (%)***
Forest	*96.17*
Agriculture	*3.83*
Fallow land	*0.00*
Built up	*0.00*
Waterbody	*0.00*

LULC Map of Sambalpur Elephant Reserve for the Year 1995 – Roy et al., 2016

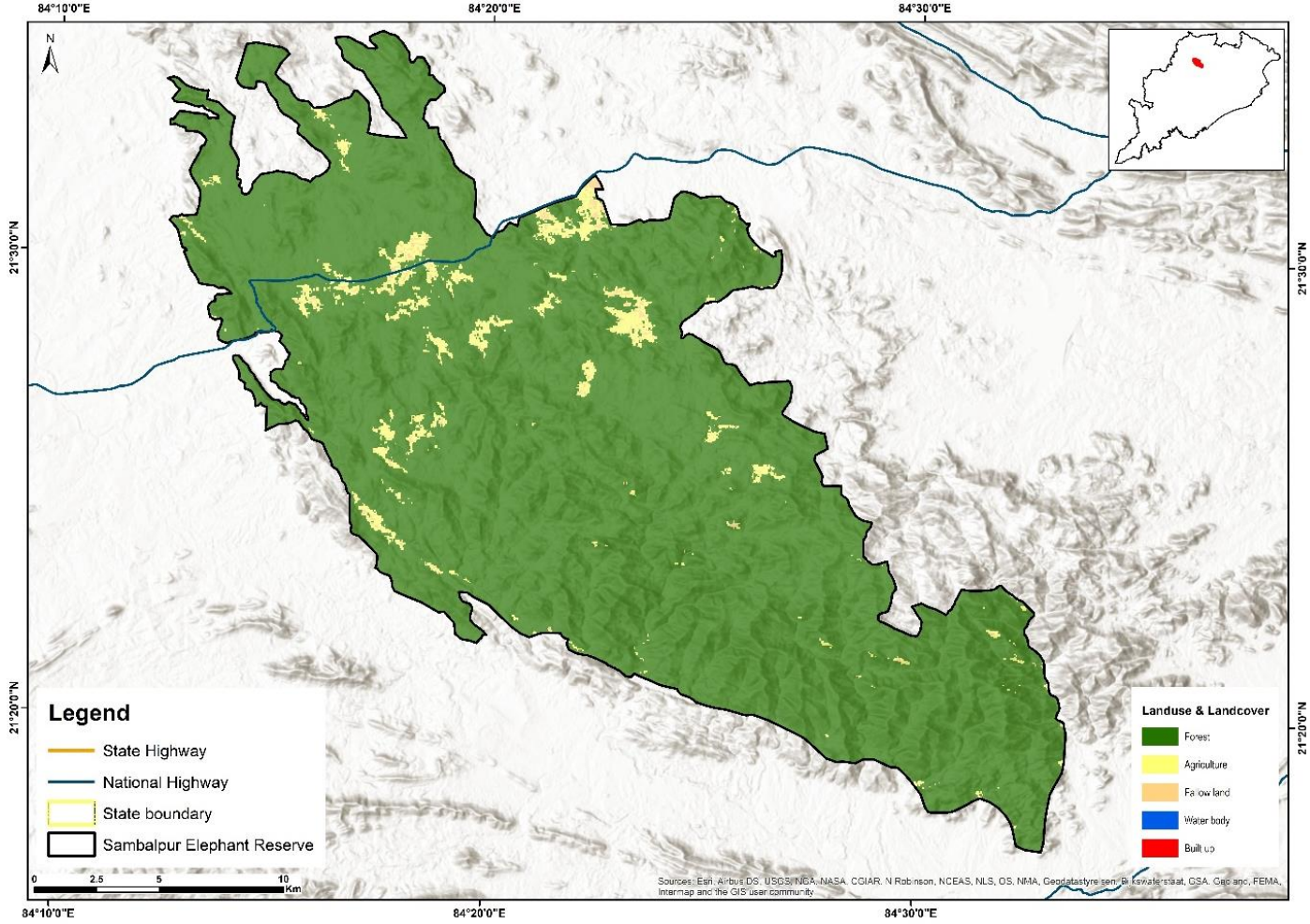
Sambalpur Elephant Reserve, Odisha 2005



LULC Type	*2005 (%)*
Forest	*96.70*
Agriculture	*3.30*
Fallow land	*0.00*
Built up	*0.00*
Waterbody	*0.00*

LULC Map of Sambalpur Elephant Reserve for the Year 2005 – Roy et al., 2016

Sambalpur Elephant Reserve, Odisha 2018

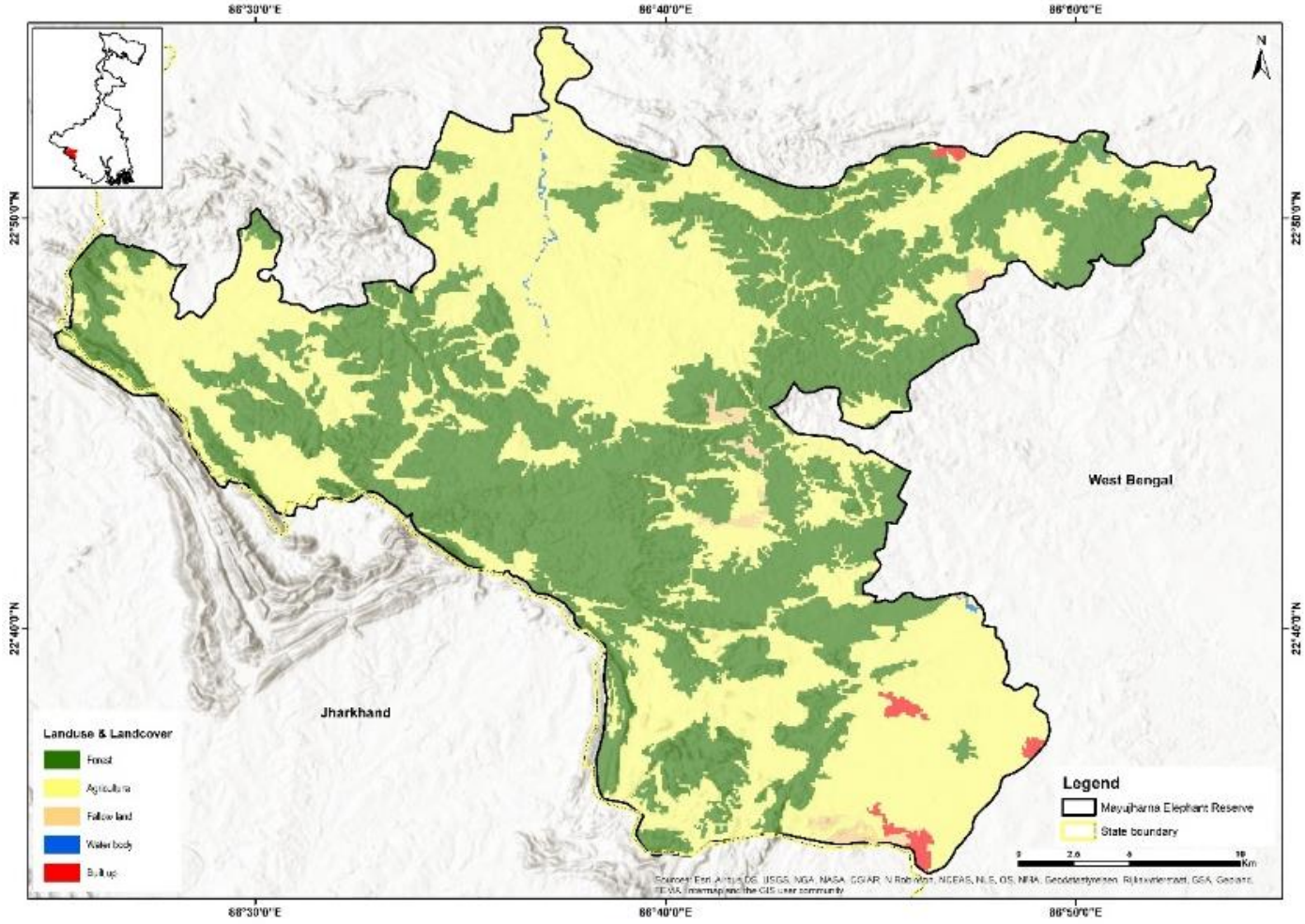


LULC Type	*2018 (%)*
Forest	*96.22*
Agriculture	*3.23*
Fallow land	*0.54*
Built up	*0.00*
Waterbody	*0.00*

About 96.2% of the Sambalpur ER is forested. No major changes in the LULC classes pertaining to forest cover was noticed between 1985 to 2018.

LULC Map of Sambalpur Elephant Reserve for the Year 2018 with linear infrastructure – Bhuvan (NRSC)

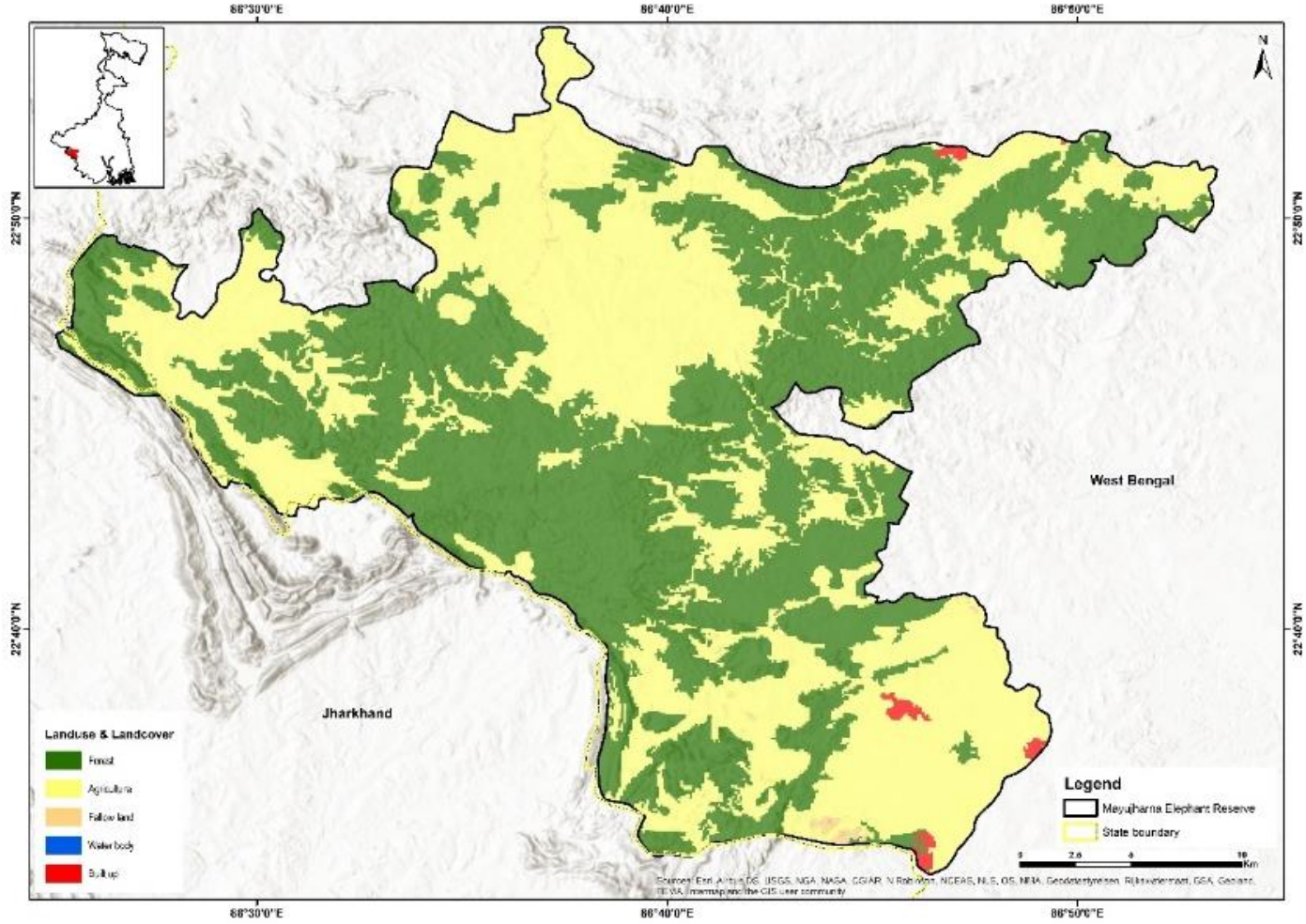
Mayurjharna Elephant Reserve, West Bengal 1985



LULC Type	*1985 (%)*
Forest	*48.07*
Agriculture	*50.3*
Fallow land	*0.86*
Built up	*0.57*
Waterbody	*0.15*

LULC Map of Mayurjharna Elephant Reserve for the Year 1985 – Roy et al., 2016

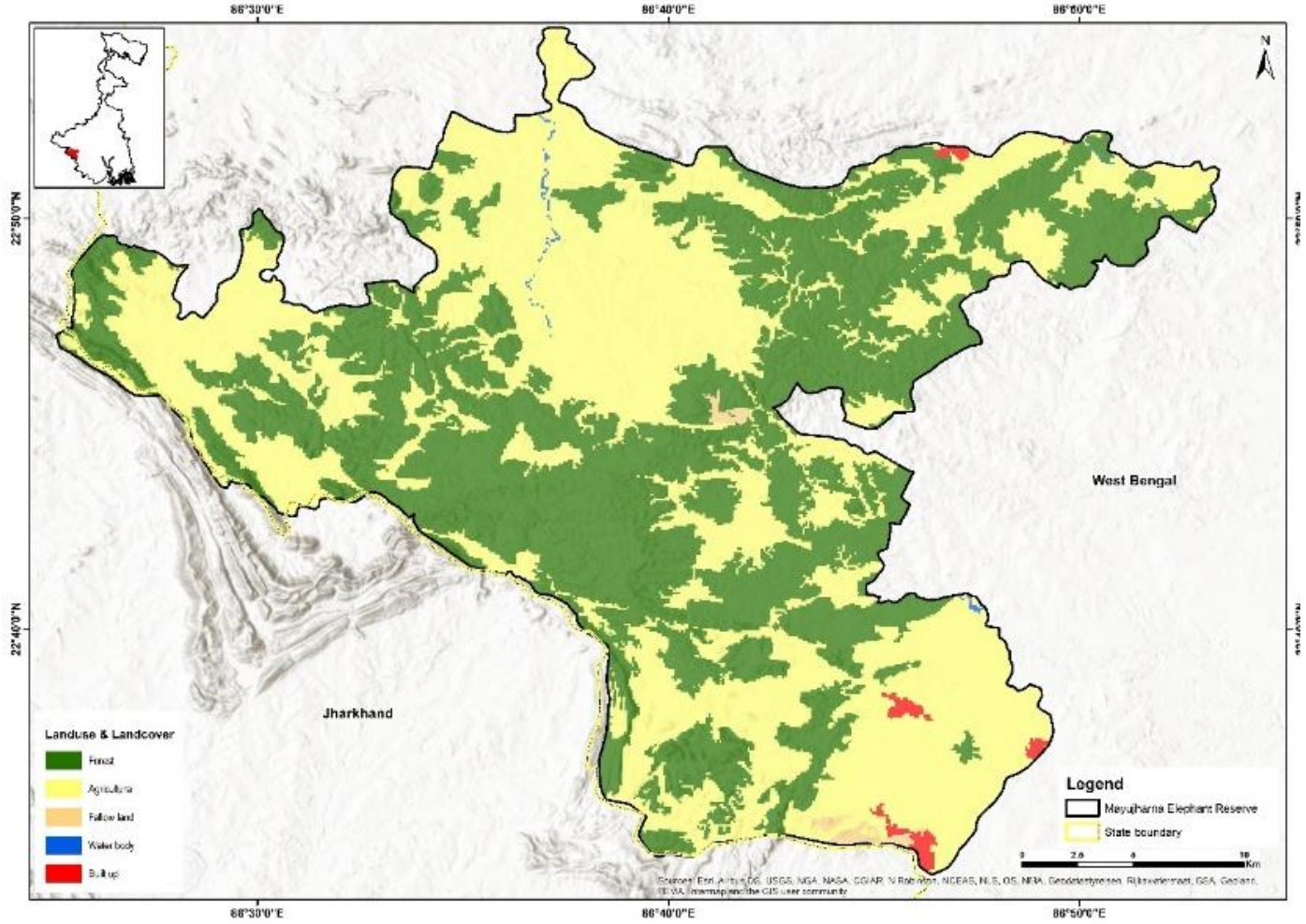
Mayurjharna Elephant Reserve, West Bengal 1995



LULC Type	*1995 (%)*
Forest	*47.97*
Agriculture	*50.81*
Fallow land	*0.48*
Built up	*0.56*
Waterbody	*015*

LULC Map of Mayurjharna Elephant Reserve for the Year 1995 – Roy et al., 2016

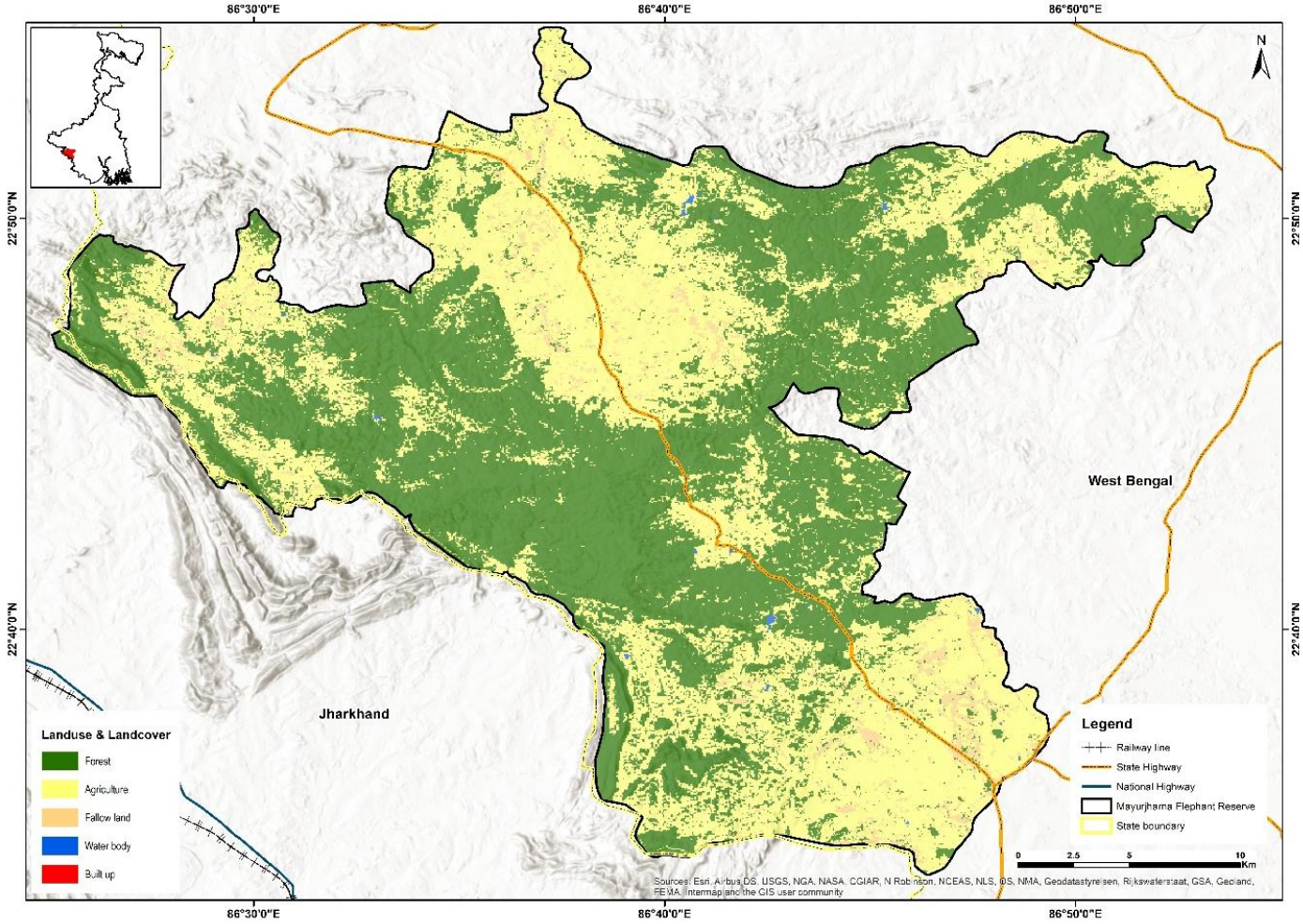
Mayurjharna Elephant Reserve, West Bengal 2005



LULC Type	*2005 (%)*
Forest	*51.7*
Agriculture	*47.66*
Fallow land	*0.16*
Built up	*0.44*
Waterbody	*0.14*

LULC Map of Mayurjharna Elephant Reserve for the Year 2005 – Roy et al., 2016

Mayurjharna Elephant Reserve, West Bengal 2018



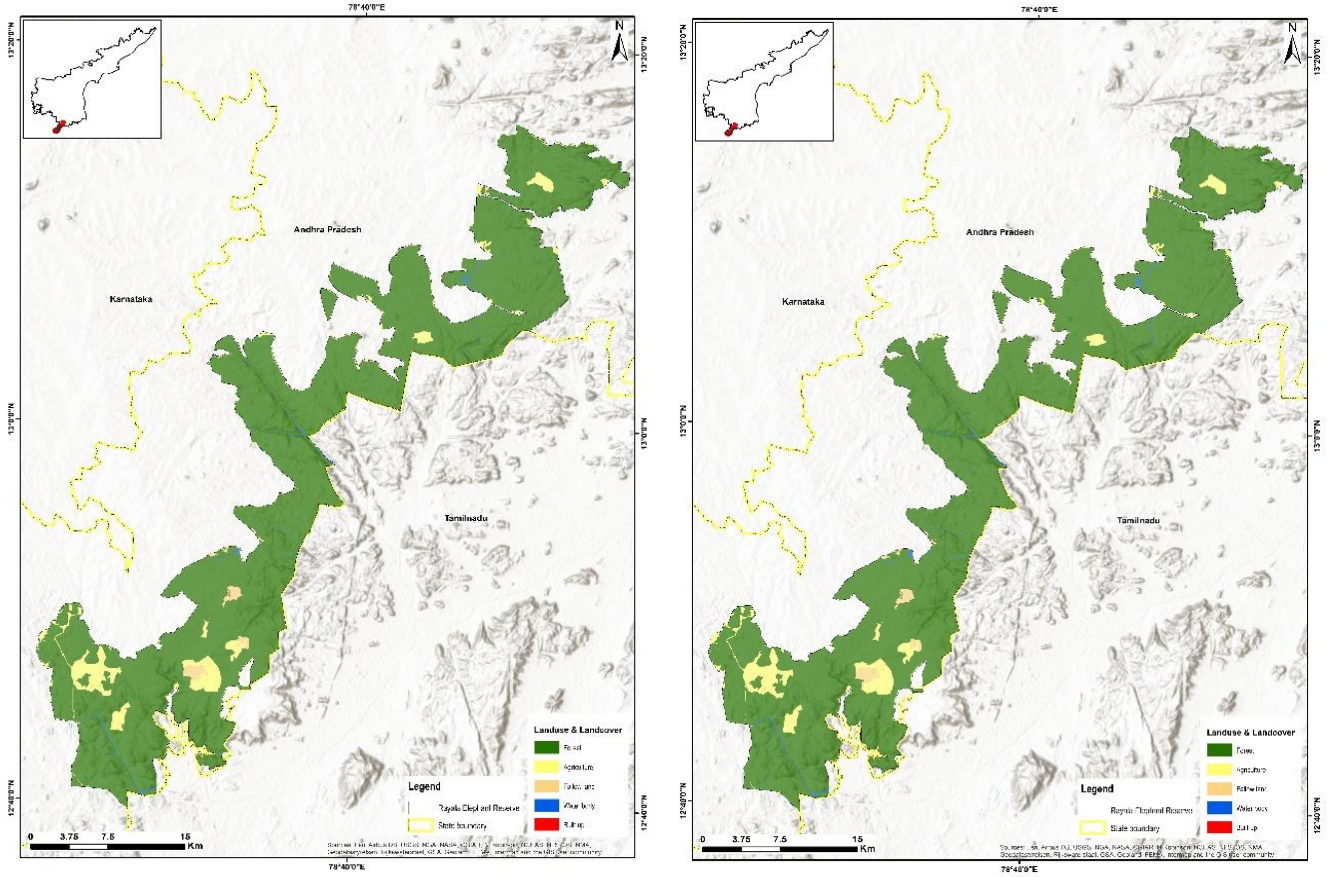
LULC Type	*2018 (%)*
Forest	*51.97*
Agriculture	*43.39*
Fallow land	*4.13*
Built up	*0.4*
Waterbody	*0.11*

About 51.97 % of the Mayurjhama ER is forested. No major changes in the LULC classes pertaining to forest cover was noticed between 1985 to 2018.

LULC Map of Mayurjharna Elephant Reserve for the Year 2018 with linear infrastructure – Bhuvan (NRSC)

ELEPHANT RESERVES OF
Southern Region

Rayala Elephant Reserve, Andhra Pradesh 1985 & 95

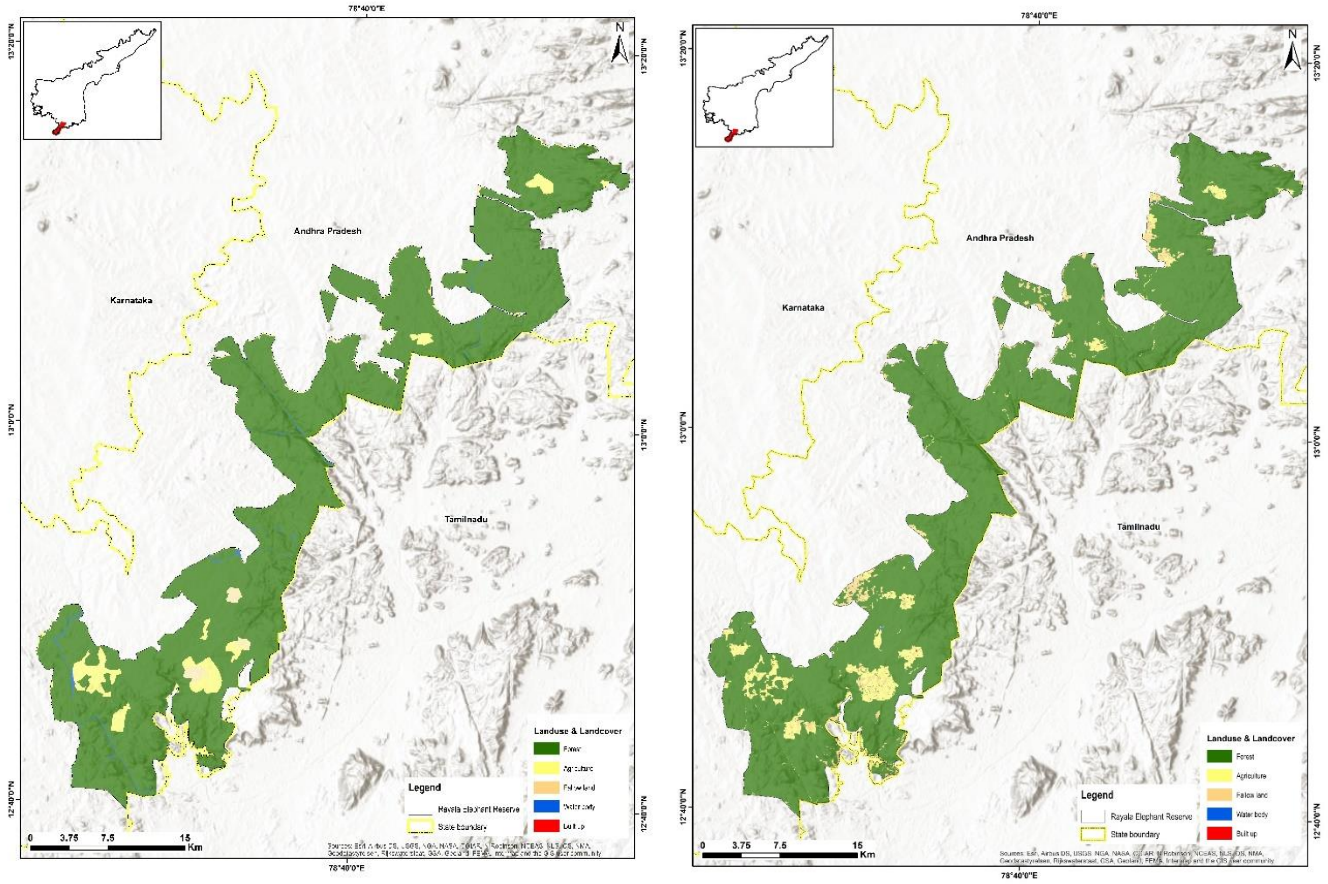


LULC Type	*1985 (%)*
Forest	*93.30*
Agriculture	*5.06*
Fallow land	*1.09*
Built up	*0.00*
Waterbody	*0.56*

LULC Type	*1995 (%)*
Forest	*93.30*
Agriculture	*5.06*
Fallow land	*1.09*
Built up	*0.00*
Waterbody	*0.56*

LULC Map of Rayala Elephant Reserve for the Year 1985 & 95 – Roy et al., 2016

Rayala Elephant Reserve, Andhra Pradesh 2005 & 18



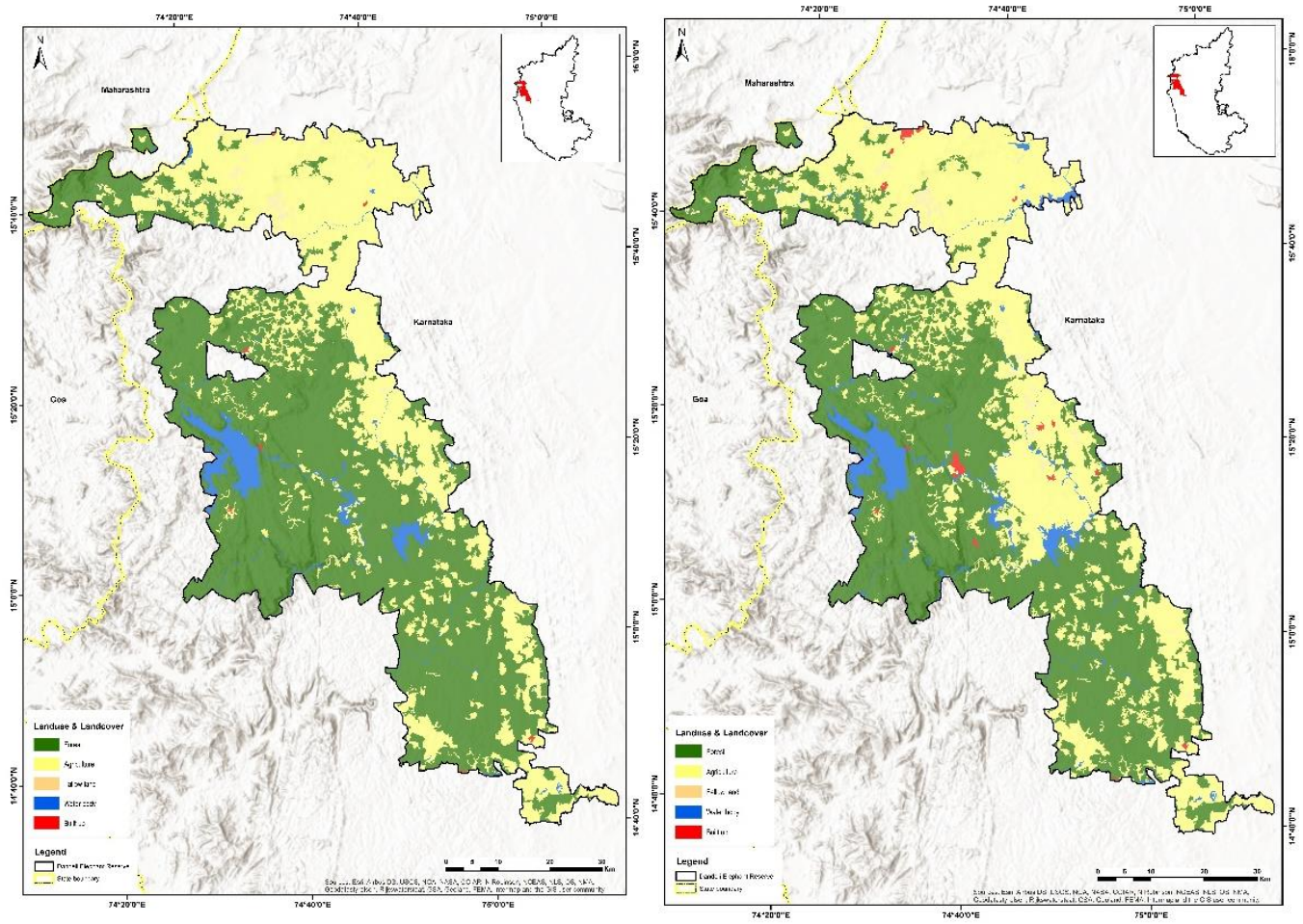
LULC Type	***2005 (%)***
Forest	*93.52*
Agriculture	*4.62*
Fallow land	*1.18*
Built up	*0.00*
Waterbody	*0.68*

LULC Type	***2018 (%)***
Forest	*91.86*
Agriculture	*5.35*
Fallow land	*2.76*
Built up	*0.02*
Waterbody	*0.02*

LULC Map of Rayala Elephant Reserve for the Year 2005 – Roy at al., 2016 & Year 2018 – Bhuvan (NRSC)

About 91.8 % of the Rayala ER is forested. A marginal decline in the forest cover was noted between 2005 and 2018. However, the resolution of LULC data for the two periods is not comparable.

Dandeli Elephant Reserve, Karnataka 1985 & 95

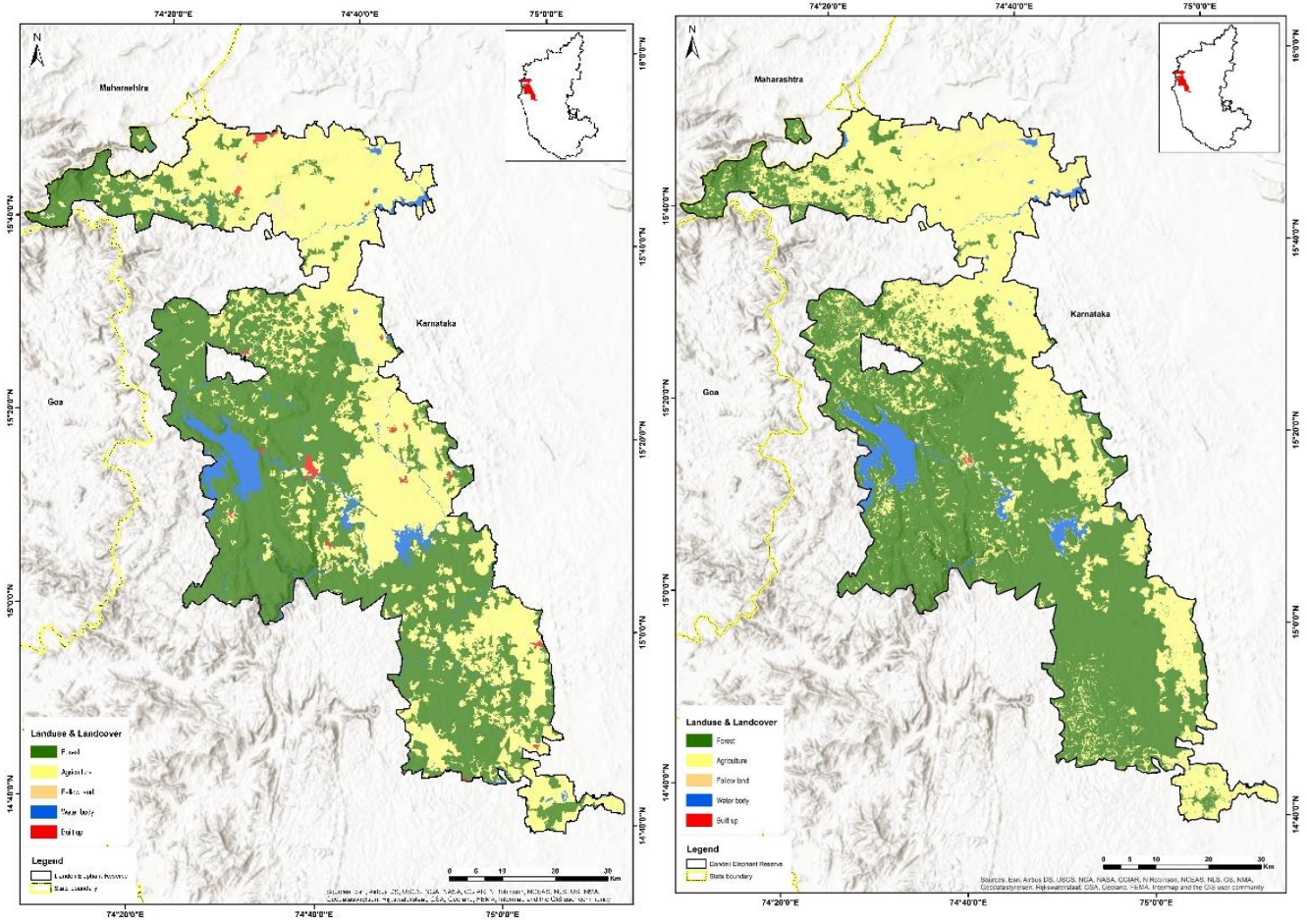


LULC Type	1985 (%)
Forest	59.71
Agriculture	35.93
Fallow land	0.67
Built up	0.09
Waterbody	3.60

LULC Type	1995 (%)
Forest	53.25
Agriculture	41.23
Fallow land	0.84
Built up	0.46
Waterbody	4.21

LULC Map of Dandeli Elephant Reserve for the Year 1985 & 95 – Roy et al., 2016

Dandeli Elephant Reserve, Karnataka 2005 & 18



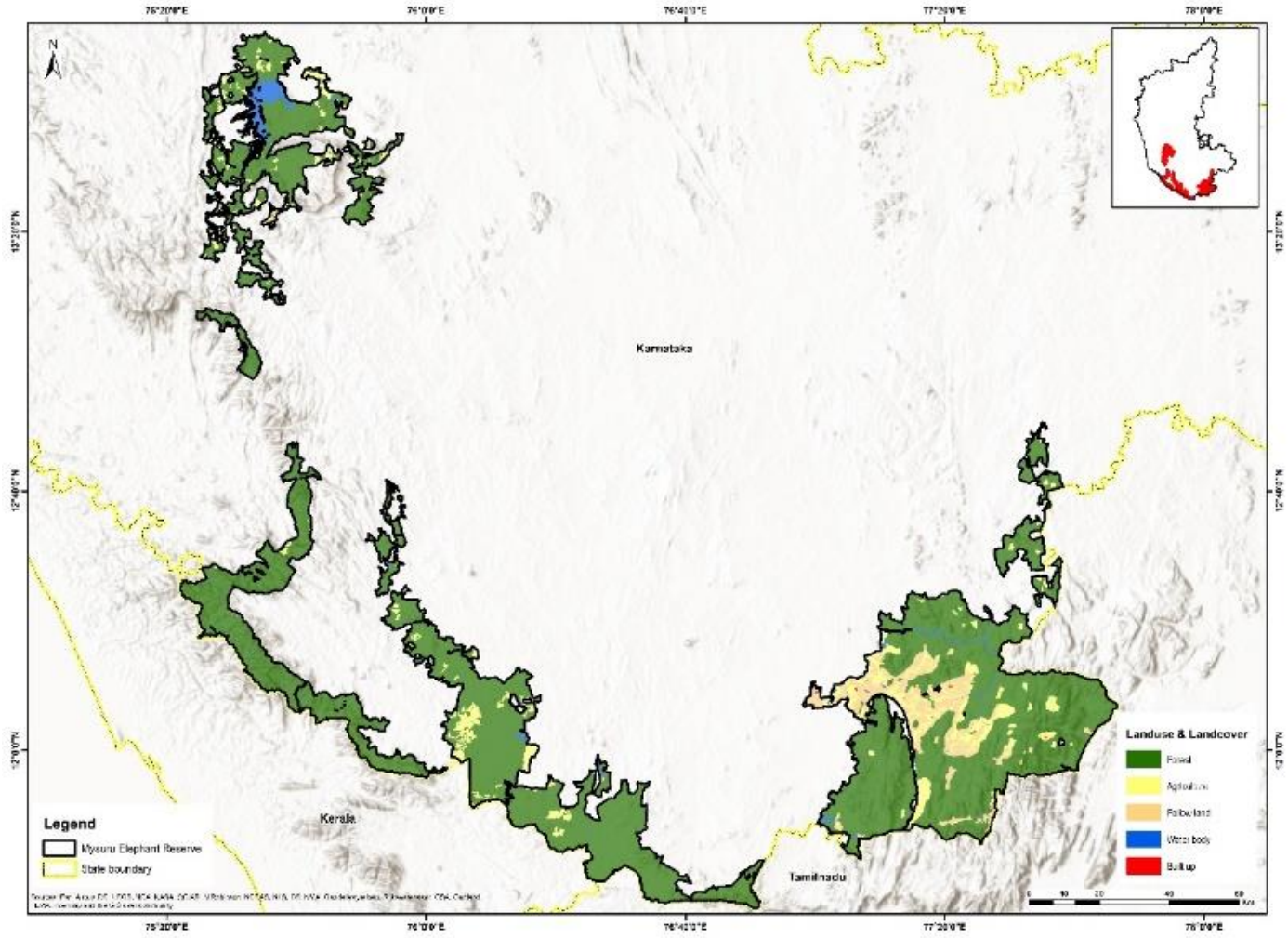
LULC Type	2005 (%)
Forest	50.51
Agriculture	44.20
Fallow land	0.88
Built up	0.51
Waterbody	3.91

LULC Type	2018 (%)
Forest	55.36
Agriculture	39.97
Fallow land	1.31
Built up	0.03
Waterbody	3.32

LULC Map of Dandeli Elephant Reserve for the Year 2005 – Roy at al., 2016 & Year 2018 – Bhuvan (NRSC)

About 55.3 % of the Dandeli ER is forested. A gradual and marginal decline in the forest cover was noted since 1995. Between 2005 and 2018, although decline in forest cover is noticed, the resolution is not comparable between the two periods.

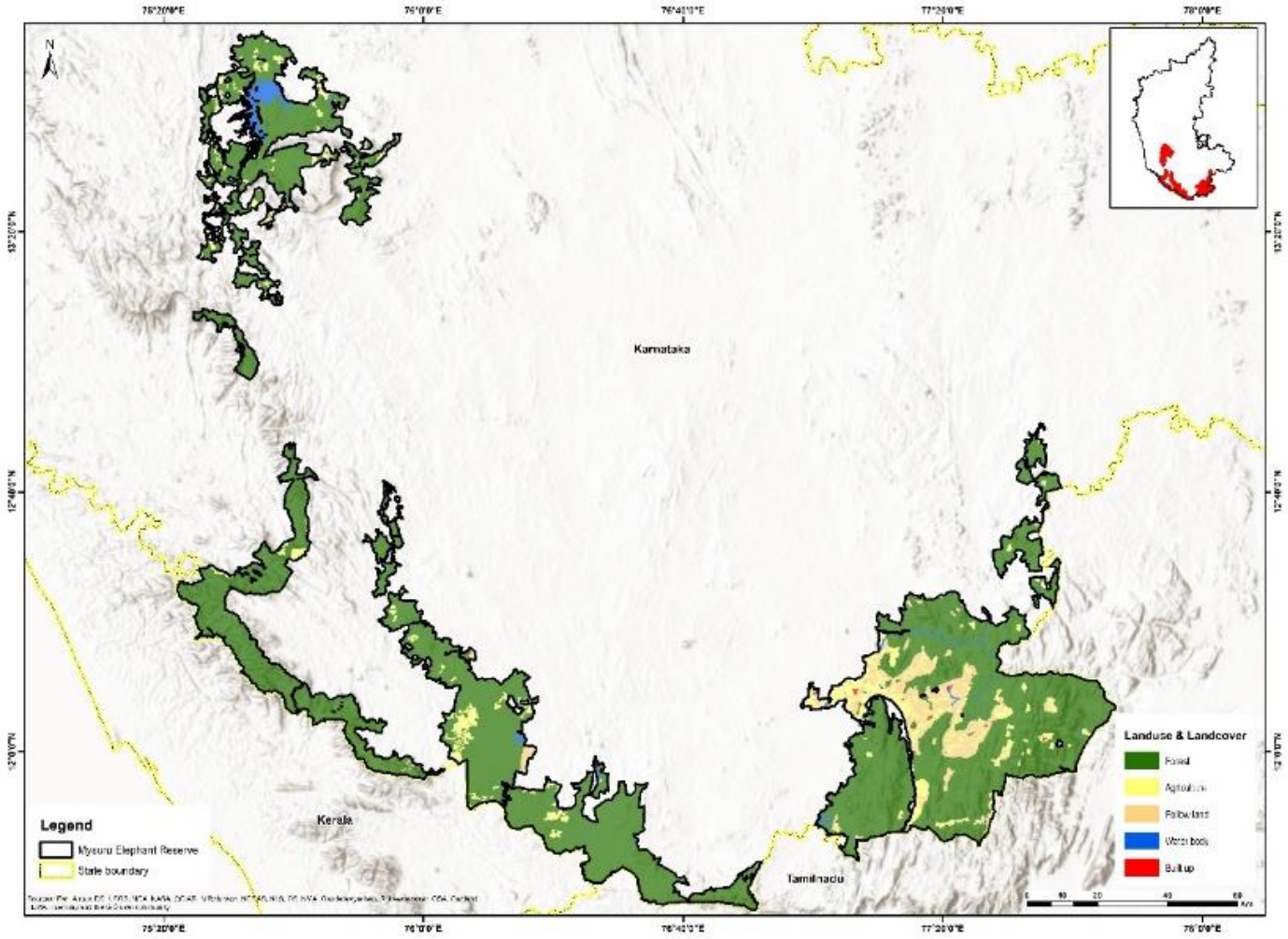
Mysuru Elephant Reserve, Karnataka 1985



LULC Type	*1985 (%)*
Forest	*82.70*
Agriculture	*9.53*
Fallow land	*5.29*
Built up	*0.04*
Waterbody	*2.44*

LULC Map of Mysuru Elephant Reserve for the Year 1985 – Roy et al., 2016

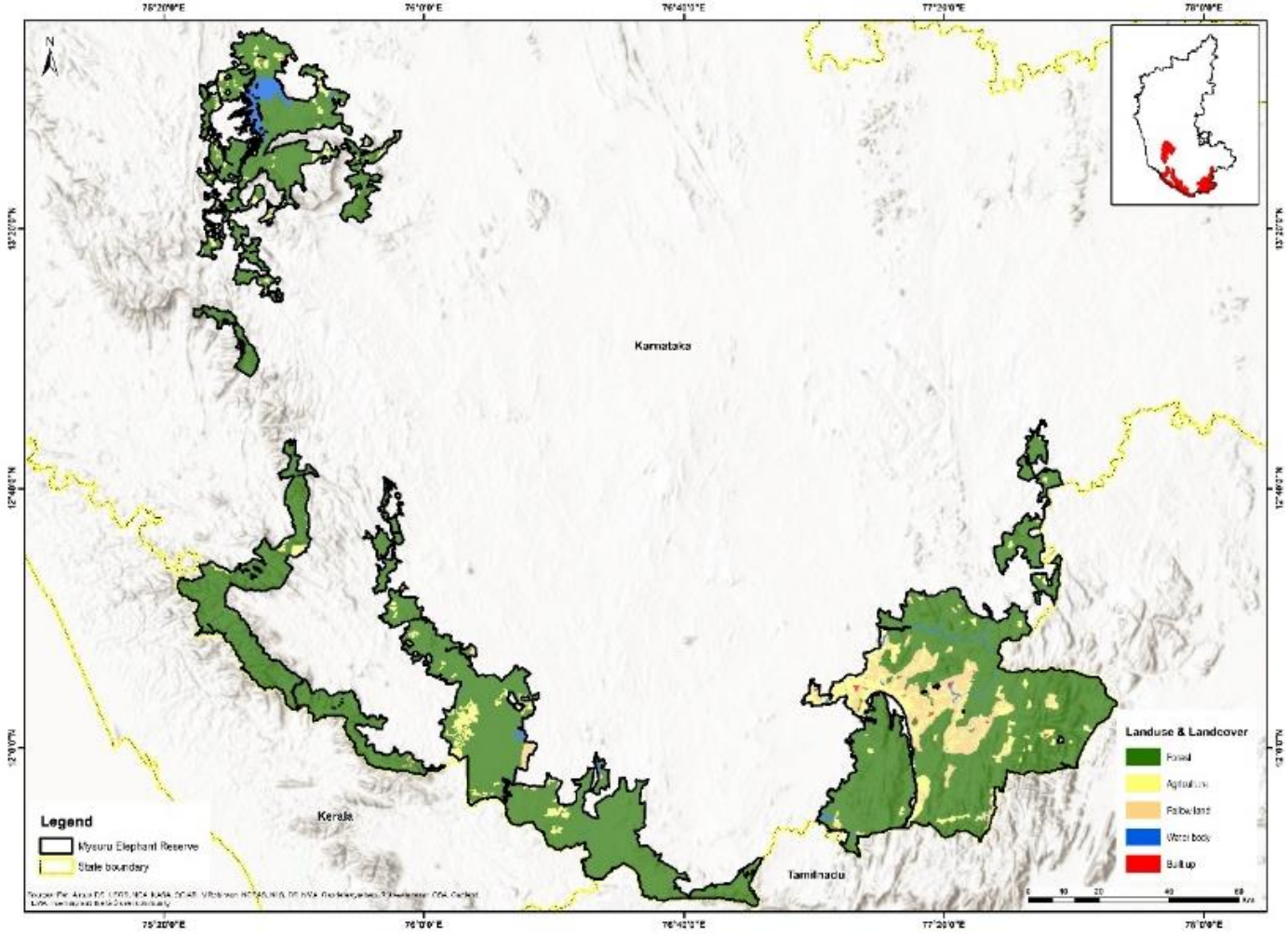
Mysuru Elephant Reserve, Karnataka 1995



LULC Type	*1995 (%)*
Forest	*82.07*
Agriculture	*9.34*
Fallow land	*5.97*
Built up	*0.09*
Waterbody	*2.54*

LULC Map of Mysuru Elephant Reserve for the Year 1995 – Roy et al., 2016

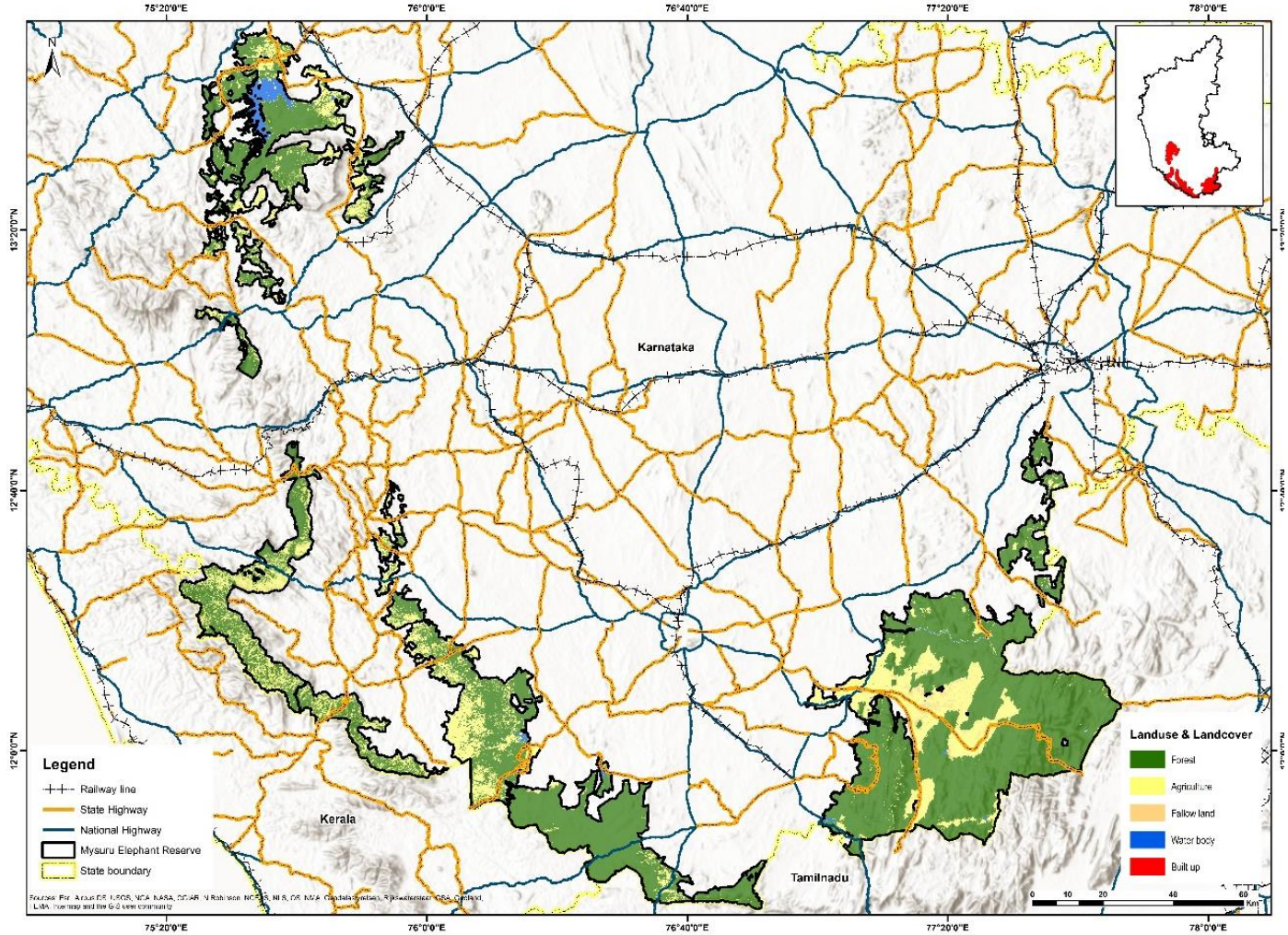
Mysuru Elephant Reserve, Karnataka 2005



LULC Type	*2005 (%)*
Forest	*80.98*
Agriculture	*10.91*
Fallow land	*5.49*
Built up	*0.15*
Waterbody	*2.48*

LULC Map of Mysuru Elephant Reserve for the Year 2005 – Roy et al., 2016

Mysuru Elephant Reserve, Karnataka 2018

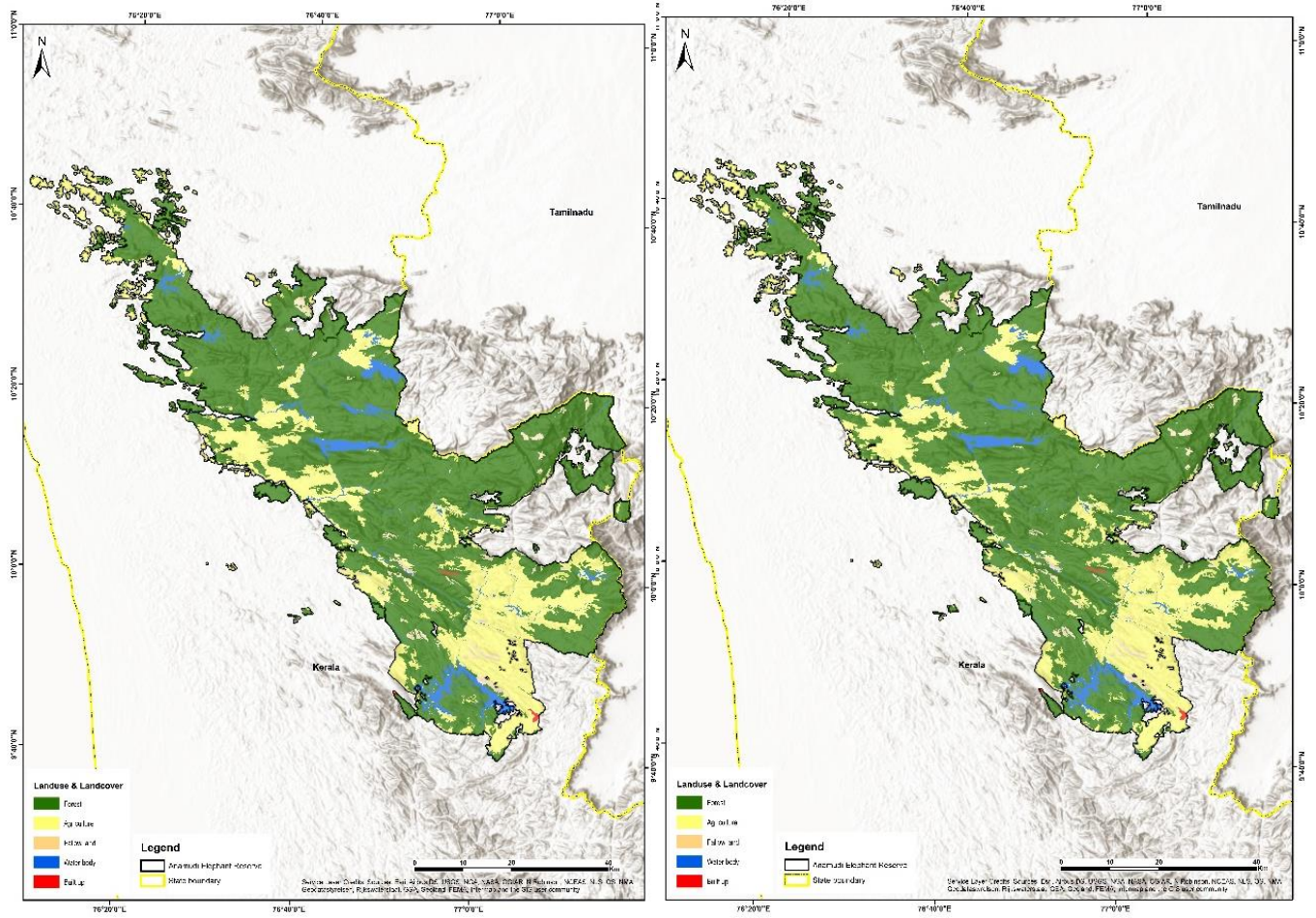


LULC Type	*2018 (%)*
Forest	*82.55*
Agriculture	*14.78*
Fallow land	*0.82*
Built up	*0.01*
Waterbody	*1.84*

About 82.5 % of the Mysuru ER is forested. There was a marginal decrease in the forest cover and increase in the agriculture between the periods 2005 and 2018. The resolution of the imagery for the period 2005 and 2018 are not comparable

LULC Map of Mysuru Elephant Reserve for the Year 2018 with linear infrastructure – Bhuvan (NRSC)

Anamudi Elephant Reserve, Kerala 1985 & 95

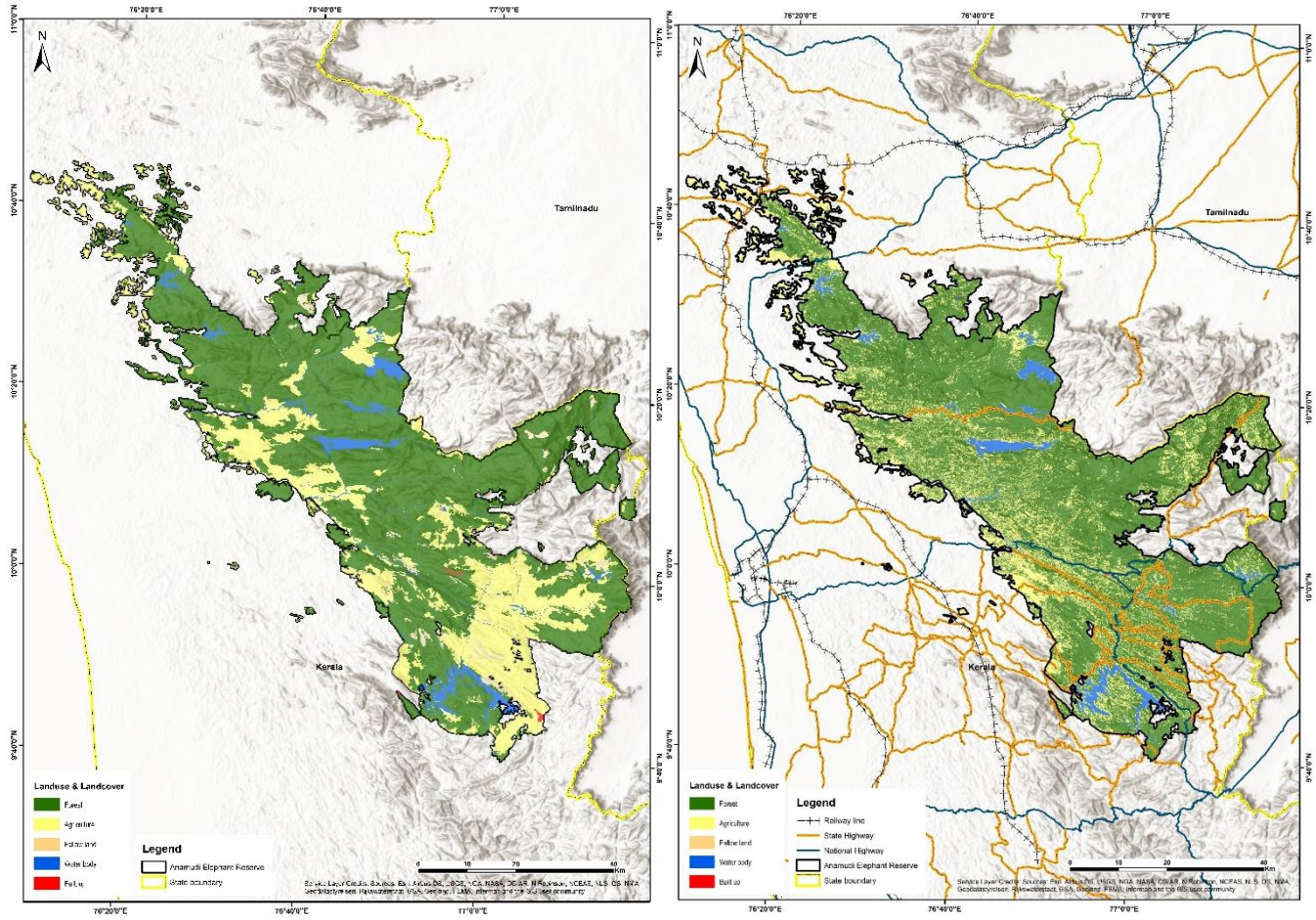


LULC Type	***1985 (%)***
Forest	*69.3*
Agriculture	*25.16*
Fallow land	*1.58*
Built up	*0.09*
Waterbody	*3.82*

LULC Type	***1995 (%)***
Forest	*69.18*
Agriculture	*25.30*
Fallow land	*1.58*
Built up	*0.09*
Waterbody	*3.83*

LULC Map of Anamudi Elephant Reserve for the Year 1985 & 95 – Roy et al., 2016

Anamudi Elephant Reserve, Kerala 2005 & 18



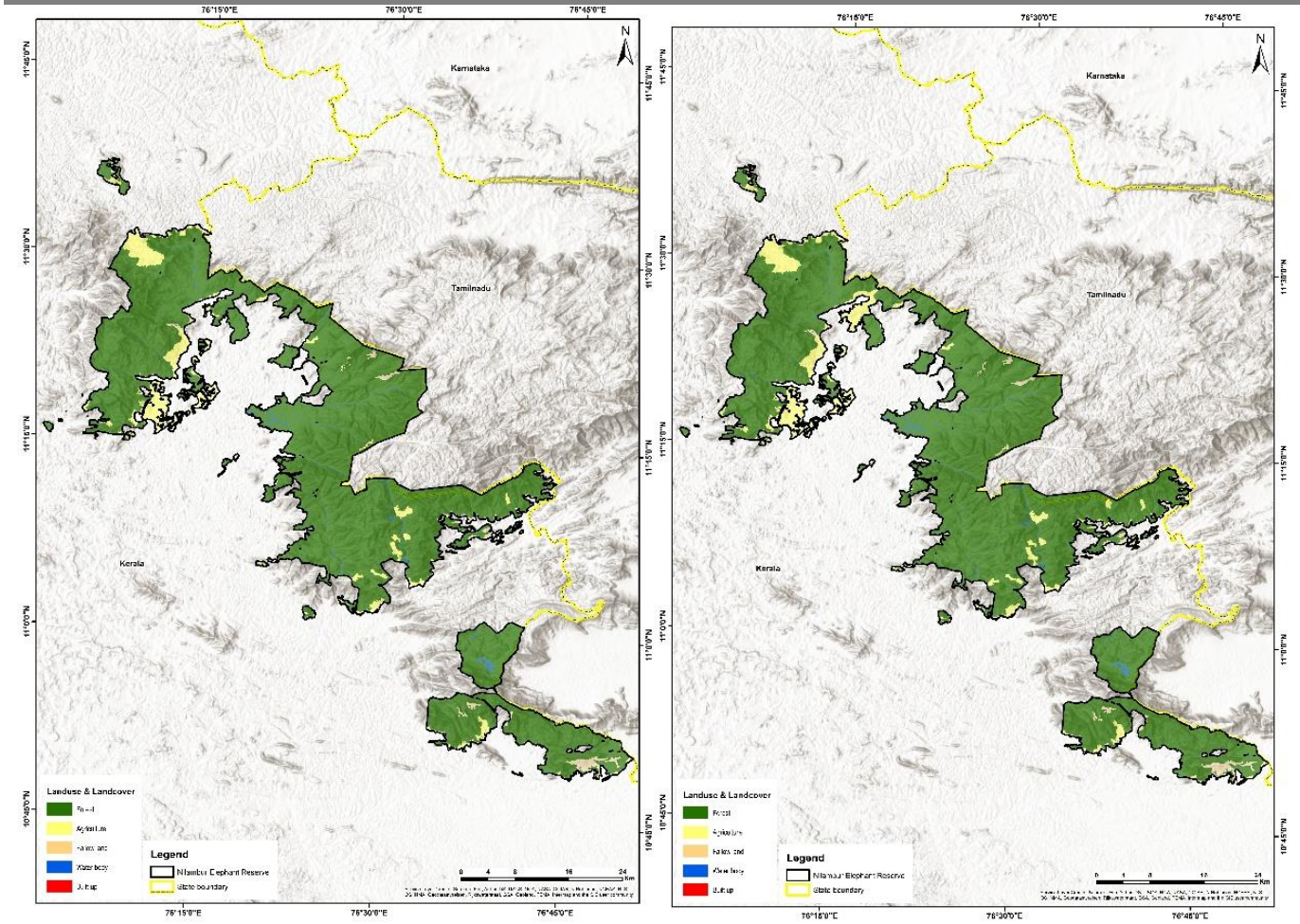
LULC Type	2005 (%)
Forest	68.8
Agriculture	25.49
Fallow land	1.77
Built up	0.09
Waterbody	3.83

LULC Type	2018 (%)
Forest	70.66
Agriculture	25.52
Fallow land	0.32
Built up	0.04
Waterbody	3.43

LULC Map of Anamudi Elephant Reserve for the Year 2005 – Roy at al., 2016 & Year 2018 – Bhuvan (NRSC)

About 70.6 % of the Anamudi ER is forested. An increase in the forest cover was noticed between 2005 and 2018. During the same period a significant decline was observed in the agricultural areas as well. The resolution of the imagery for the period 2005 and 2018 are not comparable would require a combination of ground information and high-resolution imagery for reclassification.

Nilambur Elephant Reserve, Kerala — 1985 & 95

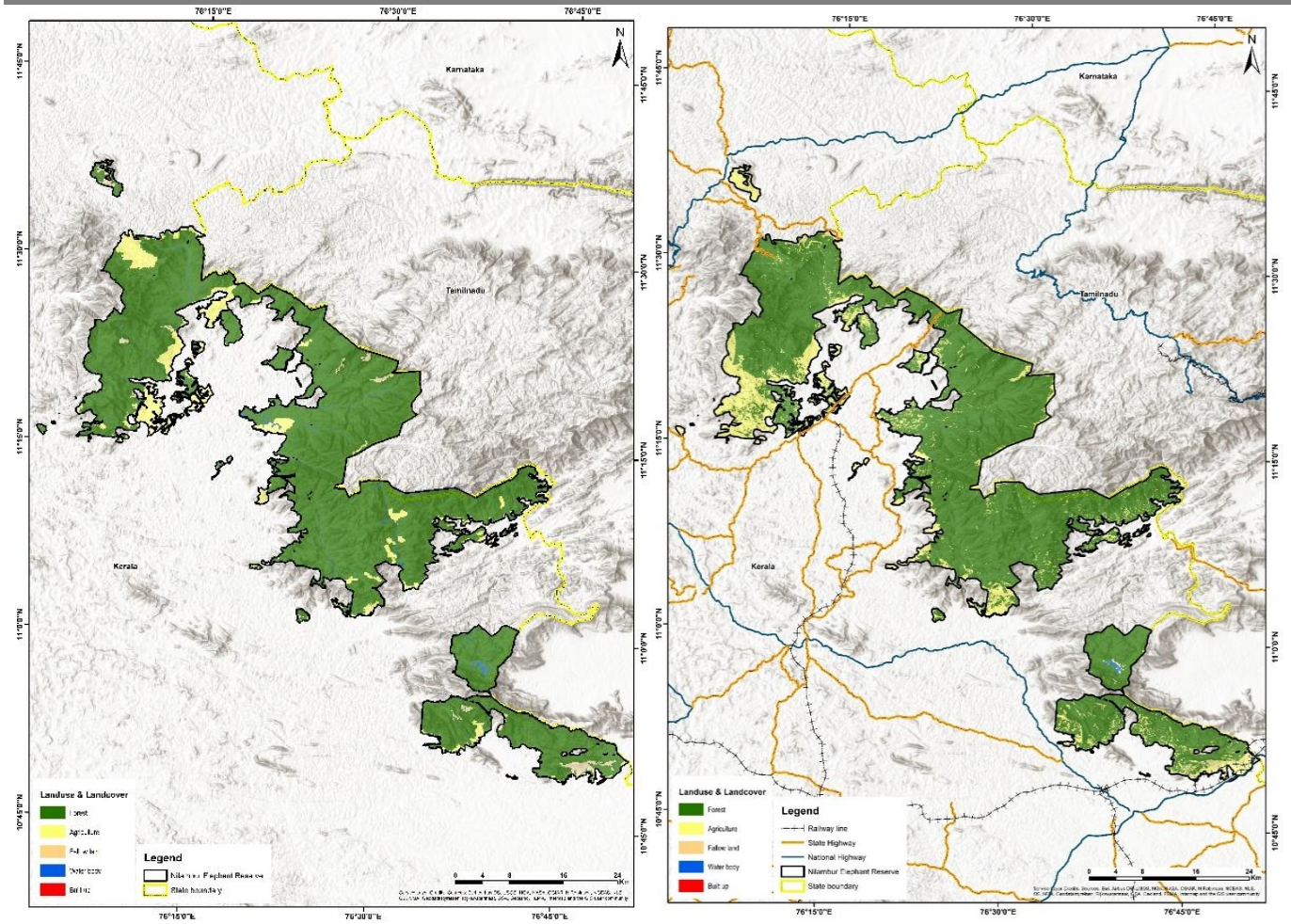


LULC Type	***1985 (%)***
Forest	*89.8*
Agriculture	*7.54*
Fallow land	*1.73*
Built up	*0.00*
Waterbody	*0.85*

LULC Type	***1995 (%)***
Forest	*88.93*
Agriculture	*9.02*
Fallow land	*1.17*
Built up	*0.00*
Waterbody	*0.86*

LULC Map of Nilambur Elephant Reserve for the Year 1985 & 95 – Roy et al., 2016

Nilambur Elephant Reserve, Kerala 2005 & 18



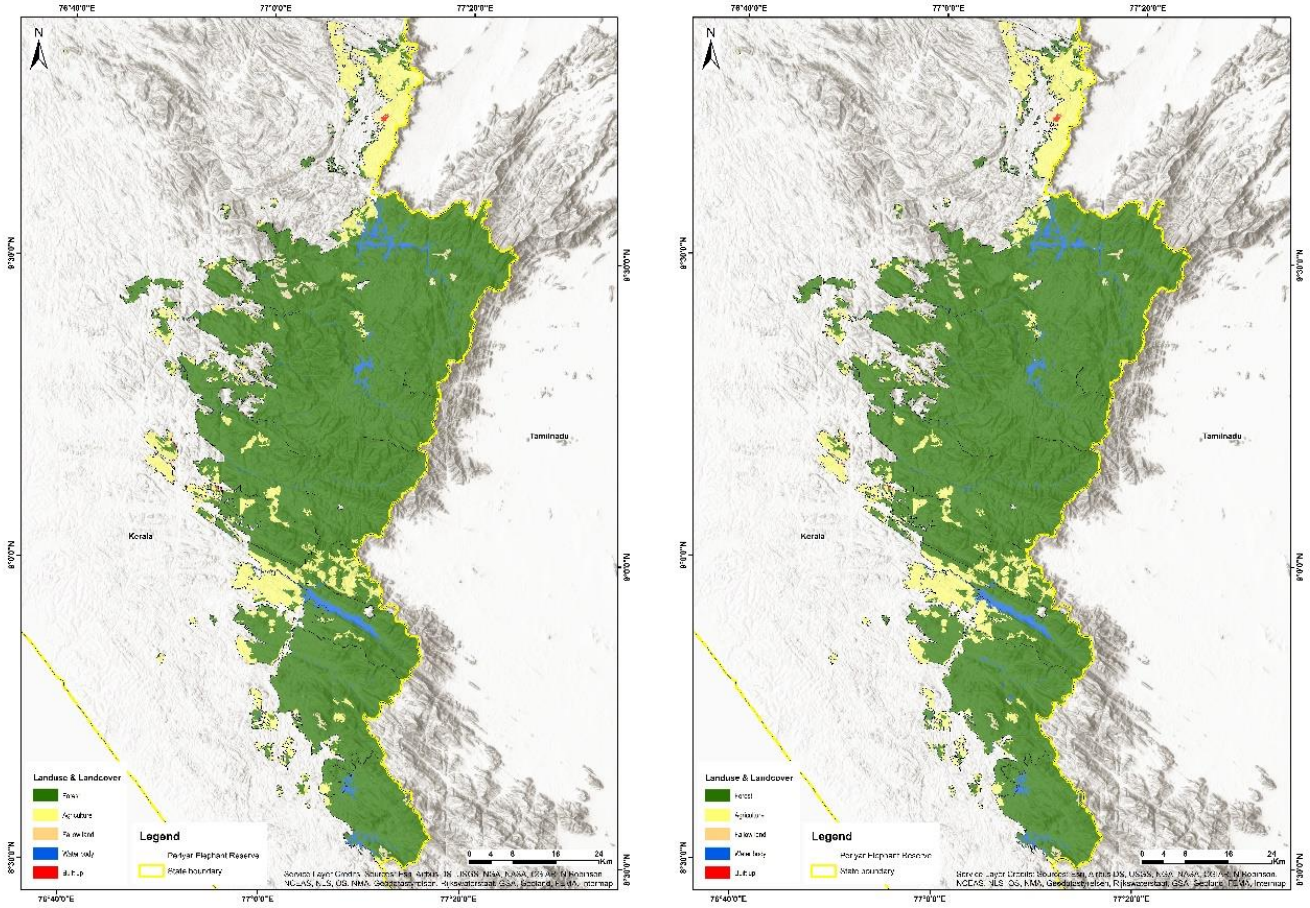
LULC Type	***2005 (%)***
Forest	*88.23*
Agriculture	*9.66*
Fallow land	*1.25*
Built up	*0.00*
Waterbody	*0.84*

LULC Type	***2018 (%)***
Forest	*82.12*
Agriculture	*17.32*
Fallow land	*0.42*
Built up	*0.00*
Waterbody	*0.13*

LULC Map of Nilambur Elephant Reserve for the Year 2005 – Roy at al., 2016 & Year 2018 – Bhuvan (NRSC)

About 82.12 % of the Nilambur ER is forested. A decrease in the forest cover was noticed between 2005 and 2018. The resolution of the imagery for the period 2005 and 2018 are not comparable would require a combination of ground information and high-resolution imagery for reclassification.

Periyar Elephant Reserve, Kerala 1985 & 95

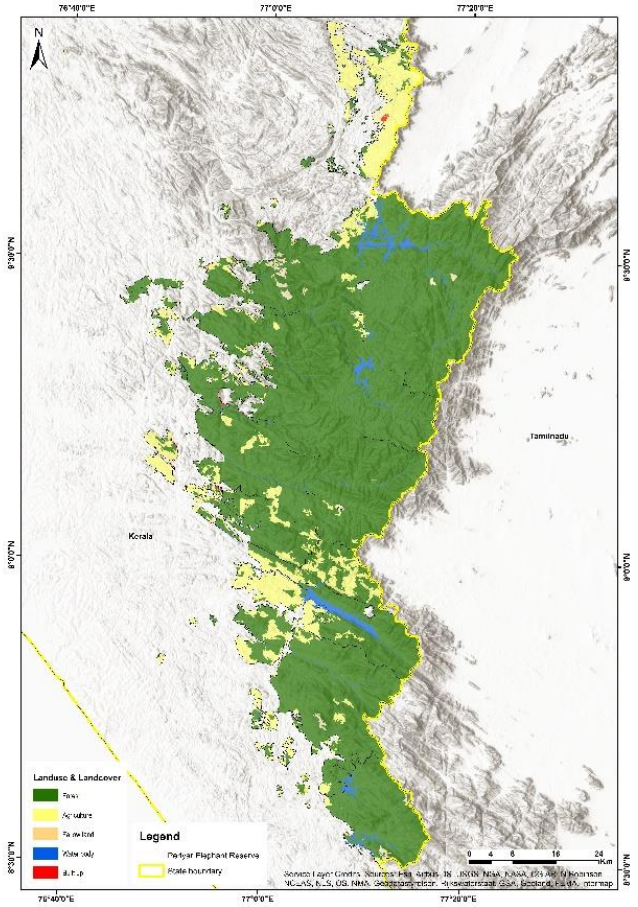


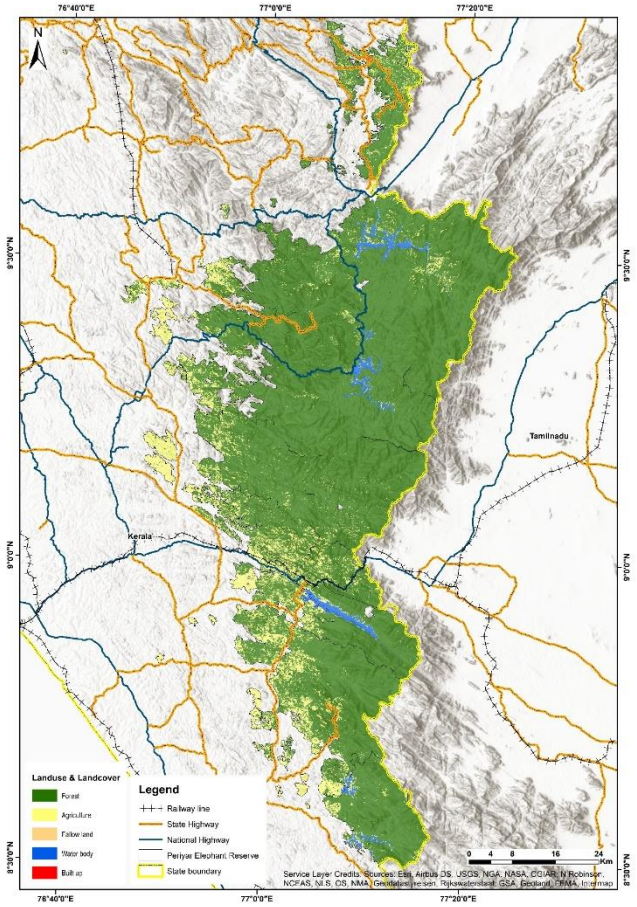
LULC Type	*1985 (%)*
Forest	*84.23*
Agriculture	*12.73*
Fallow land	*0.69*
Built up	*0.08*
Waterbody	*2.25*

LULC Type	*1995 (%)*
Forest	*83.68*
Agriculture	*13.27*
Fallow land	*0.62*
Built up	*0.08*
Waterbody	*2.32*

LULC Map of Periyar Elephant Reserve for the Year 1985 & 95 – Roy et al., 2016

Periyar Elephant Reserve, Kerala 2005 & 18





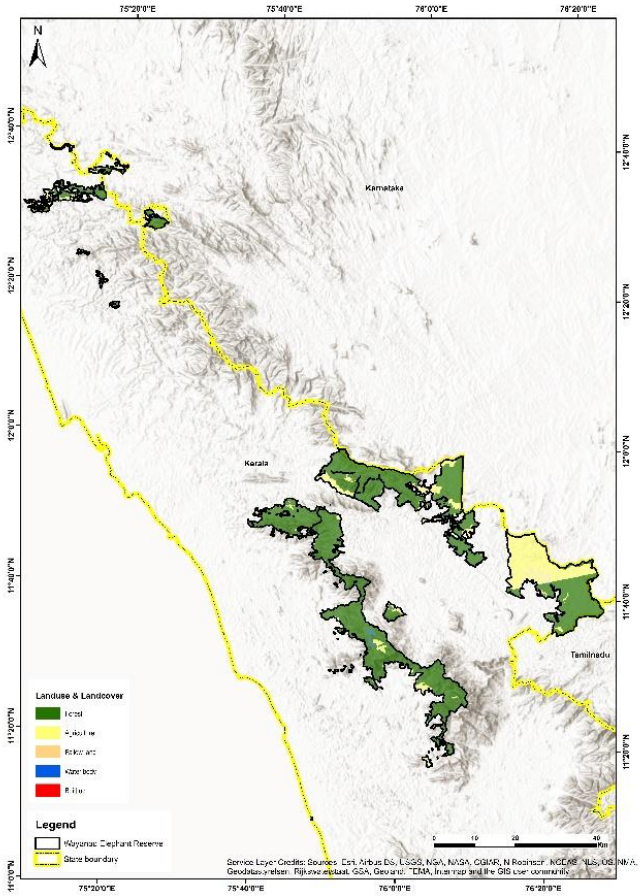
LULC Type	***2005 (%)***
Forest	*82.99*
Agriculture	*14.09*
Fallow land	*0.58*
Built up	*0.09*
Waterbody	*2.21*

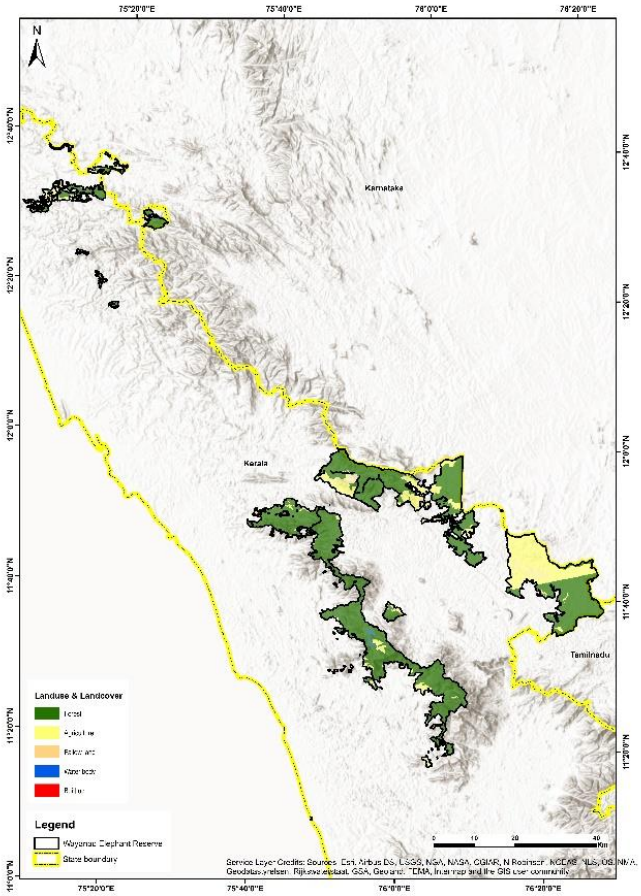
LULC Type	***2018 (%)***
Forest	*85.82*
Agriculture	*12.14*
Fallow land	*0.21*
Built up	*0.02*
Waterbody	*1.81*

LULC Map of Periyar Elephant Reserve for the Year 2005 – Roy at al., 2016 & Year 2018 – Bhuvan (NRSC)

About 85.82 % of the Periyar ER is forested. There was a marginal increase in the forest cover between the periods 2005 and 2018. The resolution of the imagery for the period 2005 and 2018 are not comparable

Wayanad Elephant Reserve, Kerala 1985 & 95



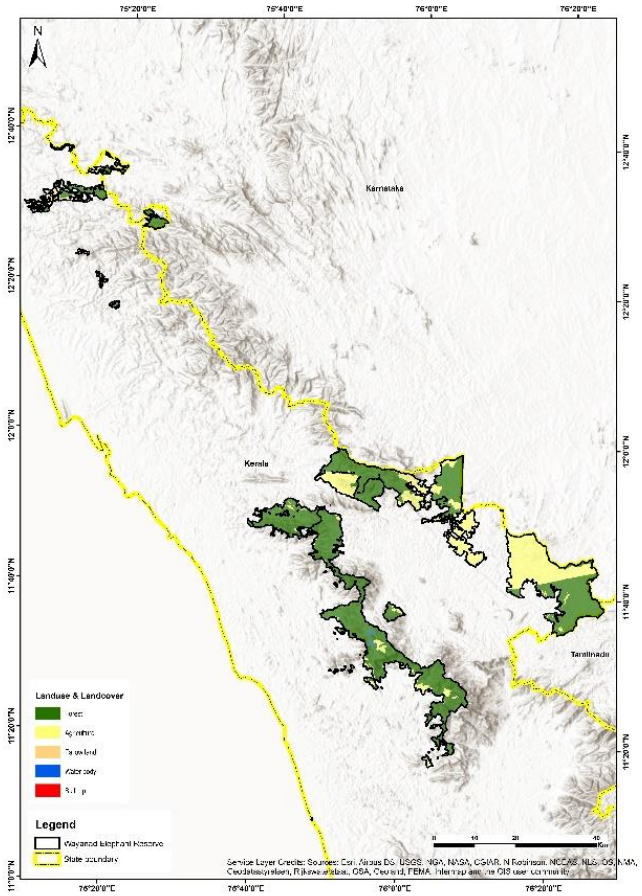


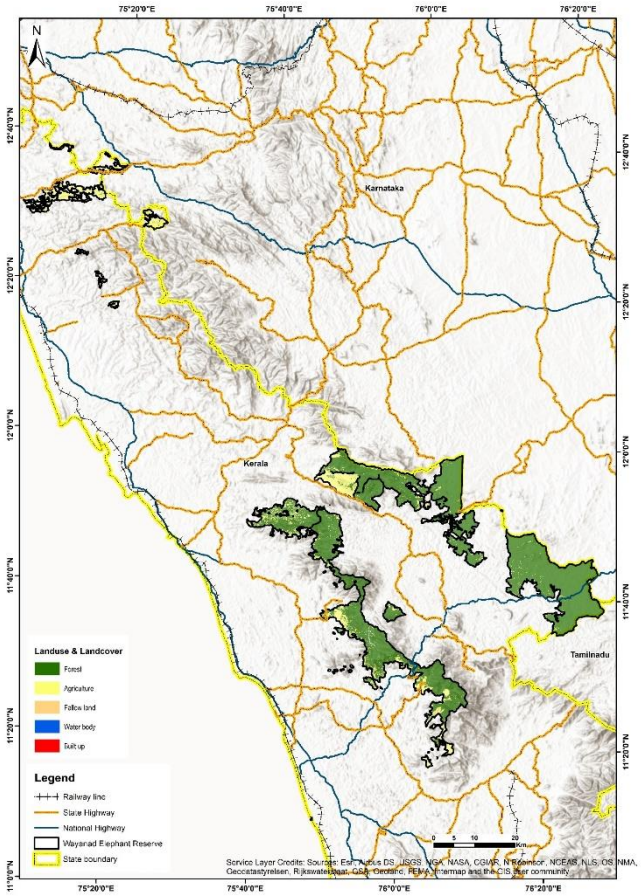
LULC Type	***1985 (%)***
Forest	*76.93*
Agriculture	*21.72*
Fallow land	*0.75*
Built up	*0.01*
Waterbody	*0.57*

LULC Type	***1995 (%)***
Forest	*72.84*
Agriculture	*25.02*
Fallow land	*1.56*
Built up	*0.01*
Waterbody	*0.54*

LULC Map of Wayanad Elephant Reserve for the Year 1985 & 95 – Roy et al., 2016

Wayanad Elephant Reserve, Kerala 2005 & 18





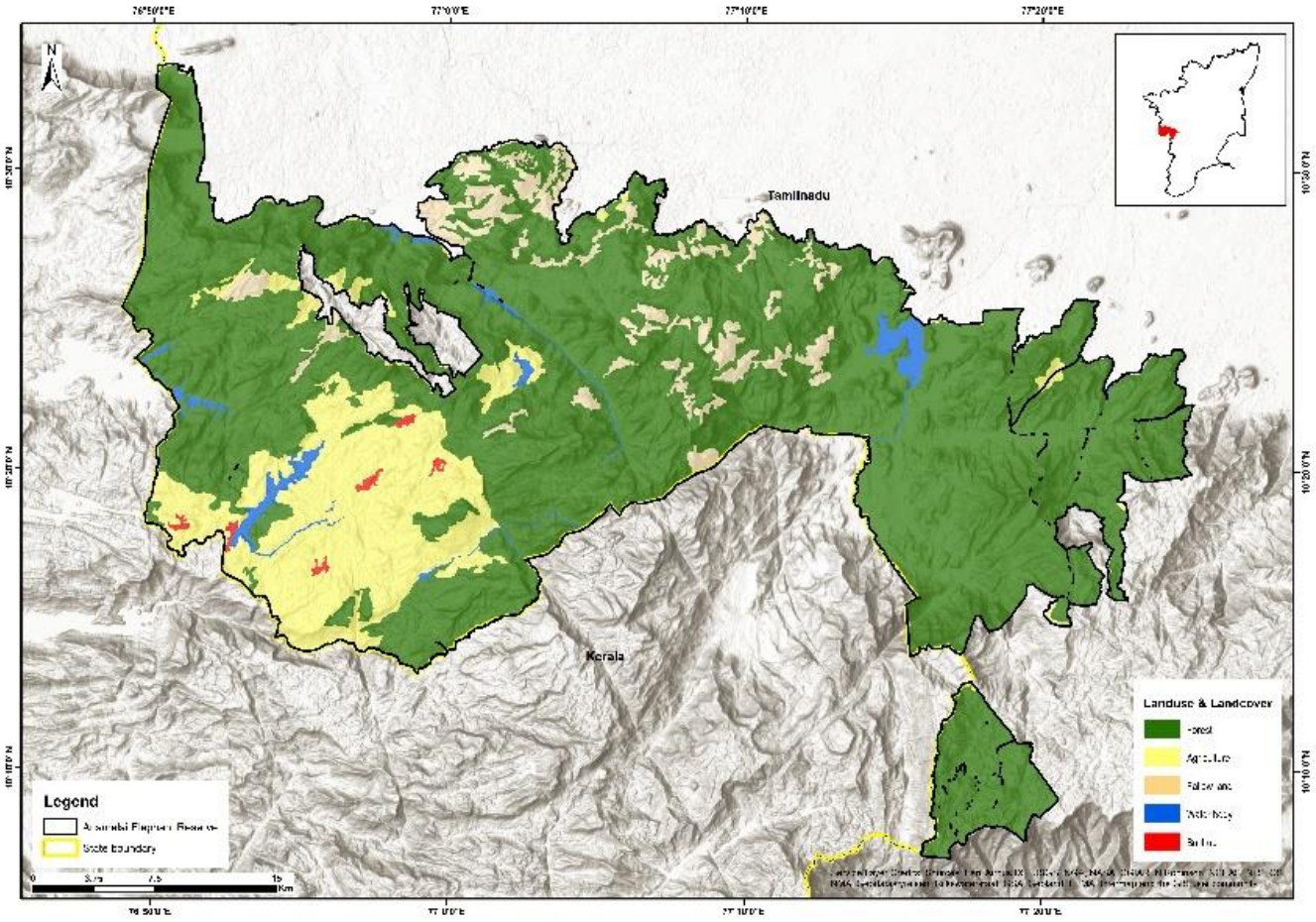
LULC Type	***2005 (%)***
Forest	*67.54*
Agriculture	*31.57*
Fallow land	*0.36*
Built up	*0.02*
Waterbody	*0.49*

LULC Type	***2018 (%)***
Forest	*78.60*
Agriculture	*16.03*
Fallow land	*2.56*
Built up	*1.01*
Waterbody	*1.80*

LULC Map of Wayanad Elephant Reserve for the Year 2005 – Roy at al., 2016 & Year 2018 – Bhuvan (NRSC)

About 78.60 % of the Wayanad ER is forested. There was a decrease in the agriculture and increase in the forest cover between the periods 2005 and 2018. The resolution of the imagery for the period 2005 and 2018 are not comparable

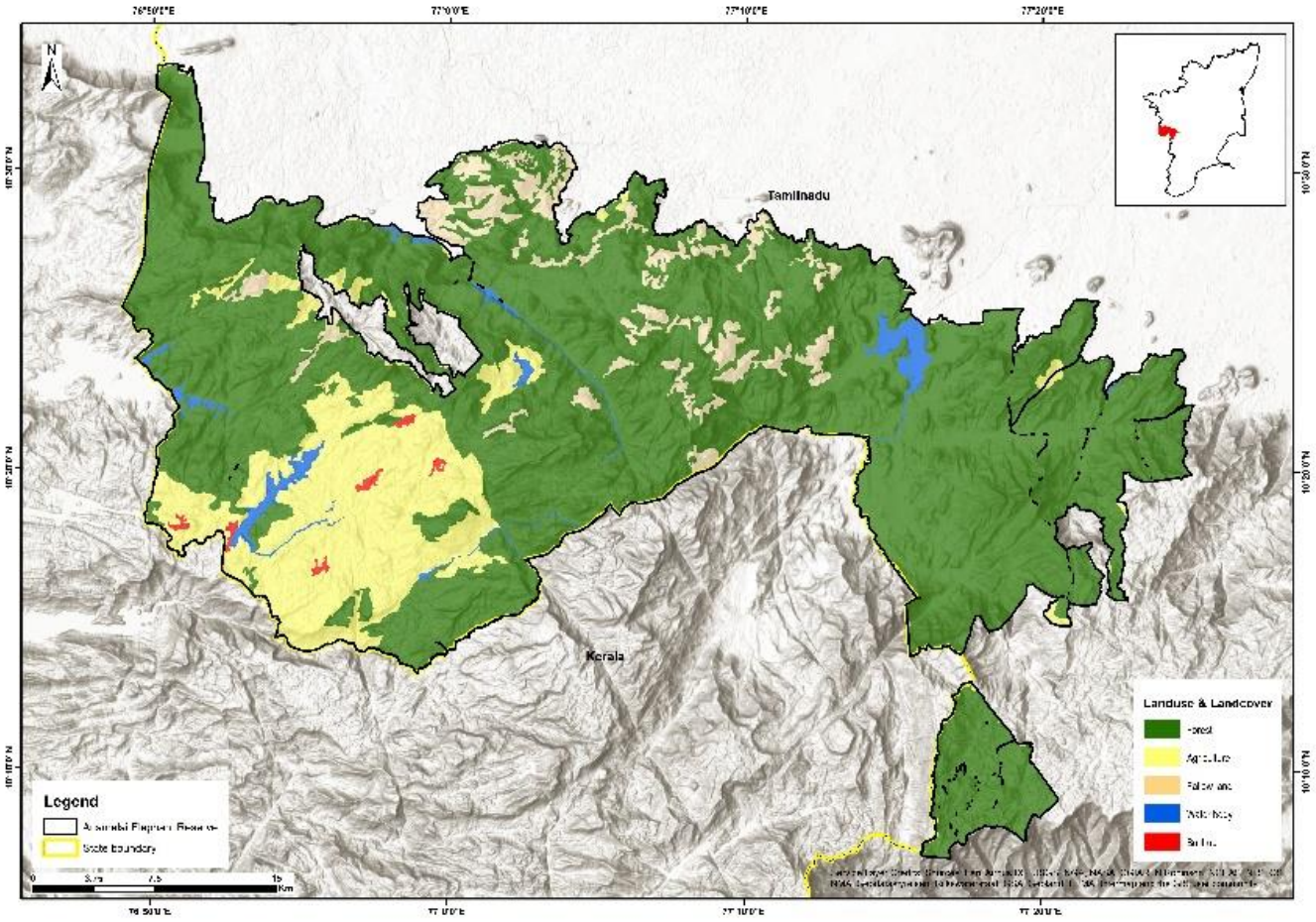
Anamalai Elephant Reserve, Tamilnadu 1985



LULC Type	*1985 (%)*
Forest	*77.83*
Agriculture	*14.9*
Fallow land	*5.08*
Built up	*0.31*
Waterbody	*1.85*

LULC Map of Anamalai Elephant Reserve for the Year 1985 – Roy et al., 2016

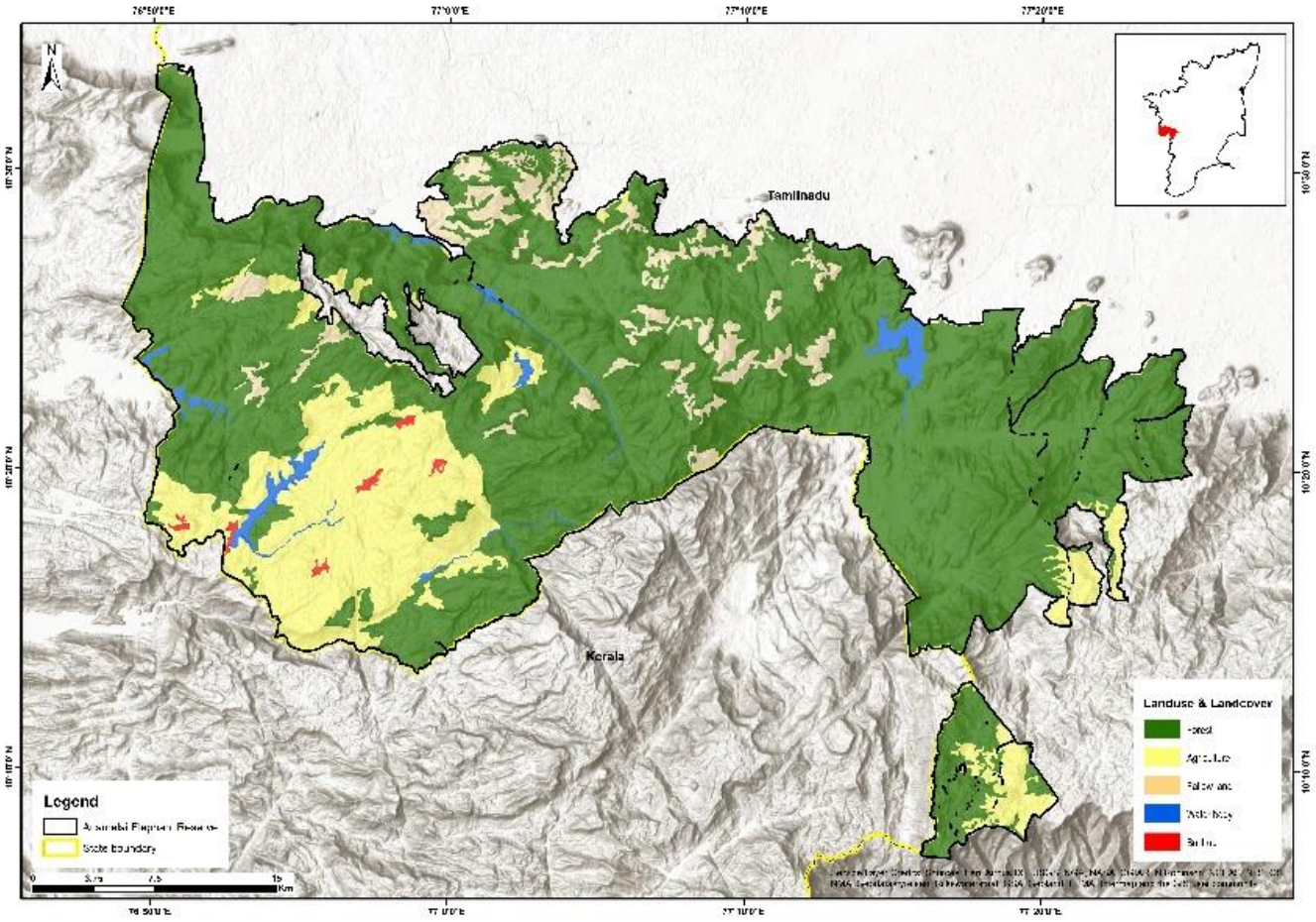
Anamalai Elephant Reserve, Tamilnadu 1995



LULC Type	*1995 (%)*
Forest	*77.67*
Agriculture	*15.03*
Fallow land	*5.02*
Built up	*0.31*
Waterbody	*1.94*

LULC Map of Anamalai Elephant Reserve for the Year 1995 – Roy et al., 2016

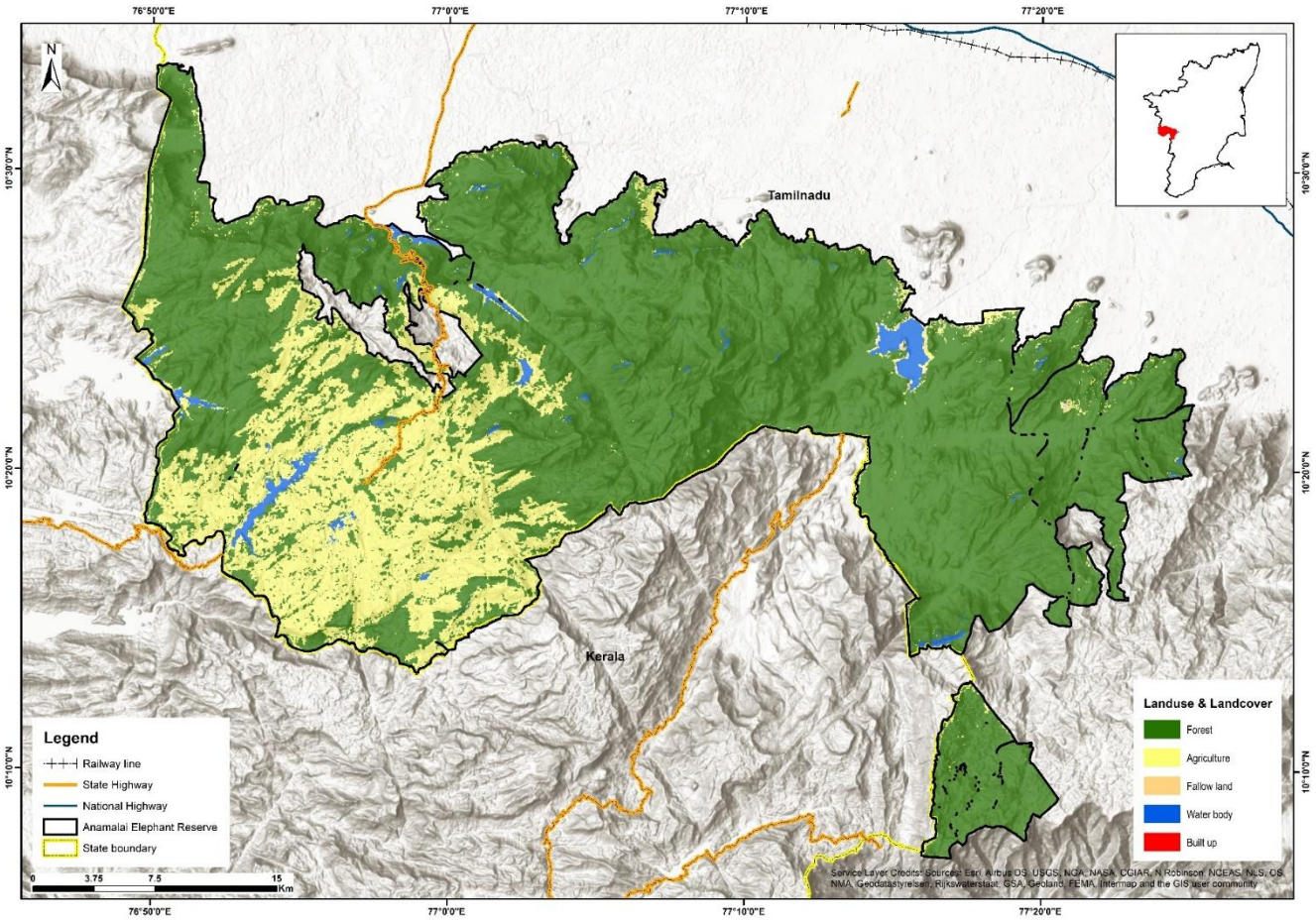
Anamalai Elephant Reserve, Tamilnadu 2005



LULC Type	*2005 (%)*
Forest	*74.78*
Agriculture	*17.76*
Fallow land	*5.28*
Built up	*0.31*
Waterbody	*1.85*

LULC Map of Anamalai Elephant Reserve for the Year 2005 – Roy et al., 2016

Anamalai Elephant Reserve, Tamilnadu 2018

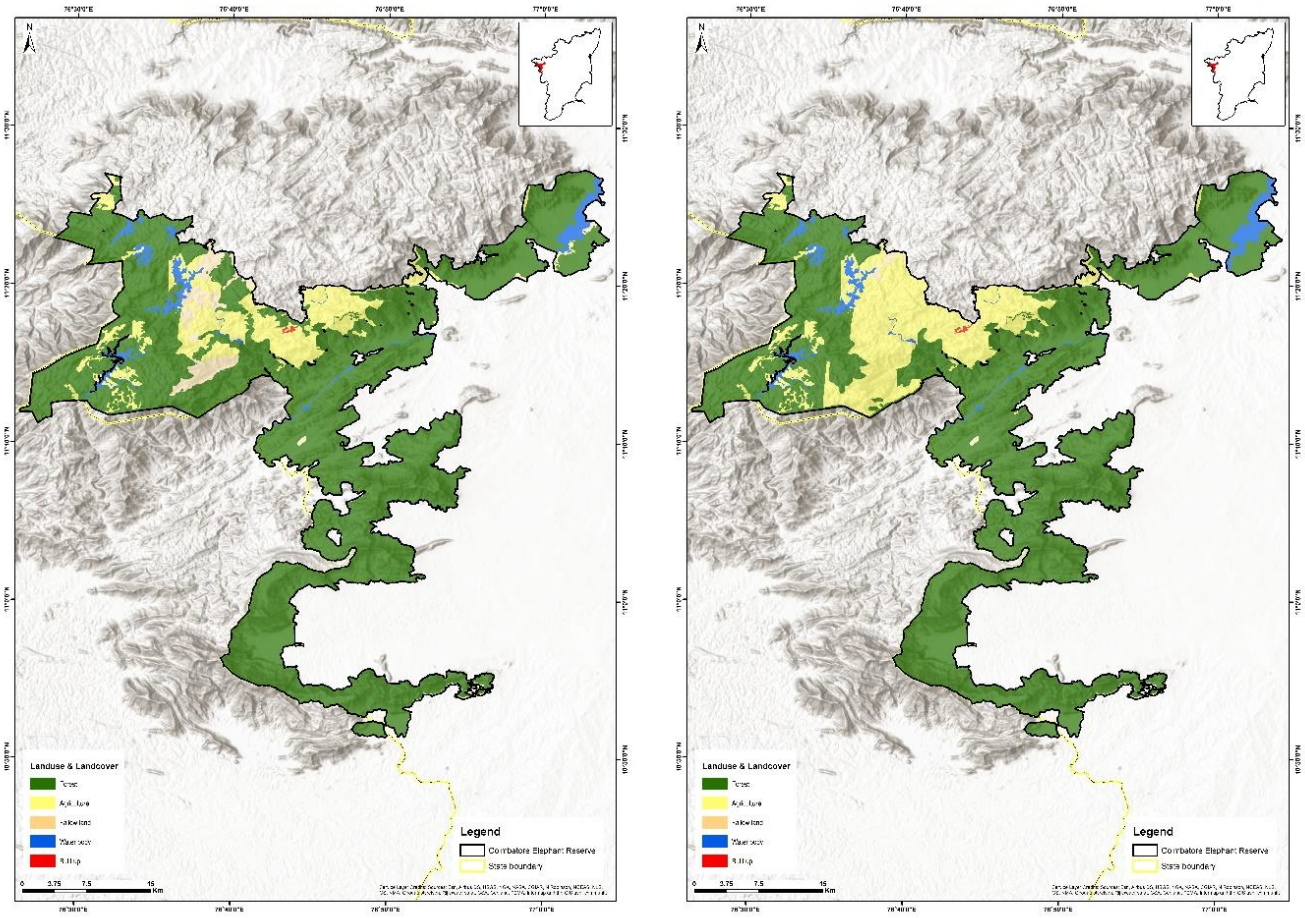


LULC Type	*2018 (%)*
Forest	*76.67*
Agriculture	*21.27*
Fallow land	*0.22*
Built up	*0.00*
Waterbody	*1.82*

About 75.6 % of the Anamalai ER is forested. There was a marginal increase in the forest cover and corresponding increase in the agriculture between the periods 2005 and 2018. The resolution of the imagery for the period 2005 and 2018 are not comparable

LULC Map of Anamalai Elephant Reserve for the Year 2018 with linear infrastructure – Bhuvan (NRSC)

Coimbatore Elephant Reserve, Tamilnadu 1985 & 95

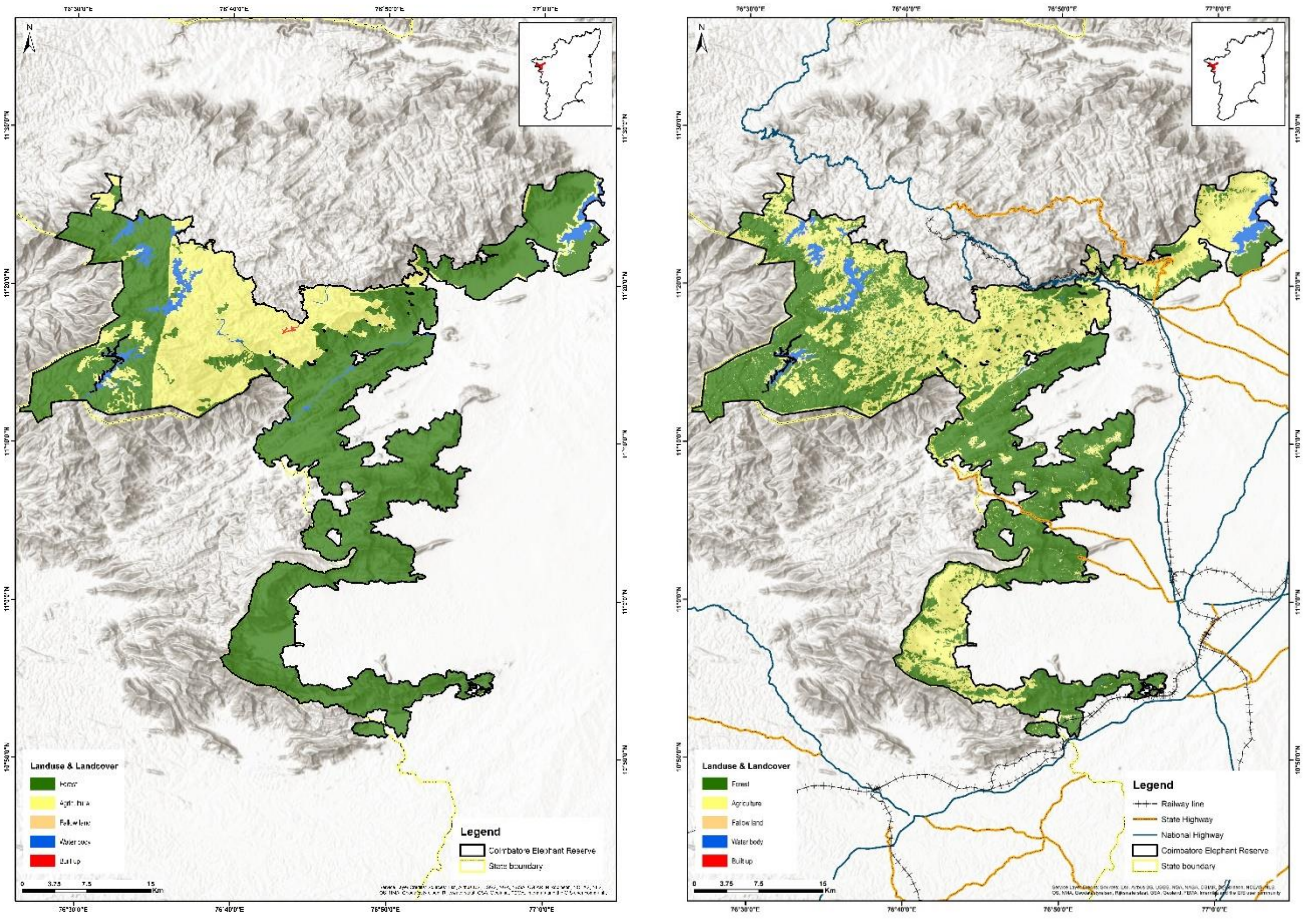


LULC Type	***1985 (%)***
Forest	*80.86*
Agriculture	*12.36*
Fallow land	*3.32*
Built up	*0.05*
Waterbody	*3.38*

LULC Type	***1995 (%)***
Forest	*75.8*
Agriculture	*19.89*
Fallow land	*0.61*
Built up	*0.06*
Waterbody	*3.62*

LULC Map of Coimbatore Elephant Reserve for the Year 1985 & 95 – Roy et al., 2016

Coimbatore Elephant Reserve, Tamilnadu 2005 & 18



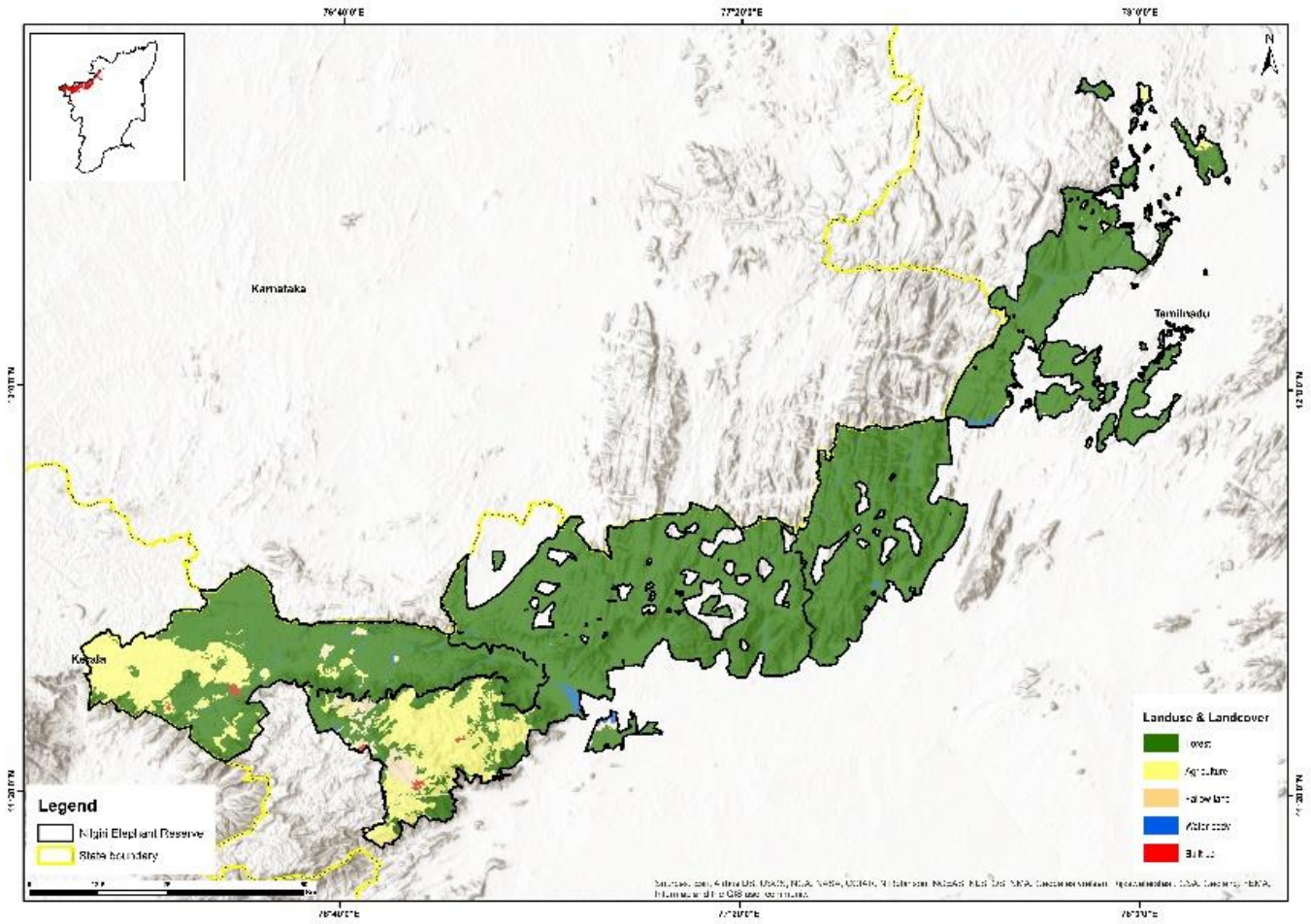
LULC Type	*2005 (%)*
Forest	*72.07*
Agriculture	*24.69*
Fallow land	*0.11*
Built up	*0.06*
Waterbody	*3.05*

LULC Type	*2018 (%)*
Forest	*43.32*
Agriculture	*53.64*
Fallow land	*0.90*
Built up	*0.00*
Waterbody	*2.11*

LULC Map of Coimbatore Elephant Reserve for the Year 2005 – Roy at al., 2016 & Year 2018 – Bhuvan (NRSC)

About 43.32 % of the Coimbatore ER is forested. There was a significant decrease in the forest cover and increase in the agriculture between the periods 2005 and 2018. High-resolution imagery to reclassify LULC and adequate ground information are required to check for misclassification of LULC classes.

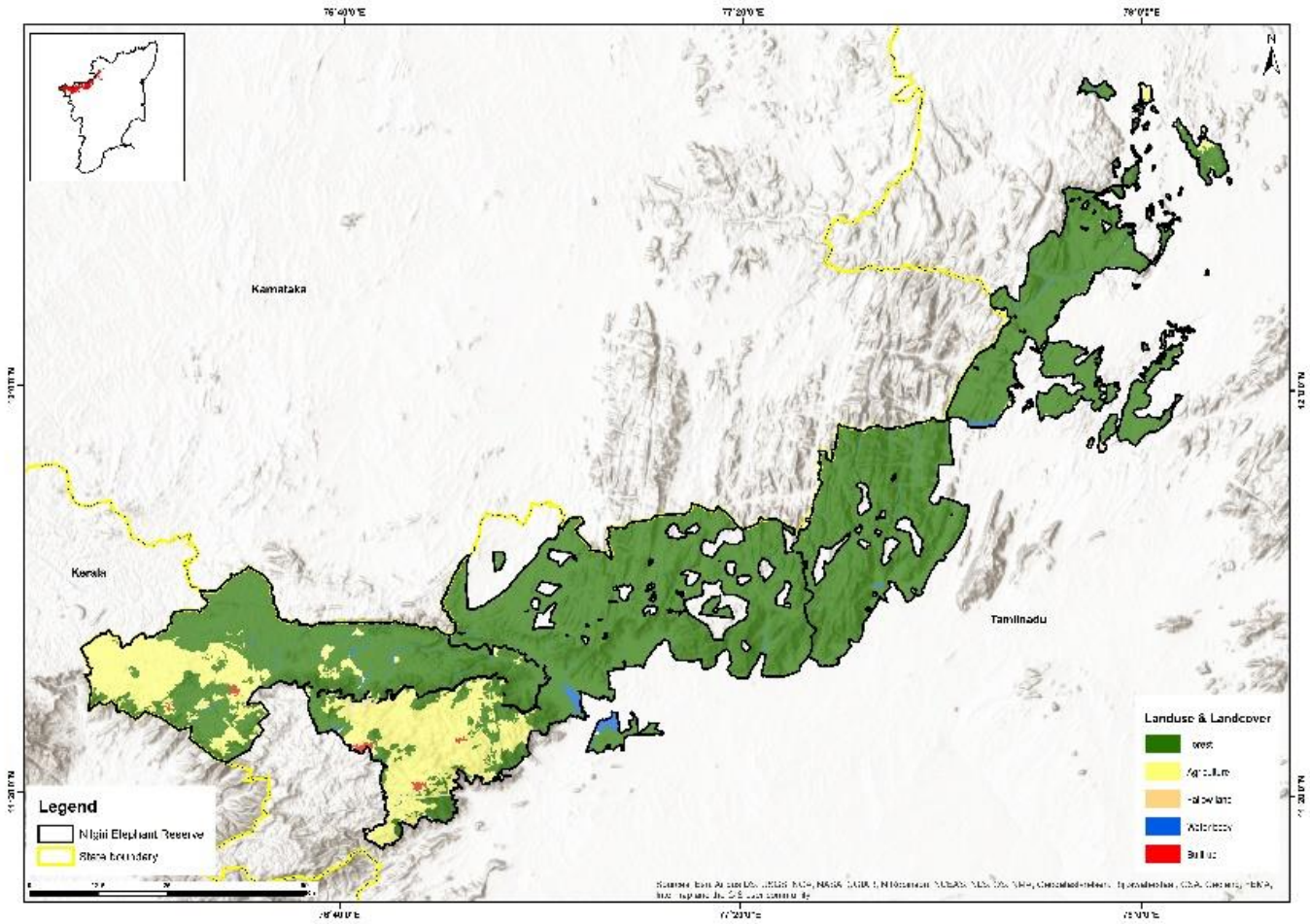
Nilgiri Elephant Reserve, Tamilnadu 1985



LULC Type	***1985 (%)***
Forest	*82.55*
Agriculture	*14.25*
Fallow land	*1.92*
Built up	*0.17*
Waterbody	*1.09*

LULC Map of Nilgiri Elephant Reserve for the Year 1985 – Roy et al., 2016

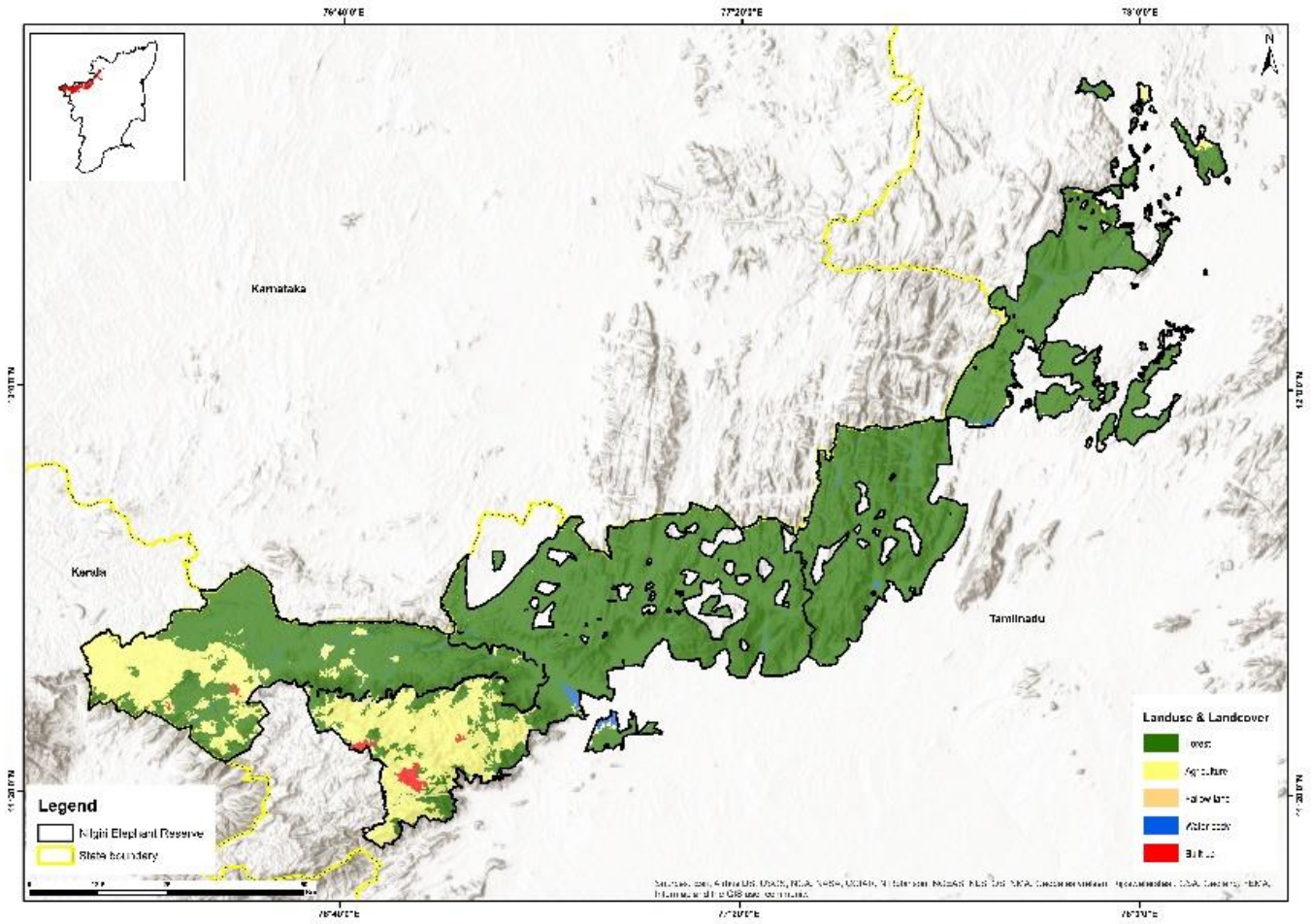
Nilgiri Elephant Reserve, Tamilnadu 1995



LULC Type	*1995 (%)*
Forest	*80.98*
Agriculture	*16.86*
Fallow land	*0.70*
Built up	*0.23*
Waterbody	*1.20*

LULC Map of Nilgiri Elephant Reserve for the Year 1995 – Roy et al., 2016

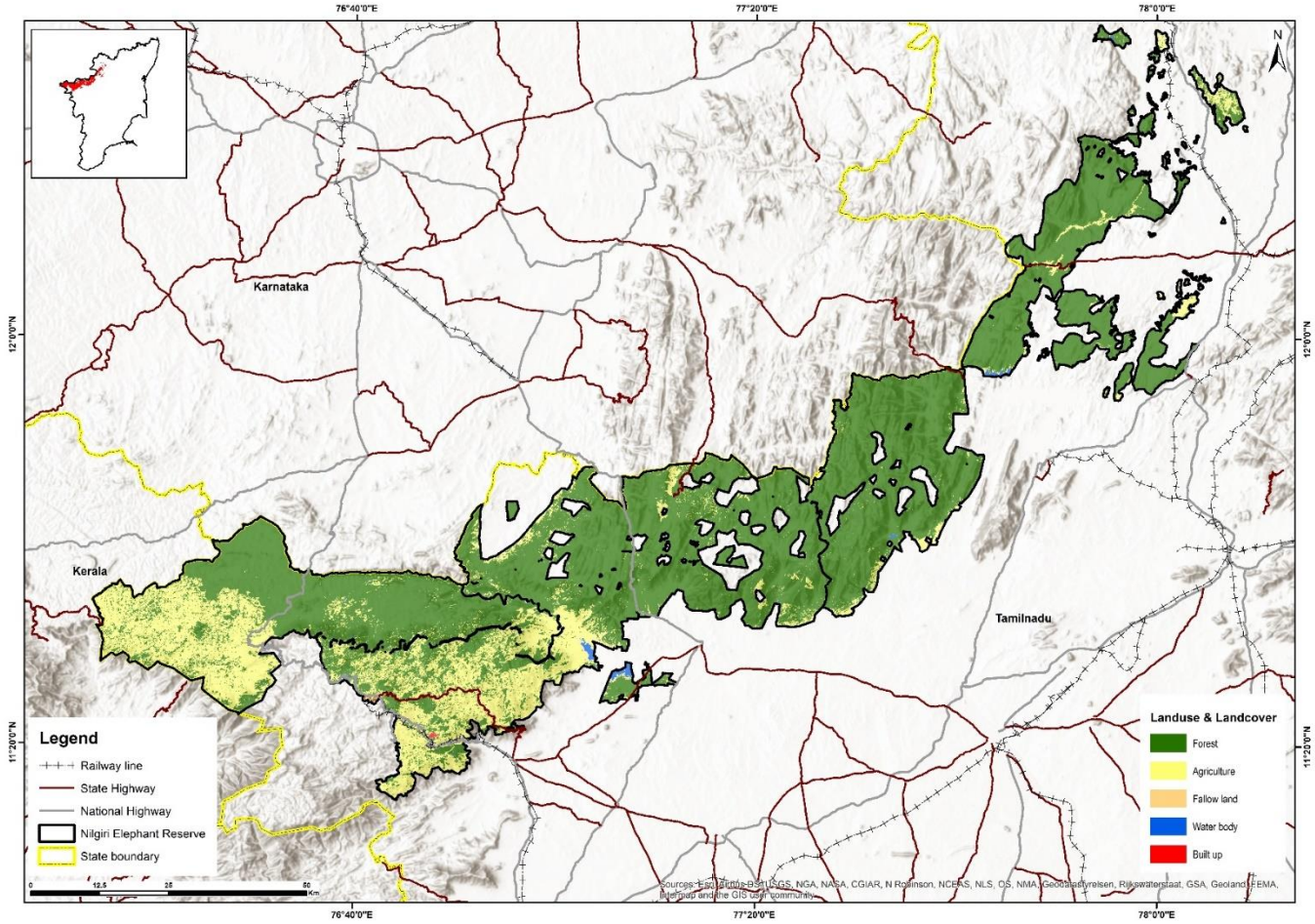
Nilgiri Elephant Reserve, Tamilnadu 2005



LULC Type	***2005 (%)***
Forest	*80.36*
Agriculture	*17.35*
Fallow land	*0.67*
Built up	*0.52*
Waterbody	*1.07*

LULC Map of Nilgiri Elephant Reserve for the Year 2005 – Roy et al., 2016

Nilgiri Elephant Reserve, Tamilnadu 2018

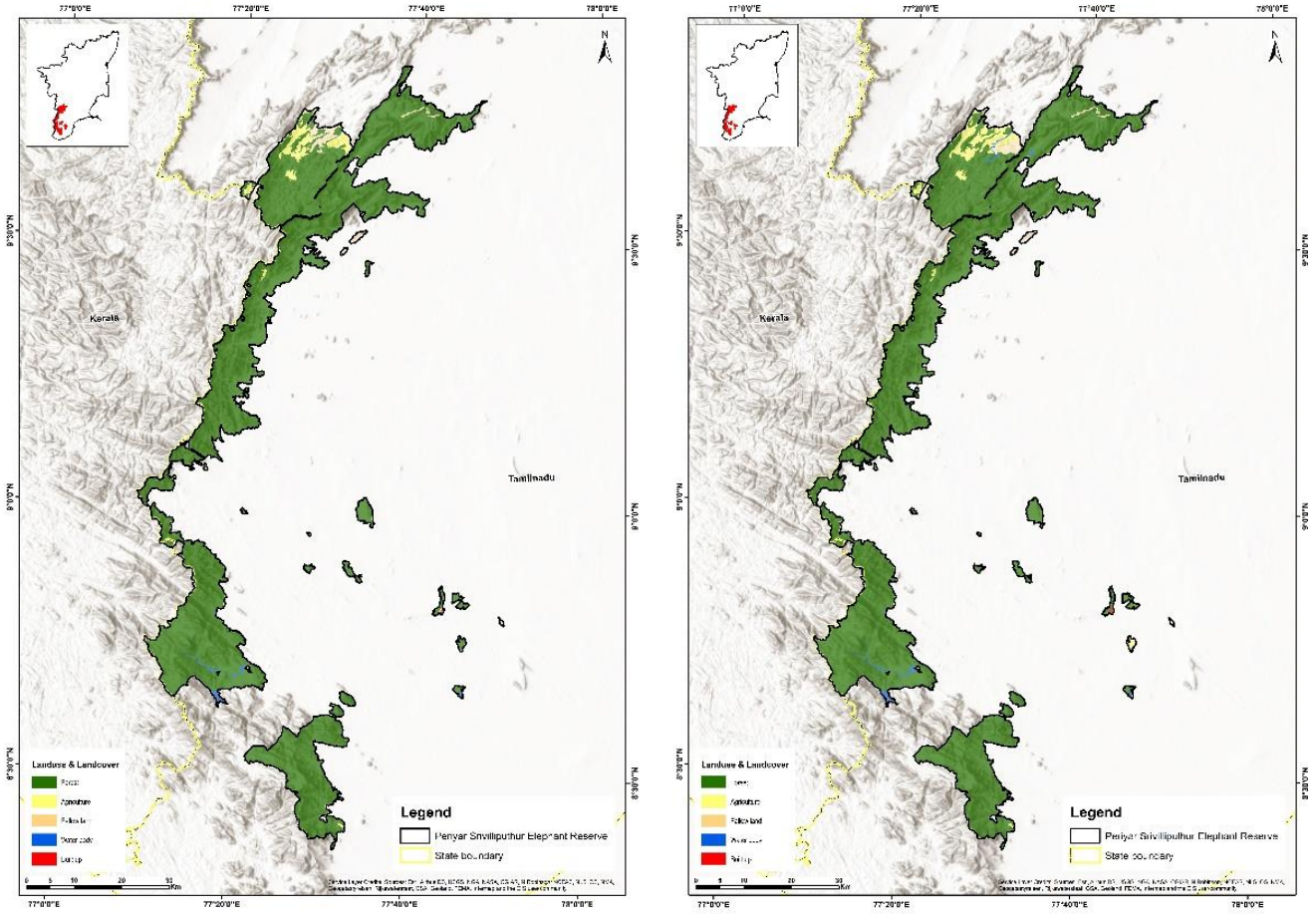


LULC Type	*2018 (%)*
Forest	*75.32*
Agriculture	*23.63*
Fallow land	*0.50*
Built up	*0.05*
Waterbody	*0.47*

About 75.32 % of the Nilgiri ER is forested. There was a significant decrease in the forest cover and increase in the agriculture between the periods 2005 and 2018. High-resolution imagery to reclassify LULC and adequate ground information are required to check for misclassification of LULC classes.

LULC Map of Nilgiri Elephant Reserve for the Year 2018 with linear infrastructure – Bhuvan (NRSC)

Periyar Srivilliputhur Elephant Reserve, Tamilnadu 1985 & 95

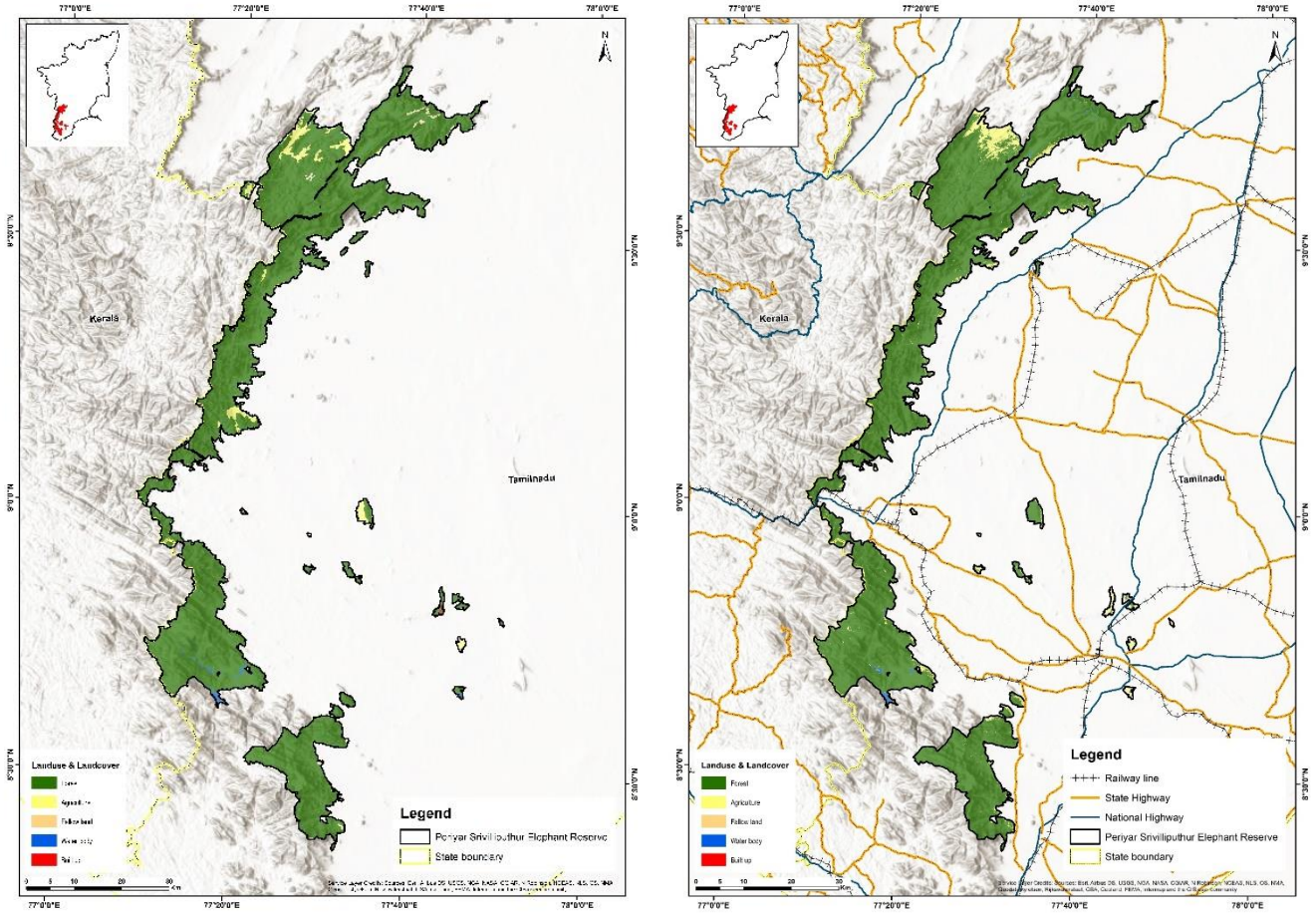


LULC Type	*1985 (%)*
Forest	*94.50*
Agriculture	*3.18*
Fallow land	*1.74*
Built up	*0.02*
Waterbody	*0.54*

LULC Type	*1995 (%)*
Forest	*93.58*
Agriculture	*3.90*
Fallow land	*1.66*
Built up	*0.05*
Waterbody	*0.77*

LULC Map of Periyar Srivilliputhur Elephant Reserve for the Year 1985 & 95 – Roy et al., 2016

Periyar Srivilliputhur Elephant Reserve, Tamilnadu 2005 & 18



LULC Type	***2005 (%)***
Forest	*93.82*
Agriculture	*4.60*
Fallow land	*0.97*
Built up	*0.07*
Waterbody	*0.51*

LULC Type	***2018 (%)***
Forest	*92.44*
Agriculture	*5.75*
Fallow land	*1.32*
Built up	*0.03*
Waterbody	*0.11*

LULC Map of Periyar Srivilliputhur Elephant Reserve for the Year 2005 – Roy at al., 2016 & Year 2018 – Bhuvan (NRSC)

About 92.4 % of the Periyar - Srivilliputhur ER is forested. There was a significant decrease in the forest cover and increase in the agriculture between the periods 2005 and 2018. High-resolution imagery to reclassify LULC and adequate ground information are required to check for misclassification of LULC classes.

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6. *Government of Andhra Pradesh gazette notification, vide G.O.Ms.No.106 dated 09/02/2003 "Declaration of Rayala Elephant Reserve" Government of Arunachal Pradesh gazette notification, vide No. CWL/D/7/2001/2868-2943 dated 19/06/2006 "Declaration of Kameng Elephant Reserve"*

7. *Government of Arunachal Pradesh gazette notification, vide No. CWL/D/21(14)06/07/517-67 dated 29/02/2008 "Declaration of South Arunachal Elephant Reserve"*

8. *Government of Assam gazette notification, vide No. FRW - 44/2002/47 dated 06/03/2003 "Declaration of Chirang-Ripu Elephant Reserve"*

9. *Government of Assam gazette notification, vide No. FRW - 44/2002/70 dated 19/04/2003 "Declaration of Dhansiri-Lungding Elephant Reserve"*

10. *Government of Assam gazette notification, vide No. FRW - 44/2002/67 dated 17/04/2003 "Declaration of Dihing-Patkai Elephant Reserve"*

11. *Government of Assam gazette notification, vide No. FRW - 44/2002/64 dated 17/04/2003 "Declaration of Kaziranga-Karbi Anglong Elephant Reserve"*

12. *Government of Assam gazette notification, vide No. FRW - 44/2002/46 dated 07/03/2003 "Declaration of Sonitpur Elephant Reserve"*

13. *Government of Chhattisgarh gazette notification, vide No. F 8-6/2007/10-2 dated 15/09/2011 "Declaration of Sarguja-Jashpur Elephant Reserve"*

14. *Government of Chhattisgarh gazette notification, vide No. F 8-6/2007/10-2 dated 07/10/2021 "Declaration of Lemru Elephant Reserve"*

15. *Government of Jharkhand gazette notification, vide No. 33/200-3640 dated 26/09/2001 "Declaration of Singhbhum Elephant Reserve"*

16. *Government of Karnataka gazette notification, vide No. FEE 362 FWL 2014 dated 26/03/2015 "Declaration of Dandeli Elephant Reserve"*

17. *Government of Karnataka gazette notification, vide No. FEE 231 FWL 2000 dated 25/11/2002 "Declaration of Mysuru Elephant Reserve"*

18. *Government of Karnataka gazette notification, vide No. FEE 202 FWL 2014 dated 26/03/2015 "Extension of Mysuru Elephant Reserve"*

19. *Government of Kerala gazette notification, vide G.O(P) No: 19/2002/F&WLD dated 02/04/2002 "Declaration of Wayanad, Nilambur, Anamudi and Periyar Elephant Reserve"*

20. *Government of Meghalaya gazette notification, vide No. FOR.132/2000/97 dated 31/10/2001 "Declaration of Garo Hills Elephant Reserve"*

21. *Government of Nagaland gazette notification, vide No. FOR/GEN-5/2001 dated 28/02/2005 "Declaration of Intanki Elephant Reserve"*

22. *Government of Nagaland gazette notification, vide No. FOR/GEN-16/2016 dated 16/08/2018 "Declaration of Singphan Elephant Reserve"*

23. *Government of Odisha gazette notification, vide No.8F(W) 17/02.10162/F&E dated 19/06/2002 "Declaration of Mahanadi Elephant Reserve"*

24. *Government of Odisha gazette notification, vide No.8F(W)-42/2001 15806/F&E dated 29/07/2001 "Declaration of Mayurbhanj Elephant Reserve"*

25. *Government of Odisha gazette notification, vide No.8F(W)10/2002.5840/F&E dated 27/03/2002 "Declaration of Sambalpur Elephant Reserve"*

26. *Government of Tamil Nadu gazette notification, vide G.O.(Ms) No.151 dated 19/09/2003 Notification – I "Declaration of Nilgiri Elephant Reserve", Notification – II "Declaration of Nilambur Elephant Reserve", Notification – III "Declaration of Periyar Srivilliputhur Elephant Reserve", Notification – IV "Declaration of Anamalai Elephant Reserve".*

27. *Government of Uttar Pradesh gazette notification, vide No.1496(1)/14-4-2009-802/2004 dated 09/09/2009 "Declaration of Uttar Pradesh Elephant Reserve"*

28. *Government of Uttarakhand gazette notification, vide No. 1777/1(2)/V.A. P/2002-19(2)/2002 dated 20/10/2002 "Declaration of Shivalik Elephant Reserve"*

29. *Government of West Bengal gazette notification, vide No.3293-For.11B-19/2000 dated 28/08/2002 "Declaration of Eastern Dooars Elephant Reserve"*

30. *Government of West Bengal gazette notification, vide No.8F(W)10/2002.5840/F&E dated 27/03/2002 "Declaration of Mayurjharna Elephant Reserve"*

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