

## **State Formation and Urbanisation: A Study of Jharkhand State Using Nighttime Light Data (1992-2012)**

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**Abstract:** The study investigates the spatiotemporal pattern of urbanisation in Jharkhand upon its attainment of statehood, using 20 years (1992-2012) of annual time series data of nighttime light (NTL) and decadal Census data. The study identified the location of rapid and emerging areas of urbanisation successfully captured by the NTL data and demonstrated by LISA hotspot analysis. State formation of Jharkhand in 2000 triggered the urbanisation process resulting in the spread of urban footprint in hitherto low urbanised districts, an increase in urban settlements, mostly non-statutory towns, and the emergence of new Urban Agglomerations. Existing industrial areas, districts, and State capital headquarters have been the nucleus of urbanisation. The satellite data could not detect any statistically significant change in terms of extent in small towns that could be associated with the coarse grain size of the NTL data.

**Keywords:** Jharkhand, Urbanisation, Urban Agglomerations, DMSP/OLS, LISA

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Date of submission: 28.10.2020

Date of review: 27.06.2022

Date of acceptance: 26.07.2022

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### **Introduction**

Jharkhand, Chhattisgarh, and Uttarakhand were carved as three new States of India in 2000 for regional development and sustainable resource use (Misra, 2019). This research focuses on the resource-rich State of Jharkhand, which contributed 70.0 per cent of its parent State- Bihar's revenue, before its statehood, while development expenditure was only 20.0 per cent for the region (Horo, 2013). More than a quarter of India's coal and iron ore (27.37 per cent and 25.70 per cent, respectively) and a fifth of cobalt and copper (20 per cent and 18.48 per cent, respectively) reserves are concentrated in Jharkhand (MSME, Government of India, 2015), but the State is inhabited by some of the poorest population of India. More than a quarter of the population of the State (26.21 per cent) comprises the Scheduled Tribes (STs) constituted by 32 communities, the majority of whom reside in rural areas. The proportion of STs is significant (above 25 per cent) in 13 out of 24 Districts of the State; In contrast, 111 out of 259 Blocks in 15 Districts are declared as Scheduled Areas under Article 244 of the Constitution of India, where provisions of the Fifth Schedule apply. Therefore, Jharkhand's statehood on 15th November 2000 was considered a critical step for the region's development.

This research monitors urbanisation as it is a common indicator of development related to socioeconomic growth, demographic dynamics, and land use dynamics (Shukla & Parikh, 2013). The

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urbanisation process is considered as an indicator of growth and progress. Monitoring and quantifying the trajectory of urban development can help understand changes and characteristics of the landscape, provide information for better environmental and resource management, and inform public policy for promoting future growth direction and development within the region.

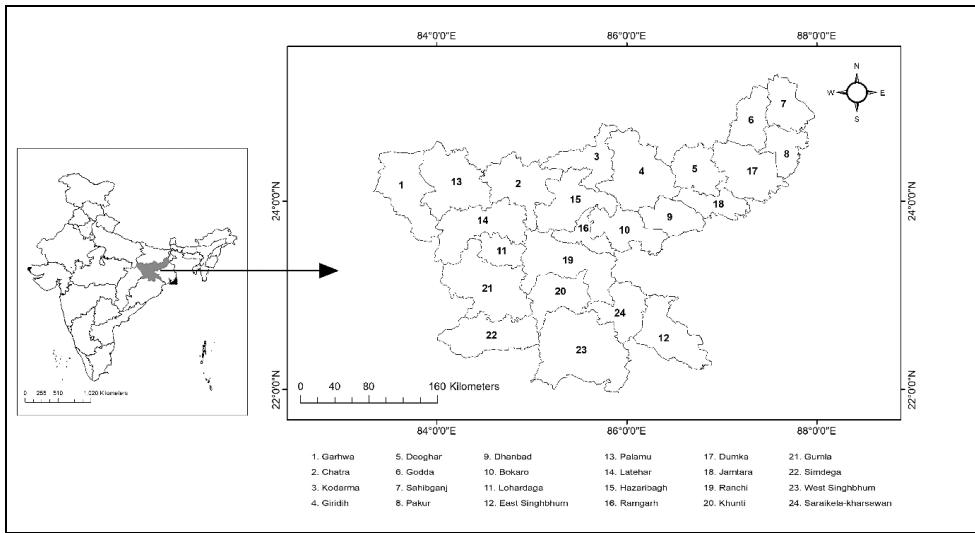
The satellite remote sensing data has proven vital for monitoring the growth and extent of urbanisation. The Night-Time Light (NTL) products from the Defense Meteorological Satellite Program (DMSP) and Operational Linescan System (OLS) is the most frequently used product for mapping urbanisation trends at global, national and regional scale (e.g., Imhoff, Lawrence, Stutzer, & Elvidge, 1997; Lu, Zhang, Sun, & Li, 2018). The NTL data captures the city lights at night, indicating the anthropogenic activity at each pixel (Roychowdhury et al., 2011). The longer timespan of the NTL dataset (from 1992 to 2013 at an annual time scale) makes it suitable to capture the urban dynamics at a much larger time scale (Zhou, 2017), and its free usage has proved to be cost-effective. The DMSP-OLS data has been used for studies related to demography, urban and economic growth (Doll, Muller, & Elvidge, 2000; Elvidge, Baugh, Kihn, Kroehl, & Davis, 1997; Small, Pozzi, & Elvidge, 2005; Sutton, 2003). The Census data are considered the most reliable source of population data in any country, collected at an interval of 10 years. However, the 10-year data gap in the Census may not be able to capture the rapid urban expansion and change in socioeconomic dynamics. Therefore, the combined use of NTL and Census data can provide an alternate method of monitoring urbanisation trends.

The study intends to explore the impact of the attainment of statehood by Jharkhand on its urbanisation process. The primary objective of this study is to examine the spatiotemporal dynamics of the urbanisation process in Jharkhand by analysing spatial changes in the time series of NTL signals between 1992 and 2012, i.e., before and after State formation. The basic premise is that Statehood provided an impetus for urbanisation, particularly in the State capital and existing larger towns, and propelled the emergence of lower-order urban settlements. This study identifies fast-growing urban settlements and their spatial spread. An attempt is also made to identify emerging urban nodes and their likely contributory growth factors in a regional context. It, therefore, addresses the following research questions:

1. How has statehood impacted on urbanisation process in Jharkhand?
2. How does urbanisation in Jharkhand compare with its parent State of Bihar?

### **Study Area**

The State of Jharkhand lies between 21° 55' and 25° 35' North Latitude and 83° 20' to 88° 02' East Longitudes (Figure 1). It shares boundaries with the States of Bihar, West Bengal, Odisha, Chhattisgarh, and Uttar Pradesh. Jharkhand has a total geographical area of around 79,714 Km<sup>2</sup> with a population of 32.98 million (Census of India, 2011). The State is predominantly covered by forest (~ 29 per cent). It forms a part of the mineral-rich Chota Nagpur plateau, a hub of heavy industry and related industrial townships. The largest city, Ranchi, is the State capital. Other urban centres include Dhanbad, Bokaro, Jamshedpur, Deoghar, and Hazaribagh (Census of India, 2011). The number of districts in the State increased from 18 in 2001 to 24 in 2011 following the formation of six new districts (Ramgarh, Saraikela Kharsawan, Latehar, Jamtara, Khunti, and Simdega)



**Figure 1: Study Area: Jharkhand State and its Districts**

**Data Sources and Methodology**

The study is based on secondary and tertiary data sources. The secondary data has been collected from the Census of India decennial reports published by the Office of the Registrar General and Census Commissioner, India, New Delhi or State Directorate of Census Operations. The prominent Census publications used here included the District Census Handbook & Primary Census Abstract of different districts for three decades (1991, 2001 and 2011) and the Town Directory, Jharkhand. The data on population counts from the Census of India for the Census years of 1991, 2001, and 2011 were sourced from State Town Directory, District Census Handbook Town Release, A-1 Tables, and A-4 Tables (<https://censusindia.gov.in/>). Indicators such as the proportion of the urban population, number, and typology of urban settlements according to size, class and municipal status have been integrated as explanations for the hot spots of urbanisation in Jharkhand generated through remotely sensed data and analysed at two spatial scales, viz. district, and Urban Agglomeration (UA).

Remotely Sensed data includes two-time series datasets: Night Time Light (NTL) from the Defense Meteorological Satellite Program (DMSP)/ Operational Linescan System (OLS)) and Normalised Difference Vegetation Index (NDVI) from the Moderate Resolution Imaging Spectroradiometer (MODIS) Terra platform from 2000 to 2012 and from Advanced Very High-Resolution Radiometer (AVHRR) from 1992-1999. The study is based on an analysis of the Census of India and remotely sensed data. Table 1 provides information about the remotely sensed datasets:

**Table 1: Remotely sensed dataset used for analysis**

Name	Spatial Resolution (km)	Temporal Resolution	Source	Time Period
DMSP-OLS NTL	1	Annual	NOAA <a href="https://ngdc.noaa.gov/">https://ngdc.noaa.gov/</a>	1992-2012
MODIS NDVI (MOD13A3)	1	Monthly	LP-DAAC <a href="https://lpdaac.usgs.gov">https://lpdaac.usgs.gov</a>	2000-2012
NDVI (AVHRR)	~5	Monthly	LP-DAAC <a href="https://lpdaac.usgs.gov">https://lpdaac.usgs.gov</a>	1992-2000

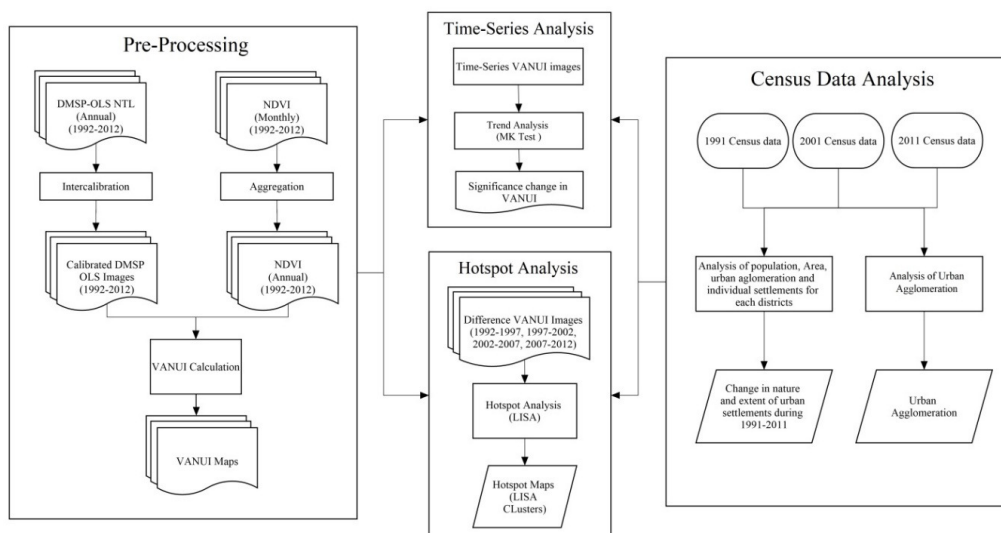
(Note: AVHRR data were resampled to 1km resolution. A linear regression model was developed between the two datasets for the year 2000, as described by (Zhao et al., 2018). Based on the

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established relationship between the two images, calibration of AVHRR NDVI (1992-1999) was carried out, and the annual mean NDVI time series for 1992-2012 were generated)

This study employed trend and cluster analysis to understand changes in temporal and spatial patterns of urbanisation in Jharkhand. The overall methodology involved four steps (Figure 2):

- 1) Pre-processing of NTL and NDVI and Vegetation Adjusted NTL Urban Index (VANUI) (Zhang, Schaaf, & Seto, 2013) calculation.
- 2) Spatio-temporal analysis using Mann-Kendall trend analysis (Mann, 1945; Kendall, 1938).
- 3) Image differencing and Local Indicator of Spatial Autocorrelation (LISA) (Anselin, 1995) hotspot analysis. The hotspot analysis was carried out by considering change every five years, i.e., 1992-1997, 1997-2002, 2002-2007 and 2007-2012.
- 4) Comparison and analysis of Census data to interpret changes in population and UA.



**Fig. 2: Methodology for investigating spatio-temporal dynamics of urbanisation in Jharkhand**

Six districts, namely Ranchi, Purbi Singhbhum, Saraikela Kharsawan, Bokaro, Dhanbad and Ramgarh, consisting of major Urban Agglomerations (UAs) that have undergone significant change in VANUI and population over the years, were further investigated for understanding spatial structure of urbanisation. This was identified using LISA hotspots and coldspots, which provided a cluster of the intensity of urbanisation. The hotspots are the area where neighbouring high values surround high values, whereas coldspots are the area where neighbouring low values surround low values. The hotspots and coldspots were calculated on four temporal differences of VANUI image with a gap of 5 years (1992-1997, 1997-2002, 2002-2007, 2007-2012). The change analysed in this study is a progressive change over time in urbanisation.

## Results and Discussion

### State formation and urbanisation

Jharkhand was carved out as a new State from Bihar in the year 2000 to ensure the socio-economic development of the State, given its vast mineral resources. However, its urbanisation level has remained consistently below the national average during the last three decades (1991 to 2011): 19.1 per cent, 22.24 per cent and 24.05 per cent in 1991, 2001 and 2011, respectively. Compared to the other two States – Chattisgarh and Uttarakhand, which also attained statehood along with Jharkhand, its levels of urbanisation have been marginally above Chattisgarh but below Uttarakhand (Table 2).

**Table 2: Levels of Urbanisation in India, Jharkhand, Bihar, Chhattisgarh and Uttarakhand (1991-2011)**

Census Year	India	Jharkhand	Bihar	Chhattisgarh	Uttarakhand
1991	25.70	-	13.10	-	-
2001	27.81	22.24	10.46	20.09	25.66
2011	31.14	24.04	11.29	23.24	30.23

This is not surprising since its parent State Bihar has remained among the least urbanised States in the country, with the proportion of the urban population remaining between 10.40 per cent and 11.27 per cent in the decades of 1991 and 2011, respectively (Census of India, 2011). Moreover, Bihar has been in chronic poverty and backwardness due to lower agricultural output, lack of industrial development and higher dependency on agriculture, contributing to out-migration primarily from rural to urban areas in north-western States (Kumar & Bhagat, 2012). These factors have severely dented its urbanisation. Likewise, Jharkhand ranked among the bottom-end States in India in its levels of urbanisation in 2011.

In fact, in the decade of its newly acquired status as an independent State, its urban population did not grow fast, registering a 32.40 per cent growth rate during 2001-11, marginally above the national average. In terms of other socio-economic indices of the urban population, Jharkhand is below the national urban average for sex ratio (910 females per one thousand males), literacy (82.26 per cent) and Scheduled Castes population (10.50 per cent) but above the national average for Scheduled Tribes population (9.79 per cent). Gaining statehood by Jharkhand provided the impetus for urbanisation, particularly of the State capital and existing large towns, and propelled the emergence of lower-order urban settlements. Prior to attaining Statehood, Jharkhand comprised 11 Districts in 1991, which were reorganised into 18 Districts in 2001 and 24 Districts in 2011. This internal administrative reorganisation of Jharkhand led to a spurt in urbanisation around the new district headquarters of Ramgarh, Saraikela Kharsawan, Simdega, Jamtara, Latehar, and Khunti. The spatiotemporal pattern of urbanisation before and after the formation of Jharkhand was analysed through the non-parametric Mann-Kendall test on two-time series of annual VANUI images (1992-2001 and 2002-2012), revealing the spread of urban footprint (Figure 3).

Between 1992 and 2001, before the separation, districts with huge mineral resources (Bokaro, Dhanbad, Purbi and Pashchimi Singhbhum) remained the focus of development and urbanisation. However, in the decade after the State's formation, i.e., between 2002 and 2012, a significant increase in urban footprint is evident in all 24 districts, but mostly in central and southeastern parts of the State (Fig. 3). Prior to the State formation, more than 40% of urbanisation was focused in three districts namely Bokaro, Dhanbad and Purbi Singhbhum Kumar (2015, p.60). After State formation, two more districts, i.e., Ranchi and Ramgarh, also picked pace and were included in the list of districts showing more than 40% of urbanisation. It is to be noted that in 2011 a majority – 170 out of 259 Sub-Districts or Tehsils mostly in the northern and western parts of Jharkhand were entirely rural, having recorded not a single urban settlement, while 45 Tehsils had only one urban settlement. The remainder 54 tehsils had more than one urban settlement. Further, districts rich in mineral reserves, such as mica and coal industries like Giridih or those with interventions like the establishment of power plants such as the Maithon power plant in Dhanbad District, Adhunik Power and Natural Resource Limited in Saraikela-Kharsawan District, and Chandrapura power plant in Bokaro District witnessed huge change since the formation of the State and contributed to its urbanisation. These developments, mostly in the southeastern part, are visible in the VANUI image of 2012 (Figure 3).

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According to NTL imagery of 2011, urbanisation in Jharkhand registered a physical expansion, accounting for 3.3 per cent of the total geographical area of the State. Against this, the Census of India data reveals only 3.0 per cent or about 2424 km<sup>2</sup>. Such a difference can be attributed to the spillover effect of big urban centres in their urban periphery, captured in NTL data.

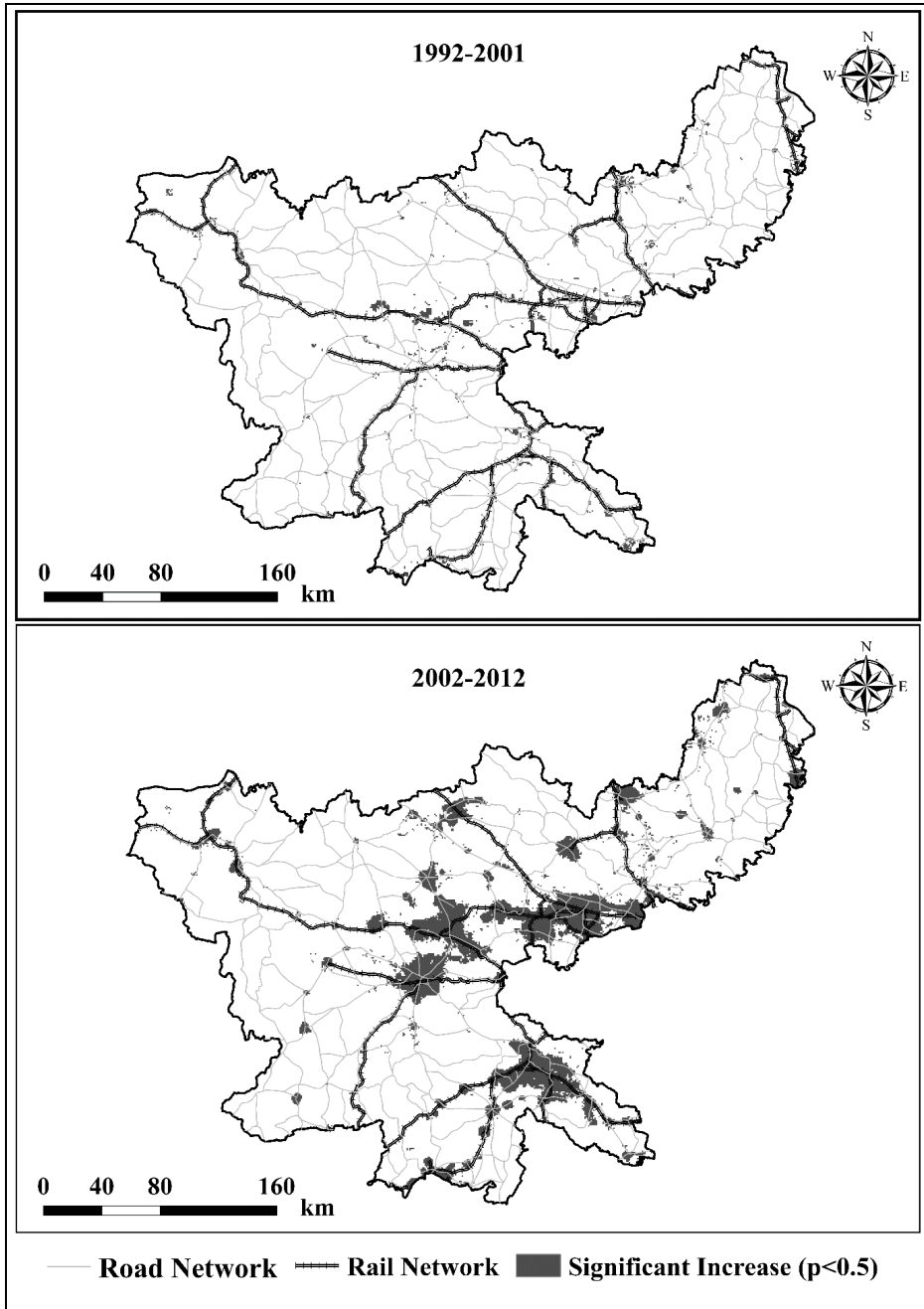


Fig. 3: Jharkhand: Intensity of the VANUI Index using the Mann-Kendall Test (1992-2001 and 2002-2012)

### Urban settlements typology in Jharkhand

A total of 228 settlements were characterised as urban in Jharkhand in 2011. Of these, only 40 are statutory towns with municipal status, while the remaining 188 are Census Towns which are non-statutory urban settlements. The Jharkhand Municipal Act of 2011 recognises three-tiered municipal governance - Municipal Corporation (M. Corp.) at the top, Municipal Council (MC) in the middle and Nagar Panchayat (NP) at the bottom.<sup>1</sup> Among the 40 statutory towns, only three – Dhanbad (11,62,472 persons), Ranchi (10,73,427 persons) and Deoghar (2,03,123 persons) enjoyed the status of a municipal corporation (Table 3). Adityapur recorded the highest population (1,74,355 persons) among the 15 Municipal Councils (Nagar Parishad); Gumla topped among the 19 Nagar Panchayats, while Bokaro Steel City topped among the 188 non-statutory urban settlements, i.e., Census Town with a population of nearly half a million (4,14,820 persons). Jamshedpur (6,77,350 persons) - the oldest industrial township, and Mango (2,23,805 persons) are the two Notified Area Committees (NACs), while Ramgarh (88,781 persons) has the sole Cantonment Board of the State.

**Table 3: Jharkhand: Municipal status of urban settlements**

<b>Municipal Status</b>	<b>Number of Towns</b>
Municipal Corporation (Mahanagar)	3
Municipal Council (Nagar Parishad)	15
Nagar Panchayat	19
Notified Area Committee	2
Cantonment Board	1
Non-Statutory (Census Town)	188
<b>Total</b>	<b>228</b>

Source: Figures calculated from State Town Directory, District Census Handbook, Town Release Census of India, 2011

With most urban settlements being non-statutory Census Towns, Jharkhand's urbanisation being led by the dominance of non-statutory towns in the settlement system aligns with the general character of urbanisation in India marked as 'hidden urbanisation' during 2001-2011 (Ellis & Roberts, 2016). Census Towns, by their very definition, are urban entities; however, they lack official recognition of an independent municipal status being administered by Panchayats (rural local self-governance) and, therefore, are not mandated to levy and collect taxes and generate revenue for development activities

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<sup>1</sup> The Act mandates a municipality with a population of more than one lakh fifty thousand to be classified as a Municipal Corporation, between forty thousand and one lakh fifty thousand as a Municipal Council and between twelve thousand and above and less than forty thousand in a transitional area, namely, Nagar Panchayat.

and municipal services. In the case of Jharkhand, Census Towns occupy an overwhelmingly dominant share in the total number of urban settlements (82 per cent) and account for one-third (32.54 per cent) of the urban population in the State. They are mainly concentrated in seven districts – Dhanbad, Bokaro, Ramgarh, Hazaribagh, Saraikela, Purbi Singhbhum and Giridih.

Further, the urban hierarchy of settlements in Jharkhand is highly skewed. Class I towns have an overwhelming dominance, with 54.56 per cent of the State's urban population concentrated in them, leading to a top-heavy urban settlement hierarchy. On the other hand, 208 out of 228 small and medium-sized urban settlements account for less than a third of the urban population (Table 4).

**Table 4: Jharkhand: Typology of urban settlements by size class**

Size Class	2001			2011		
	No. of Towns	Total Population	% Population in Size Class	No. of Towns	Total Population	% Population in Size Class
<b>Class I</b> (> 1 Lakh)	7	2425879	41.89	10	4328014	54.56
<b>Class II</b> (50,000-99,999)	12	943657	16.29	12	882716	11.13
<b>Class III</b> (20,000-49,999)	30	977790	16.88	39	1282052	16.16
<b>Class IV</b> (10,000-19,999)	38	581417	10.04	48	674280	8.50
<b>Class V</b> (5,000-9,999)	95	666639	11.51	90	634552	8.00
<b>Class VI</b> (< 5,000)	44	196362	3.39	29	131447	1.66
<b>Total</b>	226	5791744	100.00	228	7933061	100.00

Source: Figures calculated from Town Directory Jharkhand, District Census Handbook, Census of India, 2001 and 2011

As is evident from Table 4, in the decade of attaining statehood (2001-11), the overwhelming dominance of cities (Class I towns) in the urban settlement hierarchy remained strong and increased from 41.89 per cent in 2001 to 54.56 per cent in 2011. Jharkhand not only recorded an increase in the number of Class I Towns from seven to ten, with the addition of Chas, Deoghar and Giridih, but it also witnessed the rise of Dhanbad and Ranchi as million-plus cities. The remaining five Class I urban settlements include Jamshedpur, Bokaro Steel City, Mango, Adityapur and Hazaribagh. Towns of all other size categories recorded a decline in their share in the total urban population of the State. This implies a growth of large urban settlements, which could be attributed to socioeconomic pull factors and migration. Further, while an overwhelming majority - 206 out of 228 urban settlements belonged to Class III to Class VI towns, their combined population share was less



than a third of the State's total urban population. However, during this period, Jharkhand added only two new settlements (Census Towns Bachra and Sansikhara in Chatra and Dhanbad districts, respectively) to its existing 226 urban settlements, bringing the total number to 228 towns in 2011. This was unlike the previous decade (1991-2001) when an addition of 128 settlements (comprising 126 Census Towns and 2 Nagar Panchayats) to the then existing 98 urban settlements was recorded, thereby leading to a total of 226 urban settlements in 2001. The emergence of a large number of Census Towns is typically on account of the reclassification of rural settlements into urban by the Census of India based on the demographic attributes of these settlements meeting the criterion laid by the Census for such a reclassification (population more than 5000 persons, the density of population above 400 persons per square kilometre and 75 per cent male workers in non-agricultural economic activities). It must, however, be mentioned that as many as 43 of the 126 Census Towns recorded a population less than the stipulated 5000 persons. These Census Towns geographically formed a part of the urban agglomeration of the main city but were not amalgamated within the city's jurisdiction. For example, 27 Census Towns formed a part of the Dhanbad Urban Agglomeration in 2001. Many such as Bhuli, Jorapokhar with populations exceeding 80,000 persons (Class II towns) could easily be independent municipalities. However, with the non-recognition of such large urban villages as statutory towns by the State, these Census Towns continue to be administered by the Panchayats. Thus, Census Towns add to the urbanisation of the State by being part of urban statistics by the Census but negate the process of municipalisation from the State. Therefore, Jharkhand's 'slow process of municipalisation' (Samanta, 2014) has been a characteristic feature of its urbanisation since 1991. During 2001-11, as many as 24 out of 27 Census Towns were merged within the jurisdiction of Dhanbad Municipal Corporation.

## **Urban Clusters**

### **District level analysis**

The district-level analysis of the Census data reveals an uneven but highly concentrated level of urbanisation in the State. The spatial extent of urbanisation is extremely limited, with only six districts (PurbiSinghbhum, Deoghar, Ranchi, Ramgarh, Bokaro and Dhanbad) recording between 3.04 per cent and 17.41 per cent of their geographical area under urban settlements. Such is the concentration of urban areas that these six districts together constitute nearly two-thirds of the total urban area of Jharkhand. The urban footprint in the remaining 18 districts is very small, i.e., between 1.03 per cent and 3.04 per cent of the geographical area under urban settlements in 11 districts and a miniscule proportion of less than 1 per cent in the rest seven districts. Another feature of urbanisation in Jharkhand is the highly clustered location of urban settlements around the Sub-District (Tehsil/Taluk) Headquarters. More than half the urban settlements (176 out of 228) are located within a distance zone of 10 kilometres from the Sub-District Headquarters. This spatial trend is attributable to a significant proportion of about one-third of the geographical area of the State being under forests, mining activity, areas of the Scheduled Tribes and the availability of physical and social infrastructure in the administrative headquarters.

A majority of the districts (18 out of 24) recorded below the State average (24.05 per cent) proportion of the urban population (Table 5). Among these, as many as 11 districts have less than ten per cent (between 4.90 per cent and 9.58 per cent) of their population recorded as urban. One of the characteristics of these districts is that their settlement hierarchy is constituted of small-sized towns. They also had a near absence of Class I and II towns except in Giridih and Gumla Districts, respectively. Further, these districts have widespread forest cover and a predominance of the ST population.

**Table 5: Jharkhand: Levels of urbanisation in districts**

Per cent urbanised	No. of Districts	Name of Districts	No. of Towns	Per cent Urban Footprint
> 50	2	Dhanbad, Purbi Singhbhum	61	5.29 - 17.41
20 – 50	4	Bokaro, Ramgarh, Ranchi, Saraikel-Kharsawan	72	2.61 - 15.15
10 – 20	7	Kodarma, Deoghar, Hazaribagh, Pashchimi Singhbhum, Sahibganj, Lohardaga, Palamu	53	1.32 - 5.32
< 10	11	Jamtara, Giridih, Khunti, Pakur, Simdega, Latehar, Dumka, Gumla, Chatra, Garhwa, Godda	42	0.50 - 1.77

Source: Figures calculated from State Town Directory, District Census Handbook, Town Release, Census of India, 2011

Note: The state average for the urban population is 24.05 per cent. An urban footprint is a per cent district area under urban settlements.

On the other hand, six districts, namely Dhanbad, PurbiSinghbhum, Bokaro, Ramgarh, Ranchi and SaraikelaKharsawan, each recorded proportion of urban population above the State average, with Dhanbad and PurbiSinghbhum being dominantly urban (58.13 per cent and 55.56 per cent respectively). Together these six districts account for an overwhelming majority (72.52 per cent) of the State's urban population residing in 133 out of 228 urban settlements in Jharkhand (Table 5). The urban footprint ranged between 2.61 per cent and 17.41 per cent of the Districts of Saraikela-Kharsawan and Dhanbad, respectively. Broadly, high levels of urbanisation are encountered in the contiguously located central and southeastern districts, whereas low levels are in the districts to the west and northeast. Further, these spatial patterns of urbanisation reveal highly concentrated regional clusters of Class I cities in the central-east and southeast parts comprising Dhanbad-Bokaro Steel City-Chas-Giridih, and Jamshedpur-Mango-Adityapur. The three Class-I cities of Ranchi, Hazaribagh, and Deoghar formed isolated patches. Class II towns formed a relatively even distribution across the State.

### Urban Agglomerations

The urban development in Jharkhand is highly concentrated in a few urban centres, as evident from the 12 Urban Agglomerations (UAs) in the State (Table 6). UAs form a contiguous built-up area around an urban core comprising at least one statutory urban settlement (city/town) with or without one or more contiguous outgrowths outside the statutory limits of that city/town and one or more adjoining towns with their outgrowths. Their numbers have increased over the last three decades: from five in 1991 to eight in 2001 and 12 in 2011. The largest UA in Jharkhand is Jamshedpur in terms of population size and the number of constituent settlements. However, regarding the spatial extent, Dhanbad UA is the largest, spread over 240.66 square kilometres. This has been due to a merger of 27 towns (mostly Census Towns) in 2011 in Dhanbad Municipal Corporation.

**Table 6: Jharkhand: Urban agglomerations and their composition**

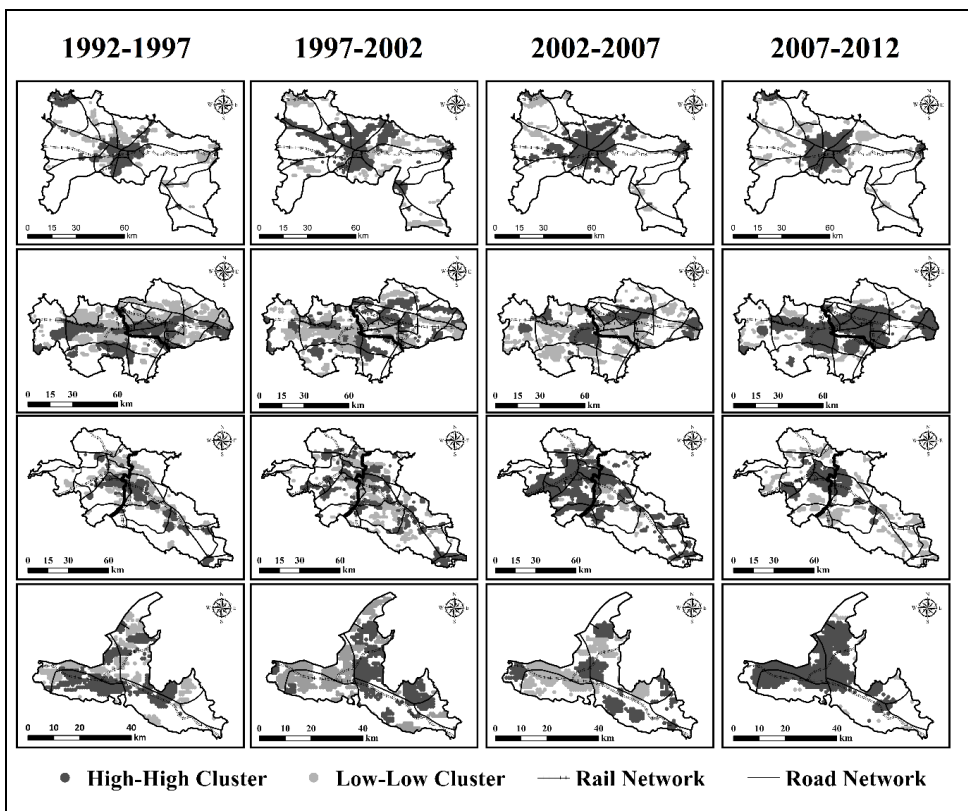
District	Name of UA & Area (in sq. km)	Population of UA	Core urban settlement & No. of settlements within UA	Constituent urban settlements of UA
Purbi Singhbhum	Jamshedpur 184.07	1,339,438	Jamshedpur NAC 12	Jamshedpur & Tata Nagar Railway Colony, Mango NAC, Jugsalai M, Bagbera CT, Haludhani CT, Sarjaunda CT, Gadhra CT, Chhota Gobindpur CT, Ghorabandha CT, Purihasa CT, Adityapur NP, Chota Gumahria CT
Dhanbad	Dhanbad 240.66	1,196,214	Dhanbad MC 5	Dhanbad MC, Railway Colony & 27 towns merged with Dhanbad MC, Malkera CT, Nagri Kalan CT, Baua Kalan CT, Pondarkanali CT
Ranchi	Ranchi 197.36	1,126,720	Ranchi MC 6	Ranchi MC & Doranda, Kanke CT, Arsande CT, Ara CT, Bargarwa CT, Tundiul CT
Bokaro	Bokaro Steel City 187.55	564,319	Bokaro Steel City CT 3	Bokaro Steel City CT, Chas NP, Bandhgora CT
Deoghar	Deoghar 119.70	203,123	Deoghar MC 1	Deoghar MC, Jasidih NA
Bokaro	Phusro 90.33	185,555	Phusro NPr 5	Phusro NP & Kargali Town, Bokaro CT, Kurpania CT, Bermo CT, Jaridih Bazar CT
Purbi Singhbhum	Hazaribag 27.22	153,595	Mango NAC 2	Hazaribagh NPr, Okani – II
Giridih	Giridih 16.37	143,630	Giridih NPr 5	Giridih NPr, Sirsia CT, Dandidih CT, Paratdih CT, Pertodih CT
Ramgarh	Ramgarh 53.82	132,425	Ramgarh CB 4	Ramgarh CB, Barkakana CT, Sirka CT, Marar CT
Palamau	Medininagar 23.96	120,325	Medininagar (Daltonganj) NPr 4	Medininagar M, Sundna CT, Baratola CT, Rerma CT
Dhanbad	Chirkunda 22.59	118,777	Chirkunda NPan 6	Chirkunda NPan, Kumardhubi Town, Egarkunr CT, Suiliban CT, Mera CT, Maithon CT, Dumarkunda CT
Kodarma	JhumriTilaiya 52.82	93,620	Jhumri Tilaiya NPr 2	Jhumri Tilaiya NPr, Karma CT

Source: Computed from A-4 Tables, Census of India, 2011

(CB: Cantonment Board; CT: Census Town; M: Municipality; MC: Municipal Corporation; NPan: Nagar Panchayat; NPr: Nagar Parisad, NAC: Notified Area Committee)

Hotspot analysis of six major districts of urbanisation, namely Ranchi, Dhanbad, Bokaro, PurbiSinghbhum, SaraikelaKharsawan and Ramgarh (Figure 4), reveals that spatial pattern of urbanisation in Jharkhand, particularly that of its UAs, is characterised by the growth of several settlements, mostly Census Towns (CTs) within proximity of existing urban cores. Among the 12 UAs, seven UAs have a large city (Class I town) as their core, while the remaining five UAs are devoid of a large city as their nucleus and comprise a cluster of small-sized urban settlements.

Most of the UAs in the State include district headquarter as their core, although districts like Bokaro and Dhanbad have recorded the emergence of a second UA centred on smaller towns along with their CTs. This is reflected in Figure 4, wherein a substantially greater number of significant pixels is noted, for example, for Bokaro Steel City UA compared to Phusro UA or Dhanbad UA compared to Chirkunda UA. Additionally, contiguous urban development across two districts is characteristic of Jamshedpur UA, which has jurisdiction in Purbi Singhbhum and Saraikela-Kharsawan. Non-statutory towns have also emerged as the new nucleus of urbanisation captured in significant pixel change, thereby giving rise to isolated patches of urban development, for example, Muri Census Town in the eastern part of Ranchi District; Barughutu Census Town in the northern part of Ramgarh District.



**Figure 4: Jharkhand: Hotspots and coldspots of urbanisation in select districts**

Note: a) Ranchi b) Dhanbad and Bokaro c) Purbi Singhbhum and Saraikela Kharsawan d) Ramgarh

**Ranchi:** The State Capital, Ranchi, has been a fulcrum of urban development even before the State formation. Between 1992 and 1997, the hotspots were mostly confined to the city's southern part and

around mining areas (Karanpura Dewalkhand Hesalong mine). There are also a few cold spots in the western part of the city and towards the northeastern edge of the district. The development axis expanded towards the northern and northeastern sides of Ranchi city between 1997 and 2002 and around major national highways (e.g., NH23 and NH75) between 2002 and 2007. These developments are well highlighted by the increase in the number of hotspots.

Interestingly, the period between 2007 and 2012 was one of consolidation of existing urban development and reflected in no new formation of hotspots (Figure 4a). The development that occurred just after the State formation, i.e., 2000, can also be seen from 1997-2002 and 2002-2007 hotspots. There has been vigorous development in the capital city after the State formation as the hotspots around the city have expanded in all directions. Ranchi remains the educational hub of Jharkhand with institutions like BIT Mesra, Birsa Agriculture University, Indian Institute of Coal Management, National University of Study and Research in Law etc., established over time, which have collectively contributed to its urban development. This urban expansion in different parts of Ranchi is also reflected in 74,330 urban households in 2011 (a 44% increase in the total household from 2001). The total population of UA in 1991 was 6,14,795 persons, which increased to 8,63,495 persons in 2001 and 12,57,335 persons in 2011. This is approximately a 45% increase in the population. The addition of new Census Towns to the UA indicates that development activity has also increased in the adjoining towns of the city core.

**Bokaro and Dhanbad:** The spatial growth of urbanisation is spread over the jurisdiction of two districts as both these districts are contiguously located. These two districts are major mining areas of the State. The LISA result (Figure 4b) of 1992-1997 indicates hotspots Chandrapura, Phusro, Bermo, Bokaro and Gumia (from east to west) in Bokaro District. The hotspot can also be seen in Bokaro Steel City in the southeastern part of the district. During 1997-2002 only a few hotspots were identified as indicative of sporadic urbanisation in the district centred on Bokaro Steel City and Gumia. After that, the Chandrapura area witnessed intensification during 2002-2007 and expansion during 2007-2012 owing to the extension of two units of the Chandrapura power plant (Figure 4b). The new units initially scheduled for commissioning in 2007 were commissioned two years later in 2009, and became operational in 2011 (Ministry of Power, Government of India, 2016). This is also visible in the map with subsequent increase in the hotspot size (For general readership, define in a footnote 'hotspot' what you mean by the term) area from 2007 to 2012. A new hotspot of development in 2007-2012 associated with Electrosteel Steels Limited near Sealjori village started production in 2012 and continued development there. Bokaro District witnessed an emergence of Phusro UA to the northwest of the already existing UA of Bokaro Steel City. The urban development was led by the transition of 19 existing rural settlements into urban settlements in the form of Census Towns during 2001-11 and a continuous belt of urbanisation in the district after 2007 (see hotspot map for 2002-07 and 2007-12).

Dhanbad District, like Bokaro District, experienced urban development from 1992-1997, but a major part of it was post-2007 (Figure 6b). The west-to-east direction of contiguous development during 1992-1997 aligns with major mining belts in both Bokaro and Dhanbad Districts and around Dhanbad city. The location of hotspots suggests some development in the district, which majorly occurred around Dhanbad city and in some nearby areas. From 2007 onwards, the entire western part of the district experienced rapid urbanisation. A clear emergence of a hotspot in 2007-2012 at the boundary of Jharkhand and West Bengal is the Maithon power plant commissioned in 2011. All the hotspots in the Dhanbad district are extensions of existing core industrial townships. The district headquarters of Dhanbad UA, which consisted of 24 CTs in 1991, gained seven CTs in 2001. In the subsequent decade, all the CTs in and around Dhanbad Municipal Corporation were merged within municipal limits, expanding the municipal area and further consolidating urban development in the district. The newly formed Chirkunda UA comprising 6 CTs in 2001 in the eastern part of the district at the Jharkhand and West Bengal border, expanded to include 41 CTs in 2011 indicating major

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development activity. Being in proximity to the then newly established Maithon power plant, where most of the development took place after 2007 when the plant was commissioned, also enabled urban development in Chirkunda and its surrounding areas.

Hotspot analysis also reveals the intensification of urbanisation in both districts post-2007. This intensification in growth is evident from the massive conversion of cold spots of the pre-2007 period into hotspots during the 2007-12 period (see Figure 4b). Both Dhanbad and Bokaro comprised one district of Dhanbad in the 1991 Census but were separated into two districts in the 2001 Census. As a result, both Dhanbad and Bokaro UAs witnessed an increase in the number of settlements comprising them, as well as population growth and spatial expansion of urban footprint.

**Purbi Singhbhum and Saraikela-Kharsawan:** The spatial pattern of urbanisation in the two districts are intricately linked as they share Jamshedpur UA, which is the nucleus of urban development in these districts. The industrial city of Jamshedpur, situated in the meander of river Subarnarekha, has considerably expanded as a UA to subsume Jugsalai Municipality to its southwest, along with several CTs in its vicinity. Consequently, there has been an increase in intensity in the hotspot areas since 2002 in Jamshedpur city core. While Jamshedpur city remained the core of urban development, in 2007, the northwest and northeast areas emerged as hotspots. This is attributable to leapfrog urban development comprising Mango NAC on the other side of River Subarnarekha. In addition, urban development in the district is also aligned with the national highway (Figure 4c). The urbanisation in Saraikela-Kharsawan District is an extension of Jamshedpur UA till 2002 and since then, in and around Saraikela town, which is its district headquarters and Adityapur industrial area and its surroundings. This region has many large-scale industries, including Tata growth plant and Adhunik Power and Natural Resource. Apart from the industries, some small townships are also present along these industries. The hotspot analysis also reveals that post-2001, most of the development occurred in the Saraikela-Kharsawan district compared to Purbi Singhbhum.

**Ramgarh:** Post its separation from Hazaribagh District and its emergence as a new district in 2007, Ramgarh experienced large-scale urbanisation centred on Ramgarh city and the mining areas in northern and western parts. The hotspot maps (Figure 4d) suggest that from 1992 to 2007 when it was part of Hazaribagh district Ramgarh, much of the urbanisation was confined to the Northern, Central and Western parts of the district in patches. During 1992-1997 the development in the district was mainly in the Northern, Central and Western parts. The Northern and Western part of the district mainly comprises the mining areas, while the Ramgarh city is in the centre. During 1997-2002 only the main city area of Ramgarh experienced urbanisation, and some of the urbanisation can also be seen in the northern part. A new hotspot can be seen in the eastern part of the district at the border, mainly comprising mining areas. Post the formation of the State, i.e., from 2002-2007, the district did not undergo much urbanisation, and it was mainly focused on Ramgarh city and the mining area present in the Northern and Western parts of the district. Acquiring district status and setting up the Jindal Steel plant in 2009 accelerated the growth of Ramgarh towards the western part of the district.

Further, Ramgarh UA grew significantly in 2011, comprising 23 CTs compared to the previous two decades when it had only three CTs. This is also reflected in a large increase of 279 per cent in the population of Ramgarh UA, i.e., from 110496 persons to 418955 persons. The hotspot map of 2007-12 captures this increase (Figure 4d).

### Conclusions

The spatial patterns and directionality of urban expansion in the State of Jharkhand upon its attainment of statehood have been identified and analysed in this study through the time series of NTL from 1992-2012 and Census data. The study reveals a limited change in general urban dynamic growth prior to the formation of the State (during 1992-2002), which mostly hinged around industrial areas. After the State formation, an increased urban footprint was found across different districts,

which has become more compact and concentrated around district headquarters. However, six districts comprising Ranchi, Dhanbad, Bokaro, Purbi Singhbhum, Saraikela-Kharsawan and Ramgarh recorded major changes. UAs increased to 12 in 2011, mostly on district headquarters and CTs. However, regarding an urban settlement hierarchy, Jharkhand has remained bottom-heavy with many small towns and a dominant of non-statutory urban settlements, i.e., Census Towns. An upward movement in the higher-size class category was highly limited as three cities (Chas, Deogarh, and Giridih) attained Class I status, and Ranchi became a million-plus city. Tracking and monitoring urban expansion is crucial to managing resources better and providing amenities in fast-growing settlements. Economic development, including industrialisation, is critical in shaping urban development, particularly in a state driven by its rich mineral resources. It would be interesting to map the impact of economic liberalisation on the urbanisation of the State, which can be a theme for exploration in future studies.

### Acknowledgements

We thank the anonymous reviewers for providing incisive comments on this manuscript which has improved its quality. Unfortunately, this research received no specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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