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Population and Land Use Characteristics of Rural-Urban Fringe Around Raipur City, Chhattisgarh

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Abstract: Uncontrolled urbanisation is a prominent phenomenon in developed and developing countries. The area most affected by fast and unplanned urban growth is the surrounding cities' fringe area. The study was conducted to determine the status of the Raipur fringe area and its regional importance through its locational aspects. Relevant data were collected from the district census handbooks of different years. The rural-urban fringe was divided into five zones through a buffer of 4 km distance to analyse population characteristics and land use. Statistically, a significant correlation was found between distance and different parameters. The result shows the dynamic nature of the rural-urban fringe, which projects a probable aspect for more rapid urban growth in the near future, which is necessary to monitor.

***Keywords*:** fringe, demography, correlation, land use, buffer

India is fast urbanising among developed and developing countries. Because of its sheer population numbers, it contains a massive urban population. Now, the fact is that with the growth of urban population locations, the urban area also has to increase to counter the growth. As the urban boundary grows in the near future, the villages in this fringe area will be included in the rapidly growing city. Here, the question arises: What is fringe, and why is it important?

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The term "urban fringe" was first introduced by T. L. Smith in 1937 to describe the built-up area outside the city limits (Ahmed et al., 2014), though the word “rurban" used by Galpin in 1915 was synonymous with the fringe (Lal, 1987). Wehrwein (1942) first defined the rural-urban fringe as a transitional area between well-organised urban and agricultural land use. Prayor (1968-69) divided the fringe into urban and rural fringes based on land use composition. In other words, the fringe is a bridge between rural areas and urban centres on the other (Sinha, 1980).

The fringe area is very important because, in the near future, this area will become part of urban settlement. However, plans have not been adopted for this area as it is outside the boundaries of urban settlements. As a result, unplanned urban growth, overpopulation, land acquisition, pollution, and land use have emerged as problems. Hence, there is a special need to know the variable features of this particular region. The present study attempts to investigate the complex interplay between land use changes and population dynamics in the fringe area of an Indian city and understand the implications for sustainable urban development and planning. Since its recognition as the capital city on November 1 2000, Raipur City has gone through a significant increase in its magnitude and pace of urbanisation. Regarding its significant geographical location and dynamic nature, the Raipur fringe has emerged as ideal for studying the speciality of fringe regions. Hence, in the present study, an attempt has been made to explore the prominent features of the fringe area of Raipur city in terms of space and time.

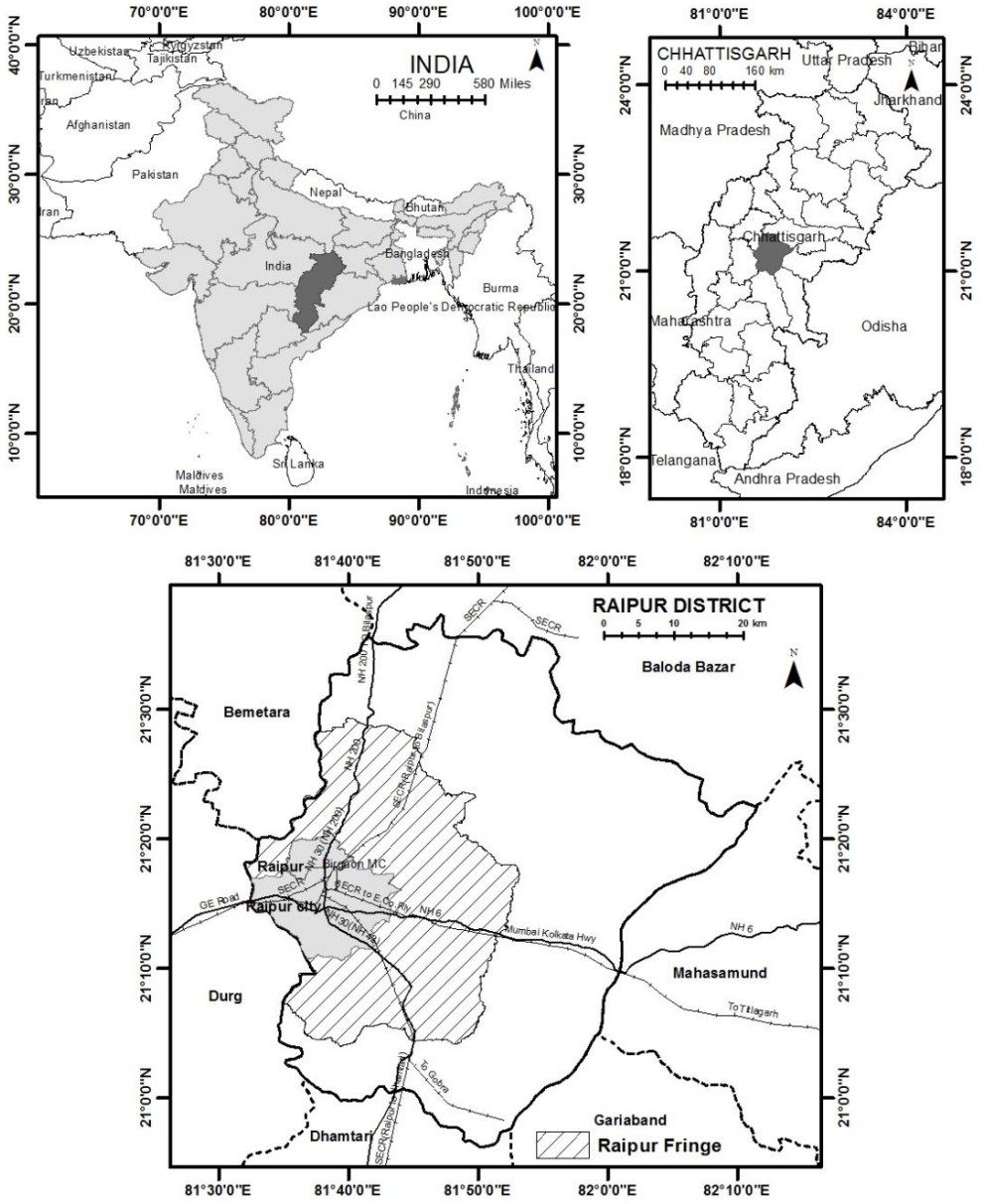
Study Area

The capital city of Raipur is located at approximately the centre of Chhattisgarh and belongs to the Mahanadi Plain. The city is extended from 21°10'35.82″ N to 21°20'40.276″ N and 81°32'29.076″E to 81°44'8.877″E. The latitudinal extension of the fringe area is 21°3'55″N to 21°29'24″N, and the longitudinal extension is 81°31'57″E to 81°53″13″E. A total area of 1078.5 sq km was covered by Raipur City and its fringe (as demarcated by the author). Mahanadi River and Kharun River flow on the eastern and western sides of the study area. The study area connects Nagpur, Howrah, and Rourkela through rail routes and several National highways.

Objectives of the Study

Examine the changing population dynamics and land use characteristics that reflect the significance of Raipur, a state capital city and its fringe area. It also configures the advantages of the Raipur fringe area from its locational point of view.

Figure 1
Location Map of the Study Area

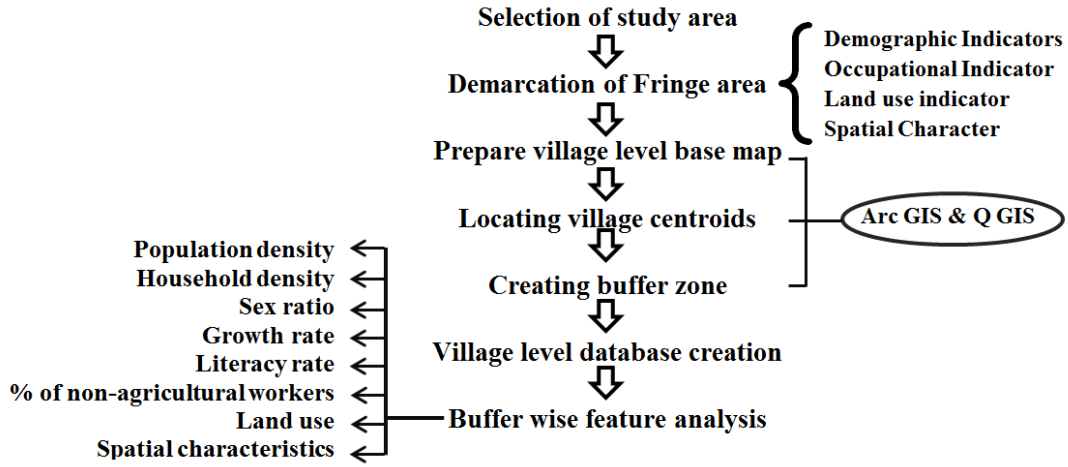


Database and Methodology

This study's village-level census data was taken from the District Census Handbook from 1991 to 2011. The fringe area of Raipur city was demarcated through various indicators. Demographic, occupational structure and land use have been taken as indicators. In the next step, the village-level base map was prepared with the help of Arc GIS software. In the next stage, the fringe region is divided into several

rings by the buffer method with ArcGIS. It has been seen that the minimum and maximum distance of the fringe area from the city centre is six km and 26 km, respectively. So now, the extension of the fringe area in different directions is 20 km. Primary observations during the pilot survey showed that changes in features in different directions are less obvious at short distances (within one or two km). Therefore, considering the stated reason and equal distance, the entire region has been divided into five zones at an interval of four km. Along with this, the help of village centroids has been taken to comprise the villages within the entire fringe area in various zones. Population density, household density, population growth, sex ratio, and literacy rate have been analysed as demographic features. The occupational structure has been explained in terms of non-agricultural main workers.

Steps Followed for the Study



Results and Discussion

After demarcation, it was found that a total of 153 villages surrounding Raipur City have come under the fringe region of Raipur City. Two census towns and one statutory town are also associated with the Raipur fringe (Fig. 2).

In the next step, five buffer zones were drawn at 4-kilometre intervals from the city centre after determining the village centroid point through Arc GIS (Fig. 3). A total of 18 villages fall within zone one (from the city centre to 10 km). Subsequently, 32, 37, 36 and 30 villages have been fallen under the 2nd zone (10-14km), 3rd zone (14-18km), 4th zone (18-22km) and 5th zone (22-26km).

Figure 2

Detail Map of Raipur Fringe Area With Buffer Zone

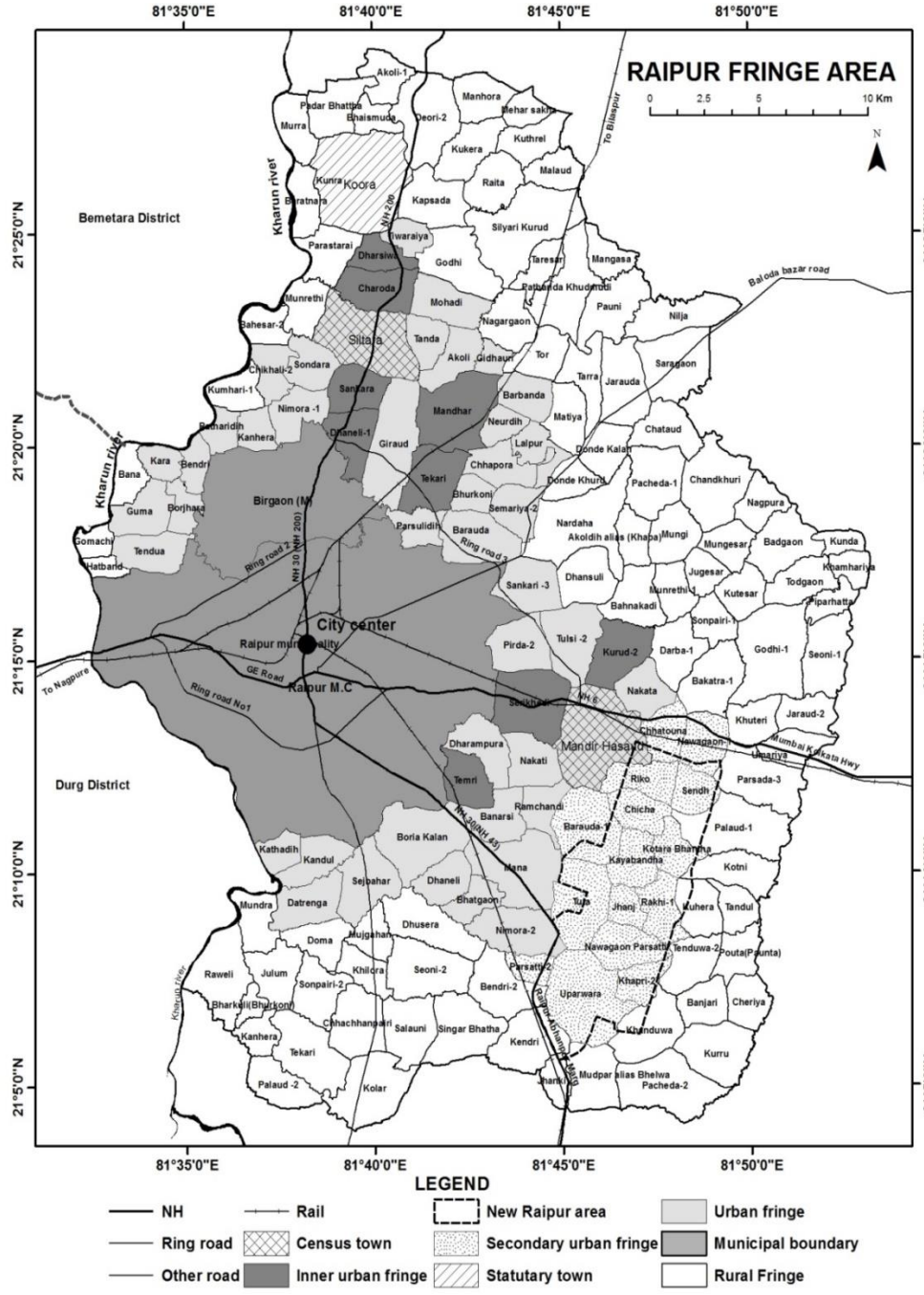
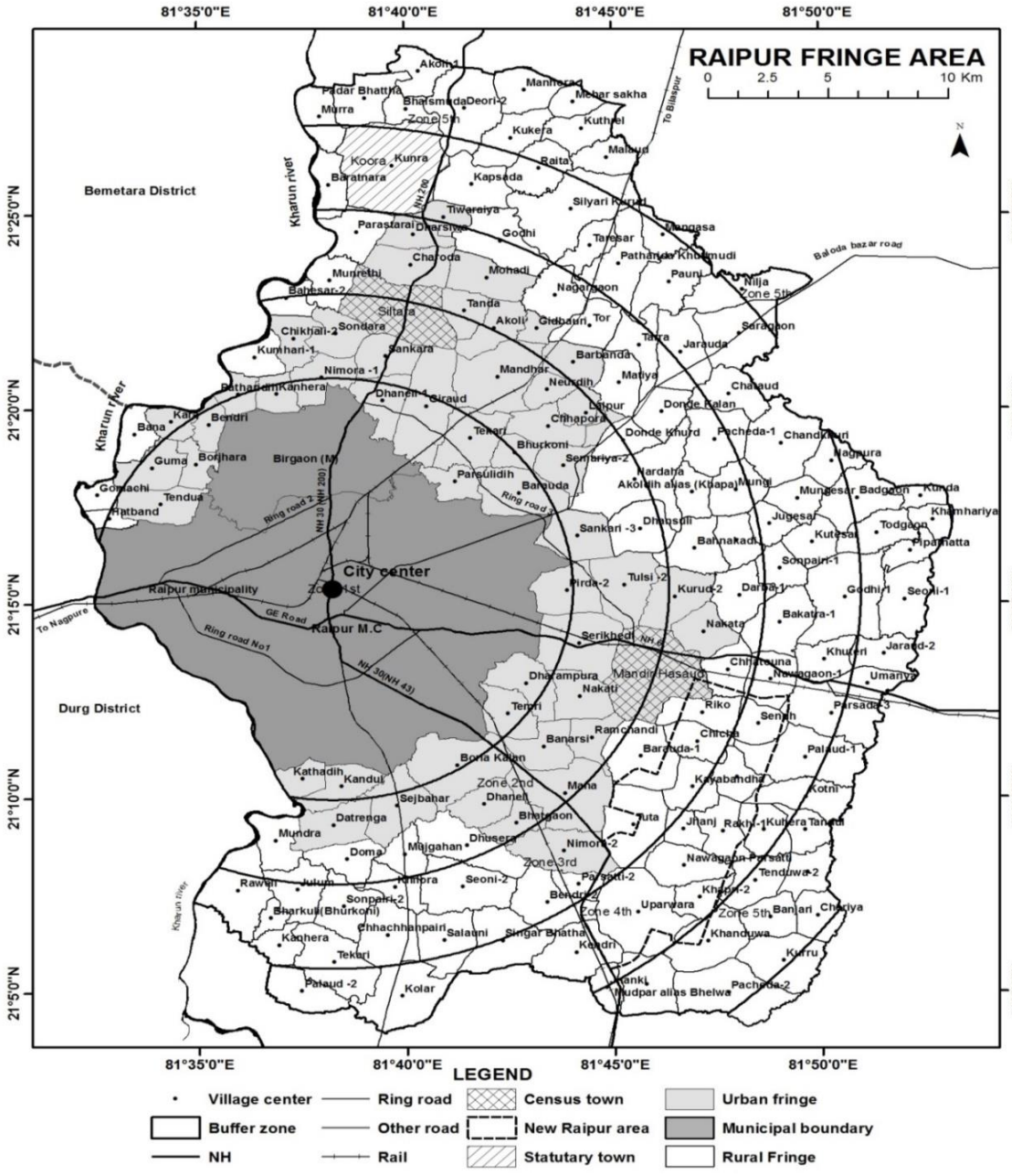


Figure 3

Village Centroids and Buffer Zone of Raipur Fringe



The characteristics of the Raipur fringe region are discussed in the ensuing sections.

Demographic Features

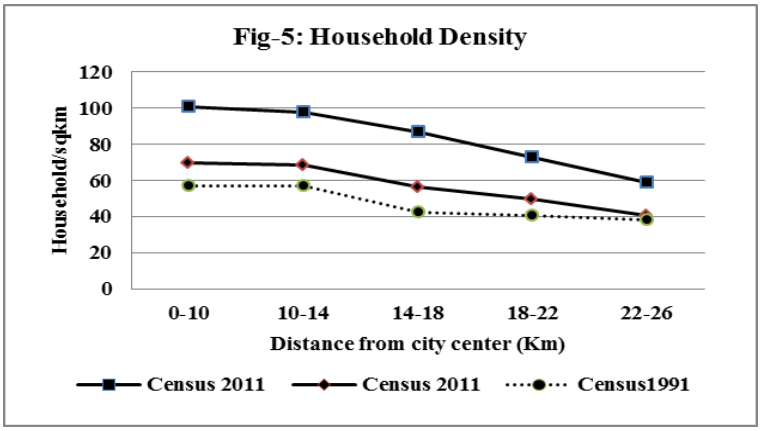
In this study, population density, household density, sex ratio, growth rate, and effective literacy rate have been analysed regarding demographic conditions.

Density of Population

According to the Census in 2011, the rural population density of Raipur district was 217 persons/ sq km. Analysis shows that the density of the first ring, i.e., 0-10 km, is highest at 520 persons/ sq km (Census, 2011), much higher than the rural proportion of the whole district. Declining population densities were found in subsequent zones (Fig. 4). According to the 2011 census, the population density of the first three zones is 520 (zone 1), 497 (zone 2) and 427 (zone 3), respectively, which is higher than the minimum census criteria of urban settlement. The lowest population density was 287 persons/ sq km, found in zone no five, with a distance of 22-26 km from the city centre. A similar trend has been observed by analysing the data of census 2001 and census 1991. In the last two decades, the population density of the first two zones has increased by about 200 persons per square kilometre, which shows the rapid change in the population of the first two zones.

Household Density

Due to the facilities and modern life in the urban areas, the migration rate from the village to the city is usually much higher. The effect of this character can be noticed in the fringe region. According to the 2011 census, the housing density in rural areas of the Raipur district is 47 households per square kilometre (calculated by the author from census data). An analysis of the 2011 census shows that the housing density in each zone is higher than the rural housing density. In the first zone, i.e., between 0-10 km, the highest housing density is 102 households per sq km. This rate of household density is generally seen to be declining in the later zones (Fig. 5). The household density is 98 households/sq km in Zone 2nd, 86 households/sq km in Zone 3rd, 72 households/sq km in Zone 4th, and 59 households/sq km in Zone 5th, respectively. However, one thing is that there is not much difference between the first and the second zones in terms of housing density. This trend is similar in the 2001 census and the 1991 census. According to the 2001 census, the household density in the first and second zones is 70 and 68 per sq km, respectively, and according to the 1991 census, it is 56 and 57 per square kilometre. In both census decades (2001, 1991), household density was lowest in the 5th zone at 41 and 38 households/ sq km. The household density of the 1st and second zones increased almost twice from 1991 to 2011.



Sex Ratio

The sex ratio is generally higher in rural areas than in urban areas. Due to the greater migration of the male working population from rural to urban areas for higher livelihood and employment opportunities, the sex ratio is generally lower in urban areas than in rural areas. According to the 2011 census, in Raipur fringe, the sex ratio is the lowest in the first and second zones. The sex ratio is 970 females/1000 males in Zone 1(within 10km)and 961 females/1000 males in Zone 2(10-14km). The sex ratio in subsequent zones is steadily increasing. In the third, fourth and fifth zones, the sex ratio is 972,985 and 999 females per 1000 males, respectively. Looking at the 1991 and 2001 censuses, the sex ratio is lower in the first zone and higher in the latter.

Growth of Population

In Raipur district, the decadal variation in urban population is 61.6% from 2001 to 2011. Decadal variation in Raipur tehsil has also been very high, showing 53 % in urban areas and 18.8% in rural areas. In the case of fringe areas, the growth rate is generally higher near the city. However, in the Raipur fringe area, the population growth rate was highest in the 2nd zone in the previous two census decades (from 1991 to 2001 and 2001 to 2011). The growth rate in 1st zone is almost similar in 2001(22.90%) and 2011(23.08%). However, in the 2nd zone, the growth rate was highest in the 2001(28.41%) and 2011(35.18%) censuses. That might be due to the high price of land proximity to the municipal boundary. The growth rate has declined in the latter zone, but the lowest growth rate in the 3rd zone, 13.88 %, was in the 2011 census. However, in the case of the 2001 census, the growth rate indicates a sharp decline after the 2nd zone (14-18km from the city centre).

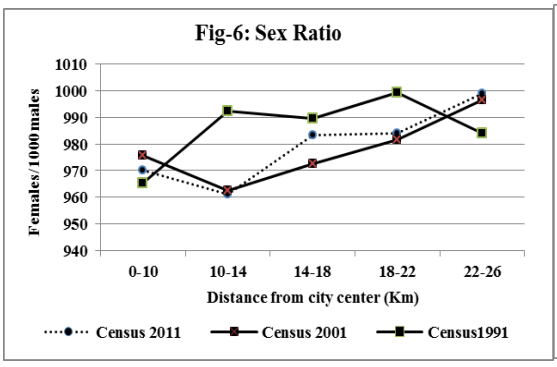
Literacy Rate

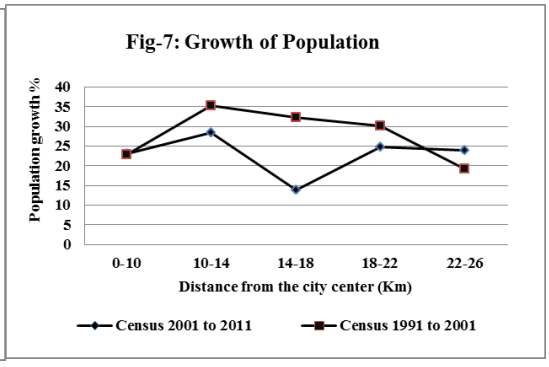
The literacy rate of the Raipur fringe region shows both rural and urban character. The impact of urbanisation is greater in the vicinity of the city, so the literacy rate (76.18%) is highest in the first zone, i.e., in villages within 0-10 km.

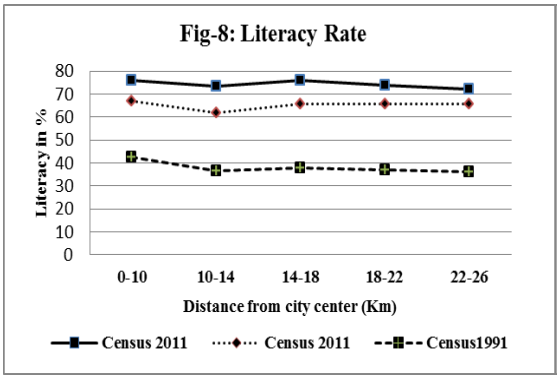
According to the 2011 census, the first zone's literacy rate was 5.7% higher than the rural literacy rate of the Raipur district. The lowest literacy rate of the Raipur fringe region has been observed in the last zone (22-26km), which is 72.14%, which is also 1.16% higher than the district's rural literacy rate. The last zone is the farthest from the city, so the literacy rate is the lowest. Also, the literacy rate has been declining with increasing distance from the city; only the literacy rate in the third circle (75.85%) is almost equal to that of the first circle.

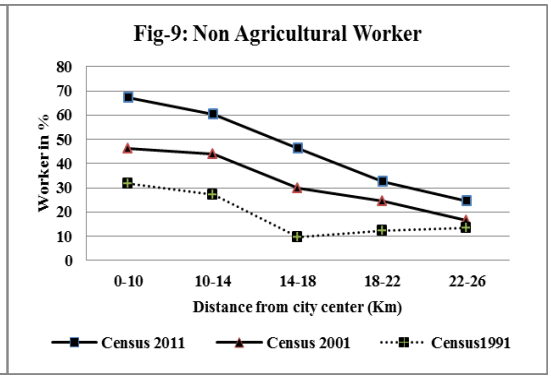
Occupational Structure

The share of non-agricultural workers of the main workers of the Raipur fringe region has been taken for this analysis. After the zone-wise analysis, it is seen that the proportion of non-agricultural workers is highest in the first zone, i.e., villages within 0-10 km. In the first round, 67.07% of the main workers are associated with non-agriculture activity, the highest in the fringe region. In the last zone, i.e., 22-26 km, this ratio was found to be 24.32%, the lowest in the fringe region. This percentage has gradually decreased from the first zone to the next zone (Fig. 9). In the second, third and fourth zones, 60.22%, 46.25%, and 35.51% of people are involved in non-agricultural activities, respectively. According to the censuses of other decades, the same pattern has been observed.









Land Use

Land use in Raipur fringe area has been analysed according to different zones. According to the village-level land use data in the 2011 district census handbook, Raipur district (village directory), this is. In the 2011 census, village-level land use was based on a nine-fold classification. However, no significant land use was found in the Raipur fringe area; the major land use types of the Raipur fringe have been analysed below.

Forest Land

Forest and tree coverage is very common in rural areas (censusindia.gov.in). The forests were not particularly observed in the Raipur fringe area. Only in the last two zones, i.e., Zone 4 (18-22 km) and Zone 5th (22-26 km), 0.78% and 0.96% forest cover have been found.

The Area Under Non-Agricultural Use

Analysis shows this land use is highest in the two belts near the city. In the first zone (0 to 10 kilometres), 10.66 % and in the second zone (10 to 14 kilometres), 15.30 % of the land was under this land use (Fig-10). The use of this type of land has been gradually reduced in the subsequent zones, i.e. 9.30 % and 8.69 % have been found in the third and fourth zones, respectively. However, in the last ring, the amount of this type of land was found to be 10.09%, which shows the opposite character.

Barren and Unculturable Land

Not much of this land was found in the Raipur fringe area. Only 1.39 % and 1.42 % were observed in the third and fourth zones. The amount of this type of land in other zones is negligible.

Permanent Pastures and Other Grazing Land

This type of land covers a good portion of all the five zones in the fringe area. The amount of this type of land is lowest in the first and second zones. This type of land occupies 11.85% (1036.8 hectares) and 10.29% (1674.64 hectares) of the total land in the first and second zones, respectively (calculated by the author). The proportion of permanent posture and other grazing land was increased in later zones. In the second, third and fourth zones, this type of land has been found at 13.05%, 14.95% and 12.65%, respectively.

Land under Miscellaneous Tree Crops

This type of land was also negligible, with only 0.76% in the third zone.

Culturable Waste Land

The amount of this type of land is most visible (11.29%) in the belt near the city. In subsequent zones, the amount of this type of land is less, respectively. As the distance from the city increases, the amount of this type of land decreases. In the second, third, fourth and fifth zones, the amount of such land was found to be 10.16%, 5.77%, 3.97%, and 8.89 %, respectively.

Fallow Lands Other Than Current Fallow

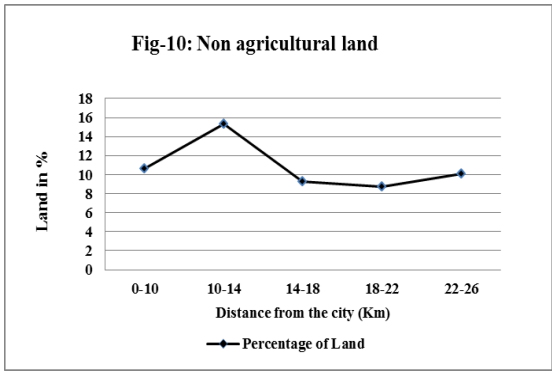
Such type of land is considered as fallow land other than current fallow. This type of land is most visible in the zone near the city. The amount of such land in the first zone is 860.06 hectares, 9.83% of the total (8748.21 hectares) land in that zone (Fig-13). Although this type of land is more in the second zone (1149.46 hectares out of 16267.8 hectares) than the first zone, the amount is less in percentage (7.07%). Subsequent zones have seen a decrease in the amount of this type of land. Only 5.45% of this land was found in the last zone.

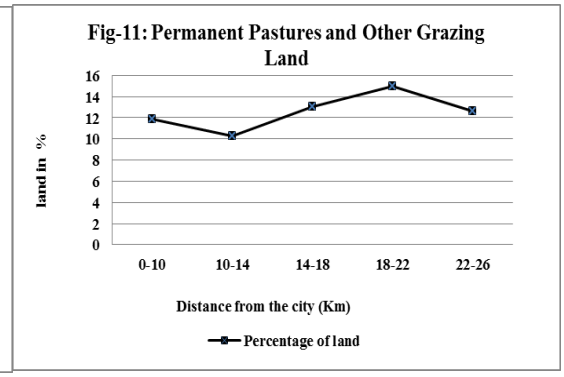
Current Fallow

The same trend has been found in using this type of land as in the previous two types of land use. The highest percentage of current fallow land has been found in the first zone within 0 to 10 km, which is 678.15 hectares (7.75% of the total land of 1st zone). This type of land is found to be lowest in the last zone (22-26 kilometres), amounting to 1.55% of the total (222.44 hectares) land in that zone. As the distance from the city increased, the amount of this type of land declined.

Net Sown area

This type of land use has the opposite character from the three types of land use discussed earlier. This means that the use of this type of land is the lowest in percentage terms near the city and has increased with increasing distance. The amount of such land in the first zone is 4247.14 hectares, 48.55% per cent of the total land (8748.21 hectares). Although increased in subsequent zones, this type of land was found in the third zone. In the second, third and fourth zones, the amount of such land was found to be 50.50%, 63.88 %, 61.67% and 60.22%, respectively.





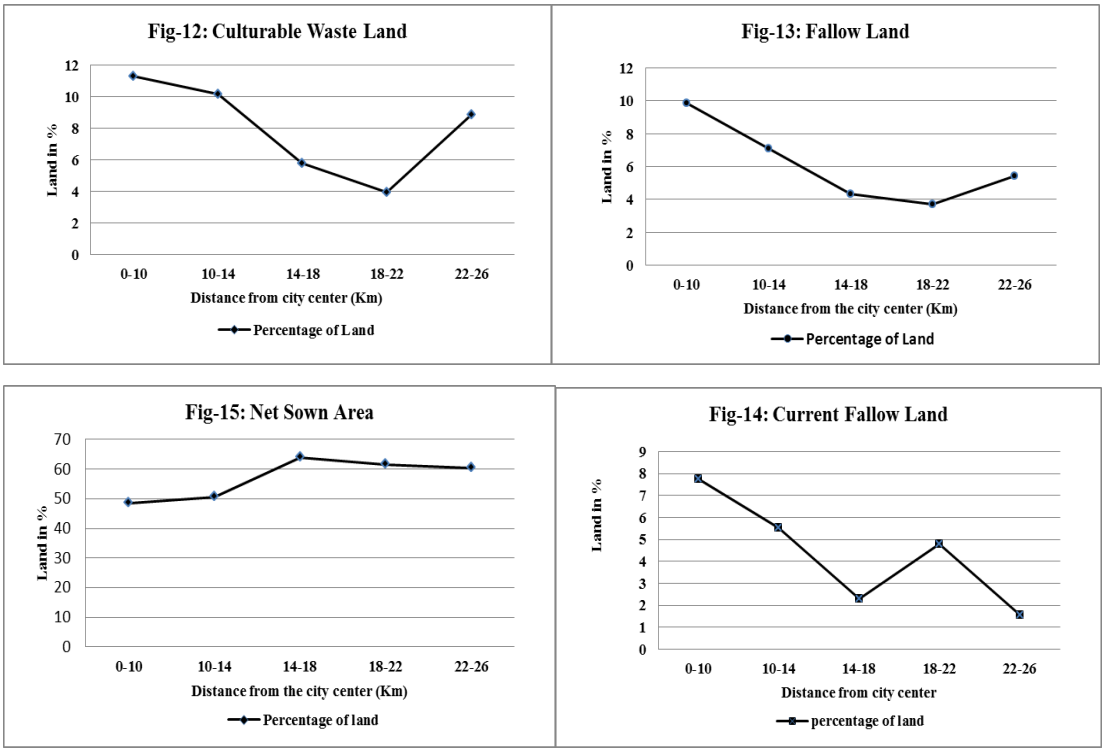


Table 1

Zone Wise Land Use Distribution of Raipur Fringe (District Census Handbook, 2011)

Land Use in Raipur Fringe Area(in Hectares), Census 2011										
Distance in km	Forest Area	The area under Non-Agricultural Uses	Barren & Un-cultivable Land Area	Permanent Pastures and Other Grazing Land Areas	Land Under Miscellaneous Tree Crops, etc. Area	Culturable Waste Land Area	Fallows Land other than Current Fallows	Current Fallows Area	Net Sown Area	total
0-10	0	932.46	5.53	1036.8	0	988.07	860.06	678.15	4247.14	8748.21
10-14	0	2488.57	64.98	1674.64	124.42	1653.08	1149.46	896.94	8215.71	16267.8
14-18	0	2016.85	301.49	2828.77	0	1251.03	933.8	498.84	13850.03	21680.8
18-22	168.32	1864.63	304.73	3208.33	0	851.76	799.43	1027.56	13232.69	21457.5
22-26	137.09	1447.05	28.05	1815.56	0	1275.65	781.73	222.44	8640.58	14348.2
total	305.41	8749.56	704.78	10564.1	124.42	6019.59	4524.48	3323.93	48186.15	82502.4
	Land use in percentage									
0-10	0.00	10.66	0.06	11.85	0.00	11.29	9.83	7.75	48.55	100.00
10-14	0.00	15.30	0.40	10.29	0.76	10.16	7.07	5.51	50.50	100.00
14-18	0.00	9.30	1.39	13.05	0.00	5.77	4.31	2.30	63.88	100.00
18-22	0.78	8.69	1.42	14.95	0.00	3.97	3.73	4.79	61.67	100.00
22-26	0.96	10.09	0.20	12.65	0.00	8.89	5.45	1.55	60.22	100.00

Correlation Analysis

An attempt has been made to determine a correlation between all the features and distances to know how they change as the distance from the city increases. To measure the correlation, the mean distance of each zone from the city center is taken as 'x', and different features have been taken as 'y' variables. The result (Table 2) shows a significant relationship.

Table 2

Degree of Correlation Between Distance and Different Features.

"x" variable	"y" variable (different features of fringe)	"r"
Distance between the zones and city centre	Population density	-0.99
	Household density	-0.99
	Sex ratio	0.90
	Growth rate	-0.05
	Literacy rate	-0.90
	Percentage of non-agricultural worker	-0.99
"x" variable	"y" variable(Major type of land use)	"r"
Distance between the zone and the city center	Non-agricultural land use	-0.60
	Permanent Pastures and Other Grazing Land	0.63
	Culturable Waste Land	-0.70
	Fallows Land other than Current Fallows	-0.90
	Current Fallows Area	-0.85
	Net Area Sown	0.90

Importance of Raipur City and its Fringe Through its Regional Setup

Raipur city is located in the Mahanadi Basin in the heart of Chhattisgarh. The city is now the capital of Chhattisgarh and the commercial hub of different minerals and power resources. Notable among these energy resources are coal, steel, aluminium and power. As one of India's richest cities, Raipur is India's largest iron and steel market. According to the Details Project Report for Financial Assistance under JnNURM, 2013, coal, electricity, steel, aluminium, etc., industries are spread throughout the entire Raipur urban aggregate area. Hence, the commercial and Industrial development is taking place in the fringe region of the development area (nagarnigamraipur.nic.in).

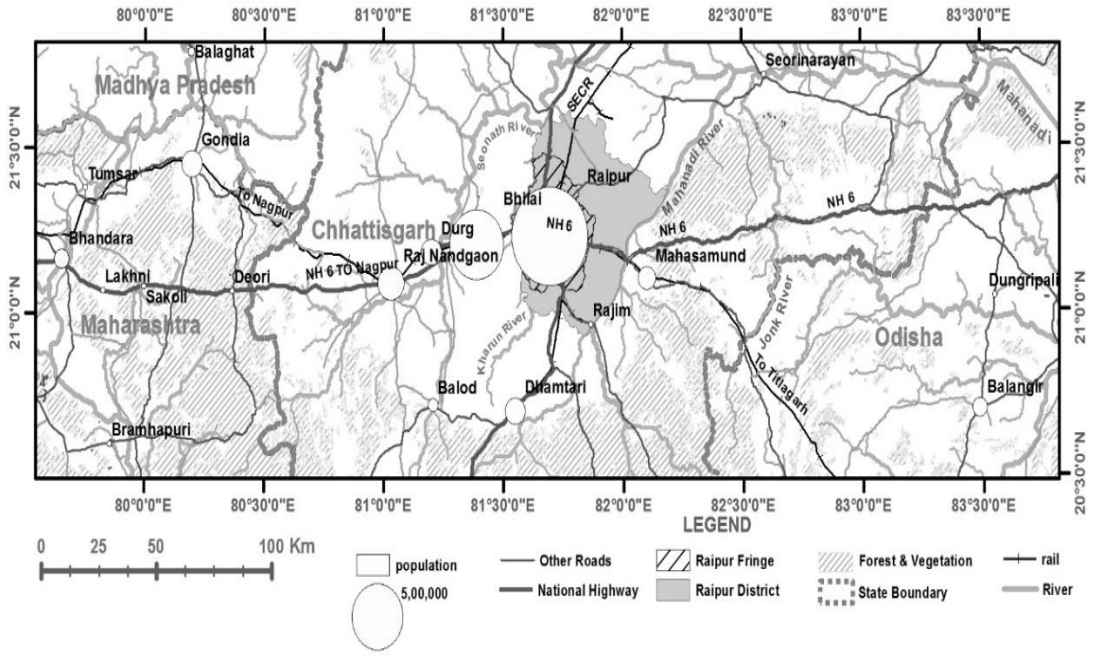
A look at the industrial profiles of the city and adjoining areas shows that there are more than 200 steel rolling mills, more than 195 sponge iron factories and more than 35 Ferro-alloy plants. In agriculture and forest-based industries, there are more than 500 agro-based industries and more than 60 plywood factories in the region. More than 800 rice milling plants are currently in production in the entire region (DPR Raipur, 2013). Some notable industrial areas of Raipur are Urla, Shiltara (heavy and medium scale industry), Bhanpur, Ganodwara, and Birgaon

(medium to small scale industry). Raipur is also emerging as a place of tourists for its ethnic art and culture. In addition to these issues, transport and communication greatly increase the importance of a city.

Being the state capital, Raipur city is well connected with other large and important districts and cities of the state and the country by road and rail network. Raipur is located along the Mumbai Howrah railway route under the South Eastern Central Railway Zone, one of the most created zones of the Indian Railways. The railway connects with Kolkata, Rourkela, Tatanagar, Durg-Bhilai, Nagpur, Mumbai, Delhi, etc. Some other important nodes connected with Raipur are Gwalior, Jabalpur, Amritsar, Jamshedpur, Pune, Visakhapatnam, Thiruvananthapuram, Patna, Ahmedabad, Gandhinagar, Jodhpur, Jaipur, Bhubaneswar, Secundrabad, Lucknow, Kanpur, Gorakhpur, and Bangalore (DPR Raipur, 2013). Besides the rail routes, some important National highways also connected Raipur to other metropolitan and mega cities all over India.

Figure 16

Regional Setup of Raipur City and its Fringe



NH 6, connecting Mumbai and Kolkata, passes through Raipur (Figure 16). Raipur and Visakhapatnam are connected through NH 43. NH 200 connects Raipur, its Industrial growth points like Siltara and Urla, and other potential mineral regions. Besides all this, Swami Vivekanand Airport of Raipur has recently become the third busiest airport in terms of passenger traffic in domestic flights to Delhi and Mumbai (DPR Raipur, 2013).

Conclusion

Chhattisgarh emerged as a separate state on November 1, 2000, which led to increased urbanisation for Raipur, the capital city. The demographic features and land use successfully reflect the typical dynamic nature of a rural-urban fringe. The correlation analysis has proven a negative and a positive relationship with distance and other variables of fringe area. In this case, it has been observed that the rate of change of different parameters is less between 1991 and 2001, in comparison to that between 2001 and 2011. In fact, on November 1, 2000, Chhattisgarh emerged as a separate state, so after 2000, the urbanisation of Raipur, the capital of Chhattisgarh, would naturally increase much more.

Raipur city and its fringe region hold paramount importance from various perspectives, making it a key regional, industrial, and locational hub. Regionally, Raipur serves as Chhattisgarh's administrative and economic epicentre, pivotal in the state's growth and development. The city's strategic location in central India enhances its connectivity, serving as a crucial transit point for trade and commerce. Industrially, Raipur is renowned for its steel and power industries, contributing significantly to the nation's industrial landscape. The city's proximity to mineral-rich regions has attracted major industrial investments, fostering economic growth and employment opportunities. From a locational standpoint, Raipur's position on the Howrah-Mumbai railway line and the National Highway 6 further bolsters its significance as a transportation and logistics hub, facilitating the seamless movement of goods and people. Raipur's multifaceted importance underscores its role as a vital player in the regional and national socio-economic landscape. Looking at all these facts, it becomes unequivocally evident that Raipur city is poised for an exponential surge in urbanisation in the imminent future. Consequently, in fostering sustainable urban development, the fringe area of Raipur city assumes a crucial significance.

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