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CORRELATION OF GEOMORPHIC ATTRIBUTES WITH URBANIZATION PROBLEMS: A CASE STUDY OF RANCHI CITY

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ABSTRACT

The present study throws light on the problems arising out of the neglect of geomorphic parameters in the urbanization of Ranchi city. It aims to investigate Ranchi city's lithological as well as topographical characteristics, geomorphic processes and hydrological conditions which determine the size and rate of urbanization and sustainability of the urbanized localities. It is the geographical features which determine the impact of urban development on the environment and geo-environmental problems emanating there from. In fact, the urban centers of Ranchi city are facing a number of problems due to the rising populations, ecological anti use of city resources and haphazard urban growth. In this city area the experiences of urban life shared by its city dwellers are different from those of living in other capitals of Indian states, at the same time many problems are the same. They describe various kinds of problems like shortage of housing, drainage, sewerage, environmental crisis, ground water crisis, suitable sites for locational set-up, relief aspect, urban settlement, use of solid geology in building materials and housing, road building, anthropological effects on urban metabolism etc. The study of correlation of geomorphic attributes with urbanization problems in Ranchi city evaluates various problems related to geomorphic, climatic and hydrological conditions and suggests solutions for the sustainability of this plateau city. The paper is based on available literature, personal surveys and primary as well as secondary data.



KEYWORDS- Lithological * Topographical * Geomorphic Processes * Geo-environmental * Environmental crisis * Urban metabolism * Geomorphic attributes.

ACRONYMS:

BAU	Birsa Agricultural University
DTO	District Transport Officer
JSPCB	Jharkhand State Pollution Control Board
IMD	India Meteorological Department
LULC	Land-Use Land-Cover
MSL	Mean Sea Level
NCDC	National Climatic Data Centre
RUA	Ranchi Urban Area
RMC	Ranchi Municipal Corporation

RRDA Ranchi Regional Development Authority

1. INTRODUCTION

Ranchi city is the capital of Jharkhand state of India. Geomorphically the structure of land - lithological and topographic characteristics, geomorphic processes, hydrological conditions, fragile zones, uneven slope as well as land forms are facing organizational implications. The region is underlain by Chotanagpur gneiss-granulite complex of Precambrian age (Ghose et al. 1973). The topography of the city is characterized by an undulating surface with hard sub soil. The landscape of Ranchi is seen with several hills and irregular pattern of roads, lanes and unplanned areas. The average slope of Ranchi city is 10 to 20 meters over kilometers.

Ranchi city enjoys good communication links of roads, railways and aviation. But the city area is being distracted. The different areas of the city are highly affected by the pattern of traffic and haphazard housing system, supply of drinking water, sewerage system, drainage system and garbage disposal system. The texture and topography of the whole land are gradually changing due to urban growth, pressure of population as well as by industrialization. Above all this plateau city which was called a hill station three decades ago is now facing several problems of urbanization and simply it does not have any strong and practical policy to get benefit of its geomorphic attributes. Ranchi district Gazetteer, 1970 stated, "The climate of Ranchi is cool and pleasant". But now it faces Urban Heat Island phenomena especially during the summer season. The general elevation of the study area ranges from 620 to 660 m above mean sea level (MSL). So the climate of Ranchi is healthy and comfortable even today. The annual average temperature is about 24°C. The annual average rainfall varies from 1,400 mm to 1,600 mm. Ranchi Plateau (23°27' North and 85°20' East) is at an elevation of 600-700 meters above M.S.L. This city is situated almost in the center of the Ranchi Plateau. The landform of Ranchi is characterized by undulating surface with several hills and irregular pattern of roads, lanes and unplanned areas. The average slope of Ranchi city is 10 to 20 meters over kilometers. Two big reservoirs viz Kanke Dam and Dhurwa Dam are located in the north-western and south-western corner of Ranchi city. These reservoirs are used for water supply in Ranchi Urban Area (RUA). The Subarnrekha River originates at Nagri, about 25 km south from the centre of Ranchi city. In terms of discharge it is one of the significant peninsular

rivers of eastern India. This river's winding thin course flows through the eastern part of Ranchi city. The Subarnrekha River with one of its tributaries like Harmu provides drainage pattern mainly of dendritic in nature. From north to south, the different nallas as well as rivers crossing across the urban area are Jumar Nadi, Potpoto Nadi, Pandra Nadi, Harmu Nadi, Dibdih Naala, the naala at Hinoo Nadi and the Subarnarekha River near Hatia. Excluding the above naalas/rivers, the rest of them flow west to east. Previously these streams were carrying clear water. They were perennial in nature; though there was variation in discharges between lean and flush periods. Presently these streams are carrying a lot of sewage discharges from the city area. At many places their courses have been encroached. The obstructing flow during the monsoon season is enough to create various geo-environmental crises in the city.

The conversion of land to urban uses viz. land use land cover (LULC) involves considerable modification of the natural environmental system. It changes geological, geomorphological bases and hydrological characteristics of the urban area. The nature of the boundary layer of the atmosphere too receives modifications. In the circumstances of Ranchi city such modifications are creating situations which are simply hazardous. These changes profoundly influence the quality of life for urban dwellers. Ranchi, a leading Centre of Socio-Cultural activity and a Class-I City in Jharkhand, is among the fastest growing cities in India. However, the city at present needs to short out its multidimensional issues facing the urban problems as well as challenges which are hampering its prospects.

2. OBJECTIVES:

The Specific objectives of the present study are as follows:

- ✦ To find out the problems arising out of the neglect of geomorphic parameters in the urbanization of Ranchi city.
- ✦ To find out the correlation of geomorphic attributes with urbanization problems in Ranchi city area.

- ✦ To analyze the geomorphic, environmental and geo-environmental shortcomings of the city.
- ✦ To point out as well as suggest the path of solution for the sustainability of Ranchi city.

3. MATERIAL AND METHODOLOGY:

Various studies have been done in different corners in the light of geomorphic attributes and urbanization problems of cities. A few of them have taken focus partly on the same of the Ranchi city. There isn't any known proper studies' regarding the correlation of geomorphic attributes and urbanization problems in Ranchi city. The present study wants to investigate the factors for suitable findings. Therefore, the present paper is based not only on empirical observations but also on the author's detailed micro level survey. Both primary and secondary data have been used to analyze the matters. Relevant information as well as data has also been obtained from RRDA, RMC, IMD, NCDC, Directorate of Census operations of Jharkhand State, Meteorological Department of BAU, JSPCB, DTO of Ranchi and Ministry of Urban Development of Jharkhand State.

4. STUDY AREA:

The study area (Fig.), Ranchi city, is located between 85° 13' to 85° 25'E and 23° 13' to 23° 26' N. Its municipal area is 175.12 km² and the latitude and longitude of city center are 23°22'N; 85°20'E. This city was made summer capital of Bihar in 1912 for its cozy and wholesome climate. From November 2001 Ranchi is the capital of Jharkhand state of India. One of the oldest towns in India, Ranchi, has been the district headquarters since 1843. The human population of Ranchi city in 1971 was 2, 55,551. Within 40 years it became 11, 20,374 persons in 2011. It was an addition of nearly 9 lakh people (Directorate of Census Operations, Jharkhand). Therefore, the morphological characteristics of this urban area are severely affected due to its industrial center and habitation of more than a million people of various cultural backgrounds. Unplanned accelerated growth of the city has created several geomorphic, geo-environmental and environmental problems in the city.

5. DISCUSSIONS AND RESULT:

Geomorphology has a remarkable influence on our lives especially in the era of today's rapid urbanization. It has been important for all creatures since the beginning billions of years ago. The environment, geo-environment, productivity of soils, its mineral composition, the capacity to store water- all depend upon the geomorphic aspect. Geomorphology also determines the shape of the landscape before being disturbed by humans. It is the shape of the land that has determined the distribution of human populations throughout our history. But the texture and topography of the whole land are gradually changing due to urban growth, pressure of population as well as by industrialization. In this light as far as Ranchi city is concerned the different areas of the city are highly affected mainly by the industrial pollution, pattern of traffic and haphazard housing system, supply of drinking water, sewerage system, drainage system and garbage disposal system. The conversion of land to urban uses has involved considerable modification of the natural environmental system. It is changing not only the geological and geomorphological bases of the city but also its hydrological characteristics. In Ranchi city the nature of the boundary layer of the atmosphere has started to receive modifications from almost three decades. In this plateau city such modifications are creating situations which are simply hazardous. These changes are profoundly influencing the quality of life for urban dwellers. In Ranchi city the dimensions of continuous urbanization, geomorphic aspect and urbanization problems are correlated due to the following factors:

5.1 Dimensions of Urbanization and Geomorphic Aspect:

The productivity of soils, its mineral composition, the capacity to store water- all depend upon the geomorphic aspect. The urbanization of Ranchi city Ranchi city.

5.1.1 Nature of Topography: The nature of the topography of Ranchi city is undulating. This city is located at the Ranchi Plateau which is a tabled plateau suitable for settlements. The land of the city was subjected to a phase of denudation. Geomorphologically it is a peneplain having some residual hill rocks. This geomorphic attribute have been an attraction for settlements from prehistoric age. The general ground elevation ranges from 596 to 700 above mean sea level with the regional slope of the area towards east.

5.1.2 Relief Aspect and Urban Growth: Ranchi is located at Ranchi plateau which resembles a tableland that

slopes away in all sides except in the west (Fig.). The 615 meter contour fixes the plateau limit on three sides. The profile shows a peneplained surface with a north to south warping. In RUA hummocky boulders or tors break the monotony of undulating uplands and lowlands. These are locally known as tanr and don. The tanr and the dons with beautiful flights of terraced fields lay over the latter. But the growing nature of Ranchi city has been altering the topography of the region by the super imposition of the urban profile. In fact the relief isn't a hindrance to urban growth at the major area of the region but the haphazard settlement is creating geomorphic crisis. A scientific mega Master plan can lessen their geomorphic hazards.

5.1.3 Natural Drainage Pattern: Sustainable urbanization as well as urban growth needs proper drainage. The undulating topographical features of Ranchi city are facilitating proper natural drainage throughout the city. The urban area is sloping away in all four directions more or less from the center, but it goes down towards the east. The geomorphic feature suits for drainage through rivers and its tributaries; even then there is a lack or almost absence of proper sewerage system due to rapid and unsustainable urbanization and urban growth.

5.1.4 Hills, Rocks, Minerals and Quality of Soil: The area underlain by schistose rocks is having more deep red soil than those of granite rocks due to the dominance of minerals, particularly garnet. The quality of soil attributes agricultural yields. So Ranchi is suitable for vegetation also. But the urbanization as well as the land pollution is crushing the quality of soil which is alarming at various parts of the city here. As far as minerals are concerned in ancient days rocks and minerals played the important role for the earlier settlements. That is why the primitive tribes like Asur and Birhors were attracted towards this region as their principal occupation was to extract iron ore for iron smelting from the laterite rocks present in this state. The early beginning of the use of iron in this region was initially noted in the late Chalcolithic cultural phase.

5.2 Aquifers and Availability of Water:

The Precambrian suite of rocks in RUA exhibits heterogeneity in structure, texture and mineral composition (B. N. Jha and A. N. Sarkar, 1985). Perhaps the most essential ingredient to any viable civilization is access to water. Ranchi urban area (257 km²) depends on aquifers for 30 % of its total drinking-water supply that is 17 million m³ per year. In Ranchi city ground water occurs under unconfined condition in phreatic aquifer, consisting of weathered mantle and saporolite zones. It is available in confined to semi- confined conditions in deep seated fractures in the consolidated formation. Weathered zone thickness varies between 5.50 m to 37 m bgl.

Ranchi city has been facing the problem of ground water availability due to rapid urbanization coupled with the presence of hard rock strata. For sustainable urbanization artificial recharge may be one of the solutions in future as the growing population requires more water. Therefore, more storage is required to conserve water for use in the time of shortage. During 2001 – 2010, the rate of built-up growth (30 %) and population growth (32.6 %) enhanced the pressure over existing ground water resources. The hard rock formations and increasing urbanization in Ranchi city has retarded ground water recharge. The exploration, exploitation, and unscientific management of ground water resources in the capital of Jharkhand have posed a serious threat of reduction not only in quantity but also deterioration in quality. Further, urban discharge also substantially degrades surface water as well as ground water quality (Mapani 2005; Held et al. 2007). Heavy population blasts and unscientific constructions in the city have created circumstances of urban crisis.

5.3 Local Weather Conditions:

Ranchi's local weather conditions have been favorable for human settlements. Its salubrious climate with moderate summer and bracing winter suits even today for urbanization. Ranchi represents a sub-tropical climate. The local weather conditions of Ranchi area are important in determining the geomorphic attributes:

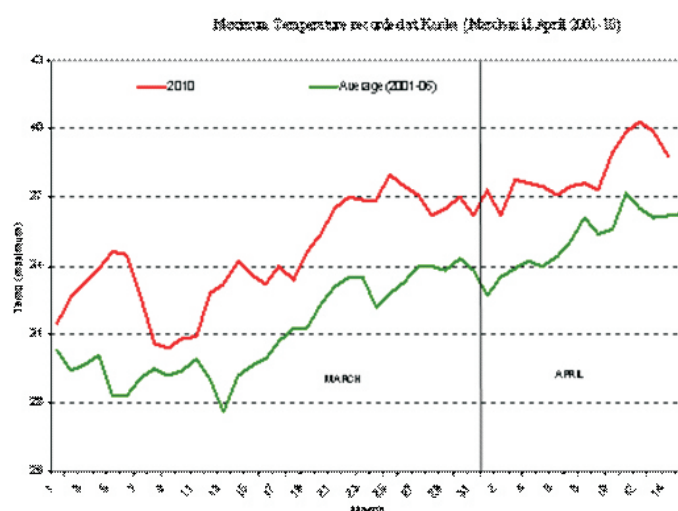
5.3.1 Temperature: The temperature of Ranchi city (40 C- to 44.40 C) has been an attribute to urbanization. The maximum temperature in 2005 and 2010 have been recorded 38.8°C in the month of May and 42.42° C in the month of April, 2010 whereas the minimum temperature was 6.3 °C in the month of January 2005 and 4.56°C in the month of January, 2010 (table 6).

Table 1: Mean Monthly Temperature of Ranchi (2005 & 2010)

Months	Maximum $^{\circ}\text{C}$		Minimum $^{\circ}\text{C}$		Mean $^{\circ}\text{C}$	
	2005	2010	2005	2010	2005	2010
January	22.3	15.58	8.6	4.56	15.45	11.57
February	26.4	26.57	11.7	10.47	19.5	18.52
3 March	31.9	34.09	15.5	14.97	23.7	24.53
April	35.8	42.42	19.8	19.79	27.8	31.11
May	38.8	36.47	22.0	26.15	30.05	31.31
June	37.5	25.96	24.3	24.51	30.9	30.24
July	28.9	28.43	23.0	23.94	26.2	26.19
August	29.4	30.34	23.0	22.68	26.2	26.57
September	29.3	29.8	22.0	20.74	25.75	25.27
October	28.0	27.85	18.8	16.82	23.4	22.34
November	25.7	27.11	9.3	15.84	17.5	21.48
December	23.4	22.1	6.3	6.83	14.85	14.66

Source: Department of Meteorology, BAU, Ranchi

The data shows that Ranchi city is becoming hotter gradually (Figure 1 and Table 1). During the pre-monsoon period temperature goes on steadily falling. The climate of Ranchi city during this period of the year remains far favorable than that of many other hill stations in India.

Figure 1: Maximum Temperature Graph, Kanke, Ranchi City

Source: Department of Meteorology, BAU, Ranchi

The figure-5 shows that the maximum temperature level of Ranchi city is increasing not only because of global warming but also due to developing UHI factor.

Table 2: Ranchi City Long Term Seasonal and Annual Rate of Change in Temperature in degrees (2001-20110)

Sl. No.	Seasons	Maximum Temperature		Minimum Temperature		Mean Temperature	
		LT Change	LT Mean	LT Change	LT Mean	LT Change	LT Mean
01.	Winter	+ 15	24.1	- 0.7	10.8	+0.3	17.5
02.	Summer	+0.6	34.6	- 0.7	20.6	0.0	27.6
03.	Monsoon	+0.5	30.3	- 0.6	22.7	0.0	26.4
04.	Post Monsoon	+1.1	27.2	- 0.2	16.2	+0.4	21.7
05.	Annual	+ 0.8	29.3	- 0.6	18.1	o.1	23.7

Source – Secondary Data

The maximum temperature of Ranchi city gets increase of 0.80 C and in every season there is an increase in temperature. The mean temperature is also becoming higher (Table 2). In surrounding rural area the increase in temperature is in accordance to global warming but in urban area it is due to the developing UHI phenomena.

5.3.2 Rainfall, Atmospheric Pressure and Wind Conditions: The area receives an annual rainfall of 1,377 mm, 85 % of which occurs during monsoon months, from June to September. Atmospheric pressure generally follows the temperature when the temperature increases to a maximum of 37.2 °C in the month of May, the pressure in June decreases to a minimum of 723.4 mbs at 17 hrs. I.S.T. It is very remarkable phenomenon which is clear from the table 3.

Table 3: Atmospheric Pressure and Temperature

<i>Month</i>	<i>Pressurembs At 8hrs.IST</i>	<i>Pressurembs at17hrs.IST temp.(0°C)</i>	<i>Meandaily minimum Temp.</i>	<i>Meandaily maximum temp.</i>
January	732.8	730.8	10.6	23.1
February	731.4	729.8	12.6	25.0
March	730.9	728.7	17.3	36.0
April	730.0	726.6	21.7	35.3
May	726.3	724.3	24.0	37.2
June	724.2	723.4	24.1	33.5
July	722.9	722.4	22.9	29.1
August	722.8	722.4	22.6	28.5
September	725.8	720.9	22.1	29.0
October	731.0	729.5	18.9	28.3
November	734.1	733.2	13.8	25.3
December	738.8	737.2	10.3	22.9

Source: Department of Meteorology, BAU, Ranchi, 2005

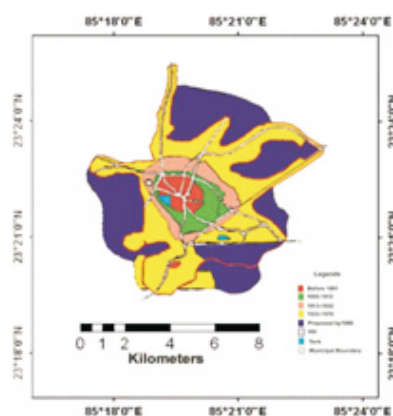
5.4 Physical Expansion and Areal Base for Settlement:

The texture and topography of the whole land are gradually changing due to the super-imposition of the urban profile as well as land-use and land-cover change. Agricultural land is being converted to residential plots and deforestation for residential, commercial or industrial purposes is continued. Ranchi city is located on a plateau which facilitates it to spread easily. The relief, the hillocks, the surface and hills all make it almost suitable and significant for settlement. This is why a 6 sq. km urban nucleus is now thinking to become a mega city of 933 sq. km in this century. Ranchi started as a small city with an area of around 6 sq. km in 1869 and population of approximately 12,000 in 1871 (Figure 2, Table 5). Now it has spread in 257 km² excluding 273.23 km² of urban sprawl (Figure 3, Table 4). Ranchi city has already spread in and around the 85 Km long Ranchi Ring Road. Planning is to develop it into a 933 sq. km² Metropolitan Region (Figure 4). .

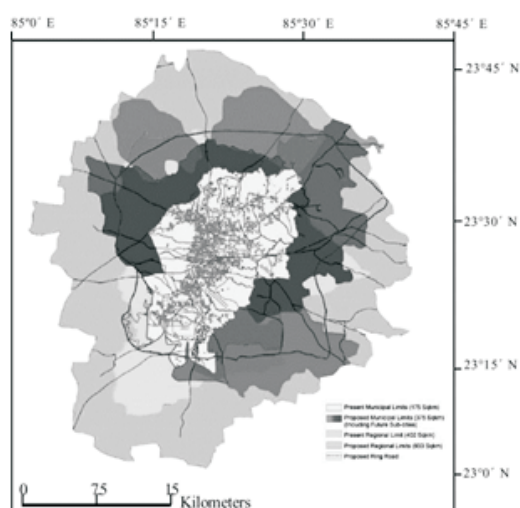
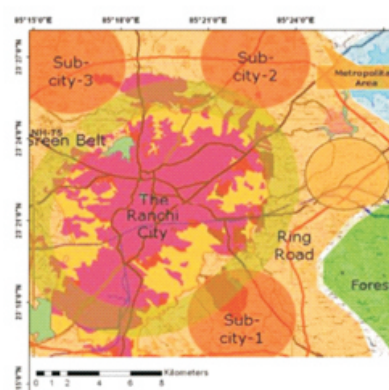
Table 4: Ranchi City: Spatial Growth (1869-2010)

Year	Area (sq. km)	Increase (sq. km)	Growth Per Year	Growth Percent	Time (years)
1869	6.00	-	-	-	-
1965	43.44	37.44	0.38	21.87	96
1985	175.29	131.85	6.60	77.01	20
2004	177.19	1.90	0.10	1.10	19
2010	257 (RMC Area) 273.23 (Urban Sprawl)	89.81 96.04	37.96 29.49	45.04 54.20	6 6

Sources: Secondary Data

Figure 2: Growth of Settlement in Ranchi (1891 - 2001)

Source: Based on RMC Record

Figure 3: Locations and Extent Map of Ranchi City (Future)**a Futuristic Plan****Figure 4: Ranchi Metropolitan Plans,****a Sub City Plan in around Ranchi**

Source: RMC & CPD, 2006

5.5 Population:

The population of Ranchi City has witnessed a continuous and rapid growth in number (Table 1). After 2001 Ranchi city experienced a very high degree of population growth i.e. 51.34 percent. According to Census, 2011 population of this city is 1120,374. Thus during the span of 100 years, Ranchi city witnessed its population size leading to over congestion and heavy pressure on the civic amenities (Table 5).

Table: 5. Ranchi City – Population Growth (1871-2001)

Census	Total Population	Increase in Population	Decadal Growth Rate (%)
1871	12,086	6,357	(+) 52.06
1881	18,443	1,863	(+) 10.01
1891	20,306	5,664	(+) 27.05
1901	25,970	7,024	(+) 27.05
1911	32,994	6,634	(+) 20.11
1921	39,628	10,889	(+) 27.48
1931	50,517	12,045	(+) 23.84
1941	62,562	44,287	(+) 70.79
1951	1,06,849	33,404	(+) 31.26
1961	1,40,253	1,15,294	(+) 82.21
1971	2,55,551	2,34,075	(+) 91.60
1981	4,89,626	1,09,680	(+) 22.40
1991	5,99,306	2,64,148	(+) 41.24
2001	8,63,180	2,57,194	(+) 51.34
2011	11,20,374		

Source: Records of the Directorate of Census operations, Jharkhand.

5.6 Sustainability for Locational Set-up

Ranchi city is experiencing a high rate of urban growth. Hence, the state govt. is planning to include 50 km radius from the center of Ranchi city. The area around and beyond Ramgarh, Bundu, Tamar and Khunti will come under this planning (Fig. 4). The jurisdiction of RMC has been widened to the Ring Road, which is on a 10 km periphery of the main city area. According to CDP & RMC (2006) the break-up percentage of land requirement has been calculated i.e. 40% (residential), 5% (commercial), 10 per cent (Industrial), 5 per cent (institutional), 5 per cent (Community facilities), 3 per cent (utilities and services), 10 per cent (park and open space), 20 per cent (traffic & transport) and 2 per cent (others). The growing city Ranchi needs sub-cities, Capital Sub-city, Ranchi Metropolitan Region and State Capital Region. The new urban planning requires locational setup for solid waste management, water management and proper vegetation to save the geomorphic attributes and urban metabolism for sustainability. .

5.7 Geomorphic Aspect and Morphology of Construction: It is morphology of construction that shapes the settlements and landscape of the city. In Ranchi city Geomorphic aspect of neglected at various places and time which may be pointed out as the following:

5.7.1 Settlement, Geomorphic Process and Geomorphic Solutions: The present study is not only to discover the impact of urbanization on geomorphic base of Ranchi city but also to get their correlations and solutions for futuristic sustainable growth of this urban agglomeration. The principal environmental geological concerns in urban areas include the provision of sufficient drinking water, waste disposal, soil degradation and the increasing vulnerability of densely populated urban areas to get rid of geological hazards and environmental disasters. Urban geomorphology examines the changes caused by the requirements of urban residential, economic and traffic functions. Towns are adjusted to the relief and the relief is also adjusted to the needs of construction and planning (Cooke, R.U., 1976). The changes that occur as a result of urban development are also influenced by their interaction with the disturbed geomorphological process response systems, such as weathering on

building stone resulting from air pollution (Ahnert, F., 1996). Landforms of Ranchi city have played a central role throughout history in the choice of sites for settlements and their further development has often been influenced by the regional geomorphology. However, in the urban environment unsustainable urbanization has supplanted or suppressed natural processes to such an extent that new or modified techniques are necessary to study the deformed system of Ranchi city.

5.7.2 Geomorphic Process, Anthropogeomorphological Process and Implications of Urbanization: Human impact on the environment, and especially on earth's surface is obvious. The study of the way man affects his physical environment is known as Anthropogenic Geomorphology. There is an intimate relation between urban development and Anthropogenic Geomorphology. Human activity and land-use change have left an imprint above and below the land in the form of artificial ground. Above all, according to geographers, urbanization results in profound changes to the geomorphic base, specifically the proliferation of asphalt and concrete, and the displacement of agriculture and forestland. Population growth, industrial expansion and urbanization are, therefore, intimately linked to the direct impact of human activity on the geo-environment of Ranchi city.

5.7.3 Use of Solid Geology and Urban Hazards: The rapid growth of Ranchi city cannot meet the solid construction without the use of solid geology in building material, housing, road and bridge construction etc. So in Ranchi and around the Ranchi city the stone quarrying and crushing industry is growing by leaps and bounds. There is a huge demand for stones of different sizes by the construction sector for buildings roads, bridges etc. Small industries have emerged quarrying large rocks for stone chips. An average of more than 200 trucks of stones per day is used here for various types of constructions. Use of Archeans, the oldest rocks containing Dharwar Charnockites, banded gneissic complex, older metamorphic and basement complex rocks causes deforestation, loss of top soil, air pollution in the form of fine dust generated by the mining and crushing of hard rocks. Fine white and grey dust forms a thin layer in the air and remains there for a longer time. This finally affects human health and also different flora and fauna. Due to quarrying, the top soil has been damaged. Topography and scenario has changed due to digging of open pits and dumping of overburden weathered rock mass in the form of large heaps. To create new areas for quarrying, forests have been removed. In some areas, especially near Tupudana in Ranchi city, there is no trace of the forests.

5.7.4 Geomorphological Effects on Road Building and Urbanization Problems: In terms of major infrastructure and services, the city has metalled road length of more than 346 km and non-metalled road length of about 130 km within the city municipal limits. 85 km long Ring Road has also been constructed around the city. Five highways converge at Ranchi which links the city with many metropolitan cities/towns in all directions. These are Patna-Ranchi Road, Chaibasa-Ranchi Road, Jamshedpur-Ranchi Road, Dhanbad-Purulia -Ranchi Road and Gumla-Lohardaga-Ranchi Road. All the above mentioned highways connect the city with its hinterland and resources, for which Ranchi acts as a gateway for exporting and importing of goods. Ranchi city has multi- urban functions like administrative, commercial and cultural. It provides regional services such as higher education and health facilities. It also has a good number of places of tourist interest in the natural settings of the area. Major contributing sources of pollution in Ranchi city are most predominantly vehicular coupled with industrial and domestic pollution.

5.8 Industrialization and Pollution: Urbanization creates environmental crisis if the urban growth does not follow the parameters of sustainable development. Ranchi city is also facing environmental crisis. Some of them are man-made and some are natural. The study needs to focus on some of them with their geomorphic solutions:

5.8.1 Industrialization: It started in Ranchi with big boost during the post-independence period (1955-1965). Several large scale industries, viz. Heavy Engineering Corporation (HEC), Metalurgical & Engineering Consultants (MECON), Usha Martin, High Tension Insulator Factory, Walpole Industries, and Sri Ram Ball Bearing were established during that period. The emission from Foundry Forge Plant (FFP) of HEC includes smoke, dust, Suspended Particulate Matter (SPM), Reparable Suspended Particulate Matter (RSPM) and many hazardous gases. The second phase of industrialization in Ranchi began after the establishment of Ranchi Industrial Area Development Authority (RIADA) in 1973. About 540 ancillary industrial units were established by RIADA in and around Ranchi. After becoming the capital of Jharkhand state industrialization in this city is faster.

5.8.2 Vehicles and Air Pollution: With increased urban-industrial activities, the number of yearly registration of new vehicles with Ranchi transport office (RTO) is also growing since late 1990s. For the year 1997 it was only

1,735. In 2000 the number of vehicles plying on the roads were 90,000 which rose to 1,03,964 in 2004 (State of the Environment Report, Jharkhand, 2005). New registration of vehicles was only 14,096 in 2010-11 and surprisingly it reached the number of 35828 in 2014-15. Transportation vehicles like car, trucks, buses, two-wheelers, three wheelers are responsible for a significant percentage of criteria pollutants, such as Sulfur Dioxide, Nitrogen Oxide, volatile organic compounds, particulates, Carbon Monoxide and lead. Old vehicles create air pollution crisis more and the percentage of old vehicles in Ranchi city is in majority.

Table 6: Ranchi City: Registered Vehicles (2010-2015)

Types of Vehicles	2010-11	2011-12	2012-13	2013-14	2014-15
Trucks	416	312	277	317	412
Bus	65	72	25	70	86
Private Taxis / Cars	1284	1975	1681	2015	2172
Taxi	172	108	175	198	212
Jeep	472	178	285	318	514
3 Wheeler	972	4375	4542	5272	6382
2 Wheeler	10372	11282	10978	18384	25372
Tractors	342	448	572	384	678
TOTAL	14096	19950	18545	26961	35828

Sources: DTO, Ranchi

Table 7: Environmental Problems of Ranchi

		Level of Problems					
		Low		Medium		High	
	Category	Absolute	Percent	Absolute	Percent	Absolute	Percent
01.	Air Pollution	4	2.68	43	28.86	102	60.46
02.	Water Pollution	26	14.28	46	25.27	110	60.43
03.	Land Degradation	145	56.20	45	17.44	68	26.35
04.	Noise Pollution	75	28.85	95	36.53	90	34.61

Source – JSPCB, Dhurwa, Ranchi

5.8.3 Land Pollution and Degradation: Lack of municipal solid waste (MSW) storage and almost absence of disposal system is a major cause of land pollution. Littering of waste on the streets, footpaths, open spaces and drains is highly harmful because its dust mixes with the air and becomes heat observing particles for UHI factor too. In Ranchi city in slum areas, the problem is aggravated due to complete neglect of MSW collection and transportation system. Land pollution level in Ranchi city is 60.46 percent in high range, 28.86 percent in medium range and 2.68 in low range (Table 8). Land pollution can also result from seepage of contaminated water from open and cultivated fields into the low lying areas. Silt and dirt accumulating from hilly areas to low lying areas as a result of heavy rainfall causes siltation in the low lying areas in Ranchi city. Land degradation level in Ranchi city is 26.35 percent in high range, 17.44 percent in medium range and 56.20 in low range (Table 7).

5.8.4 Solid Waste Combustion: It has also been seen that these toxic wastes are burned in an open area. In fact, burning of solid waste degrades the air quality. These wastes contain large amounts of plastics and medical wastes. The emissions from solid waste combustion include Carbon Monoxide, particulate matter, Nitrogen Oxides, volatile organic compounds, Mercury, Lead, Hydrogen Chloride, and minor amounts of chlorinated dioxins. Low wind speed during these hours further compound the problem.

5.8.5 Water Pollution and Degradation: This municipal waste poses a serious threat to ground water quality. The problem of pollution from landfills is greatest where high rainfall and shallow water tables occur. Ranchi city is bounded by several small rivulets like Harmu River, Jumar River, Potpoto River, etc. These rivers are becoming sites for indiscriminate disposal of municipal, household and industrial wastes which contaminates the city

groundwater. This is particularly true for the Harmu River as the flow of the river is choked with different household and municipal wastes. The water bodies get polluted due to the discharge of effluents from the industries, domestic activities and soil pollution from the nearby dumping sites and agricultural drainage. Due to increasing industrialization and population large quantities of wastes are being generated different forms such as solid, liquid, sludge and gases. Out of which most of it still remain there, which later pile up and chocks cities drainage lines. So the Geological, Geotechnical and Hydrogeological Parameters fall within the environmental category. Water pollution level in Ranchi city is 60.43 percent in high range, 25.27 percent in medium range and 14.28 percent in low range (table 4).

5.8.6 Noise Level and Sound Pollution: The rapid urbanization without proper sustainability has created gathering like situation on the roads and markets. Large number of people and vehicles are seen in public places, markets and on the roads where noise and sound pollution has become inevitable. Noise pollution level in Ranchi city is 34.61 percent in high range, 36.53 percent in medium range and 28.85 percent in low range (table 8).

Table No. 8. : Noise Quality in the Town

Serial No. & Location	Average Noise		Level in db(A)	
	Average Day Noise Level	Standard Limit	Average Night Noise Level	Standard Limit
1, Nowatoli	66	65	45	55
2. Siramtoli	60	65	43	55
3. LalpurChauk	63	65	45	55
4. Upper Bazar	80	65	51	55

Source: RMC & CDP

5.9 Wetland and Shallow Water Body: Bio friendly urbanization requires wetlands within its circumference also. Ranchi city has some significant wetlands i.e. Dhurwa Dam, Getalsud Reservoir, Kanke Dam, Bariyatu Lake, Ranchi Rake besides the three important rivers. The wetlands here regulate the flow of water and nutrients, thereby facilitating optimum functioning of the physical and biological cycles of Nature. In the personal survey of the author it is found that more than 60 ponds and smaller water bodies have vanished in Ranchi city in the last four decades due to unplanned and haphazard urbanization. Ranchi city used to have more than 100 water bodies in the 1970s, but according to a RMC officer and local media only 42 ponds remain in the city area.

5.10 Vegetation, Cultivation and Change in Forest Area: Urbanization cannot be sustainable without proper vegetation. Proper urban growth needs proper vegetation. Forest play very important role in the global carbon cycle and stores about 80% of all above ground and 40% of all below ground terrestrial organic carbon. The most important need for any city for remedy of pollution is proper vegetation. It works as lungs of the city. Ranchi is naturally lucky to have this natural feature, but it is in danger. Decrease in area of cultivation from 21.77 sq. km to 20.24 sq. km, is estimated to be (-) 1.53 sq. km/year with a percentage variation of (-) 7.56%. Forest is the most important part of the region but it is decreasing year by year. It shows negative change. In this study it was found that there is approx. 5% decrease of forest cover from 1997 to 2009, but this change is more from 1997 to 2004 but from year 2004 to 2009 there is slow rate of change because of awareness of environment in people living nearby the forest area. But, there has been increase in Acacia plantation in linear patterns along roads, railways and also airports as it is a noise absorbent tree. It is not enough. In fact, deforestation is anti-mitigation to UHI which is continued in Ranchi city. Deforestation is the first step to disturb geomorphic attributes of the city.

5.11 Geomorphic Degradation and Natural Panorama of Ranchi City: Ranchi lies at an altitude of 640 meter above sea level. It is situated on the eastern edge of the Deccan plateau, which falls on the southern part of Chotanagpur plateau. The hilly topography combined with dense tropical forests is responsible for the mild and moderate climate all-round the year. Blessed with numerous waterfalls and lakes, Ranchi is also known as the

"city of waterfalls". Several varieties of green vegetables are cultivated here. Ranchi is often described as "Vegetable Bowl" of Jharkhand. Since the British Era, Ranchi has been an important center of trade and commerce, especially for sericulture and manufacturing of shellac. It was once regarded as the summer capital of Bihar state before its division. A panoramic view of Ranchi from the top of the Ranchi Hill is something unbelievable. But the urbanization is reducing area of watersheds. Here rivers are leaning and air pollution has become a serious threat. Number of birds are decreasing and increasing the temperature of the city. Haphazard settlement and slums are destroying its natural panorama. Simply geomorphic degradation of the region is threatening the beautiful panorama of the city. The city needs proper vegetation, care and planning at the earliest.

5.12 Urban Metabolism of Ranchi City: Ranchi city is a hybrid of new and old developments. It is common to observe here that new urban areas which have been developed without consideration of urban structures and provision of services are also already settled. It is leading to uncoordinated transport systems, inefficient water/energy supply planning, no waste management plan and even no local economy analysis. This urban context carries out severe problems to the urban environment, related to water supply, urban heat island effect, hotter and colder local climate, floods, droughts, etc. not only at local scale but also at regional level (Olazabal, M., et al., 2008). The urban metabolism of Ranchi city has started to respond in the negative.

6. CONCLUSION:

The present study throws light on the problems arising out of the neglect of geomorphic parameters in the urbanization of Ranchi city. As Ranchi city is expanding more solid surfaces are being sealed by buildings, streets, roads, parking areas, industrial set-ups and commercial activities. Its haphazard growth has created several environmental problems. The texture and topography of the whole land are gradually changing due to pressure of population and industrialization. Use of land and steep slopes for heavy engineering works easily activates ecological degradation. On the one hand the solid constructions are changing the landforms and on the other hand its fine white and grey dust forms a thin layer in the air and remains there for a longer time. This is finally favoring urban heat island phenomena and has started to affect human health as well as different flora and fauna.

Over the last forty years urbanization without caring geomorphic attributes, has left adverse impact on the health of ground and surface water bodies. Due to absence of proper sewerage system the road side open drains receive all sullage water, overflow from septic tanks, soakage pits and raw sewage. This ultimately gets discharged into the rivers. That is causing contamination of water and health hazards. Fluoride in high concentration is found in ground water of southern, western and southwestern zones of the Ranchi city. The water is found to be slightly acidic in nature and high in iron concentration in most of the zones. Many of the small ponds which were main source of water in area are now filled for different construction purposes affecting the water table. Though Ranchi receives sufficient amount of rainfall but it is not an accurate indicator of groundwater level changes. It is because 35% to 40% waste of rainwater in the form of surface runoff. So in Ranchi city rain harvesting is a must to protect its geohydrologic feature. Artificial water reservoirs in suitable areas must be constructed. Ponds, lakes, rivulets and dams need to be cleaned periodically to rejuvenate their storage capacity.

Air in Ranchi city has become highly polluted. The urban metabolism of Ranchi city is weak. It has started to respond in the negative. The unique geomorphic attributes of this area is in crisis. Geomorphology of developed urban growth here suggests that expansion and development of the city should be done in an integrated manner keeping its environmental implications into consideration.

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