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Role of Road Transport Network on Educational Perspective: A Geo-spatial Analysis of District Gonda, Uttar Pradesh

Ashutosh Pathak
Research Scholar,
Deptt. of Geography,
H.N.B. Garhwal University,
Srinagar, Garhwal,
Uttarakhand,India.

V.C. Pandey
Associate Professor & Head,
Deptt. of Geography,
D.B.S. (P.G.) College,
Dehradun, Uttarakhand,India.

Abstract

Road transport network systems play a major role in socio-economic development for any geographical region. Good connectivity of roads brings multiple socio-economic benefits and helps in transformation of the whole locality. Education is one of the most effective socio-economic indicators which also improves the quality of life and further developments in concerned areas. The present research work is aimed to study the impact of road networks on education indices as a parameter of socio-economic development. In order to implement our study, the spatial data are collected using ArcGIS software i.e. calculated block-wise road densities in all the sixteen blocks of district Gonda, which are further used as primary inputs. Impacts of road densities on the educational parameters are subsequently analyzed through linear diagrams and statistical methods in all the blocks of district. At primary stage, a set of linear diagrams are implemented with the help of MS Excel; which shows a positive relationship between block-wise road densities (R.D.) and their respective educational parameters. Further, statistical analysis like correlation and simple linear regression tests have also been carried out through SPSS software, to justify these aforesaid positive relationships. The present paper envisions the relationship between road networks and their educational perspectives in all the sixteen blocks of district Gonda, Uttar Pradesh.

Keywords: Road-Network, Road Density, Education Indices, Rural Areas, Block-Wise Variation.

Introduction

The road transport means carrying of goods and passengers through road. Roads play a crucial role in transportation for short, medium as well as long distances. This is well known that road is one of most important infrastructural component and a key factor for all type of socio-economic development. Without proper connectivity of road network the basic necessities like health, education, employment, income and other services etc. mutate into limited approach. The poor road conditions create a big barrier to social and economic development at various levels i.e. local as well as national.

Since long most of the rural areas of the country India faces the problem of good road connectivity. The district Gonda of Uttar Pradesh also lies among such areas that face poor road conditions and low accessibility.

The present work is a geo-spatial analysis of road networks in the study area and foresees its impact on the socio-economic development.

To implement our research effectively, road densities are calculated for all the sixteen blocks as ratio of total length of rural roads (km) to total rural area of concerned block.

Education is one of the most effective measures for individual, cultural and social development. It is also an important socio-economic indicator, which extensively influences the quality of living and further development of any area.

In this paper, certain education indices are considered as socio-economic measures. In order to carry out the same, literacy rates as well as literate and illiterate population densities are comprehensively used to

evaluate the impact of road density on the study area. There are sixteen blocks in the district for which three parameters:

1. Male & Female Total Literacy Rate (E_1)
2. Female Literacy Rate (E_2) and
3. Differences between Literates & Illiterates Population Density (E_3) are used as socio-economic indices.

Through diagrams, correlation among road networks (i.e. calculated road densities) and educational parameters (i.e. E_1, E_2 & E_3) in all the sixteen blocks of district has been established and further, the same is meticulously justified using statistical methods.

Review of Literature

Various comprehensive studies have been carried out in India as well as abroad to assess the role of road transport network on socio-economic development. The author has attempted to review the literature related to the present investigation.

1. Lombard and Coetzer (2007) thoroughly discussed the rural road infrastructure in Africa and impact of rural road investment on socio-economic development. They also stressed to estimate the benefits of rural roads transport network on education as well as quality of living.
2. Turkarrahman (2012) extensively studied the relation between education and economic development. He concluded that education and knowledge are key provision to build a prosperous society.
3. Gherghina and Duca (2013) dynamically studied the continuation of education to economic development process for improvement of human development indices. In this paper dependence of education-human development-GDP per capita has been statistically analyzed.
4. Kumar and Sen (2014) have analyzed the role of road transport and development in Gaya region during 1980-2010; which established the correlation of road connectivity and accessibility with socio-economic development.
5. E. Tsikai (2016) critically studied the issue surrounding the transport department of South Africa from 1994-2015. The study has recognized that transport is a crucial catalyst for economic development.
6. Jain and Dhiman (2017) studied and analyzed the role of road transport for economic development in India.

Objectives of the Study

The present research work is aimed to study the role of road transport network on educational perspectives in rural areas of district Gonda. The objectives of current research work are to:

1. Analyze the road network in rural areas of district.
2. Examine the block-wise impact of road networks on educational parameters (E_1, E_2 & E_3).

Working Hypothesis

According to the topic of research and its objectives the considered hypothesis to implement in our study is:

1. At local level, the rural areas having good connectivity of road network will be comparatively in better condition from educational point of view. Therefore, the block-wise values of educational parameters (E_1, E_2 & E_3) may vary according to variation in their road densities (R.D.).

Database and Methodology

This research work is implemented on the basis of primary and secondary data. At primary stage the data (i.e. road densities) are generated from the survey of India's open series map (Toposheet) and satellite imaginary using ArcGIS 9.3 tool. Further, the required information are collected and updated through the analysis of field survey and observations as well as secondary sources. Secondary data is collected from local government bodies like Public Works Department (PWD), Rural Engineering Services (RES), Zila Panchayat, Mandi Parishad, etc. as well as national level agencies like Ministry of Road Transport & Highways and Office of the Registrar General & Census Commissioner under Ministry of Home Affairs, Government of India. According to requirement, facts and figures have been correlated through various graphical and statistical methods using MS-Excel and SPSS tools. Maps and diagrams are used for effective implementation and quality of this research work.

Study Area

Gonda district is concerned with Devipatan division and situated in north-eastern part of Uttar Pradesh, India. It is the district headquarter and also an administrative center of its division. The district lies between latitude and longitude extension in 26º47' to 27º20' north and 81º30' to 82º46' east. Total area of the district is 4003 square kilometer (as per census 2011) and average elevation is about 100 meters above sea level. The district area belongs to northern plain and considered as a part of Tarai region of Himalaya. There is no mountain, plateau or desert in the district; it is merely a plain area and has Monsoon climate that the country belongs to, in general. It has physical boundaries on two sides; Kuwano River in the north and Ghaghara River in the south. District Balrampur makes its boundary in the north and northeast, whereas some part of this district also touches to Siddharth Nagar district in northeast. In the west, the district is bounded by Bahraich as well as Srawasti in northwest. In the east, Basti district makes its boundary. River Ghaghara separates the Gonda from Faizabad district in south and from Barabanki in south-west. The shape of district is very irregular and seems to be like a cup. The general slope of the district is from west to east, but it is north to south in the western part. There are four tehsils (named as Gonda Sadar, Colonelganj, Mankapur and Tarabganj), sixteen blocks (named as Babhanjot, Belsar, Chhapia, Colonelganj, Haldharmau, Itiyathok, Jhanjhari, Katra Bazar, Mankapur, Mujhana, Nawabganj, Pandri Kripal, Paraspur, Rupaidih, Tarabganj and Wazirganj), 1054 Gram Panchayat (Village Council) and 1821 Rajaswa Gram (Revenue Village) in the district [NIC Gonda, 2013]. In total area of district (4003 square kilometer), 99 percent area is

rural and only 1 percent is urban. About 93.45 % of the population (as per census 2011) of this district lives in rural areas and their livelihood is mainly based on agriculture. Fig.1 (a) & 1 (b) are pie charts that portray the distribution of rural-urban areas and their respective population in the district.

Fig. 1 (a)

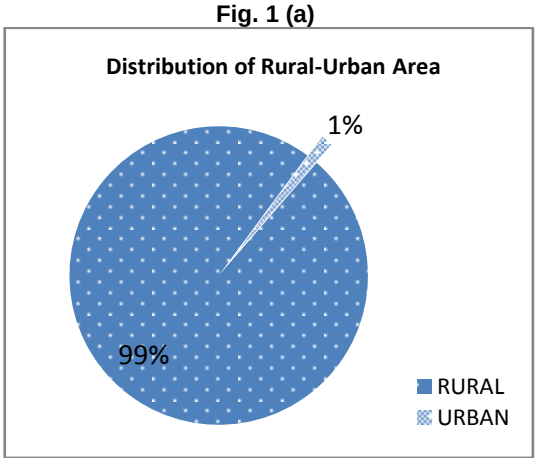
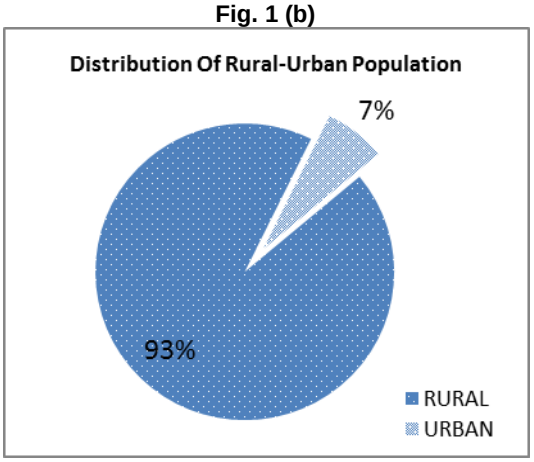


Fig. 1 (b)



The district population characteristics are briefly given in Table- I.

Table-I : Gonda District Population Characteristics at a glance (Census 2011)

Population	Absolute			Percentage		
	Total	Rural	Urban	Total	Rural	Urban
Persons	3,433,919	3,208,890	225,029	100	93.45	6.55
Males	1,787,146	1,669,058	118,088	100	93.39	6.61
Females	1,646,773	1,539,832	106,941	100	93.51	6.49
Density of Population	858	812	4,450	---	---	---
Sex Ratio	921	923	906	---	---	---
Child Population (in age group 0-6 years)	Absolute			Percentage to total population		
	Total	Rural	Urban	Total	Rural	Urban
Persons	572,386	543,982	28,404	16.67	16.95	12.62
Males	297,178	282,320	14,858	16.62	16.91	12.58
Females	275,208	261,662	13,546	16.71	16.99	12.67
Child Sex Ratio	926	927	912	---	---	---
Literates	Absolute			Literacy Rate		
	Total	Rural	Urban	Total	Rural	Urban
Persons	1,679,994	1,529,165	150,829	58.71	57.38	76.71
Males	1,034,181	950,247	83,934	69.41	68.52	81.31
Females	645,813	578,918	66,895	47.09	45.29	71.63

The district is recognized as most undeveloped part of the state. It is categorized as one of the most backward area in view of socio-economic parameters, i.e. education, health, services, industries, etc. Human Development Index of the district is also very low. The district ranks 64th in literacy with 58.7 %, which is lower than the state, average 67.7%. As per census 2011, district Gonda lies in the list of top 100 Infant Mortality Rate and also in top 57 Maternal Mortality Rate districts. In 2006, Ministry of Panchayati Raj named the Gonda as one of the country's 250 most backward districts (out of total 640).

The rural areas of the district are facing the problems of poor road conditions and low accessibility since long. The location map of study area is precisely given in Figure-2.

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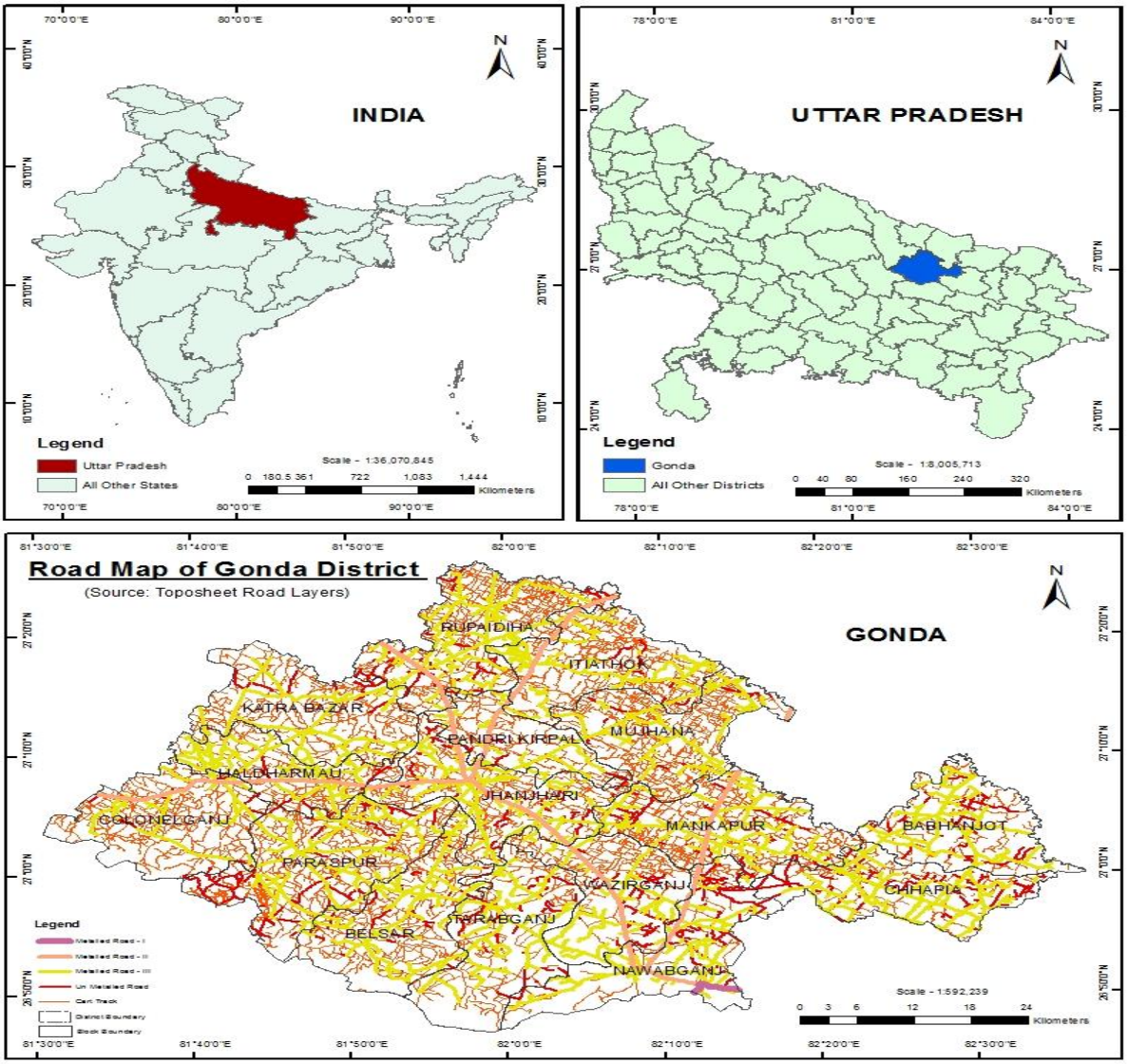
Fig. 2

LOCATION MAP OF STUDY AREA



Implementation

Throughout the district areas, about 8200 km length of roads are digitized from survey of India's open series map (Toposheet) using ArcGIS 9.3 software. The entire digitized road layers are categorized as cart tracks (65%), un-metalled roads (9%) and metalled roads (26%) [Figure-3 (a) refers]. All the categories of road layers are subdivided into their sixteen block boundaries with the help of GIS software i.e. given in Table II. As per survey of India, all the Toposheets related to the study area are updated during 2003-04 and 2006-07 sessions [Appendix-A refers]. Thus, all the digitized road lengths represent the time period of 2003 to 2007. Further, the required information is collected through extensive field survey and observations as well as government and non-government local bodies. According to the field survey and observations, it has been found that the metalled roads represent national highways, state highways, major district roads and some other district level roads of the study area. These are given in the study area road map as a metalled road type-I, II and III respectively. Un-metalled roads are related to other district level roads and some important village level roads while cart-tracks are concerned only with the village roads. These details are also given in the study area road map under Figure-2. It has also been found that most of the un-metalled roads and some cart-tracks are metalled till the present implementation of this research work. According to local government and non-government agencies (i.e. Public Works Department, Rural Engineering Services, Zila Panchayat, Mandi Parishad, etc.), about 4200 km length of roads have been metalled till date in which approximately 79% are village roads, 17% are district level roads and only 4% are state highways [Figure-3(b) refers]. Around 10 km length of road lying under

national highway passes through south-eastern part of the district i.e. Nawabganj block. It is further analyzed that approximately all digitized un-metalled roads (713.64 km) have been metalled along with 33% cart-tracks (i.e. more than 1368.79 km part of village level roads) till 2017.

Figure- 3 (a)

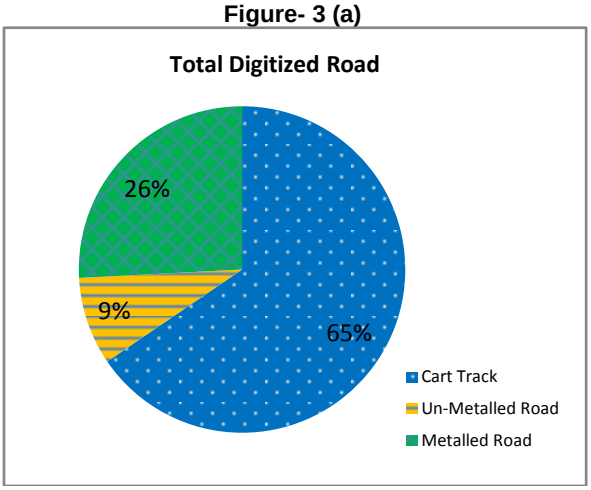
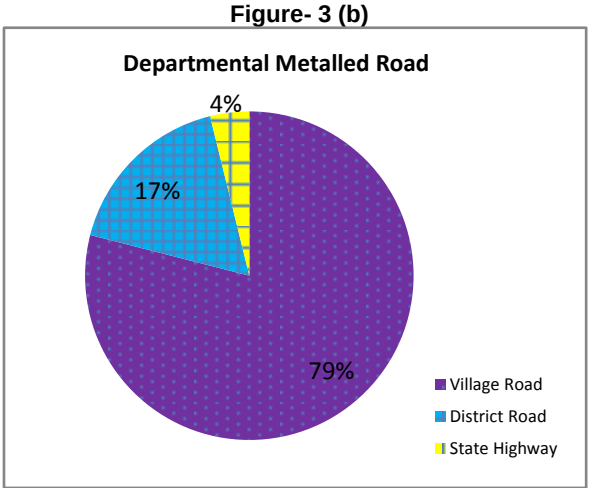


Figure- 3 (b)



The present paper analyzes the effect of road transport network on educational parameters (based on 2011 census data) in all the sixteen blocks of district. Henceforth, it is considered that before 2011, all digitized un-metalled roads were metalled, while some cart-tracks were also metalled. In this present research work, only metalled and un-metalled roads are selected for further implementations. The total length of digitized metalled and un-metalled roads are 2831.21 km, in which 49.18 km length of roads are deducted because of being urban area roads, identified with the help of satellite imaginary. Thus, after deduction of urban area road lengths, 2782.03 km roads (considered as rural roads) are implemented for the findings of this research work. These all-rural roads are distributed into their sixteen block boundaries of the district i.e. given under Table-II. The block-wise lengths of rural roads are used to calculate the road density in rural areas of concerned block with the help of formula:

Block-wise Rural Road Density = Total Length of Rural Roads in the particular Block (km) / Total Rural Area of Concerned Block (Sq km).

If we denote rural road density of the block as 'R.D.', length of rural roads in particular block as 'L' and rural area of the concerned block as 'A', then we can say;

"R.D. = L/A" (km / Sq km)

The rural road density in each block is given under Table-II.

Table –II: Block-wise digitized road details of district Gonda, U.P.

Block Code	Name of Block	Digitized Road length (in Km.)				Metalled & Un-metalled Road Length (b+c)	Urban Areas Road Length in km (d)	Rural Areas Road Length in km (b+c)-(d)	Rural Road Density (km / Sq km)
		Cart- track (a)	Un-metalled Road (b)	Metalled Road (c)	Total Length (a+b+c)				
B_1	Babhanjot	154.52	58.94	120.89	334.35	179.83	0	179.83	0.86
B_2	Belsar	359.92	31.94	140.33	532.19	172.27	0	172.27	0.62
B_3	Chhapia	155.34	83.50	156.86	395.7	240.36	0	240.36	1.16
B_4	Colonelganj	426.38	17.93	86.00	530.31	103.93	6.56	97.37	0.41
B_5	Haldharmau	256.88	18.73	125.88	401.49	144.61	0	144.61	0.81
B_6	Itiyathok	422.17	20.28	140.54	582.99	160.82	0	160.82	0.66
B_7	Jhanjhari	380.84	40.86	170.09	591.79	210.95	30.9	180.05	0.79
B_8	Katra Bazar	399.02	28.34	110.45	537.81	138.79	0	138.79	0.54
B_9	Mankapur	417.91	55.08	165.64	638.63	220.72	6.79	213.93	0.74
B_{10}	Mujehana	506.86	17.82	108.17	632.85	125.99	0	125.99	0.53
B_{11}	Nawabganj	107.54	90.12	154.66	352.32	244.78	3.33	241.45	0.81
B_{12}	Pandri Kripal	177.57	12.70	69.89	260.16	82.59	0	82.59	0.58
B_{13}	Paraspur	582.49	90.71	163.7	836.9	254.41	0	254.41	0.70
B_{14}	Rupaidih	542.29	58.17	173.36	773.82	231.53	1.6	229.93	0.80
B_{15}	Tarabganj	254.92	46.59	113.02	414.53	159.61	0	159.61	0.53
B_{16}	Wazirganj	223.94	41.93	118.09	383.96	160.02	0	160.02	0.73
Total in District		5368.59	713.64	2117.57	8199.8	2831.21	49.18	2782.03	0.70

(**Source**: *Survey of India, represents the period during 2003-2007 sessions)

Table-III elaborates the block-wise rural areas and their respective educational details of all the sixteen blocks in district Gonda. The table also enumerates the block-wise total (male and female) rural literacy (E_1), female rural literacy (E_2), count of rural literates as well as rural illiterates along with their densities and also the differences in terms of LPD-IPD (E_3).

Literate and Literacy Rate

A person aged 7 years and above who can both read and write with understanding in any language is taken as literate. A person who can only read but cannot write is not literate. Literacy rate of the population is defined as the percentage of literates in the age group seven years and above.

Literate Population Density

Literate Population Density is the number of literate Persons inhabited per square kilometer of the area. Block-wise rural literate population density is calculated through following expression:

Literate Population Density (in rural area of block) = Number of literate persons inhabited in the rural areas of a block / Total rural area of the block.

Illiterate Population Density

Illiterate Population Density is the number of illiterate Persons inhabited per square kilometer of the area. Block-wise rural illiterate population density is calculated through following expression:

Illiterate Population Density (in rural area of block) = Number of illiterate persons inhabited in the rural areas of block / Total rural area of the block.

LPD-IPD

The term shows the difference between literate population density and illiterate population density concerned with rural areas of particular blocks. In Table-III, block-wise LPD-IPD values are denoted as E_3.

Table-III: Block-wise rural area and respective educational details of district Gonda

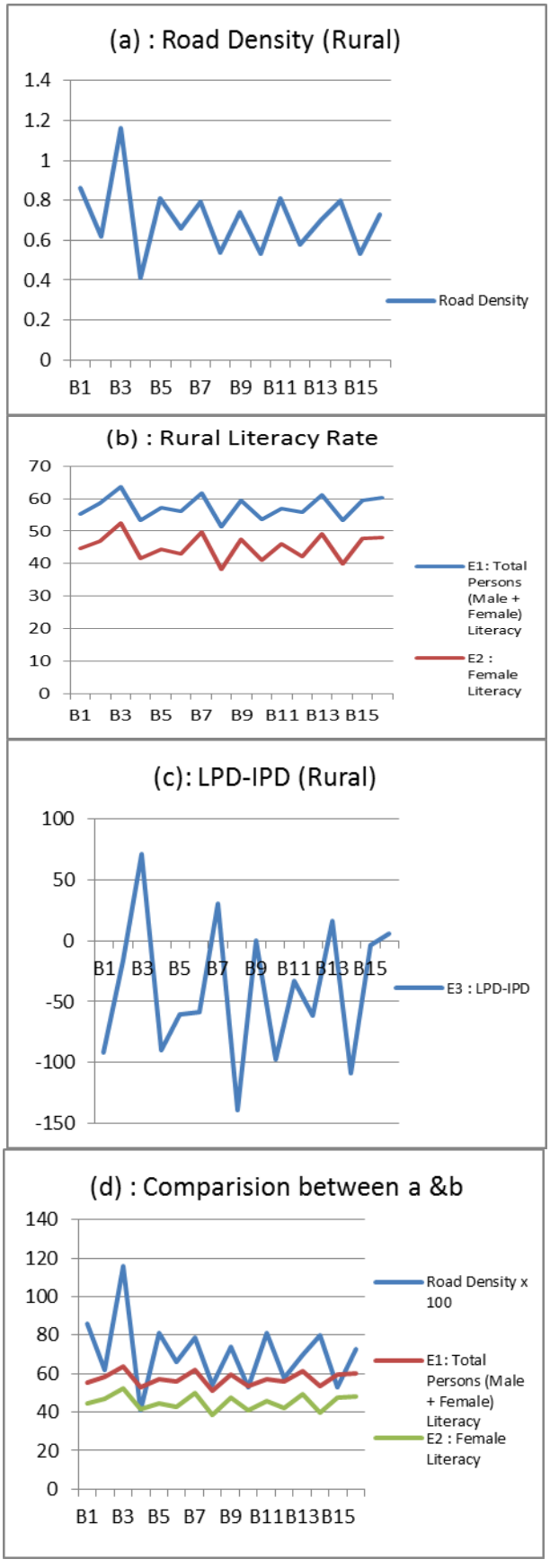
Block Code	Block Name	Rural Area (in Sq km)	Total Literacy Rate (E_1)	Female Literacy Rate (E_2)	Literate Population	Illiterate Population	Literate Population Density (LPD)	Illiterate Population Density (IPD)	LPD-IPD (E_3)
B_1	Babhanjot	209.93	55.19	44.80	97843	117091	466.07	557.76	-91.69
B_2	Belsar	279.75	58.63	46.96	100703	105091	359.98	375.66	-15.68
B_3	Chhapia	206.36	63.55	52.57	102469	87760	496.56	425.28	71.28
B_4	Colonelganj	237.07	53.27	41.49	77977	99323	328.92	418.96	-90.04
B_5	Haldharmau	177.49	57.15	44.41	81655	92314	460.05	520.11	-60.06
B_6	Itiyathok	245.39	56.02	42.94	93576	107861	381.34	439.55	-58.21
B_7	Jhanjhari	228.12	61.77	49.78	118210	111273	518.19	487.78	30.41
B_8	Katra Bazar	255.50	51.28	38.32	88311	123886	345.64	484.88	-139.24
B_9	Mankapur	287.98	59.38	47.38	112492	112376	390.62	390.22	0.40
B_{10}	Mujehana	236.83	53.53	41.02	92391	115342	390.12	487.02	-96.90
B_{11}	Nawabganj	296.34	57.06	45.95	87292	97089	294.57	327.63	-33.06
B_{12}	Pandri Kripal	141.88	55.83	42.26	59861	68601	421.91	483.51	-61.60
B_{13}	Paraspur	361.19	61.16	49.29	130307	124320	360.77	344.20	16.57
B_{14}	Rupaidih	288.62	53.39	39.99	108941	140202	377.46	485.77	-108.31
B_{15}	Tarabganj	298.91	59.59	47.72	84285	85492	281.98	286.01	-4.03
B_{16}	Wazirganj	217.84	60.32	47.98	92852	91704	426.24	420.97	5.27
Total Rural		3969.2	57.38	45.29	1529165	1679725	385.26	423.19	-37.93

(**Source**: Census-2011)

From Table-I, it is explicit that 58.71% population is literate in the district Gonda. The literacy rates are 76.71% and 57.38% in urban and rural areas respectively. The male literacy is comparatively high (69.41%) against female literacy (47.09%) creating a gap of 22.32%. In urban areas, 81.31% males are literate against 71.63% females with the gap of 9.68%. On the other hand, male literacy rate in rural areas (68.52%) is also very high in comparison to female literacy rate (45.29%) showing a wide gap of 23.23%.

If block-wise data is observed (Table-III), it has been found that Chhapia (B_3) block has highest literacy rate (63.55%) and Katra Bazar (B_8) has lowest (51.28%). These blocks also conform to female literacy rate accordingly as 52.57% and 38.32% in Chhapia and Katra Bazar respectively. Further, there are wide variations in male and female literacy rates among all the sixteen blocks. The block Pandri Kripal (B_{12}) shows the highest gap (25.74%) whereas the Babhanjot (B_1) shows the lowest (20.32%).

E_3 value for the Chhapia (B_3) block is highest i.e. 71.28 followed by Jhanjhari (B_7) i.e. 30.41 and Paraspur (B_{13}) i.e. 16.57 while Katra Bazar (B_8), Rupaidih (B_{14}) and Mujehana (B_{10}) depict lowest three values of E_3 i.e. -139.24, -108.31 and -96.90 respectively.



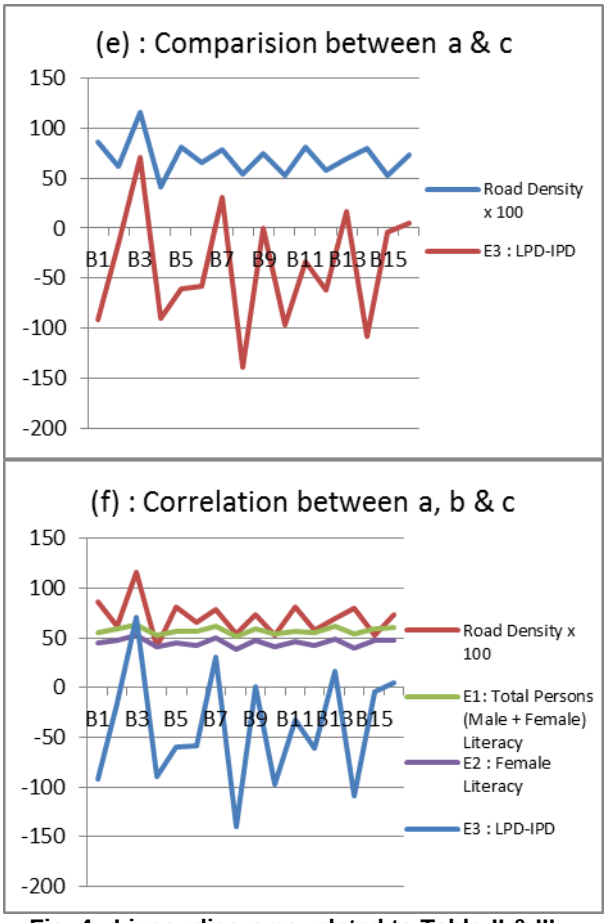


Fig. 4: Linear diagrams related to Table-II & III

The Figures 4 (a) to 4 (f) is a set of linear diagrams related to Tables-II and III. Fig. 4 (a) represents metaled road density in the rural areas of sixteen blocks i.e. concerned with Table-II while Fig. 4 (b) & 4 (c) are related to Table-III which represent the educational parameters E_1, E_2 and E_3 of all the sixteen blocks. E_1 is total (male and female) literacy rate, E_2 is the female literacy rate whereas E_3 is the difference of literate and illiterate population densities i.e. living in rural areas of their respective blocks. Fig.4 (d), 4 (e) & 4 (f) illustrate the correlation between Fig. 4 (a) & 4 (b), Fig. 4 (a) & 4 (c) and Fig. 4 (a), 4 (b) & 4 (c) respectively. All the figures represent the values for sixteen blocks distributed in block-wise alphanumeric sequence B_1 to B_{16} respectively. Each linear diagram shows block-wise variation in their values and portrays the uphill and downhill trends.

Fig. 4 (a) represents the values of block-wise road densities (R.D.) which varies from 0.41 to 1.16.

The road density values of nine blocks B_3, B_1, B_5, B_{11}, B_{14}, B_7, B_9, B_{16} and B_{13} are in descending order showing uphill trends with respect to their proximate blocks. The road densities in seven blocks B_4, B_{10}, B_{15}, B_8, B_{12}, B_2 and B_6 are in ascending order showing downhill trends to their proximate blocks. The Fig. 4 (b) illustrates the total rural literacy (E_1) and female rural literacy (E_2) among all the sixteen

blocks in which values of E_1 and E_2 vary from 51.28 to 63.55 and 38.32 to 52.52 respectively.

Fig. 4 (c) shows the block-wise difference of literate population density and illiterate population density (LPD-IPD) i.e. E_3. These values are distributed among -139.24 to 71.28.

Fig. 4 (b) represents the block-wise values of educational parameters E_1 & E_2. The block-wise values of E_1 portray uphill trends for B_3, B_7, B_{13}, B_{16}, B_{15}, B_9, B_2, B_5, B_{11} in descending order and downhill trends for B_8, B_4, B_{14}, B_{10}, B_1, B_{12}, B_6 in ascending order. The block-wise values of E_2 show uphill trend for B_3, B_7, B_{13}, B_{16}, B_{15}, B_9, B_2, B_{11}, B_5 in descending order and downhill trend for B_8, B_{14}, B_{10}, B_4, B_{12}, B_6, B_1 in ascending order.

Fig. 4 (c) shows the block-wise values of educational parameter E_3. These values show uphill trend for B_3, B_7, B_{13}, B_{16}, B_{15}, B_9, B_2, B_{11} and B_5 in descending order as well as downhill trend for B_8, B_{14}, B_{10}, B_1, B_4 and B_{12} in ascending order.

In Figures 4 (b) & 4 (c), block values of E_1, E_2 and E_3 majorly follow their uphill and downhill trends as well as sequence implying strong relationship among them.

If the values of E_1, E_2 and E_3 are analyzed with block-wise road densities (R.D.), it becomes explicit that about 75% (i.e. about three-fourth) R.D. values follow former uphill and downhill trends. However, the sequence (ascending/descending) does not follow the order of E_1, E_2 and E_3. Therefore, it appears that there is a relationship between road density (R.D.) and educational parameters E_1, E_2 and E_3 which are illustrated in Figures 4 (d), 4 (e) and 4 (f).

If we compare the block values of E_1, E_2 and E_3 i.e. Fig. 4 (b) & 4 (c) with block values of Road Density (R.D.) i.e. Fig. 4 (a), we see that the block values are not following the sequence (i.e. higher to lower), while about three-fourth (3/4) block values are following uphill-downhill trends. It seems a relationship between R.D. (road density) and education parameters E_1, E_2, & E_3 i.e. illustrated in Fig. 4 (d), 4 (e) & 4 (f).

Further, statistical analysis has been carried out to justify the relationship between road density (R.D.) and educational parameters E_1, E_2 & E_3.

Statistical Analysis

The road density R.D. is an independent variable whereas educational parameters E_1, E_2 and E_3 are dependent variables. All the variables are continuous and contain the details of sixteen blocks. Before carrying out regression analysis, the relationship between independent and dependent variables are investigated by producing scatterplot (Fig. 5 refers) and calculating the correlation coefficient.

Correlation Test

Figure-5 portrays the strength and direction of linear relationships between E_1, E_2, E_3 and R.D. coefficients. All the correlations coefficients have uphill trend i.e. positive linear relationship. Here E_1, E_2, E_3 are educational parameters (same background) and hence show strong linear relationships among these coefficients while R.D. coefficients (belongs to different background) follows only uphill linear trends. Further, Pearson correlation coefficient test is applied to investigate the correlation level between the independent variable R.D. and dependent variables E_1, E_2 and E_3 respectively.

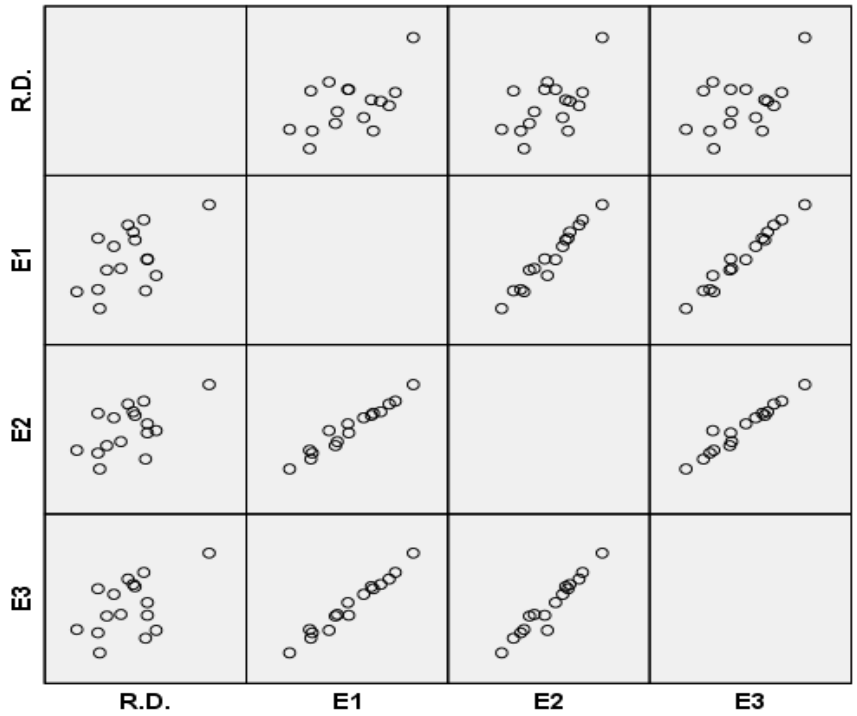


Fig. 5: Matrix Scatter Plot

Table- IV: Pearson's Correlation Test						
		R.D.	**R.D. x 100**	**E_1**	**E_2**	**E_3**
R.D.	Pearson Correlation	1	1.000**	**.555***	**.584***	**.515***
	Sig. (2-tailed)		.000	.026	.017	.041
	N	16	16	16	16	16
R.D. x 100	Pearson Correlation	1.000**	1	**.555***	**.584***	**.515***
	Sig. (2-tailed)	.000		.026	.017	.041
	N	16	16	16	16	16
E_1	Pearson Correlation	**.555***	**.555***	1	.979**	.988**
	Sig. (2-tailed)	.026	.026		.000	.000
	N	16	16	16	16	16
E_2	Pearson Correlation	**.584***	**.584***	.979**	1	.969**
	Sig. (2-tailed)	.017	.017	.000		.000
	N	16	16	16	16	16
E_3	Pearson Correlation	**.515***	**.515***	.988**	.969**	1
	Sig. (2-tailed)	.041	.041	.000	.000	
	N	16	16	16	16	16

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

In Table-IV, Road Density (R.D.) shows more than the half strength of association with E_1, E_2, E_3 and hence represent the correlation coefficient values of 0.555, 0.584 and 0.515 respectively which can interpreted as a moderate positive correlations.

Both the matrix scatterplot and Pearson's correlation co-efficient (r) suggest the moderate positive linear relationship between R.D. (road density) and Education parameters E_1, E_2 and E_3. Therefore, all the above assumptions fulfill the requirement for simple linear regression test.

Simple Linear Regression Test

Simple Linear regression is applied to look for significant relationships between the variables. It is a statistical method that quantifies the relationship between two continuous (quantitative) variables by producing an equation for a straight line of the form Y= α + βX + μ, where 'X' is regarded as the independent variable i.e. predicted the dependent variable 'Y'. Regression involves estimating the values of the gradient 'β' and intercept 'α' of the line that best fits the data.

Output of Regression Analysis between R.D. and E_1, E_2 & E_3 Variables

Model Summary[b] [E_1]				
Model	R	**R Square**	Adjusted R Square	Std. Error of the Estimate
1	.555[a]	**.308**	.259	3.02075

a. Predictors: (Constant), R.D.
b. Dependent Variable: E_1

Model Summary[b] [E_2]				
Model	R	**R Square**	Adjusted R Square	Std. Error of the Estimate
1	.584[a]	**.341**	.294	3.32360

a. Predictors: (Constant), R.D.
b. Dependent Variable: E_2

Model Summary[b] [E_3]				
Model	R	**R Square**	Adjusted R Square	Std. Error of the Estimate
1	.515[a]	**.265**	.212	51.38339

a. Predictors: (Constant), R.D.
b. Dependent Variable: E_3

The model summary tables show the coefficients of determination R^2 values are 0.308, 0.341 & 0.265 for all the regression analyses (E_1, E_2 & E_3) respectively. These values indicate that 30.8%, 34.1% and 26.5% of the variations in dependent variables E_1, E_2 & E_3 can be explained by the independent variable containing R.D. coefficients. These are approximately one-third (for E_1 & E_2) and one-fourth (for E_3) of the total value, so predictions from the regression equations seem reliable. It also means that 69.2% (for E_1), 65.9% (for E_2) and 73.5% (for E_3) of the variations are still unexplained. Therefore, adding other independent variables (like income, awareness, etc.) in each analysis may improve the fit of this model.

ANOVA[a] [E_1]						
	Model	Sum of Squares	df	Mean Square	F	**Sig.**
1	Regression	56.961	1	56.961	6.242	**.026[b]**
	Residual	127.749	14	9.125		
	Total	184.710	15			

a. Dependent Variable: E_1
b. Predictors: (Constant), R.D.

ANOVA[a] [E_2]						
Model		Sum of Squares	df	Mean Square	F	**Sig.**
1	Regression	80.107	1	80.107	7.252	**.017[b]**
	Residual	154.649	14	11.046		
	Total	234.756	15			

a. Dependent Variable: E_2
b. Predictors: (Constant), R.D.

ANOVA[a] [E_3]						
Model		Sum of Squares	df	Mean Square	F	**Sig.**
1	Regression	13319.670	1	13319.670	5.045	**.041[b]**
	Residual	36963.539	14	2640.253		
	Total	50283.208	15			

a. Dependent Variable: E_3
b. Predictors: (Constant), R.D

ANOVA table is an analysis of variance that represents the value of F- statistics and its significant p-value. Significant value 'p' (typically 0.05) is probability of F-statistics i.e. used to test the null

hypothesis H_0. Here ANOVA tables show that the Sig. values are 0.026 (for E_1), 0.017 (for E_2) and 0.041 (for E_3) which are less than 0.05. Therefore, at 5% level of significance in all the given models, the null hypothesis H_0 (i.e. H_0: both the variables of R.D. and E_1, E_2 & E_3 respectively are independent and have non-linear relationships) will be rejected against the hypothesis H_1 (i.e. H_1: R.D. is independent and E_1, E_2 & E_3 are dependent variables and have linear relationships, which represent that block-wise variations in R.D. variables affect block-wise educational parameters). Finally, from this test we conclude that at least one explanatory variable of R.D. has significant linear relationship with response variables of E_1, E_2 & E_3 and the fitted linear models are valid.

Coefficients[a] [E_1]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	**Sig.**
		B	Std. Error	Beta		
1	(Constant)	**49.579**	3.189		15.546	**.000**
	R.D.	**10.990**	4.399	.555	2.498	**.026**

a. Dependent Variable: E_1

Coefficients[a] [E_2]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	**Sig.**
		B	Std. Error	Beta		
1	(Constant)	**35.998**	3.509		10.259	**.000**
	R.D.	**13.033**	4.840	.584	2.693	**.017**

a. Dependent Variable: E_2

Coefficients[a] [E_3]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	**Sig.**
		B	Std. Error	Beta		
1	(Constant)	**-158.057**	54.247		-2.914	**.011**
	R.D.	**168.059**	74.824	.515	2.246	**.041**

a. Dependent Variable: E_3

The 'B' column in all three co-efficient tables give the gradient values β = 10.990 (for E_1), β = 13.033 (for E_2) and β = 168.059 (for E_3) along with their intercept terms α = 49.579 (for E_1) α = 35.998 (for E_2) and α = -158.057 (for E_3) for respective regression lines. Therefore, the equation models are formed as:

E_1 = 49.579 + 10.990 (R.D.),
E_2 = 35.998 + 13.033 (R.D.) and
E_3 = -158.057 + 168.059 (R.D.)

Where E_1, E_2 & E_3 are dependent variables and R.D. is independent Variable. The gradient (β) for all three equations is tested for significance, which p-value is less than 0.05 i.e. p = 0.026 (for E_1), p = 0.017 (for E_2) and p = 0.041 (for E_3) represent that the gradient is not 0. It suggests that there are relationships among independent variable 'R.D.' as well as dependent variables E_1, E_2 & E_3.

Simple linear regression is carried out to investigate the relationship between block wise road densities (R.D.) and block wise education parameters E_1, E_2 and E_3 respectively. The scatter diagram (Fig.5) shows that there is a positive linear relationship between the variables; which is confirmed with Pearson's correlation coefficients. Simple linear regression models also illustrate that there are significant relationships between R.D. & E_1, R.D. & E_2, R.D. & E_3 (i.e. $p < .05$). Therefore, statistical analyses also prove that variations in block-wise road density positively influence the block-wise education levels in this approximation.

Findings

The linear diagrams represent that about three-fourth block-wise educational values E_1, E_2 & E_3 follow uphill-downhill trends of their respective road densities (R.D.); representing a positive relationship among them. The same may further be justified with moderate positive linear relationships in matrix scatterplot and Pearson's correlation co-efficient (r) test. Simple linear regressions also illustrate that there are significant relationships between block-wise road density R.D. and their respective educational levels of E_1, E_2 & E_3 parameters (i.e. $p < 0.05$). The findings in these statistical analyses also prove that variations in block-wise road density positively influence their respective educational levels in the approximation. From above discussion, we can configure that,

$$R.D. \propto E_1, E_2, E_3$$

Therefore, it has been justified from linear diagrams as well as correlation and linear regression analysis that roads have positive influence on the educational level. The blocks having more road networks also show better level of education.

Conclusion

In this paper, educational parameters are considered as socio-economic indices to analyze the impact of road networks in the study area. The implemented methodology and findings fulfill all the requirements of the objectives as well as hypothesis of this work.

As the spatial data (i.e. road density, R.D.) and educational parameters (i.e. E_1, E_2 & E_3) are socio-economic indicators of a particular rural area, the relationship among them may not follow a scientific approach. However, the results of statistical analysis depict a moderate positive correlation between road density and educational parameters.

According to transport research wing, ministry of Road Transport and Highways, Government of India report (August 2012), total surfaced or metaled road density was about 1.03 km/sq. km in rural areas (2010-2011 session) of Uttar Pradesh state while the same has been calculated as 0.7 km/sq. km for Gonda district (Table-II refers) only.

However, from the year 2011 to 2017, approximately 1400 km. new roads have been constructed in Gonda district. Therefore, the increased value of present road density is about 0.97. As the analysis of this paper is based on 2011 census data, the calculated road density of the year 2011 has been taken into account for study of this work.

As per 2011 census data:

1. Gonda district has rural population density of 812 persons per sq. km., which is higher than the state average of rural population 666 persons per sq.km.
2. The district ranks 64th in literacy with 58.7% which is lower than state average 67.7% while rural literacy of the district is 57.38% and state rural literacy is 65.5%.
3. About 77.7% of the total population of the state is living in rural area, while about 93% population of the district is living in rural area.

For Gonda district, following conclusions have been made:

1. Road networks are not comparatively good from state level;
2. Population density is higher than the state average;
3. There is lower literacy rate than the state average;

From the above discussions, it is summarized that the rural areas of district Gonda is facing poor road conditions, low accessibility, high population burden, low literacy rate etc. resulting in poor socio-economic conditions.

Finally, the authors conclude that better road networks help to develop the educational perspectives in rural areas that further improve other socio-economic values of quality livings and create a positive change (direct or indirect) in the society.

Therefore, it is being suggested that more new roads should be built in rural areas of the district that will further improve socio-economic conditions which are vital for rural transformation and sustainable development.

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Appendix-A

***Survey of India's Toposheets details of district Gonda (Scale- 1:50000)**					
S. No.	**Toposheet No. (Open Series Map No.)**	**Implementation (in Period of Time)**			
		Modern Surveyed /Surveyed	**Updated for Major Details**	**Administrative Boundaries Updated**	**1st Edition**
1	G44D11 (63E/11)	1965-66	2003-04	----	2009
2	G44D12 (63E/12)	1965-66	2003-04	2008-09	2010
3	G44D15 (63E/15)	1965-66	2004-05	2008-09	2010
4	G44D16 (63E/16)	1965-66	2005-06	----	2009
5	G44J9 (63F/9)	1991-92	2005-06	2005-06	2011
6	G44J13 (63F/13)	1974-75	2006-07	----	2011
7	G44E3 (63I/3)	1966-67	2003-04	2008-09	2010
8	G44E4 (63I/4)	1966-67	2003-04	2008-09	2010
9	G44E7 (63I/7)	1966-67	2005-06	2008-09	2010
10	G44E8 (63I/8)	1966-67	2005-06	2008-09	2010
11	G44E12 (63I/12)	1966-67	2005-06	----	2010
12	G44K1 (63J/1)	1972-73	2005-06	2008-09	2010
13	G44K5 (63J/5)	1972-73	2006-07	----	2009
14	G44K9 (63J/9)	1972-73	2006-07	2008-09	2010