

# A Study of Correlation and Spatio-Temporal Variation in Literacy Rate and Sex Ratio in Bihar

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**Abstract:** Literacy rate and sex ratio have always been considered to be an important key for socio-economic growth of the study area. In a state like Bihar, where the literacy rate is at its lowest level, people are required to be educated because literate people will have a better understanding of their surroundings, which helps in social and economic improvement. On other side it will ultimately affect the population composition like sex ratio. As compared to nation as a whole, Bihar is having low sex ratio and low literacy rate which reveals its socio-economic backwardness. Among all the natural resources human resources is an important part, which includes, population growth, labor force, skills, working capacity etc., which can be improved by means of increasing the level of literacy. Literacy erases gender biasness, but low literacy does not necessarily imply gender biasness. In fact some of the districts of Bihar with low literacy have healthy sex ratio. Literacy rate and sex ratio are important aspects of demographic studies and indicate the status of the study area. Present paper deals with the spatio-temporal variation in literacy rate and sex ratio as well as their comparative analysis and also tries to understand the impact of literacy rate on the sex ratio by means of Karl Pearson's method of correlation, taking literacy rate as an independent variable. It has been found that there is no correlation between literacy rate and sex ratio in the census year 2001, but in the census year 2011, the value of coefficient of correlation is +0.1454, which indicates that there is a low level of positive correlation between literacy rate and sex ratio. It is also reflected by means of the fact that districts like Gopalganj, Siwan and Saran with very high literacy rate also recorded very high sex ratio. Gopalganj with the highest sex ratio of 1021 females per thousand male recorded very high literacy rate of 65.47 percent which is 3.67 percentage point higher than the literacy rate of Bihar (61.8 percent) in the census year 2011.

**Keywords:** Literacy Rate, Sex ratio, Bihar, Spatio-temporal variation, Population Growth, Coefficient of Correlation, Karl Pearson.

## 1. Introduction

The state of Bihar enjoys an advantage in terms of its location, because of its vast market around it, in eastern and northern part of India. Bihar has got all the access to resources in neighboring states like Jharkhand and Madhya Pradesh, as well as it has got an access to ports like Kolkata and Haldia. According to the economic survey (2019-20) of Bihar, Bihar registered an average growth rate of 10 percent, which is higher than the average growth rate of Bihar in the last three years. The per capita GSDP (Gross State Domestic Product) of Bihar was 47541 at current prices and 33629 at constant prices. ('Bihar's economy registers higher growth than Indian economy in last three years', Amarnath Tiwari, The Hindu, Patna, February 24, 2020) The survey also declared that the fiscal deficit of the state was 2.68% of GSDP, and revenue surplus 1.34% of GSDP, during 2018-19. In spite of this fact Bihar is considered as an agricultural state. About 80 percent of total population of Bihar is involved in agricultural activity, which is much higher than the national average of 41.49% in 2020. Bihar is the fourth largest producer of vegetables and eighth largest producer of fruits in India. Despite this there has been a poor economic growth in Bihar. This is because of systematic exploitation and getting denial from the share of central funds over a longer period of time. Poor economic growth is not due to a particular factor but it is an outcome of several socio-economic and political factors. It is undeniable that Bihar is India's poorest and most backward state and the incidence of poverty is uniformly at the highest (46-70%) in all over state of Bihar. The annual per capita income of Bihar is at Rs. 3650, which is about third of the national average of Rs. 11625. (How Bihar has been economically strangulated, Mohan Guruswamy, National Herald, 12 July, 2020)

In spite of the aforesaid facts, Bihar is the state where majority of the population is illiterate. As per NSO (National Statistical Office) of India, Bihar stands third from the bottom among the states with low literacy rate. Bihar with an overall literacy rate of 70.90 percent is 6.8 percent lower than the national average of 77.7 percent, whereas, Andhra Pradesh was at the bottom with 66.4 percent literacy rate followed by Rajasthan with 69.7%. (Times of India, Faryal Rumi, Sep. 9, 2020.) As per the report of Household Social Consumption Education in India as part of 75<sup>th</sup> round of National Sample Survey from July 2017 to June 2018, the female literacy rate in Bihar stood at 58.7 percent, and it was 75.9% in urban areas, whereas the male literacy rate was obviously higher than female. The male literacy rate in rural Bihar stood at 78.6% and 89.3% in urban areas. The overall rural literacy rate in Bihar was 69.5 percent, whereas it is 83.1 percent in urban areas, among those, who are 7 years and above. The report further says that around 36.4 percent are illiterate and if we see the literate people we find that 19.2 percent are literate up to primary school and 14.3 percent up to middle, 16.5 percent up to secondary, 7.7 percent up to higher secondary and only 6 percent up to graduation and above, which is very less as compared to other states. But one of the important aspect of Bihar is its infant mortality rate, which is 62 per thousand, which is lower than the national average of 66 per thousand. It is also lower than the state like Uttar Pradesh (83), Odisha (91), Andhra Pradesh and Haryana (both 66). In terms of life expectancy, Bihari male lives longer life up to 63.6 years, which is also longer than the average life expectancy of male (62.4 years)

According to 2011 census total population of Bihar is 104099452, of which male are 54278157 and females are 49821295. The total population of Bihar is 8.60 percent of

India in 2011, which was 8.07 percent in 2001. As per census 2011, the sex ratio in Bihar is 918 females per thousand male, which is much less than the national average of 940 females per thousand males. Whereas, the sex ratio was 919 females per thousand male in 2001. There is a decrease of 1 point from the census year 2001 to 2011. Bihar recorded a population growth 25 percent in 2011 as compared to 29 percent in the census year 2001, which is a positive sign towards the growth of population, because there has been an overall decline of 4 percent, but the sex ratio has also declined from 919 in 2001 to 918 in 2011, registered a decline of 1 point.

High level of literacy rate and sex ratio are important indicators of socio-economic development and urbanization of any particular region. Literacy is an important factor which affects the demographic characteristics, concerned with marriage, fertility, mortality, migration as well as participation of labor force. Human development and quality of life are also influenced by literacy rate among people and affects the birth rate and indicates the level of economic development, standard of living, status of women in society as well as technological development. The literacy rate and sex ratio are most significant components of Human Development Index. The area having higher literacy rate and sex ratio would be higher in human development index. Data regarding sex ratio and literacy rate help various type of the developmental planning in the study area. According to Chandana (2002), among the various elements of population composition literacy and sex composition has a great importance in population study. Literacy affects various aspects of population such as fertility, mortality, migration and above all sex ratio.

It has been observed in the patriarchal society of Bihar that the sex ratio remained favorable to women till 1961, except 1931. The state of Bihar remained far behind in terms of development as compared to other states in India. The state of Bihar remained politically neglected for so many decades in spite of rich human and natural resources, before division of Bihar into Jharkhand and Bihar. Bihar remained socially backward in terms of literacy, women empowerment and women autonomy as compared to other states.

This research paper will generate scientific analysis on the basis of correlation carried out by means of statistical technique between literacy rate and sex ratio in Bihar state. Therefore, the result will be helpful for the policy makers to frame programs related to health and education and other developmental programs.

## 2. Study Area

Bihar a landlocked state shares international border, apart from state level boundary. Bihar is located in the eastern part of India and is bounded by Nepal on the north and West Bengal to the east and Uttar Pradesh to the west, whereas, Jharkhand, which was separated from Bihar in Nov. 2000, forms the southern boundary. Bihar is located between 24°20'10" N to 27°31'15" N latitude and 83°19'50" E to 88°17'40" E longitude. Bihar constitutes only 2.68 percent of the total land of India. Bihar comprises 37 districts and Patna is its capital. Bihar has a total area of 94163 sq.km.

The state has been divided by means of Himalayan River Ganga, into two parts, North Bihar plain and South Bihar plain, which forms the part of lower middle Ganga plain. Bihar is embedded with younger geological structure in the northern part and older in the southern part by quaternary rocks. Important rivers like Ghaghra, Gandak, Baghmati, Kosi and Mahanadi along with other rivers flow down from Nepal Himalayas and make their way to river Ganga. Among all these rivers, Kosi is known as sorrow of Bihar, because of destructive flood. The soil consists of mainly older alluvium, composed of dark clay or yellow loam.

Bihar experiences three important seasons, the hot weather season (March to June), rainy season (Mid June to October) and cold weather season (November to February). The coolest month is January whereas the hottest month is May and cold weather season is the most suitable from the point of view of health. Agriculture is the mainstay of economy in Bihar about 79 to 80 percent of its population is engaged in agricultural activities. Agricultural production includes food grain, fruits, vegetables, spices and flowers, which can also be increased by means of improved methods of cultivation and management. In spite of this Bihar is one of the India's top producers of vegetables and fruits. The state has been lagging behind in industrial activity.

It is the third largest state by population after Uttar Pradesh and Maharashtra with a sex ratio of 918 females per thousand males and literacy rate 61.80 as against 74.04 percent in India, in the census year 2011. As per NITI Ayog 2016 report, total fertility rate of Bihar is 3.3 which is higher than India's total fertility rate of 2.3.

Therefore, we can say that the study area i.e., Bihar state stands third from the bottom among all the states with low literacy rate (61.8%) has a negative bearing on the sex ratio, whereas the states which have a higher literacy rate show faster movement towards gender parity. Therefore, lower the literacy rate in the state, lesser is the improvement in sex ratio.

## 3. Objective of the Study

To fulfill the aim of this research paper, this study intended to achieve some objectives, which are as follows:

- 1) To examine and discuss the spatio-temporal distribution and trends of literacy rate and sex ratio (2001 to 2011).
- 2) To evaluate the interacting factors of literacy rate and sex ratio.
- 3) To analyze the correlation between literacy rate and sex ratio and their comparative analysis.
- 4) To study the sex ratio challenges, it's emerging issues and literacy rate.
- 5) To examine the government initiative or policies in improving the sex ratio and literacy rate.

## 4. Database and Methodology

The present study focuses on the spatio-temporal variation in literacy rate and sex ratio as well as their comparative analysis in Bihar state. Therefore, the type of study is descriptive and analytical. Present study is the outcome of secondary sources of data regarding literacy rate and sex

ratio of Bihar, which is obtained from Census Reports, for a period of 2001 and 2011. The collected data are tabulated and calculated to analyze the spatial pattern of literacy and sex ratio in Bihar. The processed data has been represented by means suitable maps, tables and diagrams. The correlation technique has been used to determine the relationship between literacy rate and sex ratio. Therefore, to find out the correlation, Karl Pearson's method of coefficient of correlation has been applied. Karl Pearson's method of correlation evaluates the linear relationship between two variables. It is said to be correlated when two variables are so related that the increase or decrease in one affects the increase and decrease in other. In this study literacy rate has been considered as an independent variable, whereas the sex ratio is dependent variable. The formula applied to calculate the correlation between literacy rate and sex ratio has been given below,

$$r = \frac{\sum dxdy}{N\sigma_x\sigma_y}$$

$$= \frac{\sum dxdy}{N\sqrt{\frac{\sum d_x^2}{N} \times \frac{\sum d_y^2}{N}}} = \frac{\sum dxdy}{N\sqrt{\frac{\sum d_x^2 \times \sum d_y^2}{N \times N}}}$$

$$= \frac{\sum dxdy}{\frac{N}{\sqrt{\sum d_x^2 \times \sum d_y^2}}}$$

**Trends of Literacy Rate and Sex Ratio in India and Bihar and their Comparative Analysis**

Bihar is India's third most populous state with total population of 104099452 after Uttar Pradesh (199812341) and Maharashtra (112374333). The literacy rate in Bihar is 61.8 percent, according to 2011 census and is the country's lowest. Whereas, overall India's literacy rate has increased from 64.84 percent in 2001 to 74.04 percent in 2011, an increase of 9.2 percent during 2001 and 2011. Bihar has more illiterate people than any other state, may be due to crisis in primary education system, although there is an increase of 14.31 percent during 2001 and 2011.

Education is pre-requisite condition for the development of any country. The literacy rate in India is not satisfactory, it presents a figure which is mediocre, and the situation is even worse, when it comes to women literacy rate. Even after seventy years of independence we are lagging behind, in terms of education, as compared to other developed country. According to Purchasing Power Parity (PPP), India is the third largest economy, but the standard of education is in worrisome state. The constitution of India recognizes importance of education, therefore, it ensures education for all, excluding people below 0 to 6 years. Therefore, from 1991, literacy rate were calculated for people above 7 years. To improve the literacy rate, government has taken several steps like, scholarship, mid-day meal scheme, Samagra Shiksha Programme, as well as awareness and campaigns about the importance of education. Apart from this government also provided school uniform, textbooks and stationary, so that students and their parents will be encouraged to take up study. In spite of this fact the literacy level remained very low as compared to other countries.

Main reason behind illiteracy in India and Bihar may be attributed to complex web of social and economic divide in the country. There are several factors, which leads to illiteracy, like economic disparity, caste discrimination and gender discrimination. Apart from this technological barriers also leads to illiteracy in our country. This vicious cycle of illiteracy has been further aggravated by largest number of adults.

Literacy level has been considered as an important indicator for the level of development achieved by any country or state. Higher level of literacy, especially among female, shows an awareness of the society. Apart from this it also leads to improvement in economic and social conditions and acts as a catalyst in upliftment of the society.

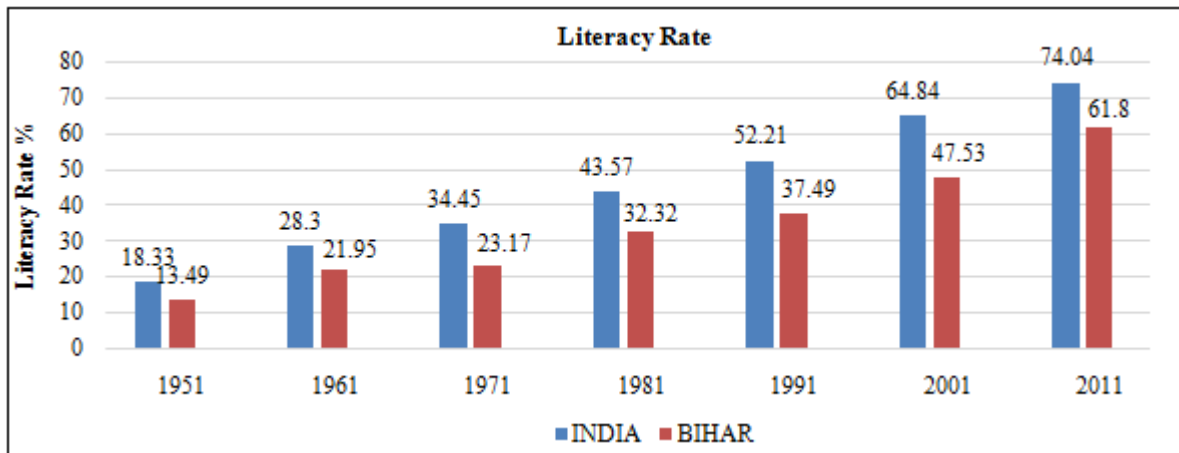
According to table 1, if we see the literacy rate in India, we find that the literacy rate has been steadily increasing from 18.33 percent in 1951 to 74.04 percent in 2011. If we see the decadal trend of literacy rate in India we find that every census year registered an increase of almost 10 percent except census year 1971, when there was an increase of only 6.15 per cent from the previous census year of 1961. If we compare data of literacy of India with Bihar we find that it is far behind the national literacy rate, but it is also encouraging that the literacy rate in Bihar has also been increasing slowly from 13.49 percent in 1951 to 61.8 percent in 2011. This lower literacy rate may be attributed to the fact that the classrooms in Bihar is most crowded but having fewer teachers. Even though, Bihar the sixth poorest state of India spends least money per student, no doubt government of India has also reduced it expenditure from 13 percent in 1999 to 10 per cent in 2010 and from financial year 2015 to financial year 2020, this percentage has dropped from 4.14 percent to 3.4 percent. Therefore the budget allocation towards education in the past has not been chest-thumping.

**Table 1: Literacy Rate and Sex Ratio**

Year	Literacy Rate						Sex Ratio	
	India			Bihar			India	Bihar
	Total	Male	Female	Total	Male	Female		
1951	18.33	27.16	8.86	13.49	22.68	4.22	946	1000
1961	28.3	40.4	15.35	21.95	35.85	8.11	941	1005
1971	34.45	45.96	21.97	23.17	35.86	9.86	930	956
1981	43.57	56.38	29.76	32.32	47.11	16.61	934	948
1991	52.21	64.13	39.29	37.49	51.37	21.99	927	907
2001	64.84	75.26	53.67	47.53	60.32	33.57	933	919
2011	74.04	82.14	65.46	61.8	71.20	51.50	940	918

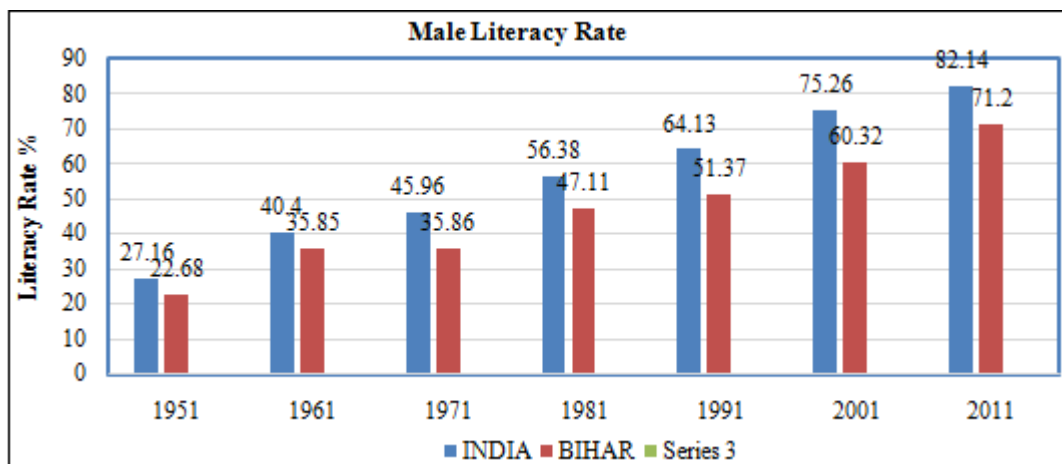
Source: Census Reports

If we go through table 1, we find that the maximum increase in literacy rate in India occurred during 1991 to 2001, with an increase 12.63 percentage points, whereas maximum increase in literacy rate in Bihar occurred during 2001 to 2011, with an increase of 14.27 percentage point. In the year 1951, the literacy rate of India was 18.33, whereas, it was 13.49 in Bihar, which is 4.84 percentage point lesser than the national



literacy rate, and the female literacy rate (4.22 percent) is even worse which is almost half of the national (8.86 percent), whereas, male literacy rate reported somewhat better as compared to female, with a decrease of only 4.48 percentage point as compared to the national male literacy rate in 1951. This low literacy in Bihar as compared to the country as whole, may be due to socio-economic condition and family background. The low level of literacy in 1951 may also be attributed to the system of education given by British, which was highly unproductive. The main aim of Britishers was to provide better education to only those people who would help them in administration, and therefore, they did not pay any attention for the spread of education to other section of the people. Apart from this, Indian languages were neglected and English was the medium of instruction and examination in college and school and there were acute shortage of schools and colleges. Therefore, the people from the downtrodden section of the society did not get any facility or chance to study.

In the year 1961 literacy rate in India increased to 28.3 percent and 21.95 percent in Bihar, with an increase of 9.97 percentage point in India and 8.46 percentage point in Bihar, from the previous decade. Male with a literacy rate of 40.4 percent registered an increase of 13.24 percentage point in India, whereas Bihar registered an increase of 13.17 percentage point, almost similar to national rate of increase in male literacy rate. This increase in level of literacy rate may be attributed to the fact that in 1950, the government of India appointed the planning commission to prepare a blueprint for the development of different aspects of life, which included education too. The main aim of this plan was to achieve universal elementary education and eradicate illiteracy and the most important was to provide facilities for better quality of education in every district of the country. Even in 1947, the government of India also appointed commissioners for suggesting reforms in education.



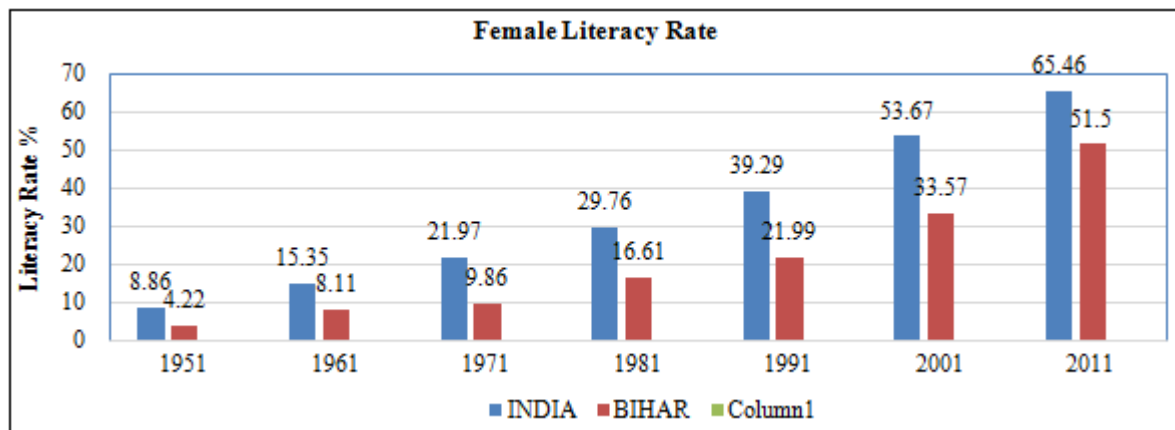
In the year 1971, India recorded a literacy rate of 34.45 percent, whereas, Bihar recorded a literacy rate of 23.17 percent, which is 11.23 less than the national literacy rate. In India male recorded a literacy rate of 45.96 percent and female recorded 21.97 percent, which is almost 5 percentage point higher than the previous decade, whereas in Bihar male recorded a literacy rate of 35.86, which is just 0.01 percentage point higher than the previous decade. Similarly female recorded a literacy rate of 9.86 percent, which is just 1.75 percentage point higher than the previous decade. Low

literacy during this period may be due to war between India and Pakistan.

There has been a rapid growth at the higher level of education from 1947 to 1977. The number of universities increased from 20 in 1947 to 106 in 1977 and in addition to this ten Deemed universities were established under section 3 of the UGC Act. In 1961-62 there were only 49 universities and 1783 colleges (Sociological Bulletin, vol. 28, No. 1-2, 1979) which increased to 95 universities and 3896 colleges during 1971-72 (University Grants



Commission Report 1971-72) and the student enrolment in the field of higher education rose from 11.55 lakhs in 1961-62 to 32.62 lakhs in 1971-72.



In the year 1981, India registered a literacy rate of 43.57 percent, which is 9.12 percentage point higher than the previous decade, whereas, Bihar registered a literacy rate of 32.32 percent which is 9.15 percentage point higher than previous decade but it is 11.25 percentage points lesser than the national literacy rate (43.57). In the census year 1981 India, registered 56.38 percent male literacy rate which is again much higher than the male literacy rate (47.11 percent) in Bihar. If we see the female literacy rate (16.61) in Bihar it is far less than the national (29.76).

The improvements in education since independence has never been satisfactory. From the first plan till the beginning of the sixth plan, the percentage of primary school students became more than double. A report by Ministry of education entitled "challenges of education: A Policy perspective, in 1985 showed that 60 percent of the children dropped out between grade one and five, whereas out of 100 children enrolled in grade one only twenty three reached grade eight. Therefore we can say that in spite of government continuous efforts the literacy rate in India, and especially in Bihar did not speeded up, may be due to socio-economic condition of the people.

Census year 1991 registered a literacy rate of 52.21 percent in India and only 37.49 percent in Bihar, which is 14.72 percentage points lesser than the national literacy rate. India registered a male literacy rate of 64.13 percent, whereas Bihar registered male literacy rate of 51.37 percent, whereas, the male literacy rate in Bihar (21.99 percent) is also far lower than the female literacy rate in India.

Kothari Commission in 1966 suggested that we should move towards common school system, where everybody can access school irrespective of caste, creed and religion and also suggested to increase expenditure in the next 20 years. This implies rise of expenditure from 12 per capita in 1965-66 to Rs. 54 in 1985-86 and the proportion of gross national product (GNP) allocated to education will rise from 2.9% in 1965 to 6.0% in 1985-86. In spite of many recommendations for increase in educational finance, the government starting with 0.64% of GDP in 1950-51 was able to reach only 3.93 percent in 1990. In spite of various attempts to provide free education, it has never been successful since independence, because it required allocation of funds at right time, which

has been continuously ignored by the political class. In spite of the national goal of Education for All, since independence, it has always remained a distant target.

In the census year 2001, India registered a literacy rate of 64.84, whereas, Bihar registered literacy rate of 47.53 percent, which is 17.31 percentage points lower than the national literacy rate. India registered male literacy rate of 75.26 percent and female literacy rate of 53.67 percent. Female literacy rate is 14.44 percentage point higher than the previous decade. Bihar registered male literacy rate of 60.32 percent, whereas, female literacy rate was 33.57, which is 11.58 percentage point higher than the previous decade 1991. Therefore, looking at the literacy rate among male and female, both in India and Bihar, we can say that the percentage growth of literacy rate is higher in females as compared to male. During this period several states were doing well in expanding literacy among their people like, Kerala, with a literacy rate of 91 percent, tops the list, which is followed by Mizoram and Lakshadweep (both 88 percent). Among all the state, Bihar registered the lowest literacy rate of 47.53 percent, but what we realizes that there is an increase of 10.04 percentage point, which is a good sign towards the improvement in literacy rate in Bihar. It is only because of the reduction in gender disparity during 1980s and 1990s. In spite of this fact literacy rates were lowest among female population of scheduled castes, scheduled tribes and the rural population.

Census year 2011 registered a literacy rate 74.04 percent in India, which is 9.2 percentage points higher than previous census year 2001, whereas Bihar registered a literacy rate of 61.8 percent, which is 12.24 percentage point less than the national literacy rate but it is 14.27 percentage point higher than the previous census year 2001. In India male literacy rate is 82.14 percent with an increase of 6.88 percentage point, whereas female literacy rate is 65.46 percent, which registered an increase of 11.79. If we see the literacy rate of male in Bihar we find that it is 10.88 percent point higher than the previous decade 2001. Similarly female literacy rate also registered an increase of 17.93 percentage point higher than the previous decade, which is much is much higher than the increase in literacy rate of female at national level.

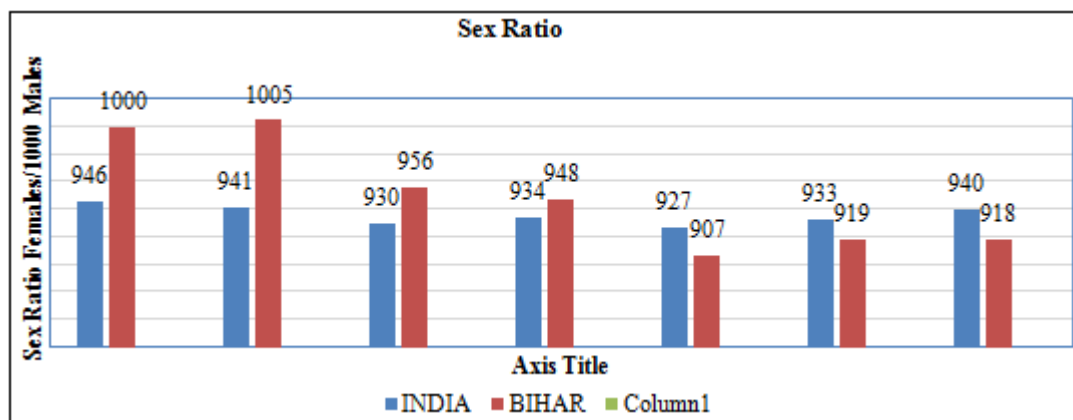
In the last decade, Bihar has seen an exceptional development in education. Efforts have been made by the Government of Bihar to increase accessibility to education facilities to all walk of life, which is showing a positive sign toward attainment of education. The increase in female literacy rate during 2001-2011 (17.93%) is the highest among all the state during this period. No doubt literacy rate in Bihar is showing some positive result but there is a wide gap between the literacy rate of rural and urban female, urban female literacy rate is 72.6%, whereas, rural female literacy rate is 49.6 percent. One of the important reason behind the increase in literacy rate among female is that with the implementation of the right to education, 25 percent of the seats in private schools have been given to students from the poorer section of the society. Apart from this government of Bihar distributed cycles and uniform, especially to girl students, so that they can travel longer distance for better and higher education, as compared to the educational facilities available in their surroundings.

### Trends of Sex Ratio in India and Bihar and their Comparative Analysis

Sex ratio is the number of females per thousand males. It is natural that the number of girls born remains lower than the number of boys but men have historically seen higher

mortality rate owing to the fact that male babies are biologically weaker than female babies. Apart from this male mortality rate may be higher due to risk taking behavior and their participation in wars. Even though sex ratio is lower not only in India but Bihar as well as in other states. This may be due to preference for the male child and killing girl child womb.

A recent report from NITI Ayog said that the nationwide sex ratio at birth (SRB) had dropped from 906 in 2012-14 to 900 in 2013-15. Seventeen states registered a drop in the number of girls born for every one thousand boys, furthermore during 2014-16, SRB dropped from 900 to 898. It has been continuously witnessing decreasing sex ratio at birth (SRB) since the 1970s which is a highly disturbing trend. Female infanticide remained preferred way of killing till 1970s because in the seventies, sex selection technologies allowed more people to use them for son preferences and opted for abortion of girl child. Low sex ratio at Birth (SRB) from the seventies have led to increasing number of male population, and this skewed sex ratio has led to violence against women and human-trafficking. Therefore, we the citizen of India should fight against boys preferences at birth.



According to census 2011, the sex ratio of India fares among the worst in South Asian countries. India ranks lowest among the neighboring countries with a sex ratio of 940 females per thousand male, whereas Bangladesh recorded 978, Pakistan 943, Sri Lanka 1034, Nepal 1014, except China, which recorded sex ratio (926) poorer than India. According to table 1, the sex ratio in India has been continuously declining from 946 in 1951 to 940 in 2011. Even from 1901 onward it kept on declining from 972 in 1901 to 945 in 1941, but 1951, register an increase of 1 point with a sex ratio of 946. But after 1951, sex ratio in India kept on fluctuating, in spite of the fact that it declined from 946 in 1951 to 940 in 2011 except 1981, when it registered 4 points increase and 2001 when it again registered an increase of 6 points from the previous decade. Above all census year 2011 registered a sex ratio of 940, which is 7 points higher than the previous census year 2001.

If we see the sex ratio of Bihar, we find that similar trend has been observed here. Sex ratio has been continuously declining from 1951 to 1991, but 2001 registered an improvement in sex ratio of 919 females per thousand males,

with an increase of 12 points from the previous decade, but unfortunately census year 2011, registered a sex ratio of 918, which is 1 point lower than the previous census year. Because of patriarchal society sex ratio always remained unfavorable for female, but it is surprising that Bihar registered sex ratio, which remained favorable to female till 1961, except 1931, when the sex ratio dropped down to 995 females per thousand male. Higher sex ratio in Bihar during this period may be attributed to the fact that Indian religion and philosophy considered womanhood nearer to divinity and has been assigned respectable position in society. After 1961, sex ratio has always remained unfavorable to females and the general trend during this period is of decreasing sex ratio except 1961, when the sex ratio was 1005 females per thousand males, which is 5 points higher than the previous decade 1951. Apart from this census year 2001 also registered an increase of 12 points higher than the previous decade 1991; with a sex ratio of 919 females per thousand males.

The Karl Pearson's method of coefficient of correlation has been used to find out the coefficient of correlation between

literacy rate and sex ratio in India and Bihar. From the calculation of correlation based on table 1, the value of Karl Pearson's correlation coefficient was found to be -0.3629 for India and -0.8138 for Bihar. The minus in both the values indicates the negative direction of relationship between literacy rate and sex ratio and the value of -0.3629 and -0.81389 in India and Bihar, respectively show the strength of the relationship. On the basis of values for India we can say that there is a medium level of negative correlation in India between literacy rate and sex ratio. We can interpret it in another way that with the increase of literacy rate sex ratio did not increase. Therefore we can say that the main reason of low sex ratio in India is not the literacy rate but the result says that the main cause behind declining sex ratio is strong son preferences and other socio-economic reasons.

Similarly if we see the coefficient of correlation between literacy rate and sex ratio in Bihar, it is -0.81389. On the basis of this value we can say that there is a high level of negative correlation between literacy rate and sex ratio in Bihar. It means that with the increase of literacy rate, sex ratio did not increase.

Apart from son preferences, there are several other reasons to explain the consistently low levels of sex ratio, in spite of increasing literacy rate, and may further decline in the country as well as Bihar. The imbalance or adverse sex ratio in India and Bihar may also be attributed to neglect girl child, which results in higher mortality rate at younger ages. Apart from this high maternal mortality and sex selective female abortion, along with female infanticide may be other reasons of declining sex ratio in both India and Bihar state. Therefore, we can say that the marked improvements in the economic conditions and literacy rate do not seem to have any impact on the declining sex ratio both at national and state level.

#### **Spatial Pattern of Literacy Rate in Bihar (2001-2011)**

Literacy is an ability to read and write with understanding any language. It affects the over-all socio-economic development of the any country or state. Bihar is India's most illiterate state, nearly 32 million cannot read and write and out of this 20 million are women. Therefore they cannot help their children in their study. Illiteracy touches every single part of their life. Because of son preference, sex selective abortion is a common issue in Bihar, which has led to low sex ratio. Poverty is one of the reason which has led to illiteracy. Therefore, impoverished family cannot afford to send their children to school. Whenever any family want to send their children to school, they normally choose son over daughter, because they are not able to send both of them to school. Apart from this there is a crisis in primary education system, because of the third populous state of India, classrooms are most crowded, but there are fewest teachers.

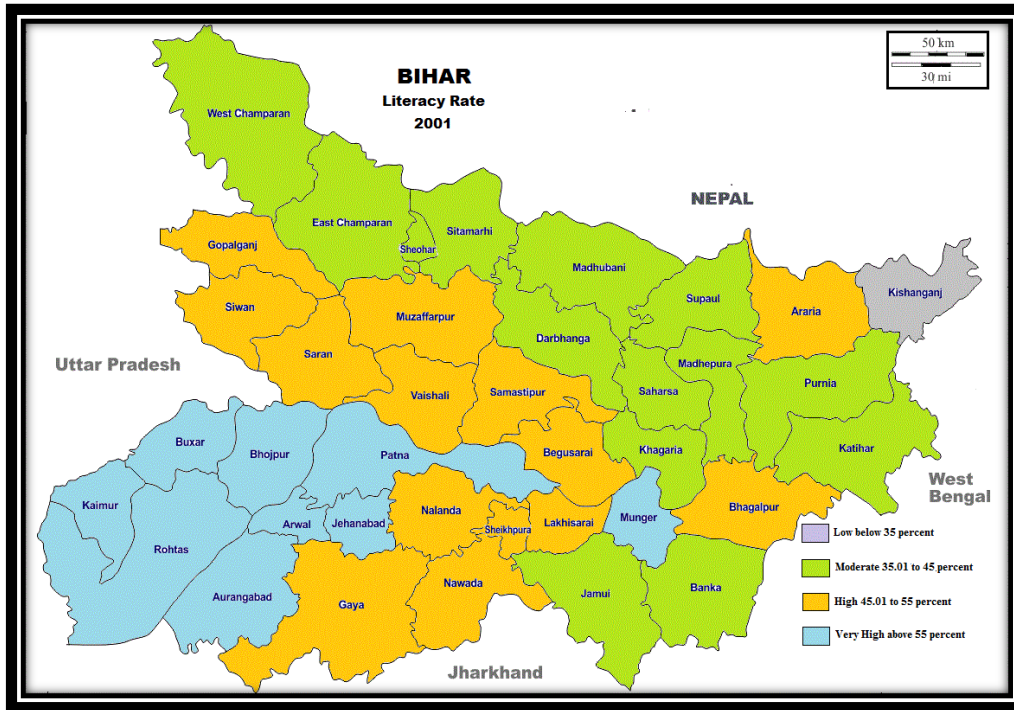
In spite of this Bihar allocates the least budget on education. But during 2019-20 Bihar government has given top priority to education and allocated higher ever budget of Rs. 34798.69 crore for education (NDTV-Education, 12 Feb. 2019) Sarva Siksha Abhiyan brought about phenomenal change in literacy rate in Bihar, especially since 2001 and it's literacy rate jumped from 47.53 percent in 2001 to 61.8 percent in 2011. This decadal increase of 14.27 is the highest among all the Indian states during this decade. Bihar has been the worst victim of the funds from the central government, but it should have the strongest claim because it is the poorest state. Therefore special packages and assistance should be given to Bihar in order to alleviate the literacy level.

In 2001 Bihar recorded a literacy rate of 47.53 percent, but the district level literacy rate differs from one district to another. Out of 38 districts in Bihar, Patna recorded the highest literacy rate of 62.92 percent, which is followed by Rohtas (61.28 percent) and Munger (59.47), whereas the lowest literacy rate was registered by Kishanganj with a literacy rate of 31.09 percent which is followed by Purnia (35.1), Sheohar (35.27) and Katihar (35.29).

Patna recorded the highest literacy rate because of its urbanization and educational facilities available. It is also connected with different districts by means of road and railways. Being a capital city of Bihar 6 percent of state's road network and 16 percent of the total number of vehicles in Bihar are found in Patna. Patna is also most prosperous district of Bihar and it's per capita GDP in 2004-05 was Rs. 36373 (India Today New Delhi, November 11, 2018). Kishanganj, which recorded lowest literacy rate among all 38 districts in Bihar is the only district to have Muslim majority population (68 percent), but gradually improving gradually.

As per census year 2001 if we divide all the districts of Bihar into low (below 35 percent), moderate (35.01 to 45 percent), high (45.01 to 55 percent) and very high (above 55 percent), there is only one district namely, Kishanganj, which can be categorized under low level of literacy rate, whereas, fourteen districts, namely, East Champaran, Madhubani, Darbhanga, West Champaran, Sitamarhi, Purnia, Katihar, Supaul, Banka, Madhepura, Saharsa, Jamui, Khageria and Sheohar can be categorized under moderate literacy rate. Apart from this, fourteen districts, named as Muzaffarpur, Gaya, Samastipur, Saran, Vaishali, Siwan, Bhagalpur, Begusarai, Nalanda, Araria, Gopalganj, Nawada, Lakhisarai and Sheikhpura can be categorized under high level of literacy rate, whereas, nine districts namely, Patna, Bhojpur, Aurangabad, Buxar, Kaimur, Munger, Jehanabad Arwal and Rohtas are categorized under very high literacy rate.

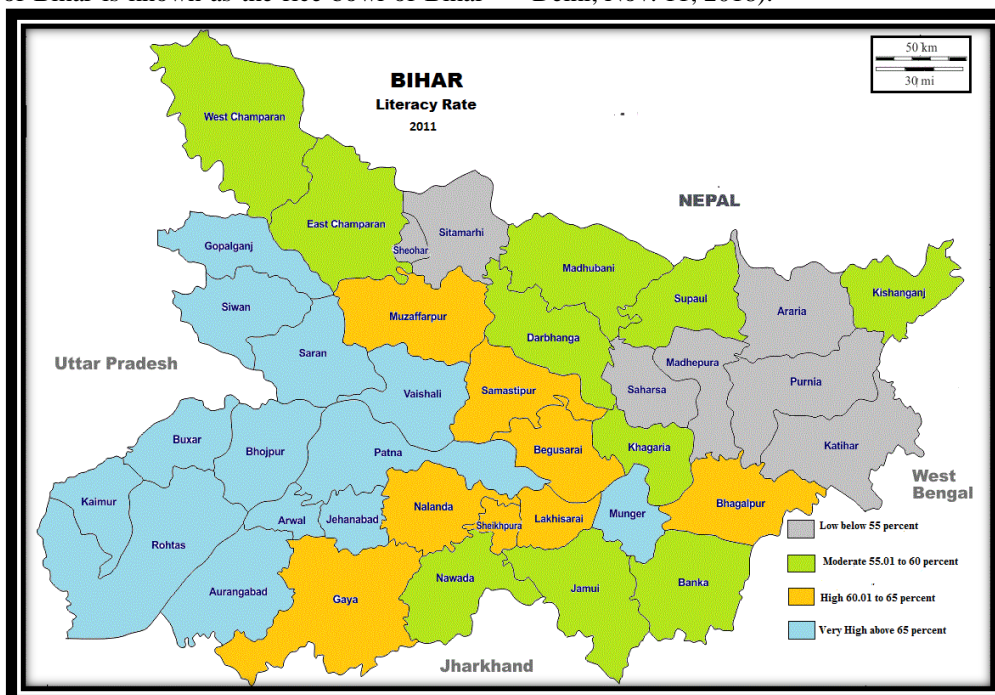




As per census report 2011, Rohtas recorded the highest literacy rate (73.37), which is followed by Patna (70.68), Bhojpur (70.47), Munger (70.46), Aurangabad (70.32) and Buxar (70.14). No doubt Patna recorded 7.76 percentage points higher than the previous census year 2001, but ranked second in 2011 after Rohtas. It is very interesting to note that Rohtas with literacy rate 61.28 percent ranked second after Patna in 2001, but gained 21.09 percent in 2011 and ranked first in terms of literacy rate among all the 38 districts of Bihar. Apart from this Purnia recorded the lowest literacy rate of 51.08 percent, which is followed by Katihar (52.24) and Madhepura (52.25).

Rohtas which recorded the highest literacy rate among all the 38 districts of Bihar is known as the rice bowl of Bihar

and has got better health facilities. A majority of the working population in Rohtas district are employed in agriculture (23.58%), whereas only 5.25% workforce are engaged in household industries and other forms of employment, accounted for 27.33%. The Muslim majority district Kihanganj went on from having the lowest literacy rate (31.09%) in 2001 to 55.46 percent in 2011. It means there is an increase of 24.37 percentage point, which may be attributed to the fact that the district has a total 1814 schools for 416744 students. On the other hand the number of primary schools per one lakh people has gone up from 80.4 in 2009-10 to 89 in 2016-17. The girl to boy student ratio has also gone up from 97.3 percent in 2009-10 to 101.9 percent in 2016-17 (India Today, Amitabh Srivastava, New Delhi, Nov. 11, 2018).





As per census 2011, we can categorize all the 38 districts of Bihar into Low below 55 percent, Moderate 55.01 to 60 percent, High 60.01 to 65 percent and Very High above 65 percent. According to this categorization, seven districts, namely, Sitamarhi, Purnia, Katihar, Araria, Madhepura, Saharsa and Sheohar can be put under low level of literacy rate, below 55 percent, whereas, ten districts, named as East Champaran, Madhubani, Darbhanga, West Champaran, Supaul, Nawada, Banka, Jamui, Kishanganj and Khagaria can be categorized under moderate literacy rate. Apart from this, eight districts, namely, Muzaffarpur, Gaya, Samastipur, Bhagalpur, Begusarai, Nalanda, Lakhisarai, and Sheikhpura are categorized under high level of literacy rate, but out of 38 districts thirteen districts, named as, Saran, Vaishali, Siwan, Rohtas, Bhojpur, Gopalganj, Aurangabad, Buxar, Kaimur, Munger, Jehanabad and Arwal and Patna are categorized under very high literacy rate.

### **Spatial Pattern of Sex Ratio in Bihar (2001-2011)**

For any fruitful demographic analysis sex composition is extremely vital component, because it affects the socio-economic as well as cultural characteristics of the region. It also measures the equality between male and female population at a given time in a particular area. The sex ratio of the population affects as well as affected by birth, death, immigration and emigration rates. Sex ratio helps us in understanding of both the relative survival of females and males and future potential of population growth.

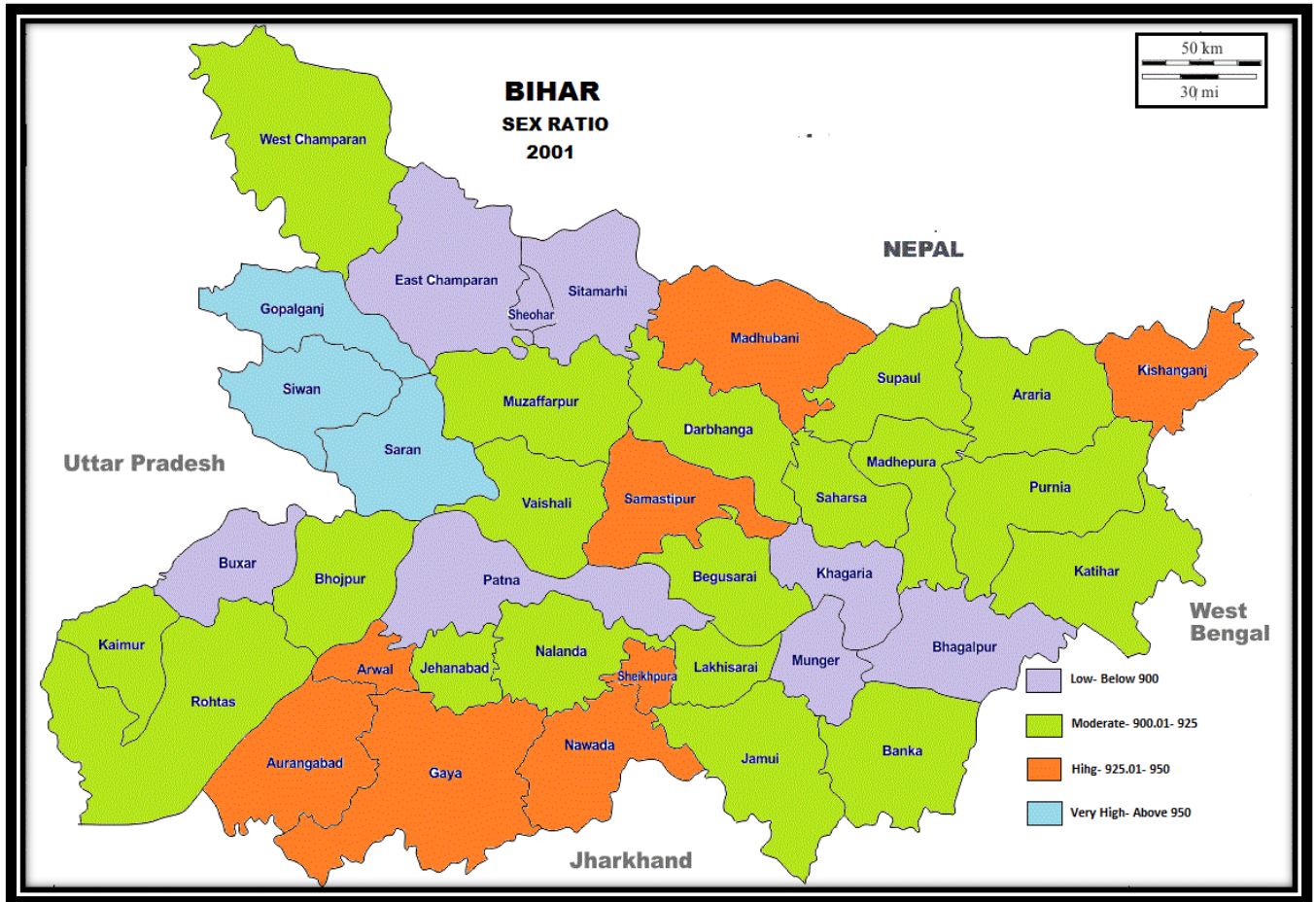
Declining sex ratio is an issue of grave concern in India as well as Bihar. Couples go for larger number of children, in order to get at least one male child in the family, because of son preferences in our society. A skewed sex ratio due to shortage of girls is detrimental to the health and welfare of women as well as for the development of society. Son preference is slowing the birth control, women continues to bear child until they get male child of desired number. This tendency in our society leads to gender discrimination, leading to sex selective abortion, infanticide, health care of girl and malnutrition of girl child.

Naturally girl child is more likely to survive than boy, therefore, women may outnumber men, but in India as well as Bihar, sex ratio is declining because of girl, child prejudice. Declining sex ratio should be taken into consideration by the government and our society, because it is man-made, not created by nature. It is well known fact that families go for sex determination, and as they come to know about girl child, they immediately get rid of it and go for abortion. The falling sex ratio has led to sharp rise in violence against women. Apart from this, due to increasing violence against women, parents don't want girl, as they feel that they cannot keep them safe. Above all, women who give birth to girl child faces domestic violence too. Therefore,

religious leaders and civil societies must come forward to stop this evil in our society, even political leader should take a fare step towards prejudice against girl child in our society. Now there has been some improvement in the sex ratio because of multipronged strategy adopted by the government to build a favorable environment for girl child by adopting gender sensitive policies. Still we have to go a long way to overcome this evil.

According to census year 2001, Bihar registered a sex ratio of 919 females per thousand male, which is 12 point higher than the previous census year 1991. Sex ratio in Bihar always remained favorable to female till 1961, except 1931. After 1961 sex ratio declined from 1061 females per thousand male in 1901 to 918 females per thousand males in 2011. After 1961, sex ratio continuously declined except 2001, when sex ratio registered and increase of 12 points, but after 2001, sex ratio again declined to 918 females per thousand males in 2011, with a decline of 1 point from the previous decade of 2001. But census year 2001 and 2011, brought a ray of hope towards improvement in sex ratio, because it has gone down to 907 females per thousand males in 1991. No doubt 918 females per thousand males in 2011 is far less than the national average of 940 females per thousand females, therefore, both India and Bihar has to go a long way to achieve balance between male and female population. If we go through the 2001 census, we find that Siwan and Gopalganj registered sex ratio favorable to female. Siwan recorded the highest sex ratio of 1031 females per thousand male, which is followed by Gopalganj 1001 females per thousand male and Saran 966 females per thousand males, whereas, the lowest sex ratio was recorded by Munger with a sex ratio of 872 females per thousand males, which is followed by Patna 873 females per thousand male. If we see the literacy rate in Siwan and Gopalganj, we find that both the districts are categorized under high literacy rate. It may be due to high literacy rate, especially high female literacy rate, in both the districts, which has got positive bearing on sex ratio. Out of 38 districts, 17 districts namely, Muzaffarpur, Madhubani, Gaya, Samastipur, Saran, Vaishali, Siwan, Katihar, Gopalganj, Aurangabad, Supaul, Nawada, Kishanganj, Jehanabad, Lakhisarai, Sheikhpura, and Arwal, recorded sex ratio which is higher than the state average 919 females per thousand male.

According to census year 2001, we categorize all the 38 districts of Bihar into Low, below 900, Moderate 900.01 to 925, High 925.01 to 950 and Very High above 950. There are eight districts, namely, Patna, East Champaran, Sitamarhi, Bhagalpur, Buxar, Khagaria, Munger and Sheohar, which can be categorized under low sex ratio, below 900, whereas, there are nineteen districts, named as, Muzaffarpur, Darbhanga,

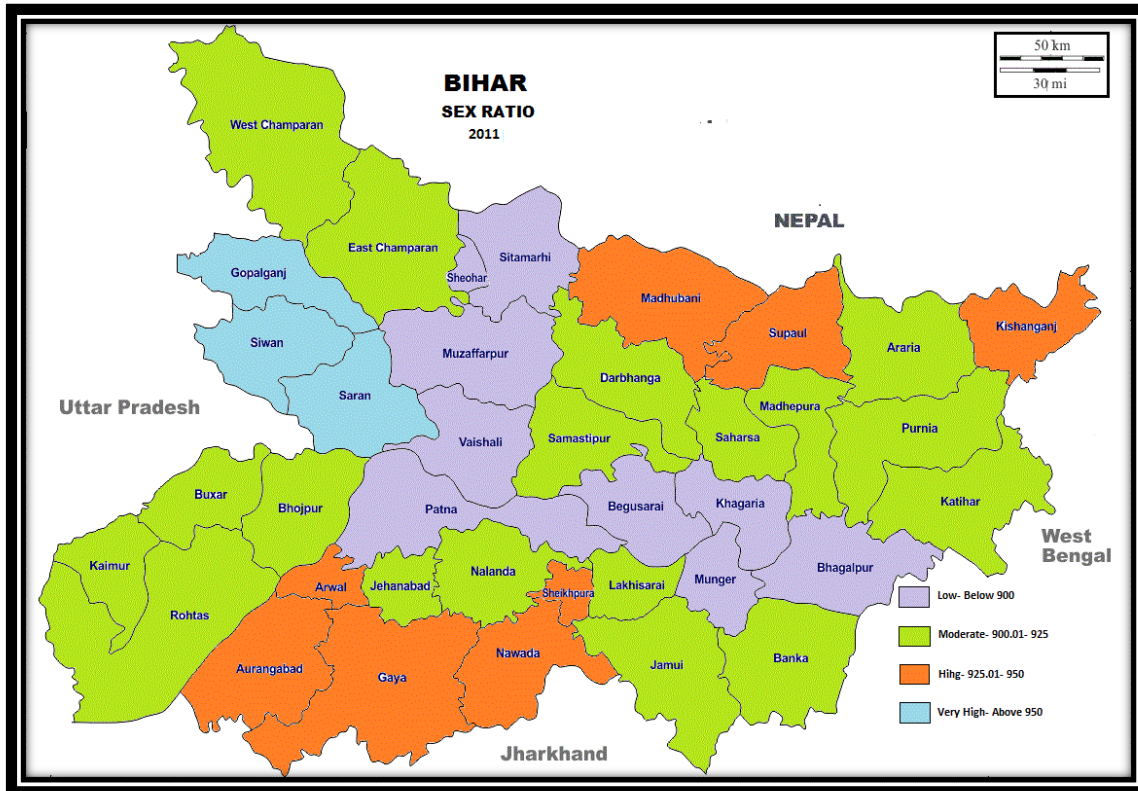


West Champaran, Vaishali, Purnia, Katihar, Begusarai, Rohtas, Nalanda, Araria, Bhojpur, Supaul, Banka, Madhepura, Saharsa, Jamui, Kaimur, Jehanabad and Lakhisarai, are categorized under moderate sex ratio. Out of 38 districts there are eight districts, which are categorized under high sex ratio, named as, Madhubani, Gaya, Samastipur, Aurangabad, Nawada, Kishanganj, Sheikhpura and Arwal, whereas, only three districts can be categorized under very high sex ratio above 950 females per thousand males which includes, Saran, Siwan, Gopalganj.

Therefore, overall increase in sex ratio in most of the districts of Bihar as well as state average sex ratio, is a positive sign towards discrimination against women in the study area. This improvement in sex ratio may be attributed to the fact that government adopted multipronged strategy to build a positive environment for girl child, by means of adopting gender sensitive policies. Improvement in sex ratio may also be attributed to awareness towards health and better health facilities. Apart from the aforesaid facts, which helped in the improvement of sex ratio, outmigration may also be one of the important cause, because younger peoples out migrated to distant or neighboring state in search of

better job opportunities. The census year 2011 recorded a 1 point decline in sex ratio of Bihar with a sex ratio of 918 females per thousand males as compared to 919 females per thousand males in 2001. If we see the district level sex ratio it is very discouraging, because out of 38 districts in Bihar, fourteen districts, namely, Samastipur, Darbhanga, West Champaran, Vaishali, Sitamarhi, Bhagalpur, Begusarai, Rohtas, Banka, Madhepura, Saharsa, Khagaria, Munger and Sheohar recorded sex ratio, which is lower than the state average of 918 females per thousand males. As against 2001, there is only one district, named as Gopalganj, which recorded sex ratio, which is favorable to female, with a sex ratio of 1021 females per thousand male which is 20 points higher than the sex ratio in 2001. But Siwan ranked second with a sex ratio of 988 females per thousand males, which is 43 points lower than the previous census year 2001. Siwan has been followed by Saran with a sex ratio of 954 females per thousand males, which is 12 points lower than the census year 2001. Apart from this the lowest sex ratio has been recorded by Munger with a sex ratio of 876 females per thousand males, which is followed by Khagaria (886) and Bhagalpur (880).





According to same categorization as has been done in 2001, into Low, Moderate, High and Very High, there are nine, in the census year 2011, district namely, Patna, Vaishali, Sitamarhi, Bhagalpur, Begusarai, Khagaria, Munger, Muzaffarpur and Sheohar, which can be categorized under low sex ratio below 900 females per thousand males, whereas, eighteen districts, which are named as, East Champaran, Samastipur, Darbhanga, West Champaran, Purnia, Katihar, Rohtas, Nalanda, Araria, Bhojpur, Banka, Madhepura, Saharsa, Jamui, Buxar, Kaimur, Jehanabad and Lakhisarai are categorized under moderate sex ratio between 900.01 to 925 females per thousand males. Out of 38 districts in Bihar there are eight districts, which can be categorized under high sex ratio between 925.01 to 950 females per thousand male, these districts are Madhubani, Gaya, Aurangabad, Supaul, Nawada, Kishanganj, Sheikhpura and Arwal and only three districts, named as Saran, Siwan and Gopalganj, can be categorized under very high sex ratio.

One of the most important thing, which we should note that during both the census year 2001 and 2011, Patna, the capital city of Bihar, observed low sex ratio, which remained below 900 females per thousand. No doubt there is an improvement of 24 points in 2011 from the previous census year of 2001. This low level of sex ratio in Patna may be attributed to high literacy rate which was 62.92 percent in 2001 and 70.68 percent in 2011. High literacy rate in Patna encouraged women, may be under family pressure, to go for sex selective abortion, due to prejudice against girl child and son preference. High level of literacy also encouraged younger generation to migrate other countries or other state for better job opportunities and better living conditions.

There has been a slight improvement in sex ratio since 2001, but we have to go a long way to achieve the balance between

the male and female population, which can be done by means of multipronged strategy adopted by government, otherwise it would lead to inadvertent social evil.

**Correlation between Literacy Rate and Sex Ratio**

To understand the socio-economic conditions of women in the society, it is necessary to know the sex ratio. Declining sex ratio or the low number of female population as against male indicates the girl child prejudice, sex selective abortion and traditional attitude of son preferences. Therefore, the study of the relationship between literacy rate and sex ratio is of immense significance. To find out the correlation between literacy rate and sex ratio, Karl Pearson’s method of coefficient of correlation has been used. Correlation is a statistical tool to study the relation between two variables. These two variables are like, literacy rate and sex ratio are said to be correlated when the increase or decrease in one corresponds with the increase or decrease in another. In this study literacy rate is considered as an independent variable whereas sex ratio is dependent variable. On the basis of table 2 coefficient of correlation by means of Karl Pearson’s method of correlation has been calculated for two successive decades 2001 and 2011 between literacy rate and sex ratio. It has been observed that there is no correlation between literacy rate and sex ratio amongst the

**Table 2:** Correlation between Literacy Rate and Sex Ratio

Districts	2001		2011	
	Sex Ratio	Literacy Rate	Sex Ratio	Literacy Rate
Patna	873	62.92	897	70.68
East Champaran	897	37.54	902	55.79
Muza@arapur	920	47.95	900	63.43
Madhubani	942	41.97	926	58.62
Gaya	938	50.45	937	63.67
Samastipur	928	45.13	911	61.86
Saran	966	51.8	954	65.96



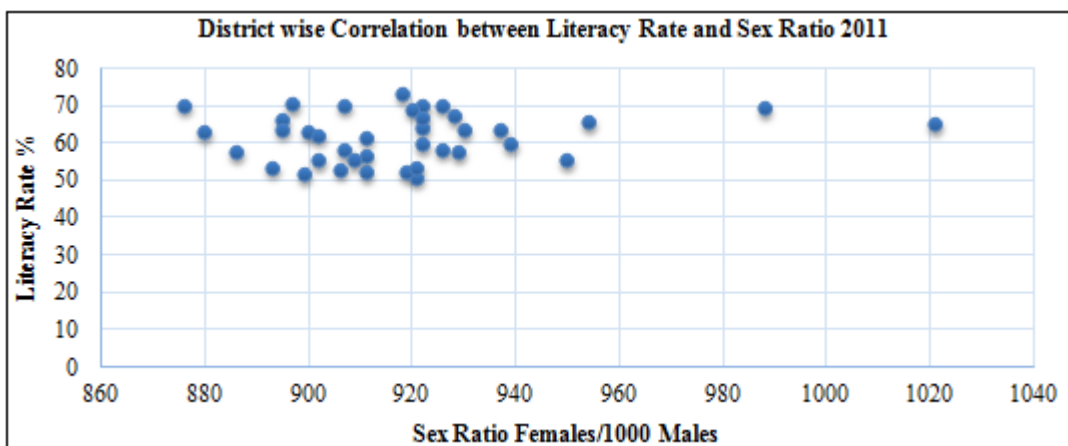
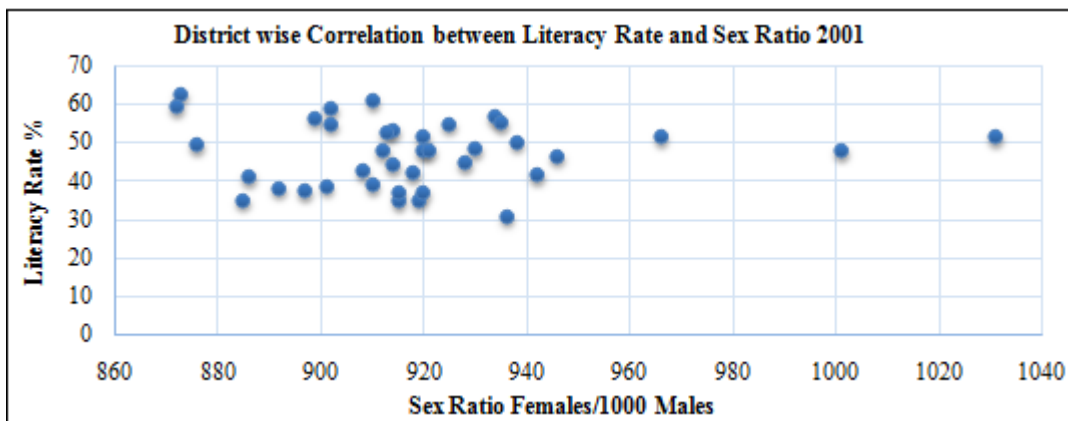
Darbhanga	914	44.33	911	56.56
West Champaran	901	38.9	909	55.7
Vaishali	920	51.63	895	66.6
Sitamarhi	892	38.5	899	52.05
Siwan	1031	51.6	988	69.45
Purnia	915	35.1	921	51.08
Katihar	919	35.29	919	52.24
Bhagalpur	876	49.5	880	63.14
Begusarai	912	48	895	63.87
Rohtas	910	61.28	918	73.37
Nalanda	914	53.19	922	64.43
Araria	913	53.01	921	53.53
Bhojpur	902	58.96	907	70.47
Gopalganj	1001	48.19	1021	65.47
Aurangabad	934	57.03	926	70.32
Supaul	920	37.28	929	57.67
Nawada	946	46.83	939	59.76
Banka	908	42.73	907	58.17
Madhepura	915	37.07	911	52.25
Saharsa	910	39.08	906	53.2
Jamui	918	42.43	922	59.79
Buxar	899	56.8	922	70.14
Kishanganj	936	31.09	950	55.46
Khagaria	886	41.35	886	57.92
Kaimur	902	55.09	920	69.34
Munger	872	59.47	876	70.46
Jehanabad	925	55.22	922	66.8

Lakhisarai	921	47.96	902	62.42
Sheohar	885	35.27	893	53.78
Sheikhpura	930	48.6	930	63.86
Arwal	935	55.31	928	67.43
Coefficient of Correlation	0.0073		+0.1454	

Source: Census Reports / Coefficient of Correlation calculated by author

districts of Bihar in 2001, because the value which has been found after calculation is 0.0073. This value indicates that the strength of relationship is zero, it means no relationship between these two variables but it is inclined towards positive correlation because the value after calculation is 0.0073.

As far as the value of coefficient of correlation between literacy rate and sex ratio in 2011 is concerned, it is +0.1454. The plus sign indicates that there is a positive direction of the correlation and the value +0.1454 showed the strength of relationship is of low level (low level of positive correlation 0 to +0.25). We can say that low level of positive correlation has been found between literacy rate and sex ratio in the census year 2011, therefore, with the increase of literacy rate, the sex ratio also increased and are directly related to each other, but are not significantly related.



It is also evident from table 2 that in the census year 2001, districts which recorded very high sex ratio observed high literacy rate, like Siwan, Gopalganj and Saran. But the census year 2011, same districts Gopalganj, Siwan and Saran with very high sex ratio observed very high literacy rate too. It is a positive sign that with the advent of new

informations people have started giving equal position to girl child in family, and our culture and religion also pay respect to womanhood. But we have to go a long way to achieve the balance between both the sexes in India as well as Bihar.

## 5. Conclusion

Literacy and sex ratio are considered as the important aspects of demographic studies and indicate the status of any region. Literacy is a necessary aspect of an individual because it helps in grooming the overall personality of a particular person which ultimately helps in the development of the society. Literacy and sex ratio have always been considered to be an important key for socio-economic growth. The economic development of any country depends upon the resources. Among all the natural resources human resource is an important part. Human resources which includes the population growth, labor force their skills, working capacity, etc., can be improved by means of literacy among the people.

In today's world literacy does not only mean to read and write with understanding but it has gone far beyond this because it guide us towards awareness and helps us to achieve better living conditions. The National Literacy Mission was started by Government of India on 5<sup>th</sup> May, 1988, to eradicate illiteracy from the country and the target group were people between 15 to 35 years. The literacy of India reached to 64.84 percent and 2001, and 74.04 percent in 2011, but the goal is yet to achieve. If we see the literacy rate of Bihar as a whole, we find that it was 47.53 percent 2001 and reached to 61.80 percent in 2011. Apart from the literacy rate sex ratio is also vital for any demographic studies, because changes in sex ratio largely affects the socio-economic and cultural characteristics of any area. It is also an important indicator to measure the equality between male and female at a given point of time in a particular area.

It is today's reality that gender discrimination still exist in India and specially in state like Bihar, where the literacy rate has increased from 47.53 percent in 2001 to 61.8 percent in 2011, whereas sex ratio has gone down from 919 females per thousand males in 2001 to 918 females per thousand males in 2011. As compared to the national sex ratio, we find that the sex ratio in Bihar remained favorable to women till 1961, except 1931, when the sex ratio dropped down to 995 females per thousand males.

If we go through the spatio temporal variation in literacy rate and sex ratio in the census year 2001, we find that Siwan with sex ratio 1031 females per thousand males ranked first, which is followed by Gopalganj with sex ratio 1001 females per thousand male and Saran 966 females per thousand males, whereas, the lowest sex ratio was observed by Munger with a sex ratio of 872 females per thousand male. As against 2001, in 2011 there is only one district, named as Gopalganj, which recorded sex ratio favorable to females with a sex ratio of 1021 females per thousand male, which is followed by Siwan with a sex ratio of 988 females per thousand males. If we go through the district wise literacy rate in 2001 and 2011, we find that in the census year 2001, Patna recorded the highest literacy rate of 62.92 percent, which is followed by Rohtas (61.28%) and Munger (59.47%), whereas, the lowest literacy rate was observed by Kishanganj with a literacy rate 31.09 percent. But according to census year 2011, Rohtas recorded the highest literacy rate (73.37%), which is followed by Patna (70.68%) and Bhojpur (70.47%), whereas, Purnia recorded the lowest

literacy rate 51.08 percent, which is followed by Madhepura (52.25%) and Katihar (52.24%).

In the present study, to find out the correlation between literacy rate and sex ratio, Karl Pearson's method of correlation has been applied, taking literacy rate as independent variable and sex ratio as dependent variable. It has been found that there is no correlation between literacy rate and sex ratio in the census year 2001, because the value of coefficient of correlation, which we calculated is 0.0073, but the value of coefficient of correlation in 2011 is +0.1454. This plus sign indicates that there is a positive correlation between literacy rate and sex ratio, but the strength of correlation is of low level. It means there is low level of positive correlation between literacy rate and sex ratio in the census year 2011. It is also evident from the fact that districts like Gopalganj, Siwan, and Saran with very high literacy rate also observed very high sex ratio in the census year 2011.

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