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Population Growth and Sex Ratio in South Bihar Plain (India): A District Level Comparative Analysis

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Abstract: ***Population growth of any region is a crucial factor in the development of any region, because it helps in the management and development of the region. Apart from this sex ratio are among the most basic demographic characteristics and helps in understanding the survival of male and female. The sex ratio is said to be favorable to women, when the number of females exceeds the males, and is said to be adverse, when the number of males exceeds the females. Sex ratio in India normally remained adverse to woman but in Bihar it remained favorable to women till 1961, except the year 1931. It is because of his fact that the growth of population in the study area, occurred at faster pace, as higher female population can have a substantially higher birth rate, which will lead to higher growth of populationin the study area, occurred at faster pace, as higher female population can have a substantially higher birth rate, which will lead to higher growth of population. Sex ratio can change not only the size of population but also their characteristics. Therefore, it is necessary to keep balance between male and female population, for the perpetual existence of the human population. In a state like Bihar and especially South Bihar plane sex ratio is a key factor in understanding the development of the society, because it has got both the demographic and social implications. The decrease in number of women will reduce the marriage rate which will be resulted into decrease in crude birth rate and will also lead to many social evils. In this research paper we will examine the spatio-temporal variation in growth of population and sex ratio at district level in South Bihar plain, furthermore there with a comparative analysis between population growth rate and sex ratio by means of Karl Pearson's method of correlation.***

Keyword: South Bihar Plain, Population Growth Rate, Sex Ratio, Karl Pearsons's Method, Coefficient of Correlation, Bihar, District Level Comparative Analysis

1. Introduction

Population geography is a division of human geography, which includes geographical study of population in terms of its spatial distribution and their characteristic. As a spatial science population geography emerged from 1950s onwards, and focused on the systematic study of the spatial distribution and variation in population characteristics, such as fertility, mortality, distribution, density, composition, migration and growth of population. Due to rapidly growing global population as well as baby boon in the developing country like India, population geographer studied the relation between population growth and sex ratio. In demographic study, the change or growth of population can be measured in two ways, one is to measure the difference between the numbers of people present on two different dates at a particular place. Then we can easily calculate the rate of change (growth) during this intervening period. On the other hand, other method is based on changesin births, deaths and migration. Total population of the world exceeded seven billion people in the year 2012, and it reached 7.8 billion in 2020, whereas it has been predicted that it will reach upto 9.6 billion by the year 2050. Over population is a worldwide phenomenon, because of it extra people are treated as a strain on environment, economy, government, social institutions as well as other infrastructure. The geographical study of population growth and sex ratio play an important role in understanding the dynamism and planning at local and regional level. In a country like India, high population growth is a big problem, but zero population growth has also become a threat to the highly developed countries because population is one of the resources for the growth and development of the society and country as a whole. Therefore, it must be understood with respect to the natural resources of the country. When population size remains in equilibrium with the available resource, the country is said to have an optimum population. A country is said to be overpopulated if there are more population than can live in comfort, happiness and health. In other word, if there is too many people, and not enough resources are there to maintain a reasonable standard of living of people in a particular area.

Since the end of the cold war, there has been a sharp rise in population of sub-Saharan, African, the Middle East, South Asia and South East Asia, specially China and India; which has become a strain on the natural resources and other amenities.

Contrary to the trends of population growth in India and other states, Bihar as well as South Bihar plain as a whole recorded a high growth rate, but birth rate rose marginally from 26.3 to 26.8 during 2015-2016 in Bihar. It is certain that the population growth will occur at slower pace, when birth rate reduces. In 2011 total population of Bihar was 104099452, which is estimated to be 12.4 in 2020. By mid of year 2020 the projected population is 124799926 as per Unique Identification Authority of India, Adhar updated 31, May 2020, whereas South Bihar plain registered a total population of 38551925 in 2011. Growth of population is Bihar and South Bihar plain as a whole has declined during 2001-2011. Bihar population growth rate has dipped from 28.62 percent in 2001 to 25.42 percent. It means there is a decline of 3.2 percent during this decade. In the same way growth of population of South Bihar also declined from 27.79 percent in 2001 to 23.64 percent in 2011, with a total decline of 4.15 percent, which is larger than the decline in

Bihar state as a whole. But during past decades population continued to surge, with the state being top three populated state of the country. Alarming population growth in Bihar and South Bihar plain has been a cause of concern and professionals should inform people about various approaches to implement family planning, but women in Bihar still likely to have over three children in her life time.

Apart from population growth gender discrimination is a common problem due to cultural preferences in India as a whole as well as Bihar and South Bihar plain. In our society females are confined to household's works and face gender discrimination in all walk of her life. Gender discrimination has been a social issue in India for centuries and birth of girl child is not welcomed. It is only because of patriarchal norms, which have marked women inferior to men. It is very difficult to imagine such a gender biased approach in the 21st century, when women have proved themselves in every field. But in our society girl child are being discriminated in most of the households, even after such a progress. In spite of Parental Diagnostic Technique Act of 1994, the female feticide through sex selective abortion are continued to be practiced. Therefore, the child sex ratio is at its lowest, ever, with 914 girls for every 1000 boy in 2011. In our country sex ratio has been gradually declining from 1901 till date. There were 972 females per thousand males in 1901, which has now decreased to 943 females per thousand males in 2011. As compared to India, Bihar registered a higher sex ratio in the year 1901, with a sex ratio of 1061 female per thousand male, which has decreased to 918 females per thousand males in 2011, and almost same conditions prevails in South Bihar plain. South Bihar plain registered 1052 females per thousand males in 1901, which has now decreased to 913 females per thousand males in 2011.

Sex ratio affects both growth rates and the evolutionary trajectories of the population and is the most important aspect of the demographic studies, sex ratio affects the socio-economic and cultural status of any area. Sex ratio is basically a ratio between female and male population, which is defined as number of females per thousand males. It is among the most basic parameters and provide indication of both the relative survival of females and males and future growth of population. Sex ratio is a key factor in the development of any region, because it helps in planning and development. Sex ratio has been continuously declining and its consequences have already been evident. The declining sex ratio has led to more violence against women and human trafficking. However it is not in dispute that over next twenty years, there will be an excess of males. These men will remain single and will be unable to have families in our society, where marriage has been regarded as universal phenomena, which provides social status and acceptance. Therefore, an imbalance between male and female population will lead lower fertility and slower growth of population. An understanding of the sex ratio and growth of population in terms of spatial variation, especially at district levels is of fundamental importance for understanding different demographic attributes of the study area.

2. Study Area

The land of alluvium, South Bihar plain is located in the eastern part of India. The alluvial plain of South Bihar is a linear tract, demarcated by river Ganga in north, Rajmahal hill to the east and Chotanagpur plateau to the south. In other words, South Bihar plain is the southern part of Bihar state and geographically it is also a southern part of Middle Ganga plain. It is bounded by river Ganga and North Bihar plains to the north, the Bengal Basin to the east, Ayodhya (Oudh) plains to west and Chotanagpur plateau to the south. South Bihar plain is narrower than North Bihar plain and is triangular, in shape. Many hills are located in this alluvial plain, like, hills of Gaya, Rajgir, Bihar Sharif, Nalanda, Jamalpur and Sheikhpura. South Bihar plain is located between 24°46'48" north to 25°30'21" north latitude and 83°36'20" to 86°59'20" east longitude. This region has been mentioned in Hindu epics like Ramayana and Mahabharata and once a center of Buddhism extends over 46179 sq.km., and bordered by Kaimur district in the West Banka in the East. It gradually tapers towards east but widen towards west. There is a general slope from South to North and the elevation decreases from 500 feet in South to only 100 feet in the north, with an average elevation of 173 feet. Gang is the main river in this region which flows from west to east in the Middle of Bihar and north of South Bihar plain. The rivers of South Bihar flow through alluvial deposits and from a wide flood plain and the catchment of these rivers are larger. The drainage pattern is trellis and dendritic due to physical conditions. Ganga, the master stream enters into the state from Chausa, which forms the boundary of Bhojpur and Saran districts. Ganga later on joined by three large rivers, viz., Ghaghra, Gandak and Son. Bihar has a continental type of climate with three district seasons. South Bihar plain is comparatively warmer than North Bihar plain, because of its distant location from Himalayas. Eastern part experiences humid climate, whereas, western parts have dry climatic conditions due to continental effect, in other words distant location from Bay of Bengal. It means there is variation in climatic condition from north to south, especially from east to west, therefore South Bihar plain experiences modified monsoon climate.

South Bihar plain has also some good resources like Bauxite in district Jamui, whereas, Bhabhua is rich in cement mortar, dolomite and Glass sand. Apart from this mica is found in Nawada, Jamui and Gaya. One of the precious mineral, Uranium and Beryllium are also found in Gaya district, whereas, precious metal Gold is found in Jamui.

The economy of South Bihar plain is dominated by agriculture due to alluvial soil and irrigation facilities from different rivers, and the chief crops are rice, wheat and oilseeds. Apart from agriculture, stone quarries, and some cottage industries produces textiles, sugar, paper and vegetable oil, and large number of handlooms and power looms are also found in Gaya and Bhagalpur. Munger has a cigarette, factory, whereas, Jamalpur has the country, major railway engineering workshops. Above all Patna the capital city of Bihar and Gaya, the religious center for both Hindus and Buddhist, are educational centers. According to 2011 census report, Bihar is the third most populous state of India. With a population of 104099452 persons, whereas, South

Bihar plain recorded a total population of 38551925 persons. If we go through the sex ratio in Bihar, in the year 2011, it is 918 female per thousand male, whereas, South Bihar plain recorded sex ratio of 913 female per thousand male, which is little less than the state of Bihar.

3. Objective of the Study

The specific objective of this research paper is to analyse the district wise decadal variation is population growth and sex ratio of South Bihar plain from 1951 to 2011, as against state as a whole. We will also try to find out the reasons behind the unprecedented growth of population and declining sex ratio in the districts of South Bihar plain as well as Bihar state as a whole. Apart from this we will try to find out the correlation between growth of population and sex ratio by means of suitable correlation statistical technique.

4. Database and Methodology

The present study focuses on the district wise comparative analysis of decadal variation of population growth and sex ratio from 1951 to 2011, as well as their correlation. Therefore the study has been primarily based on secondary sources of data. The required data have been collected from census reports published by Government of India as well as Office of Director, Census of Bihar, District Census Handbook of different districts of South Bihar plain. The study now extends over seventeen districts in South Bihar plain. Therefore, for purposeful organization of collected data from different secondary sources have been tabulated, computed and analysed, and have been represented by cartographic techniques like, bar graph and choropleth map.

Spatio-temporal analysis of population growth and sex ratio must be studied in time perspective too. The present research paper covers a time period from 1951 to 2011, because the growth of population occurred at faster pace from 1951.

Apart from the spatio-temporal variation of population growth and sex ratio, present study also depicts the comparative analysis of sex ratio and population growth from 1911 to 2011. Therefore, the correlation between population growth and sex ratio will be carried out by means of a statistical technique put forward by Karl Pearson. Karl Pearson's coefficient of correlation is very useful statistical method in which the numerical values are applied to measure the level of linear relationship between two related variables, which is expressed by r and the formula read as follows:

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

The aforesaid basic formula can be represented in the following manner,

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

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

$$= \frac{\sum dxdy}{N\sqrt{\frac{\sum d_x^2 \text{ x } \sum d_y^2}{\text{N x N}}}} \qquad = \frac{\sum dxdy}{\frac{N}{N}\sqrt{\sum d_x^2 \text{ x } \sum d_y^2}}$$

$$= \frac{\sum dxdy}{\sqrt{\sum d_x^2 \text{ x } \sum d_y^2}}$$

Therefore, the correlation between growth of population and sex ratio will be based on the formula derived from the basic formula put forward by Karl Pearson. The numerical value obtained after calculation will be classified into high, moderate and low levels and on the basis of these categories all the seventeen districts will be mapped by means of choropleth technique of cartography.

Spatio-temporal Variation in Growth of Population

Since, there is fluctuation in growth of population from 1901 to 1951, therefore, a detailed account of growth of population will be presented after 1951. An analysis of district level growth of population in South Bihar and state of Bihar as whole shows a continuous increase till 2001, but 2011 registered a decline in growth rate from the previous decade. Both Bihar and south Bihar plain registered a decline of 4 percent in the year 2011. If we see the district wise decline of population growth rate, we find that, both Nawada and Jehanabad registered a decline of 10 percent in the year 2011, which is followed by Rohtas with 8 percent decline.

Decline in growth rate may be attributed of improvement in socio-economic condition and awareness towards health facilities, which influenced the fertility rate. Apart from this migration also played an important role, because people migrated to distant places in search of job opportunities and better living conditions.

Population Growth during 1951-61

There has been a rapid increase in the growth of population during this decade in Bihar,because it increased from 11 percent in 1951 to 20 percent in 1961, there is an increase of 9 percent, but surprisingly, South Bihar plain registered a decline of 7 percent, as growth rate declined from 24 percent in 1951 to 17 percent in 1961. This decline in percentage growth of population in South Bihar plain may be attributed to socio-economic backwardness and less developed health facilities. But the higher growth rate in Bihar reflect the improved trade, transport, employment, health facilities and education. Due to improved health facilities and socio-economic status, the living

District wise Decadal Variation in Population Growth and Sex Ratio and their Coefficient of Correlation

Year	Bhagalpur		Banka		Munger		Lakhisarai		Sheikhpura		Nalanda		Patna		Bhojpur		Buxar	
	% Growth	Sex Ratio	% Growth	Sex Ratio	% Growth	Sex Ratio	% Growth	Sex Ratio	% Growth	Sex Ratio	% Growth	Sex Ratio	% Growth	Sex Ratio	% Growth	Sex Ratio	% Growth	Sex Ratio
1901		1057		1057		1045		1045		1045		1020		1020		1096		1096
1911	2	1040	2	1040	3	1046	3	1046	3	1046	-1	988	-1	988	-5	1062	-5	1062
1921	-7	1028	-7	1028	-5	1022	-5	1022	-5	1021	-2	949	-2	949	-3	1029	-3	1029
1931	15	987	15	987	13	998	13	998	13	997	17	931	17	931	10	995	10	995
1941	14	968	14	968	13	998	13	998	13	998	16	935	16	935	17	981	17	981
1951	12	944	12	987	11	940	11	988	11	1007	18	969	18	937	15	1007	15	984
1961	22	929	17	985	19	943	11	995	17	1008	17	967	16	920	16	1029	18	994
1971	22	897	22	938	18	898	25	944	20	952	20	933	21	890	20	977	20	951
1981	27	898	24	931	22	891	22	928	19	942	26	927	34	890	21	952	20	928
1991	21	864	24	893	18	856	21	880	20	896	22	898	20	867	20	904	19	884
2001	27	876	24	908	21	872	24	921	25	918	19	914	30	873	25	902	29	899
2011	25	880	26	907	20	876	25	902	21	930	21	922	24	897	22	907	22	922
Co. Cor	-0.8946		-0.9072		-0.8201		-0.8594		-0.8049		-0.6228		-0.8236		-0.8089		-0.8655	

Year	Kaimur		Rohtas		Aurangabad		Gaya		Nawada		Jamui		Jehanabad		Arwal		BIHAR		S. Bihar	
	% Growth	Sex Ratio	% Growth	Sex Ratio	% Growth	Sex Ratio	% Growth	Sex Ratio	% Growth	Sex Ratio	% Growth	Sex Ratio	% Growth	Sex Ratio	% Growth	Sex Ratio	% Growth	Sex Ratio	% Growth	Sex Ratio
1901		1096		1096		1037		1037		1037		1045		1037		1037		1061		1,052
1911	-5	1062	-5	1062	5	1035	5	1035	5	1035	3	1046	5	1035	5	1034	2	1051	0	1,033
1921	-3	1029	-3	1029	0	1003	0	1003	0	1003	-5	1022	0	1003	0	1003	-1	1020	-13	1,003
1931	10	995	10	995	11	1001	11	1001	11	1001	13	998	11	1001	11	1001	10	995	27	982
1941	17	981	17	981	16	1001	16	1001	16	1001	13	998	16	1001	16	1001	12	1002	6	977
1951	15	963	15	955	11	991	11	995	11	1040	11	1013	11	980	11	980	11	1000	24	976
1961	21	976	23	959	19	1001	18	996	21	1054	21	1020	17	1000	17	1008	20	1005	17	978
1971	25	932	26	924	22	964	24	961	21	1017	24	985	19	951	22	962	21	956	22	891
1981	19	907	23	909	22	956	25	966	23	1001	21	967	21	952	18	959	24	948	24	931
1991	24	884	22	894	24	915	24	921	24	936	22	903	18	915	21	926	23	907	22	894
2001	31	902	28	910	31	934	30	938	33	946	33	918	31	925	26	935	29	919	28	907
2011	28	920	20	918	26	926	26	937	23	939	26	922	21	922	19	928	25	918	24	913
Co. Cor.	-0.8988		-0.9185		-0.8295		-0.8427		-0.5380		-0.7573		-0.7585		-0.7477		-0.8762		-0.6695	

Source: Calculated by author, based on Census Reports

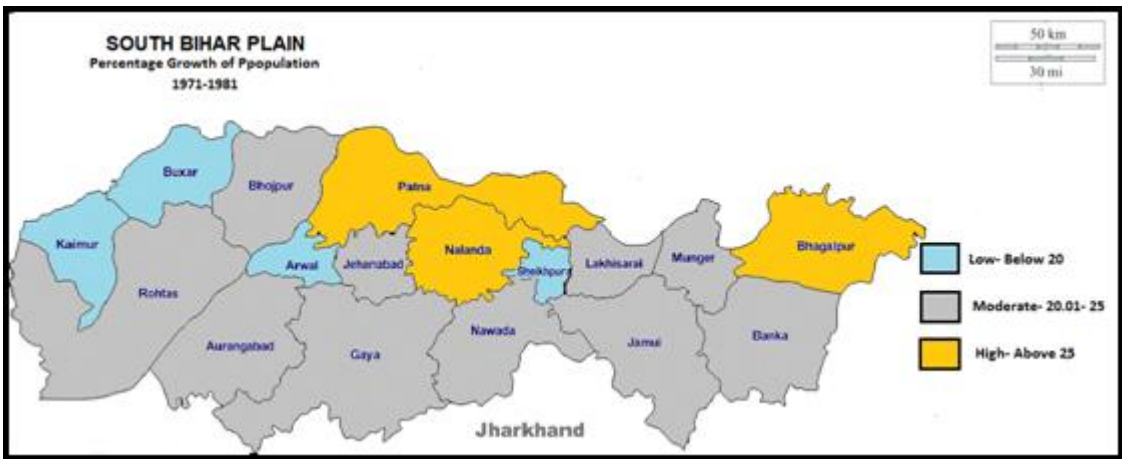
conditions have improved, which resulted into decline in death rate and faster natural increase of population. If we go through the districts of South Bihar plain, we find that Rohtas recorded the highest growth rate of 23 percent, which is followed by Bhagalpur with a growth rate of 22 percent, whereas, Lakhisarai recorded the lowest growth rate of 11 percent. If we categorize the South Bihar plain according to decadal percentage growth rate into Low (below 20), Moderate (20.01 – 25) and High (Above 25), there are twelve districts, namely, Banka, Munger, Lakhisarai, Sheikhpura, Nalanda, Patna, Jehanabad, Gaya, Arwal, Aurangabad, Bhojpur and Buxar, which recorded low growth of population, whereas, five districts can be categorized under moderate growth of population, these are Bhagalpur, Jamui, Nawada, Rohtas and Kaimur. Out of seventeen districts, none can be categorized under very high growth of population.

Population Growth during 1961-71

In the census year 1971, south Bihar plain registered a higher growth of population with a growth rate of 22 percent, which is 1 percent higher than the growth rate of Bihar. Except two districts, namely, Munger and Jehanabad rest of the districts recorded growth rate which is higher than 20 percent, whereas, maximum growth rate was observed by Rohtas with a growth rate of 26 percent, which is also higher than the state of Bihar. This increase in growth rate may be attributed to the advancement in farming technique, communication and transport facilities, urbanization and decline in death rate due to improved health facilities.

Out of seventeen districts of South Bihar plain, six districts, namely, Mnger, Sheikhpura, Nalanda, Bhojpur, Buxar, Jehanabad, recorded low growth of population between below 20 percent, whereas ten districts, namely Bhagalpur, Banka, Lakhisarai, Patna, Aurangabad, Gaya, Nawad, Jamui, Kaimur and Arwal, recorded moderate growth of population between 20.01 – 25 percent. Apart from this there is only one districts, namely Rohtas, which registered a high growth rate above 25 percent.

Population Growth during 1971-81 According to table, both Bihar plain and Bihar recorded a growth of 24 percent in 1981. Bihar recorded a 3 percent higher growth than the previous decade, whereas, South Bihar plain recorded only 2 percent higher growth than the previous decade. Among all the districts of South Bihar plain the highest growth rate was recorded by Patna, with a growth rate of 34 percent, an increase of 13 percent from the previous decade of 1971. Patna also recorded 10 percent higher growth rate than Bihar and South Bihar plain, whereas, Arwal recorded the lowest growth rate of 18 percent, and it is 4 percent lower than the previous decade of 1971. This unprecedented growth rate during



this period may be attributed to accelerated developmental activities and improvement in health facilities, as well as awareness towards the education.

If we carefully look at the growth rate of all the seventeen districts of South Bihar plain, we find that there are four districts, namely, Sheikhpura, Buxar, Kaimur, and Arwal, recorded growth rate below 20 percent, whereas, ten districts named as Banka, Munger, Lakhisarai, Bhojpur, Rohtas, Aurangabad, Gaya, Nawada, Jamui and Jehanabad recorded moderate growth of population between 20.1 to 25 percent. Apart from these fourteen districts, there are only three districts, named as Bhagalpur, Nalanda and Patna which recorded high growth rate above 25 percent.

Population Growth during 1981-91

During 1981-91, Bihar registered a growth rate of 23 percent which is 1 percent higher than the growth rate of South Bihar plain as a whole, but there is a decline of 1 percent from the previous decade, 1981. In the same way South Bihar plain also registered a decline of 1 percent from the previous decade, with a growth rate of 22 percent. Out of

seventeen districts, only six districts namely, Sheikhpura, Kaimur, Aurangabad, Nawada, Jamui and Arwal, recorded higher growth rate in the census year 1991 than the previous census year 1981. It is very surprising that, five districts named as, Banka, Kaimur, Aurangabad, Gaya and Nawada recorded the highest growth rate of 24 percent, whereas the lowest growth rate during 1981-91, was recorded by two districts, namely, Munger and Jehanabad with the same growth rate of 18 percent.

There are six districts, named as, Munger, Sheikhpura, Patna, Bhojpur, Buxar and Jehanabad, which can be categorized under low growth of population below 20 percent, whereas eleven districts namely, Bhagalpur, Banka, Lakhisarai, Nalanda, Kaimur, Rohtas, Aurangabaad, Gaya, Nawada, Jamui and Arwal can be categorized under moderate growth of population between 2.01 to 25 percent. But none of the districts can be categorized under high growth of population during 1981-91.

Population Growth during 1991-2001

Both Bihar and South Bihar plain recorded a higher growth of population during this period. Bihar registered a growth of 29 percent, which is 6 percent higher than the previous census year of 1991. In the same way South Bihar plain also registered a higher growth rate of 28 percent, which is also 6 percent higher than the previous census year. Out of the seventeen districts, the highest growth rate was observed by Nawada and Jamui, with the same growth rate of 33 percent and districts, namely, Patna, Kaimur, Aurangabad, Gaya, Nawada, Jamui and Jehanabad, recorded a growth rate which is higher than the state of Bihar. Apart from this, the lowest growth rate was observed by Nalanda, with a growth rate of 19 percent, which is 3 percent lower than the previous census year of 1991. This increase in the overall population during this decade in the state of Bihar and South Bihar plain may due to continuous surge in past decade except census year 1991, when growth of population registered a sharp decline. It is important to note that Patna, Gaya, Nawada, Jamui and Jehanabad have contributed much to the growth of population during this period. Being a capital and prime city of Bihar, Patna has more pull factors than other districts, for migrants. In spite of this fact division headquarters also attracted people from different neighboring districts. In the same way Gaya, acenter of learning and religious place for both Hindus and Buddhists attracted people from different adjoining districts, as well as from different states like, Jharkhand, Uttar Pradesh and West Bengal.

If we categorize all the seventeen districts into low, moderate and high growth of population, we find that there is only one district namely, Nawada, which can be categorized under low growth of population, below 20 percent, whereas there are five districts, named as, Banka, Munger, Lakhisarai, Sheikhpura and Bhojpur,which can be categorized under moderate growth of population between 20.01 to 25 percent. Apart from these six districts, rest of the eleven districts, namely, Bhagalpur, Patna, Buxar, Kaimur, Rohtas, Aurangabad, Gaya, Nawada, Jamui, Jehanabad and Arwal recorded high growth of population above 25 percent.

Population Growth during 2001-2011

Census year 2011 witnessed a decline in growth of population both in Bihar and South Bihar plain as a whole. Bihar registered a growth of 25 percent which is 4 percent lesser than previous census year 2001. In the same way South Bihar plain also registered a decline of 4 percent with a growth rate of 24 percent. Out of seventeen districts, there are five districts, namely Banka, Kaimur, Aurangabad, Gaya and Jamui, which recorded higher growth rate than the state of Bihar and South Bihar plain. Kaimur registered the highest growth rate of 28 percent, which has been followed by Banka, Aurangabad, Gaya and Jamui which the same growth rate of 26 percent and the lowest growth rate was observed by Arwal with a growth rate of only 19 percent, but there is a sharp decline of 7 percent from the previous census year 2001. Bihar as well as South Bihar plain registered a sharp decline in growth rate as India witnessed a steepest decline in decadal growth rate since independence in the year 2011. This decline in growth rate, both in Bihar and South Bihar plain may be attributed to migration of rural and urban people to the National capital, Delhi, and neighboring state capital, Kolkata, even commercial capital of India, Mumbai, in search of employment and better living conditions.

If we take the similar classification approach of classifying districts of South Bihar plain into low, moderate and high, we find that, there three districts, namely, Munger, Rohtas and Arwal, which can be categorized under low growth of population, whereas, there are nine districts, named as, Bhagalpur, Lakhisarai, Sheikhpura, Nalanda, Patna, Bhojpur, Buxar, Nawada, and Jehanabad, can be categorized under moderate growth of population between 20.01 – 25 percent. Apart from these twelve districts, five district namely, Banka, Kaimur, Aurangabad, Gaya and Jamui are categorized under very high growth of population above 25 percent.

This change in the growth of population has been affected by fertility rate, mortality rate and migration. Human being has found cure from the dreaded disease due to advancement in medicine and health facilities, which has resulted into decrease in death rate but fertility did not decline, so rapidly as mortality rate declined. After independence the gap between mortality and fertility rate has increased, which led to higher growth of population. But census year 2011, registered a sharper decline because the birth rate has been continuously declining from 2006 onward from 29.9 per cent in 2006 to 26.3 percent in 2011, there has been a decline of 3.6 percent during this period.

Variation in Sex Ratio

Sex ratio largely affects the socio-economic and cultural characteristics of any region, therefore, it is necessary to study sex composition for understanding different aspect of the society. India with a sex ratio of 940 females per thousand males recorded lowest among all the neighboring countries in 2011, except China, with a sex ratio of 926 females per thousand males. Sex ratio always remained unfavorable for female, because of patriarchal society in India. But Bihar recorded sex ratio favorable to female from 1901 to 1961, except 1931, whereas, South Bihar plain recorded favorable sex ratio till 1921. Higher sex ratio may be attributed to the fact that Indian religion and philosophy considered womanhood nearer to divinity and respectable position of pride has been assigned by our religious scriptures. Social reforms have been brought by social reformers against Sati Pratha, child marriage, female infanticide and prevention of widow remarriage. The great saint Swami Vivekanand stated that the country which had no respect for womanhood could never become great. India's nationalist movement under Gandhiji's leadership brought changes in prevailing attitude towards women in our society. Census year 2011 reveals an alarming sex ratio both in Bihar and South Bihar plain as a whole. Bihar recorded a sex ratio of 918 female per thousand males, whereas, South Bihar plain, even recorded lesser than Bihar, with a sex ratio of 913 females per thousand males, which is far less than the national sex ratio of 940 females per thousand males. But there the census year 2001 and 2011 registered an improvement in the sex ratio from the previous decades.

Sex Ratio during 1951-61

Census year 1961, registered favorable sex ratio in Bihar, with a sex ratio of 1005 females per thousand males, which is 5 points higher than the previous census year 1951, whereas, South Bihar plain recorded a sex ratio of 978 females per thousand male which is much less than the sex ratio of Bihar, but it is 2 points higher than the previous census year. Out of seventeen districts, seven districts, namely, Sheikhpura, Bhojpur, Aurangabad, Nawada, Jamui, Jehanabad and Arwal recorded sex ratio, which is favorable

to females, whereas the highest sex ratio was observed by Nawada with a sex ratio of 1054 females per thousand males. It may be due to literacy rate, which remained higher as compared to other districts and Patna recorded the lowest sex ratio of 920 females per thousand males.

If we classify the districts of South Bihar plain according to sex ratio into low (below 900), moderate (900.01 – 920.00), high (920.01 – 940.00) and very high (above 940), we find that none of the districts can be categorized under low sex ratio. It may

be attributed to the fact that the actual decline in sex ratio started. Patna is the only district, which recorded moderate sex ratio with a sex ratio of 920 females per thousand male. Similarly, Bhagalpur is the only district, which can be categorized under high sex ratio, with a sex ratio of 929 females per thousand male. Apart from these two districts, fifteen districts, namely, Banka, Munger, Lakhisarai, Sheikhpura, Nawada, Bhojpur, Buxar, Rohtas, Aurangabad, Gaya, Nawada, Jamui, Jehanabad, Nalanda and Arwal recorded very high sex ratio above 940 females per thousand males.

Sex Ratio during 1961-71

Census year 1971 registered a decline in sex ratio in Bihar as well as South Bihar plain. Bihar recorded a decline of 49 points from the previous census year 1961, with a sex ratio of 956 females per thousand males, whereas, South Bihar plain recorded a decline of 87 points with a sex ratio of 891 females per thousand males. Among all the seventeen districts of South Bihar, Nawada recorded the highest sex ratio of 1017 females per thousand males, whereas, Patna recorded the lowest sex ratio of 890 females per thousand males, which is 30 points lower than the previous census year.

If we categorize districts of South Bihar plains according to the sex ratio in low, moderate, high and very high, we find that there are three districts namely, Bhagalpur, Munger, and Patna, which can be categorized under low sex ratio below 900, but none

of the district can be categorized as moderate sex ratio. We can observe from the table that there are four districts, namely, Banka, Nalanda, Kaimur and Rohtas, which can be categorized as districts of high sex ratio between 920.01 to 940 females per thousand males. Out of the total seventeen districts in South Bihar plain, ten districts, namely, Lakhisarai, Sheikhpura, Bhojpur, Buxar, Aurangabad, Gaya, Nawada, Jamui, Jehanabad and Alwar, registered very high sex ratio above 940 females per thousand males.

Sex Ratio during 1971-81

During 1971-81, Bihar registered a decline of 8 points with sex ratio of 948 females per thousand male, whereas, South Bihar plain recorded a sex ratio of 931 females per thousand males which is 40 points higher than the previous census year of 1971. Out of seventeen district, eight districts, named as, Sheikhpura, Bhojpur, Aurangabad, Gaya, Nawada, Jamui, Jehanabad and Arwal registered, sex ratio higher than South Bihar plains, but seven districts, namely, Bhojpur, Aurangabad, Gaya, Nawada, Jamui, Jehanabad and

Arwal recorded, sex ratio which is higher than Bihar state. As usual Nawada recorded the highest sex ratio amongst all the districts of South Bihar plain, even till 1981, Nawada maintained sex ratio, which remained favorable to women since 1901. Apart from this Patna, with a sex ratio of 890 females per thousandmales recorded the lowest sex ratio amongst all the districts of South Bihar and maintained the sex ratio of previous census year 1971. Patna is followed by Munger with a sex ratio of 891 and Bhagalpur (898). Out of seventeen districts there are only three districts, namely, Bhagalpur, Gaya and Jehanabad, which registered an improvement in sex ratio from the previous decade.

The stratification of all the districts of South Bihar plain according to sex ratio reveals that there are three districts, namely, Bhagalpur, Munger and Patna, which recorded low sex ratio, below 900 females per thousand male, whereas, two districts, namely Kaimur and Rohtas, can be categorized under moderate sex ratio between 900.01 – 920 females per thousand males. Four districts, named as Banka Lakhisarai, Nalanda and Buxar, are categorized under high sex ratio between 920.01 to 940 females per thousand males, whereas, rest of the eight districts, namely, Sheikhpura, Bhojpur, Aurangabad, Gaya, Nawada, Jamui, Jehanabad and Arwal are categorized under very high sex ratio above 940 females per thousand males. Improvement in sex ratio may be attributed to emigration of male population to the distant places in search of better job opportunities and health facilities. Higher number of districts categorized under very high sex ratio is a positive sign toward the declining sex ratio.

Sex Ratio during 1981-91

Census year 1991 registered a sharp decline in sex ratio both at state level and South Bihar as a whole. Bihar with a sex ratio of 907 females per thousand males registered a decline of 41 points from the previous census year, whereas South Bihar plain with a sex ratio of 894 females per thousand males recorded a decline of 37 points which is 4 points lower than the state of Bihar. As usual Nawada again registered the highest sex ratio (936) among all the seventeen districts, Nawada has be followed by Arwal with a sex ratio of 926 females per thousand male, whereas the lowest sex ratio has been observed by Munger with a sex ratio of 856 females per thousand male.

Out of the seventeen districts in South Bihar plain, Bhagalpur, Banka, Munger, Lakhisarai, Sheikhpura, Nalanda, Patna, Buxar, Kaimur, and Rohtas can be categorized under low sex ratio below 900 females per thousand male, whereas, Bhojpur, Aurangabad, Jamui and Jehanabad are categorized under moderate sex ratio between 900.01 to 920 females per thousand males. Apart from the above fourteen districts there are only three districts, namely, Gaya, Nawada and Arwal, which are categorized under high sex ratio between 920.01 to 940 females per thousand males and none of the district can be categorized under very high sex ratio above 940 females per thousand males. This is a matter of grave concern that larger number of districts in South Bihar plain has been categorized under

low sex ratio, i.e., below 900 females per thousand males. Declining sex ratio has become a challenge towards our society and state as well as central government. It may also be attributed to literacy rate, because of awareness women have been opting for sex determination, and as they come to know that they are having girl child, the immediately go for abortion, because of girl child prejudice.

Sex Ratio during 1991-2001

Census year 2001, helped us to take a respite from the gloomy data of declining sex ratio in 1991. Bihar with a sex ratio of 919 females per thousand males recorded 12 points higher sex ratio than the previous census year, whereas, South Bihar plain as a whole recorded a 13 points higher sex ratio than previous census year 1991, with a sex ratio of 907 females per thousand males. Nawada again registered the highest sex ratio of 946 females per thousand males, which is followed by Arwal with a sex ratio of 935 females per thousand male, whereas the lowest sex ratio was observed by Munger, with a sex ratio of 872 females per thousand males. Nawada with the highest sex ratio recorded 10 points higher than the previous decade, whereas, Munger, with the lowest sex ratio, recorded 16 points higher sex ratio.

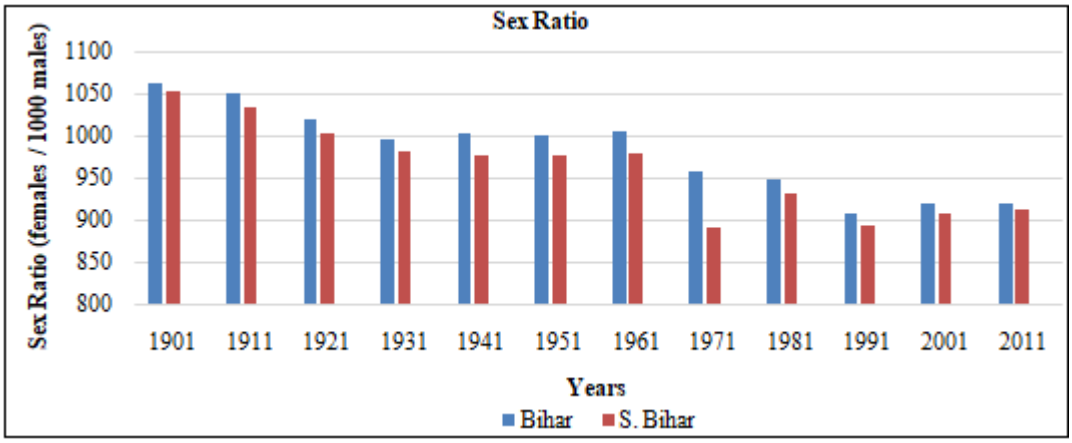
If we categorize all the seventeen districts of South Bihar plain in low, moderate, high and very high, we find that there are four districts, namely, Bhagalpur, Munger, Patna and Buxar are categorized under low sex ratio below 900, whereas, Banka, Sheikhpura, Nalanda, Bhojpur, Kaimur, Rohtas and Jamui are categorized under moderate sex ratio between 900.01 to 920 females per thousand males. Apart from these eleven districts, Lakhisarai, Aurangabad, Gaya, Jehanabad and Arwal are categorized under high sex ratio between 920.01 to 940 and only one districts named as Jehanabad (946) has been categorized under very high sex ratio above 940 females per thousand and males.

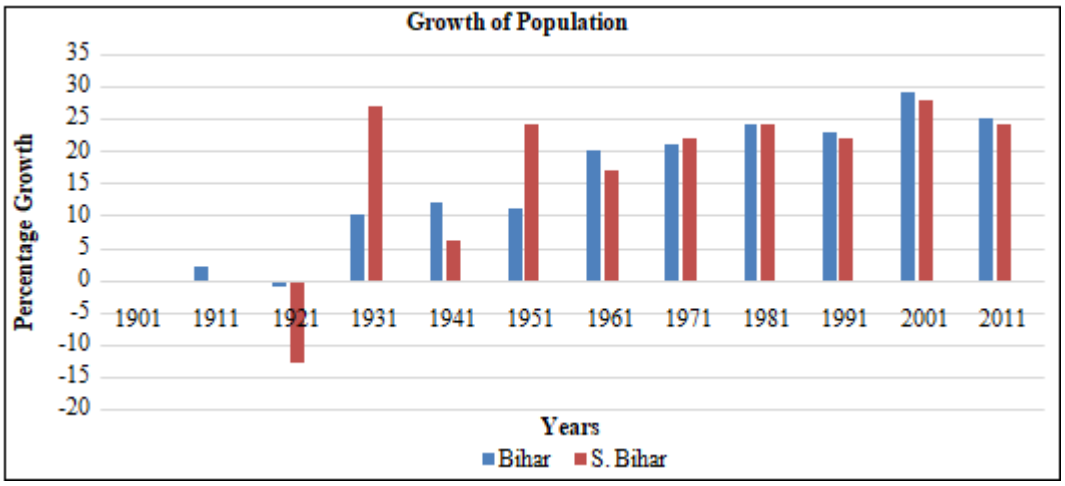
Sex Ratio during 2001-2011

During 2001-2011, Bihar registered a decline of 1 point from previous census year of 2001, with a sex ratio of 918 females per thousand males, whereas, South Bihar plain as a whole registered a growth of 6 points with a sex ratio of 913 females per thousand male as compared to 907 females per thousand males in 2001. In the census year 2011, Nawada again registered the highest sex ratio of 939 females per thousand males, which is followed by Gaya (937), Sheikhpura (930) and Arwal (928), whereas, the lowest sex ratio was observed by Munger with a sex ratio of 876 females per thousand males. District level data of sex ratio is somewhat discouraging, because out of seventeen districts, namely, Banka, Lakhisarai, Aurangabad, Gaya, Nawada, Jehanabad and Arwal registered sex ratio, which is lower than the previous census year of 2001. Eleven districts of South Bihar plain registered a sex ratio, which is higher than the state of Bihar. Similarly there are eleven districts which recorded sex ratio higher than south Bihar plain (913).

Out of seventeen districts, three districts, namely, Bhagalpur, Munger and Patna are categorized under low level of sex ratio, below 900. On the other hand Banka, Lakhisarai, Bhojpur, Kaimur, and Rohtas are categorized under moderate sex ratio between 900.01 to 920. Apart from the above mentioned districts, nine districts, namely, Sheikhpura, Nalanda, buxar, Aurangabad, Gaya, Nawada, Jamui, Jehanabad and Arwal are categorized under high sex ratio between 920.01 to 940 females per thousand male, but none of the district can be categorized under very high sex ratio above 940 females per thousand male.

It is very surprising that Nawada always registered the highest sex ratio in the respective census year, and Patna, the capital city of Bihar normally registered the lowest sex ratio among all the districts of South Bihar plain. The low level of sex ratio in Patna may be attributed to literacy rate, which encouraged women to go under sex selective abortion due to prejudice against girl child in the society, whereas, the high sex ratio as compared to other districts in Nawada may be attributed to the migration of young and working people to distant places and adjoining states in search of better job opportunities and living conditions.





Correlation between Sex Ratio and Growth of Population

The ratio of females to per thousand males, in other words sex ratio, strongly affects the growth of population. Higher female population can have a substantially higher birth rate than predominantly male population. For perpetual and continuous existence of human population, it is necessary that the process of reproduction should remain continue. There must be sufficient number of eligible males and females for the continuous reproduction, which will ultimately lead to growth of population. Therefore, it is necessary to keep balance between the male and female population. Imbalance in sex ratio may arise due to various reasons like, natural incident, war, sex selective abortion,

etc. Naturally in human population more males are born. It may be due to the biological characteristics of X and Y chromosomes, Y chromosomes are comparatively lighter than X chromosomes, therefore, it moves faster and reaches to egg, earlier. Y chromosomes are responsible for birth of baby boy. Therefore, more males areborn, but males experiences higher mortality as compared to female, at all ages after birth. But during last one century it has been observed that the birth rate of girl child and total population has been declining in India and almost all the state. In spite of the fact, till 1961, Bihar observed sex ratio in favor of females, but after that there has been a continuous decline. The sex ratio within a population has a significant impact on growth of population because it affects the marriage, and ultimately affect the birth rate.

In our country and especially state like Bihar, where the literacy is at the lowest level among all the states, imbalance in sex ratio is matter of grave concern, because it affects the growth of population. Strong son preference and discrimination against girls is widespread in Bihar and especially in South Bihar plain. Discrimination leads to imbalanced sex structure of population and affects demography of the state, such as population growth, rate of increase of elderly people, insufficient people of working age. Which will ultimately hinders the productivity, efficiency and economic progress of the state.

Table shows the relationship between decadal variation in population growth and sex ratio. The correlation between these two variables has been carried out by means of Karl Pearson's method of coefficient of correlation. On the basis of the correlation obtained by means of aforesaid statistical technique we can say that all the districts of South Bihar plain and state of Bihar as well as South Bihar plain as a whole reflected a negative correlation. It means population kept on growing but sex ratio continuously declined during last century.

If we classify all the districts of South Bihar plain into Low level of negative correlation (0 to -0.25), Medium level of negative correlation (-0.25 to -0.75) and High level of negative correlation (-0.75 to -1), we find that there are twelve districts, namely,

Bhagalpur, Banka, Munger, Lakhisarai, Sheikhpura, Patna, Bhojpur, Buxar, Kaimur, Rohtas, Aurangabad, and Gaya are categorized under high level of negative correlation between -0.75 to -1, whereas, there are five districts, named as, Nalanda, Nawada, Jamui, Jehanabad and Arwal which can be categorized under medium level of negative correlation between -0.25 to -0.75. None of the district can be categorized under low level of negative correlation. The highest negative correlation has been observed by Rohtas (-0.9185), because of higher population growth and declining sex ratio, whereas the lowest negative correlation has been observed in Nawada (-0.5380). It is only because of the fact that among all the seventeen districts of South Bihar plain Nawada alone recorded highest sex ratio, throughout the census year from 1901 to 2011 and maintained sex ratio in favor of females till 1981. Bihar registered a high level of negative correlation (-0.8762), whereas, South Bihar plain as whole, recorded medium level of negative correlation (-0.6695). Out of seventeen districts, four districts, namely, Bhagalpur, Banka, Kaimur and Rohtas, recorded negative correlation higher than the state of Bihar.

5. Conclusion

South Bihar plain is located south of river Ganga and extends over the fertile alluvial land formed by Himalayan River Ganga and its tributaries and distributaries. South Bihar plain has been characterized by very high population growth rate and low sex ratio as compared to the country. This high growth of population along with low sex ratio has hampered the socio-economic development of the study area, which aggravated the poverty and reduced the employment opportunities. Bihar ranks among top three populated states of the country. South Bihar plain has been characterized by very high population growth, 28 percent in 2001 and 24 percent in 2011, with a decline of 4 points. Similarly Bihar registered even a higher growth rate of 29 percent in 2001 and 25 percent in 2011, with a decline of 4 points, similar to South Bihar plain. But one of the most encouraging thing is that Bihar registered a sex ratio, which remained favorable to women till 1961, except the year 1931, when sex ratio went down to 995, but in South Bihar plain sex ratio remainedfavorable to women till 1921, and almost same trend has been observed among all the districts of South Bihar plain, except Patna, where the sex ratio

remained favorable to women in 1901 only. Among all the district of South Bihar plain sex ratio remained unfavorable to women after 1931, but Nawada registered sex ratiofavorable to woman till 1981. The sex ratio started declining in Bihar from 1061 in 1901 to 918 in 2011, almost same conditions prevails in South Bihar plain, but the population growth rate kept on growing from 2 percent in 1911 to 25 percent in 2011 and 0.23 percent in South Bihar plain in the year 1911 to 24 percent in 2011. This skewed sex ratio along with high growth rate of population is very unfortunate and is a cause of concern. The decline in sex ratio may be due to son preference in the society, they are supposed to continue the family lineage and are recipients of inheritance as well as considered to earn higher wages in a state like Bihar, where, economy is based on agriculture. On the other hand girl child are considered as a burden because of deep rooted dowry system in Bihar, which leads to sex selective abortion of girl child. In spite of declining sex ratio, growth of population occurred at faster pace, but year 2011 registered a decline in population growth rate from the previous census year of 2001. This decline may be attributed to use of contraceptives for birth control and inclination towards family planning.

The ratio of females per thousand male, in other words sex ratio strongly affects the growth of population. Substantially higher birth rate can be observed in predominantly female population as compared to predominantly male population. Therefore, it is necessary to keep balance between male and female population to keep the perpetual existence of human population. In this concern significant measures should be taken,and the key issue is not only the growing population and declining sex ratio, but its consequences are far too worse, as it appears at first sight, like crime against women and social injustice. But there is a hope from the last census year 2011, when population growth rate registered a declining trend and sex ratio observed an improvement from 907 females per thousand females in 2001 to 913 females per thousand males in South Bihar plain, and most of the districts also reported an improvement in sex ratio.

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