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Mamon Chowdhury
Research Scholar, Jamia Millia
Islamia, New Delhi, India

Spatial pattern of age-specific sex ratio in urban areas in West Bengal, India: A district-level analysis

Mamon Chowdhury

Abstract

A low sex ratio is noted over the northern, central, south-western, and southern parts which are very low to very high industrially developed regions. Nearly eleven districts of central and northern, south-eastern, and western parts have reported above state-level urban sex ratio (944) in all age groups. Around 37% of the total districts noted a low urban sex ratio (<936) and 10% of districts reported moderate (937-950) while the remaining 53% district has experienced a high (>951) sex ratio. In the Juvenile (<16 years) group, nearly 26% of districts of central-north and southern parts have noted a high sex ratio (>954). In the active age group (16-59), approximately 32% of districts of northern and south-eastern parts have reported a high sex ratio (>970). While at the senile age group (>60 years), a high sex ratio is observed compared to other age groups, therefore, 32% of districts have noted more than 1000 sex ratio. Uneven rate of change of sex ratio is noted from 1951 to 2011. Maldah has noted a negative (-4%) rate of change of sex ratio while other districts experienced a positive sex ratio in 2011. However, this paper attempt to examine the overall urban sex ratio in West Bengal in 2011 on the one hand and the age-specific sex ratio on the other hand. To find out the trend of sex ratio, the rate of change has been assessed.

Keywords: Sex ratio, rate of change, age group, district, population, peripheral, urban

1. Introduction

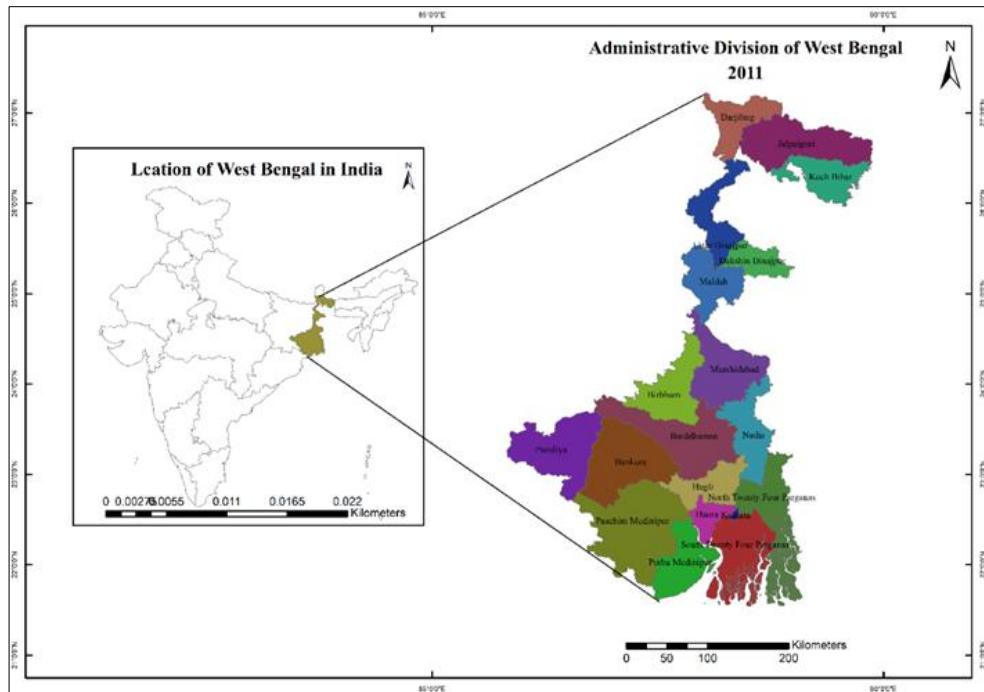
The sex ratio is generally defined as the number of females per 1000 of the male population. The sex ratio is one of the most important components of social indicators. It is a significant variable that denotes the quality of life, population composition, the work participation rate in various activities, and the level of development of society. Nevertheless, it is seen that literacy and economic development have a positive relationship with a sex ratio (Saha and Debnath, 2016) [22]. In worldwide, the sex ratio is 980 (102 male per 100 female). But in Asia and Oceania males are more than females (105 and 100.2 males per 100 females respectively), on the other hand, the number of females are more in Africa (99.5), Europe (92.9), Latin America and Caribbean (97.2), and Northern America (97.7) (UN, 2011). In India, the overall sex ratio is 943 where rural is 947 and urban is 926 (Census of India, 2011). At the state level, Kerala has recorded the highest sex ratio (1058) and Haryana has noted the lowest (861). The urban sex ratio of West Bengal (944) is concerned, it is lower than the overall sex ratio of the state (950), but it is higher than the country's overall sex ratio (943) in 2011. It is observed that some districts like Maldah, Uttar Dinajpur, Jalpaiguri, Barddhaman, Puruliya, Haora, and Kolkata have recorded very low sex ratio in all ages as well as different age groups. It should be pointed out that except for Kolkata and Haora, all districts are socio-economically backward. It is detected that the highest sex ratio (nearly 949) was recorded over the sixty years of age group population in the state.

2. Database and methodology

2.1 Study Area

West Bengal is spread over an area of 88,752 sq. km. which is 2.70% of India's total geographical area and it is the fourth largest state of India by size. West Bengal is situated between 21° 25' North to 27° 13' North latitudes and 85° 48' East to 89° 53' East longitudes. It adjoining with three international boundaries which are Nepal, Bangladesh, and Bhutan. West Bengal is divided into 19 districts as per the 2011 Census, under 3 administrative units (Jalpaiguri Division, Barddhaman Division, and Presidency Division (Figure 1).

Corresponding Author:
Mamon Chowdhury
Research Scholar, Jamia Millia
Islamia, New Delhi, India

**Fig 1:** Location Map of West Bengal

2.2 Data source

This study is secondary data based. The pertinent data is taken from social and cultural table, census of India 2011.

2.3 Selection of Indicators and Variables

Indicators	Variables
Sex ratio	1. Total sex ratio (%) Juvenile sex ratio (%) Active age sex ratio (%) Senile sex ratio (%)
Rate of change	2. Rate of change of sex ratio (%)

2.4 Data Analysis Method

2.4.1 Statistical Processing of Data

$$SR = F/M * 1000 \quad (1)$$

Where,
SR=Sex ratio,
F=female,
M=male

$$SR_{a0-15} = F_{a0-15}/M_{a0-15} * 1000 \quad (2)$$

Where,
SR_{a0-15}= Sex ratio at the age group of 0-15 years,
F_{a0-15}= female at the age group of 0-15 years,
M_{a0-15}= male at the age group of 0-15 years

$$SR_{a16-59} = F_{a16-59}/M_{a16-59} * 1000 \quad (3)$$

Where,
SR_{a16-59}= Sex ratio at the age group of 16-59 years,
F_{a16-59}= female at the age group of 16-59 years,
M_{a16-59}= male at the age group of 16-59 years.

$$SR_{a>60} = F_{a>60}/M_{a>60} * 1000 \quad (4)$$

Where,

SR_{a>60}= Sex ratio at the age group greater than 60 years,
F_{a>60}= female at the age group greater than 60 years,
M_{a>60}=male at the age group greater than 60 years.

$$\text{Rate of change of sex ratio} = SR_{pr} - SR_p/SR_p * 100 \quad (5)$$

Where,

SR_{pr}= present sex ratio,

SR_p= past sex ratio

From 1 to 5 equation, a denoted age group.

2.4.2 Cartographic Representation of Data

Based on the general urban sex ratio, the study area has been classified into three categories; very low to low sex ratio districts, moderate sex ratio districts, high to very high sex ratio districts. On the other hand, the age-specific sex ratio has been analysed through three age groups; Juvenile sex ratio (0-15), Active age sex ratio (16-59), and Senile sex ratio (>60 years). Each age group of sex ratio has been classified into three groups; low, medium, and high. Based on sort out data, choropleth maps are drown out by using ArcGIS to illustrate the regional difference of sex ratio of 2011. On the other hand, the rate of change of sex ratio has been shown through bar graph from 1951-2011. The trend line of growth rate for 2001-2011 has been drawn with four quartiles as per the district's growth rate.

3. Results and Discussion

It is noted that the sex ratio in urban areas across districts in West Bengal is inadequate. It is perceived that the imbalanced sex ratio is the result of the son's preference and dislike of a daughter. The educational level of women plays a significant role in the ascertain child sex ratio in India (Inchani and Lai, 2008) [14]. It has been noticed that out of nineteen districts, eleventh districts namely Darjeeling, Koch Bihar, Dakshin Dinajpur, Murshidabad, Birbhum, Nadia, North 24 Parganas, Hugli, Bankura, South 24

Parganas, and Paschim Medinipur has reported above state-level sex ratio in all age group.

3.1 Very Low to Low Sex Ratio Districts

It has been observed that three districts, namely Uttar Dinajpur, Maldah, and Kolkata, have noted very low (<921), and four districts, i.e., Bardhaman, Puruliya, Haora, and Purba Medinipur, has recorded a low sex ratio (922-936) that consisted 37% of the total districts (Figure 2).

3.2 Moderate Sex Ratio Districts

Only two districts, one northern (Jalpaiguri) and another south-eastern district (Hugli) registered medium criteria (937-950) sex ratio which is 10% of all districts.

3.3 High to Very High Sex Ratio Districts

Under the high category (951-968) sex ratio districts, nearly six districts, namely Darjeeling, Nadia, Birbhum, North and South 24 Parganas, and Bankura. While four districts namely, Koch Bihar, Dakshin Dinajpur, Murshidabad, and Paschim Medinipur have categorized very high (>968) sex

ratio districts. The new developing centers of various socio-cultural-economic activities are pulling more migrants, especially female migrants into four districts. Therefore very high and high, both groups aggregately shared 53% of all 19 districts.

A low sex ratio is generally occurred due to sex-selective migration mainly male (Gautam *et al.*, 2015) [11] and gender biases (Bhat and Zavier, 2003) [21]. Though it is discussed that the sex ratio in Kolkata is low instead of high educational level and economic development because of sex-selective migration from rural areas in search of work (mostly males are more migrating) in Kolkata. This is also revealing that the districts adjacent to Kolkata metropolitan have also experienced a moderate sex ratio. But the high sex ratio is a result of social awareness, high literacy level, the status of women in society, etc. However, it has been assessed that migration has less expectable effects on sex ratio than births and death rates (Dyson, 2012) [5]. Clarke (2000) [2] has appropriately defined that migration tends to be linear, spasmodic, and localized in impacts on sex ratio.

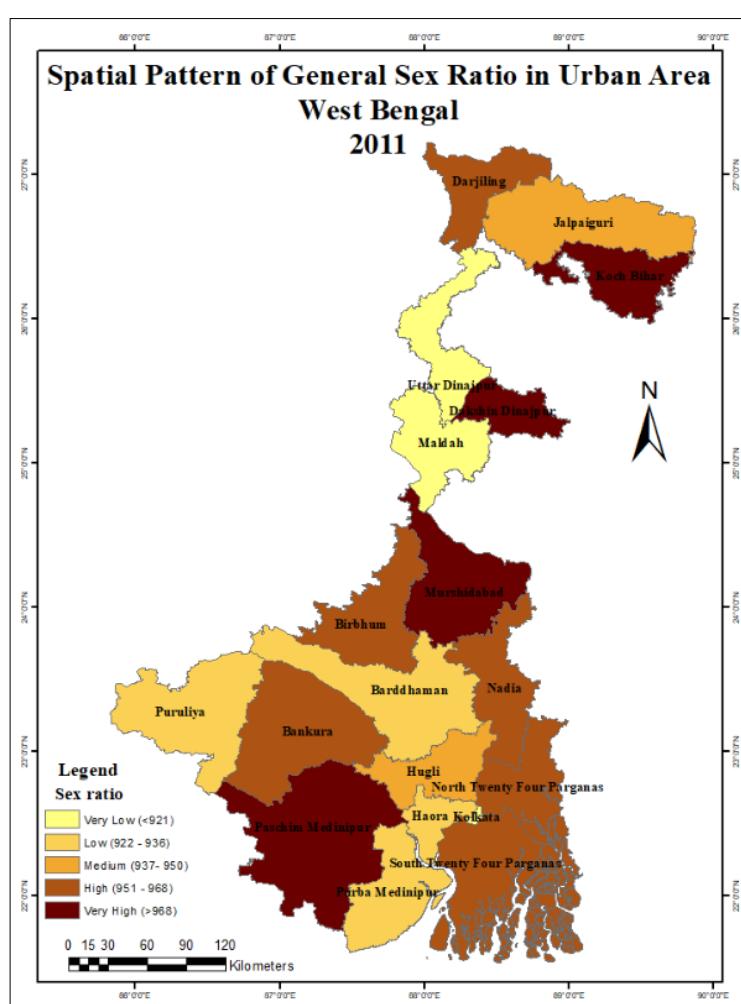


Fig 2: Spatial Pattern of Sex Ratio in Urban Area in West Bengal, 2011

3.4 Age-Specific Sex Ratio

The age-specific sex ratio in urban areas is varied in the same districts as well as among the districts in West Bengal. Senile sex ratio is higher than general, juvenile, and active age group population in West Bengal. Except for a few districts (Darjeeling, Bardhaman, North 24 Parganas, and Hugli), all districts have recorded a higher senile sex ratio than the general urban sex ratio.

3.4.1 Juvenile sex ratio (<16 years)

Age group less than 16 years, sex ratio is 945 in the state where Murshidabad has reported the highest sex ratio (973), followed by Paschim Medinipur (972), Dakshin Dinajpur (971), Nadia (955), and Purba Medinipur (954). On the other hand, Uttar Dinajpur, Darjeeling, Maldah, Bardhaman, North 24 Parganas, Puruliya Kolkata have noted less than the state average (Table 1).

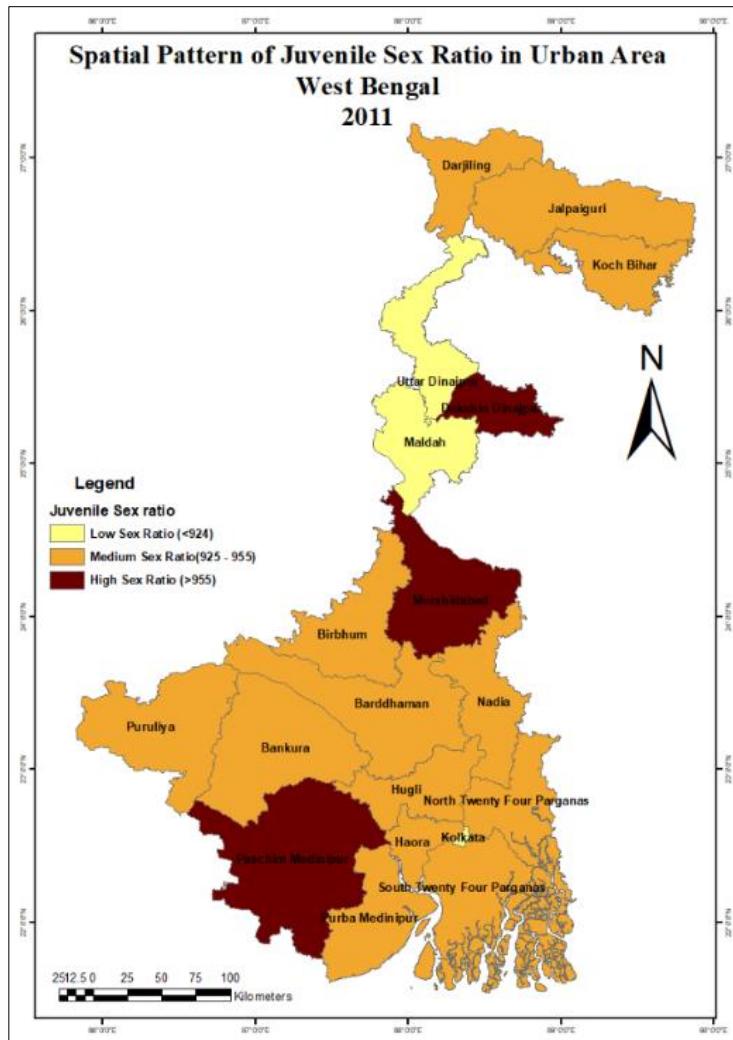


Fig 3: Spatial Pattern of Juvenile Sex Ratio in West Bengal, 2011

It is detected that 16% of districts; two northern and one south-eastern have noted a low juvenile sex ratio (<924) while 68% of districts of northern, south-eastern, and western parts have reported medium (925-955) sex ratio.

And only 16% of districts (Figure 3); Dakshin Dinajpur, Paschim Medinipur, and Murshidabad have registered a high juvenile sex ratio (>955).

Table 1: District level category wise juvenile sex ratio in West Bengal, 2011

Low	% of Total Districts (19)	Medium	% of Total Districts (19)	High	% of Total Districts (19)
Uttar Dinajpur, Maldah, Kolkata	16%	Darjeeling, Jalpaiguri, Koch Bihar, Puruliya, Birbhum, Bankura, Bardhaman, Nadia, Haora, Hugli, both 24 Parganas, and Purba Medinipur	68%	Dakshin Dinajpur, Paschim Medinipur, and Murshidabad	16%

3.4.2 Active age sex ratio (16-59 years)

Age group 16-59, sex ratio is 944 for the state where Paschim Medinipur has shown the highest sex ratio (986) followed by Darjeeling (982), Koch Bihar (978), Dakshin Dinajpur (977), North 24 Parganas, and Birbhum (970).

Maldah has reported a very low sex ratio (902) in this age group that is less than the state average followed by Kolkata (903), Purba Medinipur, Uttar Dinajpur, Haora, Bardhaman, Puruliya, and Jalpaiguri (Table 2).

Table 2: District level category wise active age sex ratio in West Bengal, 2011

Low	% of Total Districts (19)	Medium	% of Total Districts (19)	High	% of Total Districts (19)
Uttar Dinajpur, Maldah, Jalpaiguri, Puruliya, Bardhaman, Haora, Kolkata, and Purba Medinipur.	42%	Birbhum, Bankura, Nadia, Hugli, both 24 Parganas, and Murshidabad.	37%	Darjeeling, Koch Bihar, Dakshin Dinajpur, and Paschim Medinipur.	21%

About 42% of districts of northern, central, southern, and western parts of the state have accounted low active age sex ratio while 37% of districts of central-north and south-

eastern parts has observed medium sex ratio. On the other hand, 21% of districts of northern and south-western have noticed high sex ratio in this age group (Figure 4).

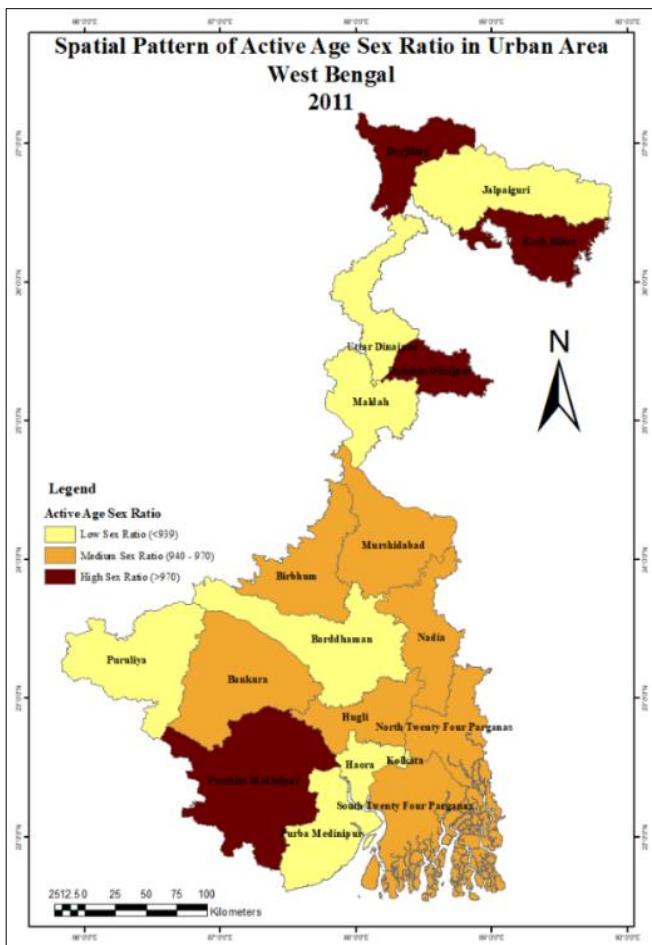


Fig 4: Spatial Pattern of Active Age Sex Ratio in West Bengal, 2011

3.4.3 Senile sex ratio (>60 years)

The highest sex ratio (949) is noticed in this age group population than another age group in the state in urban areas. It has been noted that Koch Bihar, Dakshin Dinajpur, Murshidabad, Nadia, Bankura, and Paschim Medinipur has registered more than 1000 female per thousand male. On the other hand, Kolkata, Darjeeling, Jalpaiguri, Bardhaman, North 24 Parganas, Hugli, Haora, and Purba Medinipur have experienced less than the state average. It is worth remarking that the life expectancy of females is higher than males in India. In other words, the male death rate is high than females above the sixty years of age group. Females have better immunity to disease during the life cycle,

therefore females have low mortality rate than males in all age groups instead given similar care and facilities. (Waldron I, 1983) [26]. About 42% of districts of northern, central, and south-eastern parts of the state have recorded low senile sex (<946) ratio and 21% of districts have registered medium sex ratio (947-971). While 37% of districts of northern and south-western parts have noted a high sex ratio (>971).

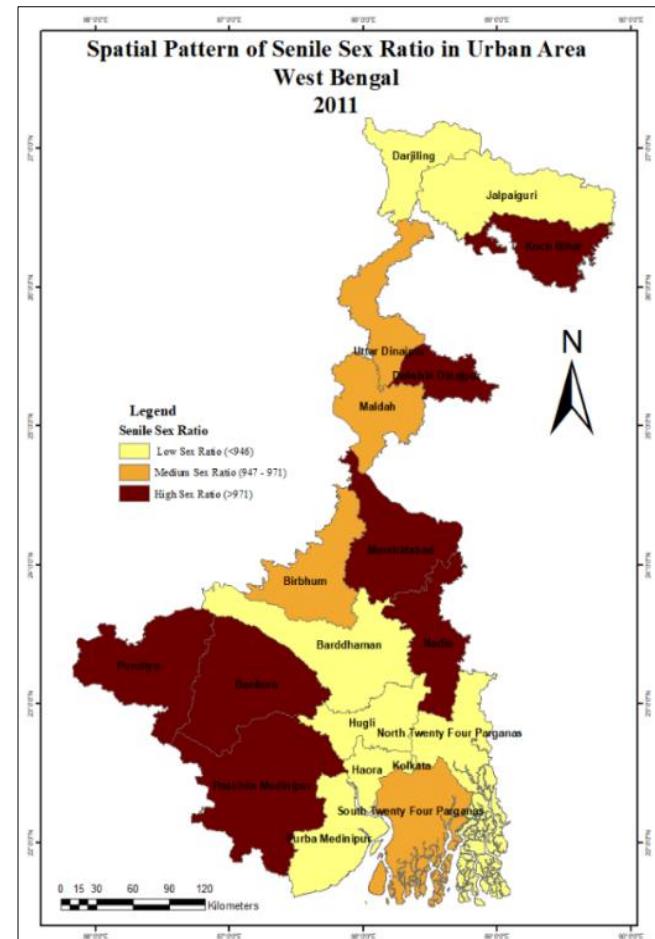


Fig 5: Spatial Pattern of Senile Sex Ratio in West Bengal, 2011

However, in all age group, Kolkata, Maldah, and Uttar Dinajpur has noted a low sex ratio. While Paschim Medinipur, Koch Bihar, and Murshidabad have accounted for a high sex ratio in all age as well as general urban sex ratio.

Table 3: District level category wise senile sex ratio in West Bengal, 2011

Low	% of Total Districts (19)	Medium	% of Total Districts (19)	High	% of Total Districts (19)
Darjeeling, Jalpaiguri, Bardhaman, Haora, Kolkata, Hugli, North 24 Parganas, and Purba Medinipur.	42%	Uttar Dinajpur, Maldah, Birbhum, and South 24 Parganas.	21%	Koch Bihar, Dakshin Dinajpur, Nadia, Puruliya, Bankura, Paschim Medinipur, and Murshidabad.	37%

It is pointed out that the age and sex structure of a country reflect its collective past demographic experience. Nevertheless, it is noted that the number of females started to surpass the number of males population in the age group of 45-49 in the United States, 30-34 in Russia, and 60-64 in India in 2010 (Dyson, 2012) [5]. Nevertheless, many researchers (Das Gupta *et al.*, 2003; Good kind, 1999; Guillot, 2002; Bhat and Zavier, 2003; Mallik, 2003; and Garg and Nath, 2008) [21, 10, 6, 18, 12, 28] have demonstrated that

group of factors such as the desire to have a son, considered of small family norms, abortion, disrelish of daughters and available of pre-natal sex determinant test have deteriorated the sex ratio balance.

3.5 Rate of Change of Sex Ratio

The sex ratio in West Bengal has improved from 1951 to 2011, though the rate of change has fluctuated across the districts in the state. Therefore, four North Bengal districts,

namely Darjeeling, Jalpaiguri, Koch Bihar, Dakshin Dinajpur, and six south Bengal districts, including Kolkata and its all peripheral districts, has observed a positive growth rate of sex ratio from 1951 to 2011 (figure 6). A large number of females are migrating to the hilly region (northern part of the state) for employment in tea industries and other opportunities. Still, Kolkata Metropolitan areas are the centre of attraction in many perspectives that motivates males to migrate (Banerjee, 2016) [1]. From 1951-1961, a high growth rate of sex ratio has been noted in Jalpaiguri, followed by Hugli, 24 Parganas, Koch Bihar, Kolkata, and Haora. In the same decade, many districts such as Murshidabad, Bardhaman, Birbhum, Bankura, Puruliya, Purba, and Paschim Medinipur has experienced a negative growth rate of sex ratio because of low-level migration of females in urban centres, migration of urban females to other urban centers or rural areas, natural reason, a drop of child sex ratio, and many more.

All the districts in 1961-1971 have reported less than 1% positive growth rate. The high rate of change in 1971-1981 has been accounted for in all districts in West Bengal. Haora, Kolkata, Koch Bihar has registered above 10% sex ratio growth rate. In 1981-1991, Uttar Dinajpur, Maldah, Murshidabad, Bankura, and Puruliya observed a negative growth rate. On the other hand, Kolkata, Haora, Darjeeling, and Dakshin Dinajpur have recorded a high growth rate. Again, all the districts have noted a positive growth rate of sex ratio in 1991-2001 where Darjeeling, Kolkata, Hugli, Haora, North and South 24 Parganas, and Paschim Medinipur has listed above 3% growth rate. Maldah experienced a negative (-4%) growth rate in 2001-2011 due to the decline of the child sex ratio but several districts, specially neighbouring districts of Kolkata, have reported a high growth rate as a result of the increase of child sex ratio between this decade (Census of India, 2001, 2011) [20].

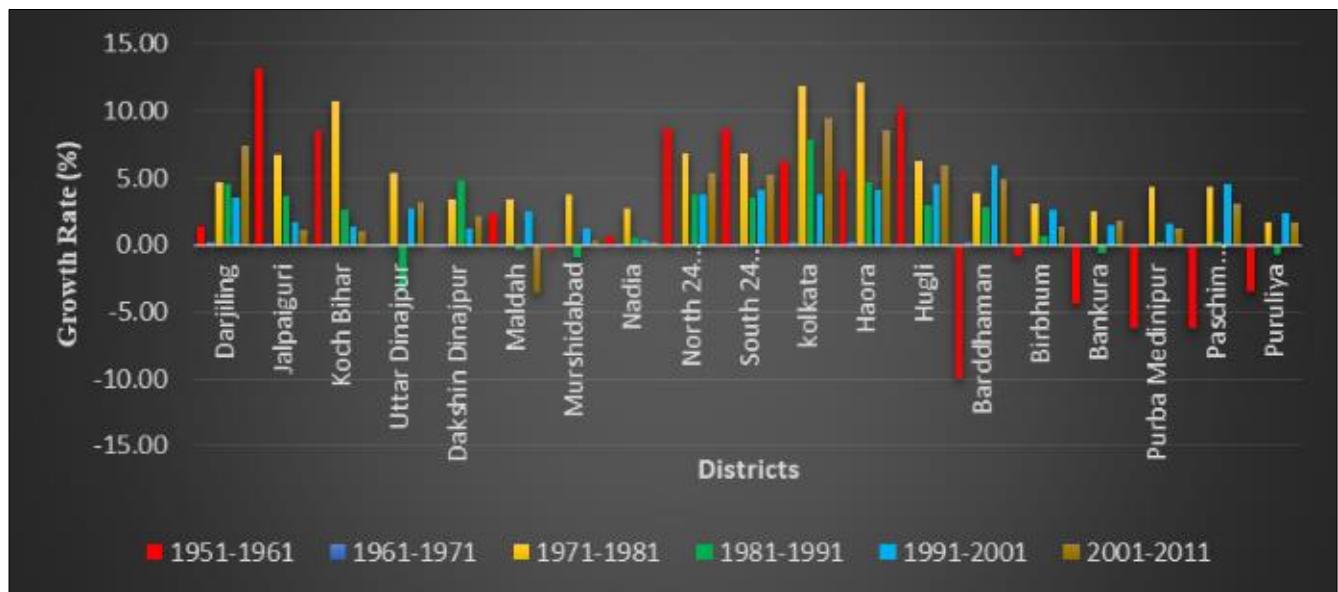


Fig 6: Trend and pattern of Growth Rate of Sex Ratio in West Bengal, 1951-2011

All the districts of the state have put in their places in four quartiles as per the rate of change in 2001-2011 (Figure 7). However, it is clearly indicating the urban sex ratio is growing faster in 2001-2011. North 24 Parganas, south 24 Parganas, Darjeeling, Bardhaman, Haora, and Bankura are located on the right-hand side of the diagram that signifies a high urban sex ratio. On the other hand, Birbhum, Murshidabad, Jalpaiguri, Koch Bihar, both Medinipur, Puruliya, etc. showed a low sex ratio. While only Maldah is located on the lower left-hand side because it experienced a negative growth rate (total and urban) while Koch Bihar and Purba Medinipur both districts have registered positive growth rate for urban and negative for total. Whereas Kolkata on top means it retains a high total sex ratio. The trend line of sex ratio of this graph shows an upward inclination that signifies a good sign for the future trend of sex ratio growth.

Three factors are significant for sex ratio that is sex ratio at birth, the mortality rate among different ages and sexes, and migration (Coale, 1991) [3]. Sex ratio at birth upkeep male

that means for the first births, biological ratios might privilege more males than females while contrasting gender-based mortality favour females (Teitelbaum, 1970) [25]. All over the world almost 5% more boys are born than girls (Sen, 1992) [23] that contributes to more gender gap. A lower sex ratio in Asia and northern Africa could be due to a higher fertility rate and lower life expectancy rate. (Sen, 1992) [23]. Because of son preference, sex determination, and sex-selective abortion in prenatal and neglect and desertion of female children in postnatal which resulted in the high mortality rate of females (Klasen and Wink, 2002) [17]. The sex ratio gap is high due to the small family culture and sex-selective abortion (Gu and Roy, 1995) [8]. Sen (1992) [23] assessed that due to the differential mortality rate of females there are more than 100 million women are missing all over the world (China 44 million and India 37 million). Females at birth dropped in those regions where HDI (Human Development Index) is quite enhanced and life expectancy is higher (Gautam *et al.*, 2015) [11].

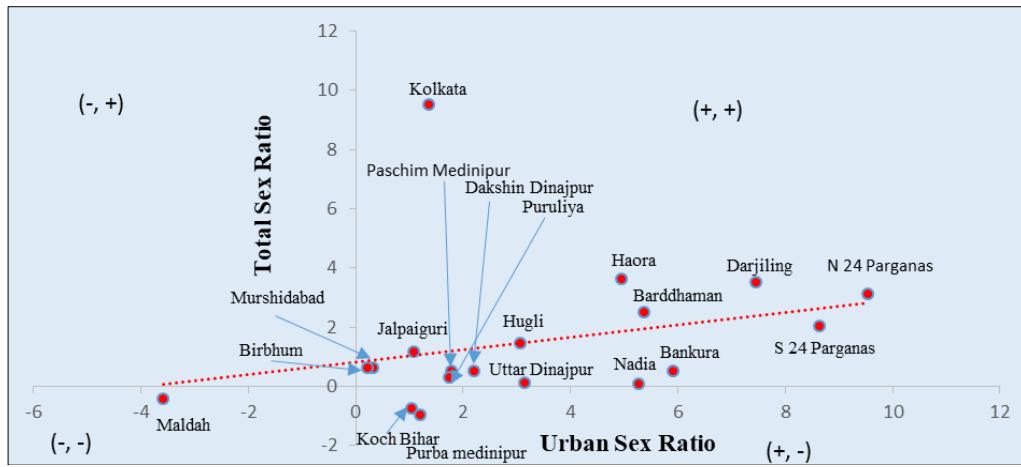


Fig 7: Decadal change of sex ratio of total and urban in West Bengal, 2001-2011

Though prenatal sex determination and sex-selective abortion are prohibited in India and China, yet these methods are still used on a huge scale with virtual impunity that probably comprises approximately all of the shortfall in the number of females born as second or third children after preceding female births (Jha *et al.*, 2006) [15]. Unequal sex ratio at birth may be as a result of female infanticide (George *et al.*, 1998) [9], time taken to conceive (Smits L. J *et al.*, 2005) [24], under-reporting of female births (Hatti N *et al.*, 2004) [13], father's occupation (Norberg K, 2003) [19], hormonal factors (James WH, 1996) [16] and smoking (Fukuda M, *et al.*, 2002) [7].

4. Conclusion

Sex ratio all over the state are unequal and numerous reasons are responsible for this. Though the sex ratio has increased from 1951 to 2011 but an asymmetrical growth rate is experienced in West Bengal. Low sex ratio are noted in very high industrialized districts as well as very low economic areas. High sex ratio are recorded mainly in northern, south-eastern, and south-western parts of the state. However, urban areas are the centre of attraction, as a result, more male migrants are assembled for employment, and still, a low sex ratio is observed in Kolkata, Bardhaman,

and Haora while a sound rate of change is witnessed. Therefore, gender disparity makes serious demographic imbalance in our society which creates social volatility against the women's violence such as female foeticide, rape, trafficking of a girl child, prostitution, sex-selective abortion, marital rape, etc. Though, female education, empowerment, and equality are the main way to stable the demographic structure within the society. Many districts have shown a worsening of sex ratio status in the state. Therefore, the deteriorating sex ratio is really an unannounced emergency crisis that has its profound and scary consequences for our society and the future of mankind. Hence, this makes worry to specialists and policymakers to inversion the trend to get it back to standardization. Though, it is the duty of each and every organization to look into the matter that is sustainable sex ratio which will help balance growth and sex ratio in the society. Therefore, female literacy and education, providing equal health facilities, awareness about their right, and empowerment is the approach to the equilibrium demographic structure in our society. However, in neoliberal society, females are not less in any point of view than males which is necessary to promote in a backward society where girls are considered as a burden on the family.

Table 4: District-wise rate of change of sex ratio in urban area in West Bengal from 1951-2011.

District Name	1951-61	1961-71	1971-81	1981-91	1991-01	2001-11
Darjeeling	1.37	7.82	4.46	4.38	3.45	6.94
Jalpaiguri	11.59	7.36	6.33	3.49	1.71	1.06
Koch Bihar	7.88	7.53	9.71	2.52	1.35	1.03
Uttar Dinajpur	NA	6.57	5.12	-3.34	2.69	3.04
Dakshin Dinajpur	NA	1.95	3.32	4.55	1.25	2.15
Maldah	2.29	2.57	3.34	-0.32	2.43	-3.72
Murshidabad	-0.33	1.39	3.62	-0.94	1.24	0.31
Nadia	0.64	-0.43	2.62	0.52	0.31	0.21
North 24 Parganas	8.01	7.06	6.38	3.64	3.62	5.10
South 24 Parganas	8.01	7.06	6.38	3.42	3.94	4.99
Kolkata	5.87	4.83	10.66	7.26	3.62	8.70
Haora	5.28	8.26	10.80	4.49	3.96	7.94
Hugli	9.35	4.46	5.88	2.91	4.35	5.58
Bardhaman	-11.16	10.96	3.68	2.74	5.63	4.72
Birbhum	-0.83	5.49	2.93	0.65	2.53	1.35
Bankura	-4.53	1.63	2.44	-0.64	1.47	1.76
Purba Medinipur	-6.63	4.05	4.10	0.22	1.53	1.18
Paschim Medinipur	-6.63	4.05	4.10	0.22	4.34	2.98
Puruliya	-3.60	0.11	1.66	-0.67	2.28	1.71

Note: NA= data is not available.

Source: Calculated by author from DCHB, Census of India, 2011

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Annexure**Table 1:** General and age-specific sex ratio in urban areas in West Bengal, 2011

Districts	All age group	Age group (0-15)	Age group (16-59)	Age group (>60)
Darjeeling	966	935	982	939
Jalpaiguri	943	951	939	945
Koch Bihar	974	947	978	1011
Uttar Dinajpur	921	907	923	956
Dakshin Dinajpur	979	971	977	1002
Maldah	913	923	902	964
Murshidabad	974	973	962	1080
Birbhum	963	943	970	971
Bardhaman	932	941	930	924
Nadia	964	955	956	1032
North 24 Parganas	961	944	970	942
Hugli	950	945	956	924
Bankura	968	949	964	1041
Purulia	936	935	929	999
Haora	932	949	925	932
kolkata	908	924	903	917
South 24 Parganas	961	952	965	961
Paschim Medinipur	974	972	986	1023
Purba Medinipur	929	954	918	946
West Bengal	944	945	944	949

Source: Social and Cultural Table, Census of India, 2011