sciendo

Bulletin of Geography. Socio-economic Series, No. 46 (2019): 103–118
http://doi.org/10.2478/bog-2019-0037

ISSN 1732–4254 quarterly

BULLETIN OF GEOGRAPHY. SOCIO–ECONOMIC SERIES

journal homepages:
https://content.sciendo.com/view/journals/bog/bog-overview.xml
http://apcz.umk.pl/czasopisma/index.php/BGSS/index

The impact of population displacement due to river bank erosion on the education of erosion victims: a study in jangipur sub-division of murshidabad district, West Bengal, India

Debika Ghosh[1, CDFMR], **Abhay Sankar Sahu**[2, MR]

Krishnagar Govt. College, Faculty of Geography, Department of Geography, Krishnagar, Nadia, West Bengal, India; [1]phone: +918926059023, e-mail: idebikaghosh@gmail.com *(corresponding author)*; Department of Geography, University of Kalyani, Kalyani, West Bengal, India, [2]phone: +919830620422, e-mail: sahu.abhaysankar@gmil.com

How to cite:
Ghosh, D. and Sahu A.S. (2019). The impact of population displacement due to river bank erosion on the education of erosion victims: a study in jangipur sub-division of murshidabad district, West Bengal, India. *Bulletin of Geography. Socio-economic Series*, 46(46): 103-118. DOI: http://doi.org/10.2478/bog-2019-0037

Abstract. The present research aims to find out whether population displacement due to river bank erosion has any impact on education of the erosion victims of the developing countries or not. To fulfil the objective of the study, 19 erosion affected study units were selected along the banks of the Ganga-Bhagirathi river in the Jangipur sub-division of Murshidabad district, West Bengal. Pearson's correlation analysis and multiple linear regression analysis were performed using SPSS software. The result of the study shows that frequency of population displacement due to bank erosion and percentage of child labour are positively and significantly correlated (r = 0.51). A low mean year of schooling has been observed in almost all selected study units. The result of multiple linear regression analysis shows that river bank erosion has an adverse impact on the education of the people living along the river banks.

Article details:
Received: 7 July 2019
Revised: 12 August 2019
Accepted: 27 September 2019

Key words:
river bank erosion,
population displacement,
erosion victims,
child labour,
mean year of schooling,
protective strategies.

Contents:

1. Introduction

River bank erosion is a natural and inevitable phenomenon of rivers. River bank erosion is a dynamic natural process. It involves the washing out of materials from the banks of a river. Bank erosion generally happens when the magnitude of flowing water overtakes the strength of materials on the basal part of river banks (Ghosh and Sahu, 2018; Das et al., 2014). A normal condition is indicated when there is balance between rate of river bank erosion and rate of sediment accumulation at the base of river bank. But problems start in the flood plain area of a river when the rate of sediment accumulation at the base of the river bank is lower than the rate of sediment removal. This is a situation of active and continuous river bank erosion (Charlton, 2008). When rate of bank erosion exceeds rate of bank deposition, there is continuous river bank erosion (Charlton, 2008). River bank erosion has a considerable impact on physical as well as social environments. In the lower Brahamaputra flood plain of Bangladesh, people are displaced from their own land due to river bank erosion (Haque et al., 1986). The River Ohio is gradually washing away its banks and creating various erosion-induced problems (Hagerty and Ullrich, 1981). In the mid-1970s, huge numbers of people were displaced due to devastating erosion in the Dhulian municipality of the Murshidabad district of West Bengal (Rudra, 1992). Population displacement is one of the main consequences of river bank erosion, and creates a chain effect in society, generation after generation (Ghosh and Sahu, 2018). River bank erosion creates huge economic losses and it has a long-term chain effect in the society. The adverse consequences of bank failure of the river Penobscot in USA is observed (Briggs et al., 2008). Huge losses to real estate are found due to Ganga river bank erosion in the Maldah district of West Bengal (Laha et al., 2013). Guite and Bora (2016) commented on the Subansiri river bank erosion in the state of Assam. They said that lateral migration of bank lines caused a total of 461.49 square kilometres (sq. km) loss of agricultural lands and 134.05 sq. km loss of forest areas in the state of Assam between 1956 and 2010. This natural disaster is observed to have an adverse impact on human livelihood (Ferris, 2018). Displaced people lose their profession and fall into depression and trauma. River bank erosion has an adverse impact on the socio-economic sectors of erosion victims (Ghosh and Sahu, 2018; FPMP, 2014; Laha et al., 2013; Briggs et al. 2008; Rudra, 1992). According to interviews with the people of erosion-affected areas in the Jangipur sub-division of Murshidabad district, it can be opined that population displacement away from river banks is one of the important impacts of river bank erosion. This population displacement has a considerable impact on the livelihoods of erosion victims. The present research deals with identifying the impact of river bank erosion on the education of erosion victims and tries to find a connection between child labour and river bank erosion in erosion-prone areas. The present study not only contributes to the existing literature but also practically shows the real impact of river bank erosion on the education of erosion victims in developing countries. This study helps the policy makers of the Jangipur sub-division to adopt remedial measures to minimise the impact of bank erosion on the education of erosion victims. The adopted methodologies can be applied to other erosion-affected areas to reveal the impact of river bank erosion on human livelihood. The study presumes that river bank erosion has an adverse impact on the education of erosion victims.

2. Study area

The study area was selected in the Jangipur sub-division of Murshidabad district, West Bengal (Fig. 1). The study area is the Jangipur sub-division located between 24˚13'14"N to 24˚52'15'N and 87˚48'00"E to 88˚15'39"E (Fig. 1). The main river of the study area is the Ganga and its distributary river, the Bhagirathi. The total area of the sub-division is 1097.82 sq. km (Census of India, 2011). The study area is situated very close to the India–Bangladesh border area. To serve the purpose of the study, 19 erosion-prone cadastral units (small administrative units in India) along the banks of the Ganga-Bhagirathi were selected as study units (Fig. 2).

The study units, with their Jurisdiction List numbers (J. L. No.) (Census of India, 2011), are: Farakka barrage township, Kuli (058); Arjunpur Census Town (CT); Paranpara Census Town, Dhulian municipality, Nimtita (108); Aurangabad Census Town, Chameghoan (70); Icchlampur Census Town, Arazi Gotha (074); Chak Saiyadpur (087); Jangipur municipality, Diar Ramnagar (144); Char Dafarpur (091); Giria Census Town, Mithipur Census Town, Sekendara (014); Kismat Gadi (042); and Kamarpara (183). According to the census of India report (2011), Jangipur sub-division presently covers seven community development blocks, two municipalities, 254 gram panchayets, and 2,210 mouzas (small administrative units in India / cadastral units). Physiographically, the Jangipur sub-division is more-or-less similar to the Murshidabad district. According to the district statistical handbook for Murshidabad (2010 to 2011), the river Bhagirathi divided the Murshidabad district into two broad geographical regions of almost equal area. But there is a difference in their geology. The western tract, or the Rarh area, is located to the west of the Bhagirathi river. It is a succession of the Sub-Vindhuyan region composed of lateritic clay and characterised by nodular ghuting. It is slightly undulating. The soil is greyish and reddish in colour, with high content of lime and iron-oxide (Census of India, 2011). The eastern tract of the river Bhagirathi is the Bagri region. It is generally composed of Gangetic alluvial deposits. The Bagri region is very fertile due to the deposition of fresh silt almost every year (Census of India, 2011). The slope of the study area ranges from zero to 61 degrees (Fig. 3). It is found that the slope in almost all of study area is zero to five degrees. According to the district statistical handbook for Murshidabad (2010 to 2011), the climatic conditions in the Jangipur sub-division are more-or-less similar to the Murshidabad district. The district has very hot summers and high humidity throughout the year. Rainfall occurs due to the south-west monsoon from June to September. The economy of Murshidabad district mainly depends on agriculture. According to the district statistical handbook for Murshidabad (2010 to 2011), the majority of the population is engaged in agricultural sectors and a small proportion in industrial activities. The literacy rate of the Jangipur sub-division is 60.95% as per the 2011 census of India report.

2.1. Limitation of the study

Jangipur sub-division is located very close to the India–Bangladesh border area. Local people of the selected study units, such as Kuli, Arjunpur, Paranpara, Giria, Mithipur, Sekendara, Dhulian municipality, and Lalpur(P), are deprived of modern amenities. Sometimes, the respondents became very aggressive towards answering the asked questions, because the people are deprived of all types of governmental and other help. This was deeply felt during the field survey, and many of the respondents were unable to answer the asked questions (especially women). Access to some areas is made very risky by the fact that some study units are situated very near to the India–Bangladesh border, where various antisocial activities are prevalent.

3. Research materials and methods

The methodologies adopted to conduct the present study are as follows:

3.1. Sample design

Erosion affected a total of 19 cadastral units along the banks of the Ganga-Bhagirathi river, and these

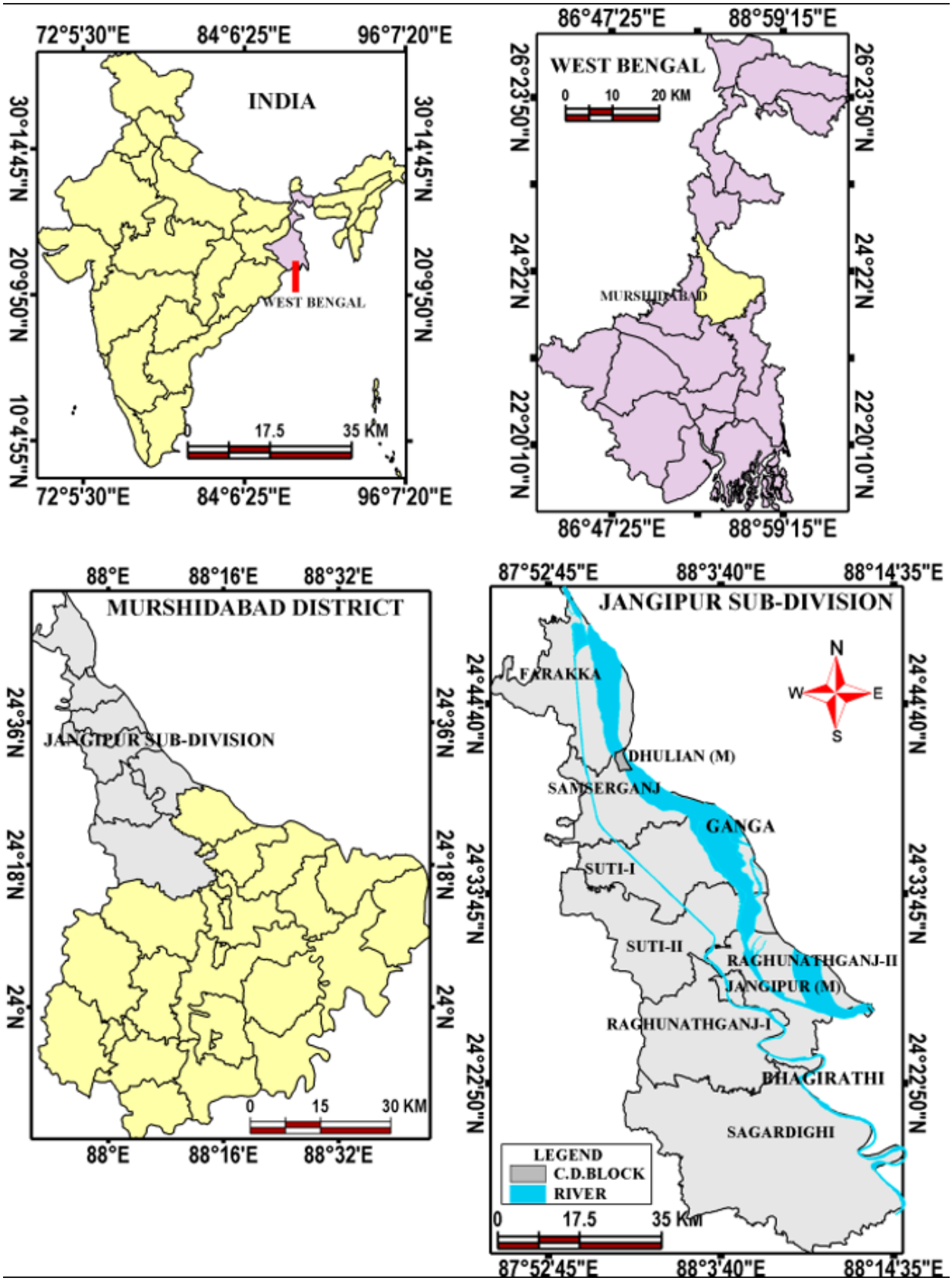

Fig. 1. Location of study area

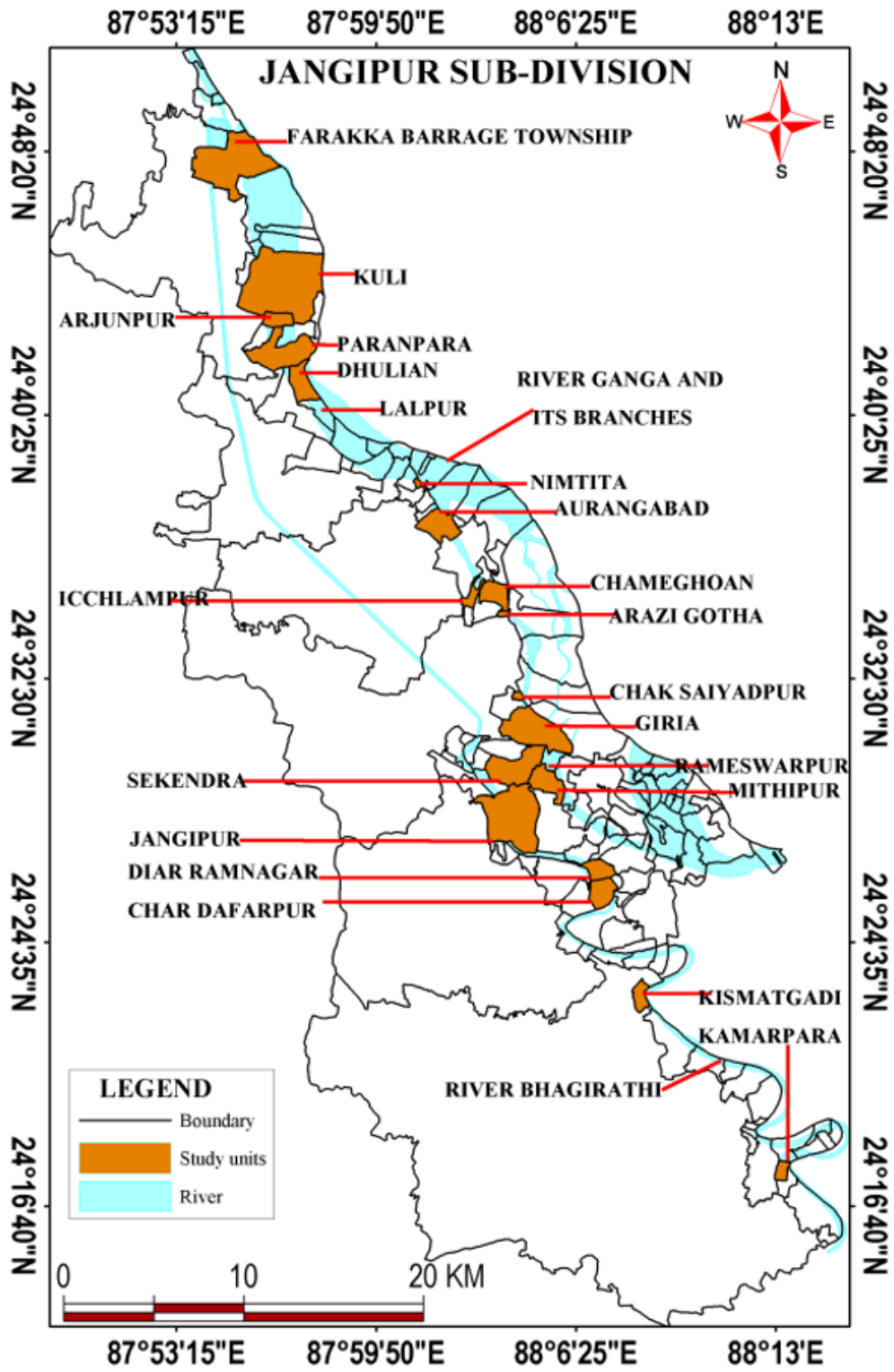

Fig. 2. Location of study units
Source: NATMO, Census of India (2011)

have been selected to identify the impact of river bank erosion on the education of erosion victims, taking into account the severity of bank erosion in these areas. For the purposes of the study, only people along the river bank areas were selected as the sample population. The study is based on a purposive sample technique. Forty to sixty households from each selected study unit along the banks of the Ganga-Bhagirathi river in the Jangipur sub-division were selected as the sample, depending on the total number of households living there.

3.2. Data sources

Both primary and secondary data have been used here. Primary data was collected from people living along the river banks in the selected study units. Group discussion and direct interviews with erosion victims were arranged with the help of a questionnaire about the impact of river bank failure on their education. Secondary data were gathered from the office of the census of India, Kolkata, Government of West Bengal. Cadastral maps were collected from the Office of District Land and Land Reforms Officer, Murshidabad, Government of West Bengal and from the website of the land reforms officer for Murshidabad (http://dllromsd.org/). Satellite images were collected from reliable sources (Table 1).

3.3. Database preparation and data analysis

To know the impact of river bank erosion on the education of erosion victims, field visits were conducted from 2015 to 2018. Data were collected on the frequency of population displacement due to river bank erosion of the Ganga-Bhagirathi from each selected study unit through field survey. To know the relationship between river bank erosion and frequency of population displacement due to river bank erosion, Pearson's correlation analysis was performed using SPSS software. River bank erosion from 2000 to 2010 has been considered here because, since 2010, population displacement has not occurred in the selected study units but population displacement due to river bank erosion has a long-term effect, generation after generation. Areas under erosion and deposition were computed

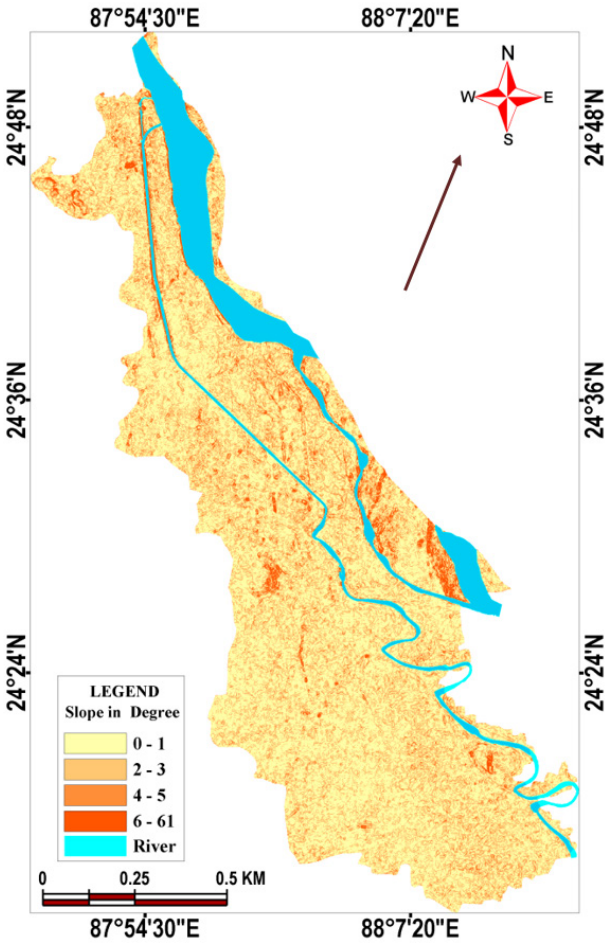

Fig. 3. Slope of study area

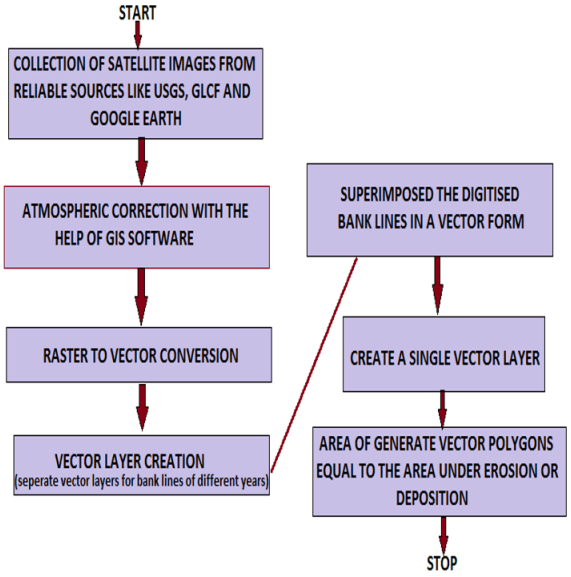

Fig. 4. Methodology to estimate erosion and deposition
Source: SRTM data 30 metre (USGS)

for the years 2000 and 2010 by direct digitisation of bank lines from Google Earth Images with the help of GIS software and a detailed method for estimating areas under erosion and deposition is been discussed here (Fig. 4 and Fig. 5). Bank lines from 2000 and 2010 are superimposed to measure the areas under erosion and deposition with the help of GIS software. To evaluate the consequences of Ganga-Bhagirathi river bank erosion on the education of the erosion victims, a detailed study has been carried out.

The selected parameters for this analysis are: percentage of child labour in 2017, bank erosion in square metres from the year 2000 to 2015, frequency of population displacement due to bank erosion up to 2017, average age of marriage in year (2017), percentage (%) of marriage within area in 2017, mean year of schooling in 2017, illiteracy rate in 2011, and average monthly income in rupees in 2017. The formula of mean year of schooling is as follow:

$$\mathbf{MYS} = (\mathbf{E_p} / \mathbf{P_a})$$

Where, **MYS** = Mean Year of Schooling, $\mathbf{E_p}$ = Total number of years spent in educational institutions by people in an area, $\mathbf{P_a}$ = Total number of people in the same area (Based on UNDP, 2004)

In the present study literacy rate is not taken into consideration because if a person can read, understand and write any one language recognised by the state, they are considered literate. So, here, literacy rate cannot express the real scenario of a particular area's educational status itself. In place of literacy rate, mean year of schooling has been selected as a parameter. UNDP (2010) used mean year of schooling instead of literacy rate to measure educational development. To find out the impact of bank erosion on the education of erosion victims, multiple linear regression analysis was performed using SPSS software. There is one dependent and various independent variables in multiple linear regression analysis. In the present study, the dependent variable is mean year of schooling and the independent variables are: percentage of child labour, frequency of population displacement due to bank failure, average age of marriage, percentage of marriage within area, illiteracy rate and average monthly income. The following statistical techniques were adopted for data analysis.

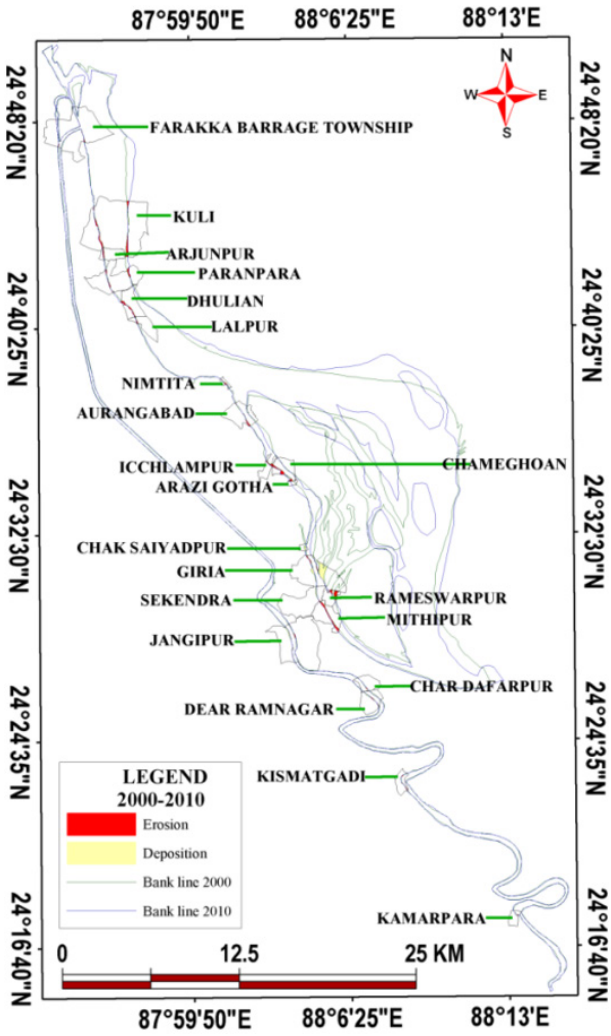

Fig. 5. Estimation of erosion and deposition for 2000 to 2010
Source: Satellite images as in Table 1

I) Pearson's correlation analysis

Pearson's Product Moment correlation analysis is a parametric test to measure the relationship between two variables. This measurement of relationship is based on the assumption that both variables come from the normally distributed populations (Gaur and Gaur, 2009 and Sarkar, 2012). The formula is:

$$r = \frac{\sum XY}{N} - \bar{X}.\bar{Y}/\sigma X.\sigma Y$$

Where, r = Product Moment correlation coefficient, N = Number of data-pair, = Mean of X, = Mean of Y, ∑XY = Sum of the products of X and Y, = Standard deviation of X and = Standard deviation of Y.

II) Multiple linear regression analysis

Multiple linear regression is a statistical technique which uses to understand the relationship between the explanatory and response variables (Gaur and Gaur, 2009 and Ofuoku, 2011). This model explains how a single response variable Y depends on a number of explanatory or predictor variables ($X_{1.....}X_n$).

Model

$$Y = f(X_1, X_2, X_3, X_4 \ldots Xn)$$

[Where Y = Dependent variable, $X_{1.....}X_n$ = Dependent Variables, U = Error Term.]

In this research, to study the impact of bank erosion on the education of erosion victims, multiple linear regression analysis is used. This analysis was done using SPSS software.

Hypothesis testing was done using the Student *t* test with the help of SPSS software and discussed as follows:

III) Student *t* test

This hypothesis test is used for small samples, i.e. of fewer than 30. This test is used to understand whether the sample mean is different from or the same as the population mean (Saha and Basu, 2010; Sarkar, 2012; Yang-chun, 2017). In the present research, this test was used to know whether the correlation between the selected variables is significant or not. The formula is as follows:

$$t = \sqrt{r2(n-2)/(1-r^2)}$$

Where, (n - 2) = degree of freedom, and r = correlation coefficient.

When the computed value of the *t* test is greater than the corresponding tabulated value, the correlation co-efficient will be considered as significant. And if there is significant correlation between variables then the relation cannot be influenced by chance factors. So, it expresses a satisfactory relationship. A level of significance at 0.05 (95 percent level of confidence) or 0.01 level (99 percent level of confidence) denotes that the probability of rejection of the null hypothesis is 5 in 100 and 1 in 100, respectively.

4. Research results and discussion

4.1. Problem of river bank erosion in Jangipur sub-division

Murshidabad district has been suffering from continuous river bank erosion problem for a long time (Rudra, 1996). Though erosion is a natural phenomenon in alluvial channels, it brings different socio-economic problems in flood plain areas when the rate of erosion exceeds the rate of deposition. In the selected study units, the total erosion for the year 2000 to 2010 was 1,401,159.22 square metre and total land accumulation was 1,014,170.001 square metres (Table 2). It is found that total land erosion exceeds total land deposition. Therefore, it can be said that the area is suffering from active bank erosion by the Ganga-Bhagirathi river (Fig. 6). When rate of erosion exceeds rate of deposition, the situation leads to continuous and active bank erosion (Charlton, 2008). This continuous erosion introduces various problems in the flood plain area. Loss of land due to bank failure during the period 1979–89 was observed in Bangladesh and this active and continuous bank erosion problem has long-term adverse consequences in society (Haque, 1989). Sudden river bank collapses have taken human life and caused huge losses in real-estate (Saha and Basu, 2010). The erosion issue of West Bengal and associated different socio-economic problems due to river bank erosion present different social and physical problems (Rudra, 1996).

People of Dhulian town have been suffering by various problems (population displacement, crisis of habitation etc.) due to devastating bank erosion of river Ganga (Ghosh and Sahu, 2018). The bank erosion of river Ganga in Maldah district, West Bengal has adverse impact on land use change and riparian environment (Laha et al., 2013). Continuous Ganga-Bhagirathi river bank erosion problem brings huge loss of habitable land, vegetation cover, houses, and cultivable land in Murshidabad district (Rudra, 1996, 2003, 2006 and 2009). Ganga-Bhagirathi river bank erosion is a burning problem in the Jangipur sub-division of Murshidabad district (FPMP, 2014). A considerable percentage of child labour has been observed in the erosion affected

Table 1. A detail of satellite images

Date of image acquisition	Path/Row	Data Set	Producer
23.09.2014	30 METER	SRTM	USGS
2010.10.28	138/044	ETM+	USGS
2000.11.17	138/044	ETM+	EARTSAT

Table 2. River bank erosion, deposition and frequency of population displacement

Study Units	Bank erosion 2000–2010 in square metres	Deposition in square metres	Frequency of Population displacement
Farakka Barrage Township	51,107	85,987	2
Kuli	369,397	50,642	4
Arjunpur	41,016	0	3
Paranpara	124,485	18,802	3
Dhulian Municipality	105,720	0	4
Nimtita	27,628	0	3
Aurangabad	49,900	50,151	1
Chameghoan	135,120	34,024	3
Icchlampur	40,268	0	1
Arazi Gotha	72,027	0	1
Chak Saiyadpur	0	36,790	2
Jangipur Municipality	32,247	93,768	0
Diar Ramnagar	24,298	44,592	1
Char Dafarpur	21,014	394	1
Giria	66,828	546,537	3
Mithipur	188,736	0	3
Sekendara	9,690	49,010	3
Kismat Gadi	34,183	2,643	2
Kamarpara	7,495	829	2
Total	1,401,159	1,014,170	-

wards of Dhulian municipality of Murshidabad district (Ghosh and Sahu, 2018).

4.2. River bank erosion and population displacement

Among many socio-economic consequences of river bank erosion, population displacement from the river bank area is one of the main impacts of river bank erosion. Thousands of people became homeless due to bank failure (Rudra, 2006; Ghosh et al. 2018; laha et al., 2013; and Chatterjee et al., 2013). In mid 1970s, more or less 50,000 people have lost their home due to river bank erosion in Dhulian municipality of Murshidabad district (Ghosh and Sahu, 2018; Rudra 2006). Bhagirathi river bank erosion at Santipur in Nadia district, West Bengal brings mass displacement of population (Chatterjee et al., 2013).

The problem of population displacement due to Ganga river bank failure in Maldah district of West

Fig. 6. Some vulnerable pockets in Jangipur sub-division; Explanation: From left to right, vulnerable pockets at Lalpur, Giria and Mithipur photographed during field survey

Source: Field survey on 07.10.2017

Table 3. Correlations between bank erosion in square meter and frequency of population displacement due to bank erosion

		Bank erosion 2000-2010	Frequency of population displacement
Bank erosion 2000-2010	Pearson Correlation	1	0.551(*)
	Sig. (2-tailed)		0.015
	N	19	19
Frequency of population displacement	Pearson Correlation	0.551(*)	1
	Sig. (2-tailed)	0.015	
	N	19	19

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

Bengal has been observed (Laha et al, 2013). According to the collected responses from the erosion affected people in the selected study units, reveals that population displacement from the bank line is the main impact of river bank erosion which generally creates long term chain effect in the area come under river channel. People of the study units opined that they have been suffering from the erosion induced displacement problem from the past decades. The correlation between river bank erosion and frequency of population displacement due to bank erosion is positive (Table 3). The correlation is significant at 95 percent level of confidence. The correlation value 0.551. So, it can be sated that river bank erosion creates population displacement from the riverine flood plain of Jangipur sub-division. People lost their almost everything when they displaced from their own land and it brings chain impacts on their life. The problem of river bank erosion due to sudden and rapid channel migration in major floodplain of Bangladesh in almost every year, introduces loss of cultivable land, markets, towns, loss of village settlements, etc (Haque et al., 1989 and Haque, 1986) . It is observed during field survey that the way of life of the people along river bank area is highly controlled and affected by the nature of river. River bank erosion has adverse impact on occupation, education, marriage and health of the erosion victims in greater extent.

4.3. Population displacement and its impact on education of the erosion victims

It can be stated that river bank erosion and frequency of population displacement due to river bank erosion from the river banks are positively interrelated with each other and their relationship is significant (Table 3). As per responses of the local people along the river bank in the selected study units, population displacement is one of the main impacts of active bank failure, snatched almost immovable properties from them which directly influence economic condition of the erosion victims.

Table 4. Correlations between bank erosion in square meter (2000-2015) and child labour in percentage

		Land loss due to Bank erosion	Child labour in %
Land loss due to Bank erosion	Pearson Correlation	1	0.51(*)
	Sig. (2-tailed)		0.044
	N	19	19
Child labor in %	Pearson Correlation	0.51(*)	1
	Sig. (2-tailed)	0.044	
	N	19	19

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

When people are displaced from their own land they lost almost everything. In the selected study units a considerable percentage of child labour is observed. Almost family members of the erosion victims are engaged in work to fight against poverty. According to the Child labour Prohibition and Regulation (CLPR) Act (1986), amended (2016), a child can be defined as any person, age is below the age of 14 and the CLPR act bans employment of a child in any employment also including as a domestic help. As per the Factory Act (1948), children between age of 14 and 18 are called adolescence and the law allows adolescence to work except in the listed hazardous occupations and processes, includes many inflammable substances, explosive related work, and any other hazardous processes. Children of the selected study units of Jangipur sub-division are generally engaged in *bidi* (low category cigar) industry and building making activities. In the selected study units low mean year of schooling has also been observed. School dropout rate is generally higher in the flood prone areas of Zambia than the non-flood affected areas (Conteh, 2015). According to the report of the Economic institute of Cambodia (2008), high rate of school dropout has been found in flood prone areas of Cambodia.

Here, the correlation between the percentage of child labour and land loss due to bank erosion (2000-2015) is positive and the correlation is significant at 95 percent level of confidence (Table 4). The correlation value is 0.51. So, it can be said that with the increasing land loss due to bank erosion, the percentage of child labour starts to increase. And again, the percentage of child labour and frequency of population displacement due to bank erosion are positively correlated with each other and the relation is significant at 95 percent level of confidence (Table 5). Therefore, it can be stated that land loss due to river bank erosion and frequency of population displacement act as an influential factors in considerable percentage of child labour in the erosion prone study units. The performance of the students in non-flood affected areas is much better than flood affected areas and again school dropout rate is also higher in the flood prone areas of Zambia than the non-flood affected areas (Conteh, 2015). An attempt has been made in this paper to identify the impact of population displacement due to bank failure on education of the erosion victims. Multiple linear regression analysis has been accomplished to serve this purpose of study. The dependent variable is mean year of schooling and the independent variables are: average age of marriage, illiteracy rate, child labor, average monthly income, and frequency of population displacement due to bank erosion. From this analysis, the parameter river bank erosion in square meter has been excluded and frequency of population displacement has been taken into consideration. We know that river bank erosion and deposition are continuous processes, go hand in hand. The main impact of river bank erosion is population displacement and population displacement due to river bank erosion creates long term chain effect in society. The result of the multiple linear regression analysis shows the impact of population displacement due to bank erosion on education clearly. In the model summery (Table 6) the adjusted 'R square' value is 0.65 and 'R square' value is 0.747 which means near about 74 percent variance of the dependent variable can be

Table 5. Correlations among the selected variables

		Frequency of population displacement	Average monthly income in rupees	Illiteracy rate	Child labour in %	Mean years of schooling	Average age of marriage
Frequency of population displacement	Pearson Correlation	1	-0.248	0.191	0.51(*)	-.758(**)	-.649(**)
	Sig. (2-tailed)		0.305	0.433	0.035	0	0.003
	N	19	19	19	19	19	19
Average monthly income in rupees	Pearson Correlation	-0.248	1	-0.372	-0.267	0.299	0.427
	Sig. (2-tailed)	0.305		0.117	0.269	0.214	0.069
	N	19	19	19	19	19	19
Illiteracy rate	Pearson Correlation	0.191	-0.372	1	0.308	-0.341	-0.364
	Sig. (2-tailed)	0.433	0.117		0.199	0.154	0.126
	N	19	19	19	19	19	19
Child labour in %	Pearson Correlation	0.51(*)	-0.267	0.308	1	-0.235	-0.423
	Sig. (2-tailed)	0.035	0.269	0.199		0.332	0.071
	N	19	19	19	19	19	19
Mean years of schooling	Pearson Correlation	-.758(**)	0.299	-0.341	-0.235	1	0.34
	Sig. (2-tailed)	0	0.214	0.154	0.332		0.154
	N	19	19	19	19	19	19
Average age of marriage	Pearson Correlation	-.649(**)	0.427	-0.364	-0.423	0.34	1
	Sig. (2-tailed)	0.003	0.069	0.126	0.071	0.154	
	N	19	19	19	19	19	19

* Correlation is significant at the 0.05 level (2-tailed), ** Correlation is significant at the 0.01 level (2-tailed)

Table 6. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.864(a)	0.747	0.65	0.78355673

(a) Predictors: (Constant), Average age of marriage, Illiteracy rate, Child labor in %, Average monthly income in rupees, frequency of population displacement

explained by this model. The Analysis of variance (ANOVA) table clearly predicts that the data set is fit for multiple linear regression analysis because the significant level (***p*** value) is less than 0.05. So, the fitted model is significant (Table 7).

The coefficient table shows the order of importance of independent variables. The variable with highest beta value is comparatively most important independent variable (Uyanik, 2013). The coefficient Table 8 clearly shows the order of important independent variables which have comparatively more contribution to this model. Frequency of population displacement due to bank erosion has highest beta value i.e. 1.044. Again, frequency of population displacement due to bank erosion and mean year of schooling are negatively correlated

Table 7. ANOVA (b)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	23.564	5	4.713		
	Residual	7.981	13	0.614	7.676	.001(a)
	Total	31.545	18			

a Predictors: (Constant), Average age of marriage, Illiteracy rate, Child labor in %, Average monthly income in rupees, frequency of population displacement, b Dependent Variable: Mean years of schooling

Table 8. Coefficients (a)

Model B		Un standardized Coefficients		Standardized Coefficients	t	Sig.
		Std. Error	Beta	B	Std. Error	
1	(Constant)	14.464	3.508		4.123	0.001
	Frequency of population displacement	-1.218	0.227	-1.044	-5.371	0
	Average monthly income in rupees	0	0	0.169	1.053	0.311
	Illiteracy rate	-0.045	0.024	-0.303	-1.917	0.077
	Child labor in %	0.015	0.01	0.231	1.394	0.187
	Average age of marriage	-0.346	0.166	-0.421	-2.084	0.057

(a) Dependent Variable: Mean years of schooling

(r = -0.758) with each-other and their relationship is significant at 99 percent level of confidence (Table 5). Next the average age of marriage has second highest beta value i.e. 0.421. And average age of marriage and frequency of population displacement due to bank erosion are negatively correlated with each other (r = -0.649) and relationship is significant at 99 percent level of confidence (Table 5). Next third and fourth important independent variables with beta value 0.303 and 0.231 are illiteracy rate and child labour respectively. Lastly, the fifth independent variable is average monthly income with beta value0 0.169. The variable with highest beta value is comparatively most important independent variable (Uyanik, 2013).

5. Conclusions

It can be concluded that in the river bank erosion prone area, a considerable percentage of child labour has been observed. The hightest percentage of child labour is observed at Dhulian (80 percent) and the lowest percentage of child labour is observed at Giria (11 percent). Child labour in percentage and frequency of population displacement due to river bank erosion are positively (r= 0.51) and significantly related with each other. Erosion victims treat their children as financial assistant to their family. Mean year of schooling is very low in almost cases and it ranges from 8.6 to 3.14. The highest mean years of schooling is found at Jangipur municipality and the lowest mean years of schooling is found Kuli respectively. It can be stated that population

displacement due to river bank erosion acts as an important factor in low mean year of schooling of the erosion victims along the banks of Ganga-Bhagirathi in Jangipur sub-division of Murshidabad district. The frequency of population displacement due to bank erosion and river bank erosion in square meter are positively (r= 0.551) and significantly correlated with each-other. The frequency of population displacement due to bank erosion and mean year of schooling are negatively (r = -0.758) and significantly correlated with each-other. And it is clearly proved that frequency of population displacement due to bank erosion has considerable impact on occurrence of low mean year of schooling in the selected erosion affected study units than the other selected variables like average age of marriage, illiteracy rate, child labour, and average monthly income. Therefore, the pre-conceived idea under the study is 'river bank erosion have adverse impact on the education of the erosion victims' is fitted very well. To minimize the impact of river bank erosion on education of the erosion victims, protective strategies like effective environmental strategies (increasing soil cohesion, vegetation cover along river bank, implementation of rock rip-rap with wooden fencing etc.) and engineering measures (concrete bolder jacketing and construction of spurs) can be adpoted. It is very important to avoid any kind of concrete structures (settlement, industry) along the river banks. To prevent the misuse of human resource or to prevent child labour, it is very important to introduce hostel facility in school through proper channel for the children of the erosion victims. Arrangement of rehabilitation package and work support for the erosion victims are very necessary.

Acknowledgements

The authors are greatly thankful to the respondents of the study units in Jangipur sub-division of Murshidabad district. The author wants to thank to Dr. Swati Mollah, Associate Professor, Department of Geography, Dumkal College, Murshidabad, West Bengal, India, for her valuable comments during the research and staffs of Department of Land and Land Reform Officers, Murshidabad for providing cadastral maps of the study units.

References

Briggs, N.A. Freeman, R. Larochelle, S. Theriault, H. Lilieholm, R.J. and Cronan, C.S. (2008). Modelling river bank stability and potential risk to development in the Penobscot river estuary of Maine, USA. Environmental Problems in Coastal Regions, 99(7): 111-118. DOI: http://doi.org/10.2495/cenv080101

Census of India. (2011). District census hand book: Village and town dictionary part-XII- A (20). Murshidabad, West Bengal. Available at: http://censusindia.gov.in/2011census/dchb/dchb_a/19/1907_part_a_dchb_murshidabad.pdf

Census of India. (2011). District census hand book: Village and town dictionary part-XII- B(20). Availabel at: Murshidabad, West Bengal. http://censusindia.gov.in/2011census/dchb/1907_part_b_dchb_murshidabad.pdf

Conteh, I.K. (2015). The impact of flood hazard on primary school education in Zambia. (Doctoral thesis, Maastricht University, Maastricht, Netherlands). Availabel at: https://cris.maastrichtuniversity.nl/portal/files/1088798/guid-33dcfb62-ec63-4e29-a623-057ee6344a9d-ASSET1.0

Charlton, R. (2008). Fundamentals of Fluvial Geomorphology. London, United Kingdom: Routledge.

Chatterjee, S. and Mistri, B. (2013).The impact of river bank erosion on human life: A case study in Santipur Block, Nadia District, West Bengal. International Journal of Humanities and Social Science Invention, 2(8), 118-111. Available at: http://www.ijhssi.org/papers/v2(8)/Version-3/Q028301080111.pdf

Das, T.K., Halder, S.K, Gupta, I.D. and Sen, S. (2014). River bank erosion induced human displacement and its consequences. Living Rev. Landscape Res, http://dx.doi:10.12942/lrlr-2014-3

Economic Institute of Cambodia (2018). Impact of the disasters on the education sectors in Cambodia. Developed under the advocacy pilot implementation project on the education sector in East Asia Bangkok. Available at: https://www.preventionweb.net/files/15375_mdrdeducationcambodiafinalmar08

Flood Preparedness and Management Plan (FPMP), Murshidabad (2014). Government of West Bengal,

West Bengal, India. Available at: http://wbdmd.gov.in/writereaddata/uploaded/DP/DM%20Plan%20Murhidabad.pdf

Ferris, E. (2018). Displacement, Natural Disasters, and Human Rights. Available at: https://www.brookings.edu/on-the-record/displacement-natural-disasters-and-human-rights/ (29.07.2018).

Gaur, A.S. and Gaur, S.S. (2009). Statistical methods for practise and research: A guide to data analysis by using SPSS. India: Sage Publications India Pvt Ltd. DOI: http://doi.org/10.4135/9788132108306

Ghosh, D. Sahu, A.S. (2018). Problem of river bank failure and the condition of the erosion victims: A case study in Dhulian, West Bengal, India. Regional Science Inquiry, 10(2): 205-214. Available at: http://www.rsijournal.eu/ARTICLES/July_2018/18.pdf

Guite, L.T.S. and Bora, A. (2016). Impact of river bank erosion on landcover in lower Subansiri River Flood plain. International Journal of Scientific and Research Publications, 6(5): 480-486.

Haque, C.E. (1986). Impact of bank erosion on population displacement in lower Brahamaputra (Jamuna) floodplain. PopulGeogr, 8(1-2): 1-16. Available at: https://www.ncbi.nlm.nih.gov/pubmed/12179018

Haque, C.E. and Zaman, M.Q. (1989). Coping with river bank erosion hazards and displacement in Bangladesh: Survival strategies and adjustments. Disasters, 13(4): 300-314. DOI: http://doi.org/10.1111/j.1467-7717.1989.tb00724.x

Hagerty, D.J. and Ullrich, C.R. (1981). Bank failure and erosion on the Ohio river. Engineering Geology, 17(3): 141-158. DOI: http://doi.org/10.1016/0013-7952(81)90080-6

Laha, C. and Bandyopadhyay, S. (2013). Analysis of the changing morphometry of River Ganga, shift monitoring and vulnerability analysis using space-borne techniques: A statistical approach. International Journal of Scientific and Research Publications, 3(7): 1-10. Available at: http://www.ijsrp.org/research-paper-0713/ijsrp-p1917.pdf

Ofuoku, A.U. (2011). Rural farmers' perception of climate change in central agricultural zone of delta state, Nigeria. Indonesian Journal of Agricultural Science, 12(2): 63-69. DOI: http://doi.org/10.21082/ijas.v12n2.2011.p63-69

Rudra, K. (1996). Problems of river bank erosion along Ganga in Murshidabad district of West Bengal, India. Journal of Geography and Environment, 1: 25-32.

Rudra, K. (2003). The encroaching Ganga and social conflicts: The case study of west Bengal, India. Available at: http://25.7.188.233/default/files/Rudra.pdf (22.04.2018)

Rudra, K. (2006). Shifting of the Ganga and land erosion in West Bengal / A socio-ecological viewpoint. West Bengal, India: Indian Institute of Management Calcutta. Available at: https://www.researchgate.net/publication/285786494_Shifting_of_the_Ganga_and_land_erosion_in_West_Bengala_socio-ecological_viewpoint (12.03.2018)

Rudra, K. (2009). Dynamics of the Ganga in West Bengal (1764–2007): implications for science–policy interaction. Quaternary International, 227(2):161–169. DOI: http://doi.org/10.1016/j.quaint.2009.10.043

Sarkar, A. (2012). Practical Geography: A systematic approach. Kolkata, India: Orient Black Swan Private Limited.

Schumm, S.A. Schumm, S.A. Dumont, J.F. and Holbrook, J.M. (2002). Active tectonics and alluvial rivers. Cambridge, England: Cambridge University Press.

Shields Jr.F.D. Simon, A. and Steffen, L.J. (2000). Reservoir effects on downstream river channel migration. Environmental Conservation, 27(1): 54-66.

Uyanik, G.K. and Gular, N. (2013). A study on multiple linear regression analysis. Procedia: Social and Behavioral Sciences, 106(1): 234-240. DOI: http://doi.org/10.1016/j.sbspro.2013.12.027

United Nations Developmental Programme. (2004). Reducing disaster risk a challenge for development, (UNDP bureau for crisis prevention and recovery). NewYork. Available at: http://www.planat.ch/fileadmin/PLANAT/planat pdf/alle_2012/20012005/Pelling__Maskrey_et_al_2004

United Nations Development Programme (2010): Human Development Report 2010.The real wealth of nations: Pathways to human development, UNDP. Retrieved from http://hdr.undp.org/en/content/human-development-report-2010

Yang-chun, F. Yan-chun, H. and Xiu-min, M. (2017). The application of student's t-test in internal quality control of clinical laboratory. Frontiers in Library Medicine, 1(3): 125-128. https://doi.org/10.1016./j.flm.2017.09.002

https://pencil.gov.in/THE%20CHILD%20LABOUR%20(PROHIBITION%20AND%20REGULATION)%20AMENDMENT%20ACT,%202016(1).pdf

Appendix

Table. Data set for analysis

Study units	Population displacement due to river bank erosion	Average monthly income in rupees	Illiteracy rate 2011	Child labour in %	Mean year of schooling	Average age of marriage in yeras	Erosion in square Meter (2000-2015)
1. Farakka Barrage Township	2	10000	21.1	26	6.5	18	58378.842
2. Kuli	4	3500	39.05	77	3.14	16	2187793.8
3.Arjunpur	3	8000	43.9186	66	4.2	16	3369.781
4.Paranpara	3	7200	46.76	68	4.8	17	453277.28
5. Dhulian	4	6000	36.97	80	4.31	16	18429.129
6. Nimtita	3	6355	42.9	65	6.1	18	27627.84
7. Aurangabad	1	9480	35.76	20	6.56	19	1343.449
8. Chameghoan	3	5870	50.9	39	5.1	16	21985.531
9. Icchlampur	1	5300	55.83	41	5.56	18	40268.03
10. Arazi Gotha	1	4895	46.77	42	5.25	19	38998.446
11.Chak Saiyadpur	2	5200	34.98	44	6.5	16	1511.2856
12. Jangipur	0	6312	20.76	37	8.6	20	108259.93
13. Diar Ramnagar	1	5978	39.788	38	6.4	18	25121.863
14. Char Dafarpur	1	6542	41.33	30	6.9	17	31369.561
15. Giria	3	4832	35.92	11	4.23	16	61008.84
16. Mithipur	3	6111	39.19	28	5.5	17	60496.147
17. Sekendra	3	4780	39.28	25	4.1	16	38110.796
18. Kismat Gadi	2	7968	39.08	17	4.5	20	2465.482
19. Kamarpara	2	7422	27.68	19	4.1	21	2463.1061

Ministry of Science and Higher Education
Republic of Poland

The proofreading of articles, positively reviewed and approved for publishing in the 'Bulletin of Geography. Socio-economic Series', was financed from the funds of the Ministry of Science and Higher Education earmarked for activities popularizing science, in line with Agreement No 695/P-DUN/2018.