

Impact of Climate Change and Resultant Urban Flooding in Alipurduar Town, West Bengal - Its Vulnerability and Mitigation

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ABSTRACT: Climate change means sudden variation in the global climatic phenomena i.e temperature, rainfall etc which can be caused naturally or by man- made activities. Flood simply means inundation of extensive land area with water due to torrential rainfall for several days in continuation. More than 1 lakh people in Alipurduar are affected by this flood almost every year. A source in the India Meteorological Department said: "These areas are prone to heavy rains as they are close to the Bhutan hills. Sometimes the areas get over 200mm of rains in a day". Continuous dumping of garbage on either side of the Kaljani River, some Anthropogenic activities i.e., Urbanisation, channel manipulation, construction of bridges, deforestation have made the bed shallow. Prolonged rainfall is responsible for this River to overflow and inundate surrounding town area as a result of which water quality is getting deteriorated.

.KEYWORDS: Climate Change, Urban flooding, Channel Manipulation, Torrential rainfall, Deforestation, Inundation

I. INTRODUCTION

“A flood is an unusual stage of a river due to Run-off from rainfall or melting of snow is quantities too great to be confined in the normal water surface elevation of the river or stream as the result of unusual meteorological condition”- (H.M RAGHUNATH,2006). Urban Flooding means overflowing of water and inundation of streets, buildings, underpasses, institutions etc in a low lying urbanized area caused due to lack of proper drainage systems or limited drainage in the aforesaid area. Alipurduar Municipal Town is situated on the east and north bank of Kaljani River on the foothills of the Himalayas. The river flows somewhere from North to south and somewhere from West to East within the town. Mainly Flood occurs in Alipurduar town due to three reasons- 1) Siltation, debris accumulation on the Kaljani river and the resultant rise in river bed 2) Bank failure and decrease in river depth 3) Gradual dumping of garbage on either sides of the Kaljani by the local inhabitants.

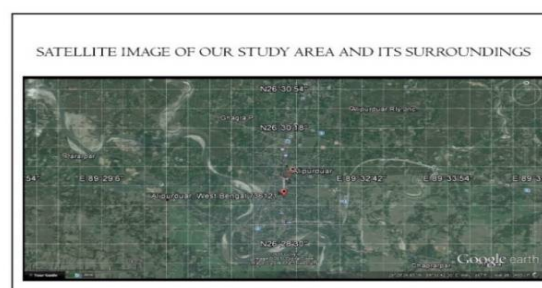


Figure1- Location Map

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Location of the study area:-Alipurduar was a sub-divisional town of Jalpaiguri district. On 25th June, 2014, Smt. Mamata Banerjee, the Honorable Chief Minister, of WB, declared Alipurduar as the 20th district of West Bengal. Figure 1 depicts that this town covers an area of 9.79 sq. km. and is situated at approx. 305 ft, on the coordinates - 26°489' N latitude and 89°527' E longitude.

II. OBJECTIVES

The precise and direct objectives for dealing with this study area are noted below—

- To highlight the history of flood occurrences in Alipurduar town area
- To Find out the possible reasons for flooding in this town
- To evaluate its dangerous impact on human lives.
- To suggest some remedial measures to lessen its vulnerability

III. METHODOLOGY

A systematic methodological principle was followed in this research work. The entire work can be represented into three broad categories which are noted below-

- 1) **Pre field study:**At the beginning a thorough literature review from related books, journals, articles, government publication etc. has been done to identify the research problem and select the study area and topic for this research work. The Satellite Imagery of the concerning area has been prepared. Relevant secondary data has been collected from various Govt offices like NATMO, Geological survey of India, Indian Meteorological Department etc and Internet as well to have a rough sketch of physical and climatic condition of the area.
- 2) **Field study:**Dima river (a tributary of The Kaljani) has been chosen for our survey. Primary data has been gathered from the survey of River Dynamics by plotting long and cross profiles across the river. Secondary data has been collected from the municipality about flood occurrences and Rainfall statistics for the last 10 years. Also some information have been gathered from the interaction made directly with the local inhabitants through a questionnaire survey.
- 3) **Post field study:**Data and others information available and generating on the field have been quantified, compiled, analyzed and synthesized using appropriate modern techniques like GIS, standard statistical methods, various diagrams to satisfy our objectives

IV. EXPERIMENTAL RESULTS

This devastating scenario can be better described through the illustration of The Change Detection Map of Alipurduar Municipal town area from 1980-2016 period

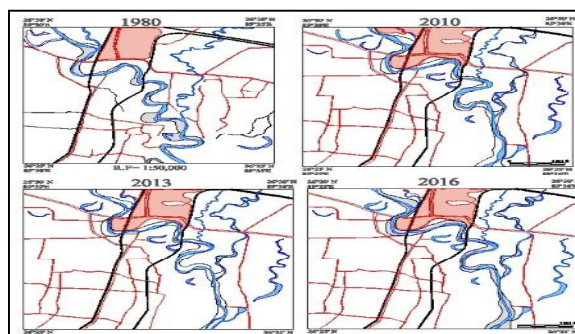


FIGURE 2-CHANGE DETECTION MAP(1980-2016):----

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This map clearly depicts the change in the direction and position of River Kaljani and its tributary Dima. In 1980, The sinuosity of River Kaljani was higher than that in 2016. This river flows from NW to SE direction. Figure 2 states that during this time period, the settlements of Alipurduar has been flourished and there has been a tremendous shift in the position of River Kaljanieastward. Naturally this river has encroached much towards the town area. The people of this area have been too habituated to misuse the water of this As a result, the Riverbed experienced a decline in depth.

* DYNAMICS OF DIMA RIVER:--

The Long profile was carried out one side of the river parallel to the banks. Figure 3 depicts that the profile appears to be less undulating than the cross profile. The relief ranges from 49 to 51 mts.(Approx). Two Cross profiles of Dima river was done at starting and ending point of the long profile. Dumpy Level survey was carried out across the river. It was observed that the cross profile was more undulating than the long profile. The first cross profile at the starting points is 24 mts and the second cross profile at the ending point is 32 mts. We notice a sudden drop on the second cross profile after 20 mts. And again there is rise in the relief. This can be due to presence of soft rocks on the river beds. The deepest relief is found 47.5 mts (approx). That is the deepest point on the river bed on this second cross profile of the river Dima.

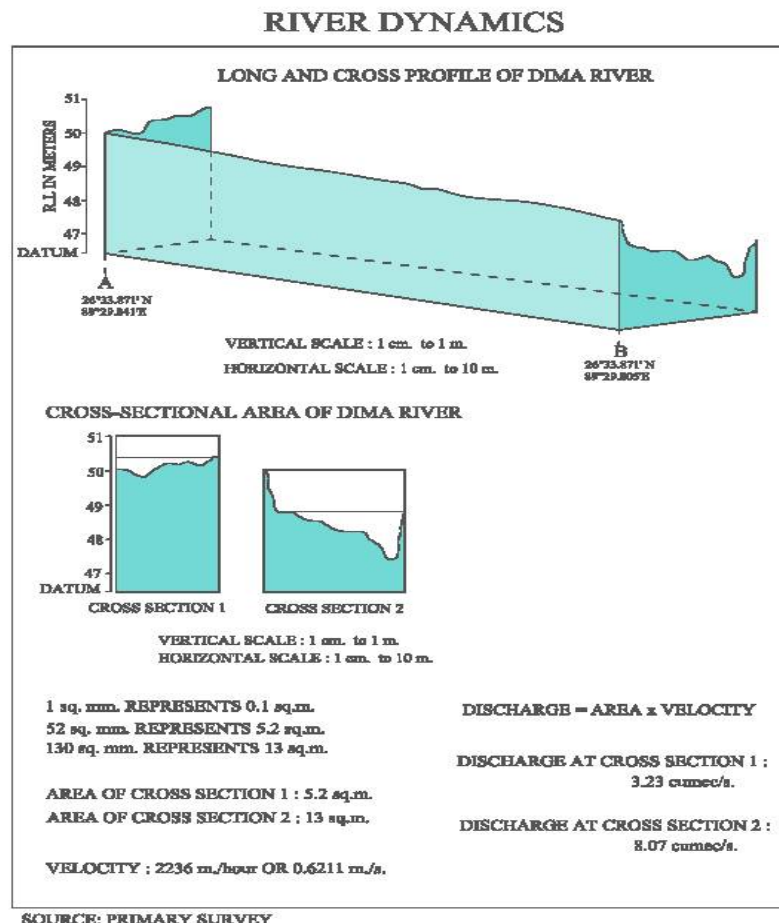


FIGURE3

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History of Flood occurrences in Alipurduar town:-

The major incidents of floods in Alipurduar (Jalpaiguri previously) are mentioned in Table 1 below—

TABLE-1: FLOOD OCCURRENCES IN ALIPURDUAR (2009-16)

Date	Year	River Responsible	Rainfall(mm)	Affected Areas	People Affected	Problems Faced
22 Aug	2009	Teesta	219	Vivekananda palli, Motiachak	More than 17000	Families marooned, damage of crops, hundred houses washed away
19 Aug	2010	Teesta	190	Saradapalli, Sukantopalli, Bala para	2500	500 people shifted, Inundation
27 Aug	2010	Teesta	-	Naxalbari, Nayabasti	5000	Waterlogging, roads chocked
25 June	2012	Nonai	226.20	Nonai village	1 child died	Waterlogging, death of a child, power cut
15 July	2012	Teesta and Torsa	-	Dooars area	40000	Damage of lands, crops, houses washed away
7 July	2013	Kaljani, Nonai, Dima	244	Market area, 17 out of 20 wards	1 lakh	Trees uprooted, transportati on derailed
21 June	2016	Dooars rivers	175.4	Wards- 1,5,8,11,12,15,18,19	400	People shifted, inundation, power crisis, 2000 houses marooned
25 July	2016	Kaljani	330	Alipurduar I block	5000	Schools shut, watchtower damaged, 200 families moved, tea estates affected

SOURCE- <https://www.google.co.in>

This table clearly shows that the major devastating flood occurred in 15 July, 2012 that snatched 40000 lives and made many people homeless. The very recent flood event occurred in Alipurduar I block in the surrounding areas of River Kaljani which took 5000 lives and devastated many families.

* Problems-- Causes of Flood in Alipurduar:-

The reasons for devastating flooding in Alipurduar are as follows—

- 1) **Prevalence of High temperature:** Figure 4 depicts that Alipurduar itself is a town which experiences high temperature—approx. 36-39 degree centigrade during summer months mainly. So, it's quite obvious that due to such highness in temperature, evaporation rate is also high, as a result percolation rate decreases gradually and in turn, most of the rainwater flows over the ground and falls into Kaljani River ultimately. This causes overflowing of the river and massive inundation of the town area.

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YEAR	MAX TEMPERATURE(degree C)
2010	37
2011	41.3
2012	37.1
2013	38.3
2014	37.9
2015	39

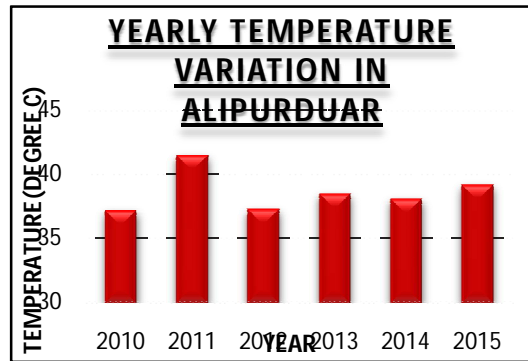


Table-2/ Figure-4: YEARLY TEMPERATURE VARIATION IN ALIPURDUAR, SOURCE- Ministry Of Earth Science, GovtOfIndia

- 2) **Gradual increase of Rainfall:** From the last 12 years rainfall statistics it can be obviously stated that there has been a 2.8% increase in the amount of rainfall in the last 6 years than it has been before (Table 3, Figure-5). Due to high amount of Rains, The Kaljani River fails to bear excess volume of water because of shallow river channel and inundates surrounding town area.

TABLE-3- VARIATION IN RAINFALL IN ALIPURDUAR (2004-2015)

YEAR	TOTAL	6 YRS TOTAL	INCREASE IN %
2004	3952.8		
2005	3405.8		
2006	3120.7		
2007	3507.8	20684.2	
2008	3559.3		
2009	3137.8		2.8
2010	4146.2		
2011	3035.1		
2012	3820.8	21265	
2013	3472.7		
2014	3299.1		
2015	3491.1		

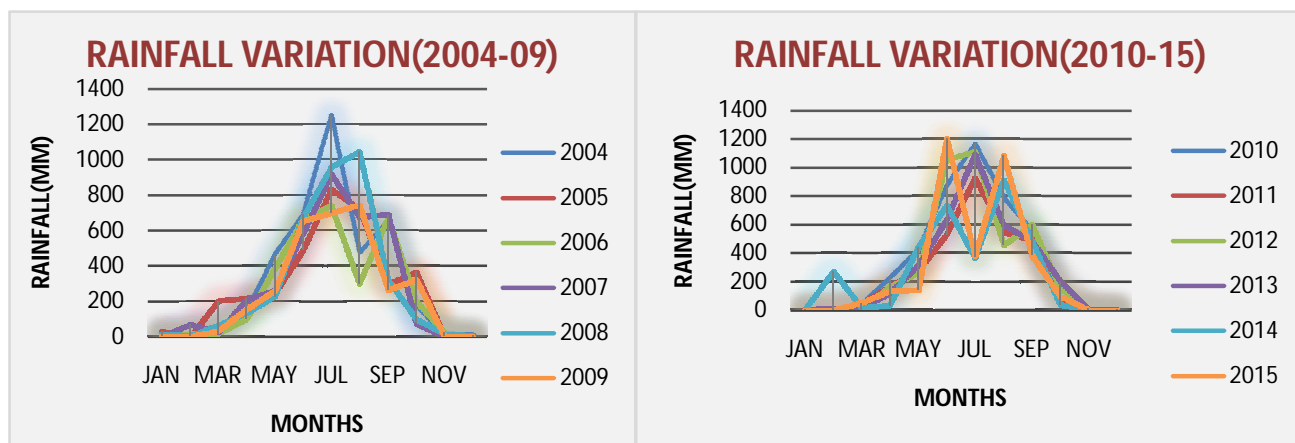
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FIGURE- 5- VARIATION IN RAINFALL IN ALIPURDUAR (2004-2015)



SOURCE- Indian Meteorological Department

- 3) **No barrage on Bhutan rivers/ Dolomite mining:** Bhutan rivers are mainly devoid of any barrage or reservoirs. The origin of Kaljaniriver(a tributary of the Torsa) is in Bhutan actually. Bhutan people do dolomite mining in the rivers as a result of which these rivers carry a hump of dolomite dust, pebbles, boulders from the upper catchment and deposit these in the low-lying rivers like The Kaljani, The Dima. Therefore, it results in breaching of river banks as well as upliftment of river beds.
- 4) **Garbage dumping on the River:** Alipurduar town has only one dumping station at ward no 3. So, sometimes the local inhabitants of other wards dump garbage just outside their residential places. Also washing of clothes on the river banks is a very common occurrence as a result of which banks are getting breached. So, when heavy rain occurs, it carries the heaps of garbage and deposit on either sides of the river. The enormous volume of water in the river then overflows and inundation takes place.

TABLE- 4: RECENT FLOOD OCCURANCES (2016):-

Date	Gauge height(M)	Height above danger level/ extreme danger level(M)
24-Jun	43.75	0
25-Jun	44.35	0.25
24-Jul	45.3	1.2
25-Jul	46	0.3
26-Jul	45.45	1.35
27-Jul	44.5	0.4

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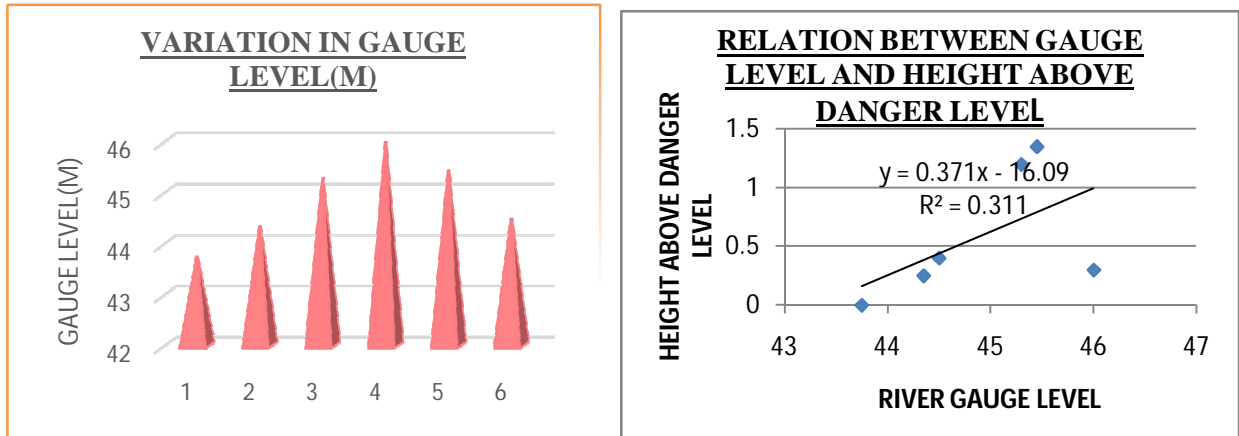


FIGURE- 6: VARIATION IN GAUGE LEVEL AND DANGER LEVEL OF KALJANI RIVER

SOURCE-<http://www.wbiwd.gov.in/index.php/applications/dailyreport>)

From Table 4/ Figure 6, it is quite apparent that specially the two months- June and July have experienced massive flood events due to heavy to very heavy rainfall occurred during those months recently e.g. 128 mm in 24 June, 115 mm in 25 June, 94.8 mm in 25 July and 138.2 mm in 26 July. As a result, the height of water in the Kaljani River has risen tremendously, sometimes it has crossed the extreme danger limit.

* **Consequences on Environment and Human lives:-**

- Many families have been marooned. A mass of people have been migrated
- Agricultural crops have been damaged
- There has been severe water crisis, water got contaminated. Acute water scarcity has been found in Alipurduar
- Roads have been devastated, waterlogged. Big cracks have been formed on the roads which have disturbed the entire transportation system.

* **Mitigation measures:-**

- Barrages should be made immediately on Bhutan rivers .Bank protection measures should be undertaken by the Government of Alipurduar district
- Garbage dumping stations must be set up in every wards
- A Mass awareness in needed to make people conscious about after effects of washing clothes on either sides of river bank
- Flood forecasting is crucial to aware local inhabitants prior to the event and prevents such loss of human lives.

V. CONCLUSION

Flood is a threatening problem in our study area. Floods can't be stopped totally as it's a natural phenomenon but its intensity can be controlled if human beings become a little bit conscious about the dangerous implications of this natural calamity and take precautionary measures. Government should come forward also and stand by the common people by framing proper flood management policies to lessen the risks in their lives.

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