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SUFFERINGS OF FLOODPLAIN USERS TO COPE WITH ANNUAL FLOOD HAZARDS AT GHATAL SUBDIVISION, PASCHIM MEDINIPUR, WEST BENGAL

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Abstract

The hazards are unevenly distributed in time and space. Man takes many decisions previously to live with the hazards among a range of alternatives based on his experience and knowledge but not always are able to collect all available information and not by efficient analysis. The flood prone areas are used to describe the distributional effect of hazard on individual and community. In this paper the various types of vulnerability of flood hazards in the lower reach of Shilabati river is determined. The floodplain users in this area are coped to different losses in every year. This area is frequently inundated for duration of 10-15 days on an average. The flood history in that study area upto2020, represents many high, medium and low-level floods along Shilabati river and its connecting tributaries but the severe flood occurred in 1978, 1993, 2007, 2011, 2017, 2019 and 2020, which was devastating flood which caused severe damages in this area. On the basis of Sub divisional office data about 390623 people faces this problem among the 1072357population, 21178 houses were smashed, 327 villages were affected by the devastating flood occurred in 2017. This damages, crops, cattle and causes break down of communication, dislocation of transport system and disruption of essential services. They have to take shelter on road sides, school buildings or at neighboring houses. Academic activity of the locality is ceased as the school buildings are occupied by the distress people. People have to struggle at their own for restoration of livelihood and life support system. They already have taken some decisions among a range of alternatives- but that are not always rational or judicious enough only follow the traditions and practices.

Introduction

Flooding is a natural process during monsoon due to unpredictable weather patterns and increasing number of intense rainfall events. Indian floods are naturally occurred during the month of July and August due to incessant monsoon rainfall which is called floods season and leading to an increasing number of fatalities and damage due to variability of landscapes. **(Duncombe 2019).** In India, different types of floods are happened during monsoon period like riverine flood, dam break flood and storm surge floods **(Kale, 1998**, **Singh, 2009).** It is common phenomenon because it is occurred every one or two interval period**.** Many rural and urban places have experienced floods on regular basis due to the disposition monsoonal behaviour **(Prasad, Jyoti and Joy-2020)**. Various factors like less water bodies, drainage channel encroachment, mismanagement of waste water bodies, excessive concretization create the large scale inundation **(Kulkarni, Sabade, and Kripalani, 2006).** In every year, flooding have displaced the many people, halted the economic activity, disrupt the livelihood **(reliefweb.int 2017).** Flood have some benefits also, likes It brings fertile soil into the field and nutrients into the field, recharging the ground water, refilling and restoring the water bodies etc **(india.mongabay.com, 2020).** So, scientific flood preparedness approach should be implemented

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for effective sustainable flood management. Flooding as a natural hazard and disaster causes different types of influences & damages in our physical and cultural environment **(Mallinis, Emmanoloudis, & Giannakopoulos, Maris, & Koutsias, 2011).** Every year different living species like human, flora and fauna etc faces widespread loss in different parts of the world due to hazardous frequent flood **(NRC, 2007, Sanyal & Lu, 2004).** Potentiality of flood creates the risks and vulnerability for the floodplain dwellers and their assets like housing, agricultural lands, roads because floodplain is comparatively low-lying area where flood water overflown and cause tremendous damage during flood **(Smith, 1996, Benito, Gerardo, Hudson, 2010 Singh and Awasthi, 2011**). Sometimes various high value flood management works in flood hazard areas mislead the security and safety of floodplain dwellers and their properties during severe flood period in flood hazard areas due to channel breaking, sand moulding etc **(Gaurav, Sinha, & Panda, 2011).** The relevant information aids and improves effective actions helps mitigate damage from flood event at both an economic and psycho-social level which are experienced very differently by different social group **(Tunstall and Parker, 1999).** Various flood control measures are taken on the basis of all technical and scientific, economic and social factors and locations which are indicated by flood hazard maps (**environment.agency.gov.uk, 2012**). Floods are the most disastrous natural calamity in the concerned area, resulting in serious social and environmental losses (**www.thestatesman.net, 2011**). However on account of substantial temporal and spatial variation in the monsoon rainfall the flood affected area varies considerably in different year (**www.meteoprog.de, 2012**). The flood history in that study area upto 2020, represents many high, medium and low-level floods along Shilabati river and its connecting tributaries but the severe flood occurred in 1978, 1993, 2007, 2011, 2017, 2019 and 2020, which was devastating flood which caused severe damages in this area. On the basis of Sub divisional office data about 390623 people faces this problem among the 1072357population, 21178 houses were smashed, 327 villages were affected by the devastating flood occurred in 2017. This flood damaged infrastructure, roads, irrigation and drainage system throughout the area and effected the social life of about 2 million people across the area. The Lower reach of Shilabati river basin is a flood prone zone. The high magnitude flood in different years affected the millions of people who were displaced or homeless during different years and destroyed the existing infrastructure partly or fully. Most of the family members fell sick during and after flood. They suffer from water borne fever, dysentery, cholera and snake bites. Even they suffer from psychological trauma. Existing medical facilities, available in Ghatal block, mainly from hospital, health centre, allopathic doctors, homeopathic doctors and quacks (**www. accessmylibrary, com, 2016**). Flood experiences in study area shows that flood plain dwellers in Ghatal Subdivision are more effective during this time **(Das, DasGupta, 2010).** Recent major floods in 2017 experienced that 21178 households were flooded while 08 people lost their lives. The rainfall during 22.7.2017 to 06.8.2017 storm resulting the cumulative flooding. The efficient management and the rehabilitation activities are significant for the affected people. The damage assessments are very essential for reducing the socio- economic losses. In the present study area majority of the people are living below poverty line, therefore their responses are not always possible to follow land use planning, regulations, policies or shift to other places. The main aims of this study is to evaluate the sufferings of people's perception and behavioural responses of individual and community towards the flood hazard in this area. They are also unable to take rational decisions among a range of alternatives based on their experiences and knowledge. They are mostly used in some structural and non-structural measures to control flood in this area. A forum is very essential for

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interacting the flood related knowledge, interactions between individuals and high exposure community people who are connected with floods and their impact on settlements, gender related practices of annual preparation for coping with floods and innovative measures for survival and minimizing the flood challenges and forwarding the possible ways.

Methodology

A social survey was conducted using structured questionnaire on five affected blocks of study area, 334 houses were surveyed in 2019 and 226 households in 2020 randomly in this area. Survey reveals that extreme differences in economic composition in this area. The primary data have been collected through standard questionnaire by door to door survey by random sampling method for assessment of sufferings of people of that area through selection of study community and household interviews, Flood experiences of the surveyed households, impact of flood and losses and damages of floodplain occupants were surveyed by Focus group discussions and Key informant interviews mainly elder persons and high exposures community **(Subbarao and James 2008 & Antwi 2015).** Information related to the impacts of flood on women, children and their adaptation policies are find out from the society through the door to door survey with structured questionnaire by the method of **(CARE, 2010**). Secondary data have been collected in the form of published and unpublished information from different offices at district town, like District Collector ate Office Paschim Medinipuir, Bureau of Applied Statistics and **Census book of India (2011)** etc. Year wise damage data has been calculated on the basis of damage and losing report of different storms periods in particular year. An appropriate flood risk assessments and preparation of maps of flood risk areas are followed by the method of **(Asare-Kyei, Forkuor, & Venus, 2015).** Detection and delineation of local flooding zone and identify the damaged features, the thematic maps of study area has been done using the GIS techniques (using ERDAS IMAGINE 10.3) and develop the various maps consisting of transparent information regarding total flood affected area by the method of **(Malinowski, Groom, Schwanghart& Heckrath, 2015).** Identification of demolished household, damaged infrastructure, flooded roads to achieve the level of better decision making help the responsible authorities for developing, designing, and operating flood control infrastructure and preparing aid and relief operations for high-risk areas during future floods. The digital photographs of these damaged houses, roads, education institutes, health units, bridges, were obtained during the field survey.

Identification of the Catchment area:

The whole Shilabati catchment lies between $22^0$30'N-$23^0$15'N latitude and $86^0$40'E-$87^0$45'E longitude. The lower catchment faces the fury of flood almost annually. The geophysical condition and geographical location is experiencing with riverine floods mainly by the Shilabati river and its tributaries. This area is linked also river Kangsabati to the south and Dwarakeswar and Damodar river to the east **(en.wikipedia.org, 2017).** The area has an average elevation of 5 meters (16 feet). During monsoon period, water contributions from the river Dwarakeswar, Kangsabati and the Shilabati concentrates in this low land and create flood.

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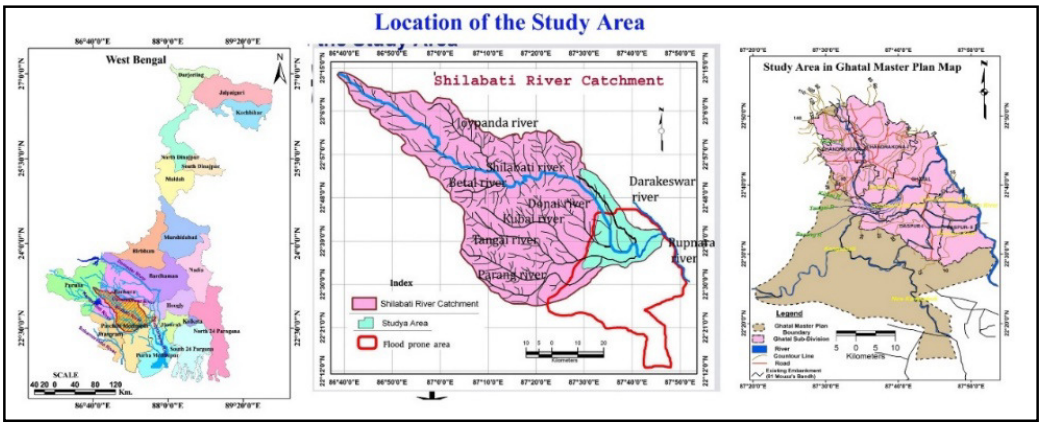

Fig-1: Identification of the Study area

Fig-2, A,B,C,D showing the sufferings of Men. Women and Children

Table-1: Socio Economic Background of the study area:

		Survey Data of Five Blocks showing in Percentage					
Category	Particulars	Ghatal	Chandrakona--1	Chandrakona-11	Daspur-1	Daspur-2	Average
Respondents	Male	62	70	49	68	58	61.4
	Female	50	42	63	44	54	50.6
Type of House Pattern	Mud and Fencing	76.92	86.20	87.67	94.30	91.30	87.28
	Cement and Brick	23.08	13.80	12.33	5.70	8.7	12.72
Educational Characteristics	Below-Secondary	47.35	58.45	49.65	53.24	46.52	51.04
	Secondary-	26.02	20.78	25.17	23.38	26.74	24.42

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	Higher Secondary						
	Graduation	18.30	14.75	20.15	17.08	20.14	18.08
	Post Graduation and others	8.33	6.02	5.03	6.3	6.6	6.46
Occupational Characteristics	Cultivators &Agricultural Labourers	38.75	43.93	91.74	71.26	71.09	63.35
	Household Industry	2.82	3.59	1.70	10.76	5.67	4.91
	Manufacturing & construction	9.9	1.94	1.31	4.78	1.35	3.86
	Other Services	48.53	50.54	5.25	13.2	21.89	27.88
Income Level/month	Below 15000	50.16	56.03	41.88	59.52	54.17	52.35
	15000-30000	34.92	27.99	38.12	30.24	30.91	32.44
	Above 30000	14.92	15.98	20	10.24	14.92	15.21

Source: House hold survey, 2019 and 2020

Table-1 shows that on an average 87.28 percent houses are mud and fencing houses, average 12.72 percent are cement and bricks made buildings. Block wise data of house pattern, are shown in above tables. Mud is mainly used for repairing the houses after and before flood in every year. The house pattern indicates that these regions are economically backward and they construct their house with easily available materials, in spite of regular damage by frequent flood. Survey also revealed that, 51.04 percent people have below secondary education, only 18.08 percent have graduation and 6.46 percent population have post-graduation and other degrees. Sample survey in study area reveals that most of them 63.35 percent are engaged in agricultural and related activities and only 4.91 percent engaged in small scale household industrial activity to avoid the heavy losses and damages during flood season. Most of the people average 52.35 percent have below 15000Rs and only 15.21 have above 30000 per month.

The house pattern indicates that these regions are economically backward and they construct their house with easily available materials, in spite of regular damage by frequent flood. Most of the people are engaged in animal husbandry at Ghatal subdivision such as ducks, cattle and goat farming and lumbering. Food grain and commercial grain farming is practiced in many parts of the area and poultry farming is a most important occupation in this area, mainly in Chandrakona-1 and Chandrakona-2 block, but Daspur-1 block is receded in this practice. Agricultural dependent small scale industries such as rice, rice bran oil, wheat, jute, oilseed , potato, pulses and vetches cropping, husking meal, fried rice and sweetened parched paddy, beckery industry activities have mainly practicing in this area. They practice mainly those activities which has low damage potentiality so that they try to recover their losses in short time loans which have facilitated from commercial banking and co- operative bank.

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Table-2: Block wise damage categorization in flood victims from (21.7.2019—30.7.2019)
Data source: House hold survey after flood 2019, 2020

Discussion: Different types of sufferings of floodplain users
Impact on settlements.

Category	Ghatal	Chandrakona--1	Chandrakona-11	Daspur-1	Daspur-2
Affected Mouzas	156	64	57	162	87
	Loss in Agricultural and Horticultural Crops in percentage				
Area Inundated in hectare	19.4	19.92	19.01	20.94	21.07
Area Damaged in hectare	23.94	14.20	8.86	25.95	27.03
Production loss in tonne	21.50	11.30	7.50	35.00	24.65
No of affected farmers	9.36	20.79	10.80	24.94	34.09
	Animal resource affected in percentage				
Cattles and buffaloes	25.94	33.99	9.37	11.72	18.97
Sheep and Goats	43.11	50.72	30.81	33.94	50.47
Poultry and Ducks	46.02	62.86	58.17	27.42	31.06
Pig and others	20.99	33.33	29.01	22.22	50
Cattle shed damaged	64.99	11.55	9.79	16.49	15.12
	Health Affected in percentage				
No of patients admitted	52.37	38.41	37.70	47.59	45.86
Diarreaha patient	62.50	30.65	31.20	32.03	41.19
Fever	58.47	15.74	18.25	19.31	18.63
Snake biting	33.33	28.20	38.46	30.77	51.28
Drowning	09	00	00	02	12
Death due to Snake biting, electric shock, others	05	02	03	05	01
	Problem in sanitation system damaged				
Tube well	102	132	140	214	201
Well	142	113	143	75	132
Pond	175	220	114	152	131
	Road damaged in Km				
Total road length damaged in km.	45.75	16.23		14.50	16.23
Overflow stretches of the road in km	39.20	13.90	02	03	14
Height of water over the road in mm.	800	1200	-	9000	1600
	School Education affected				
Total School affected	168	117	110	129	162
Pucca buildings	100	37	38	48	59
Partially Kancha	21	21	21	45	70
Mixed Type	45	58	50	36	32

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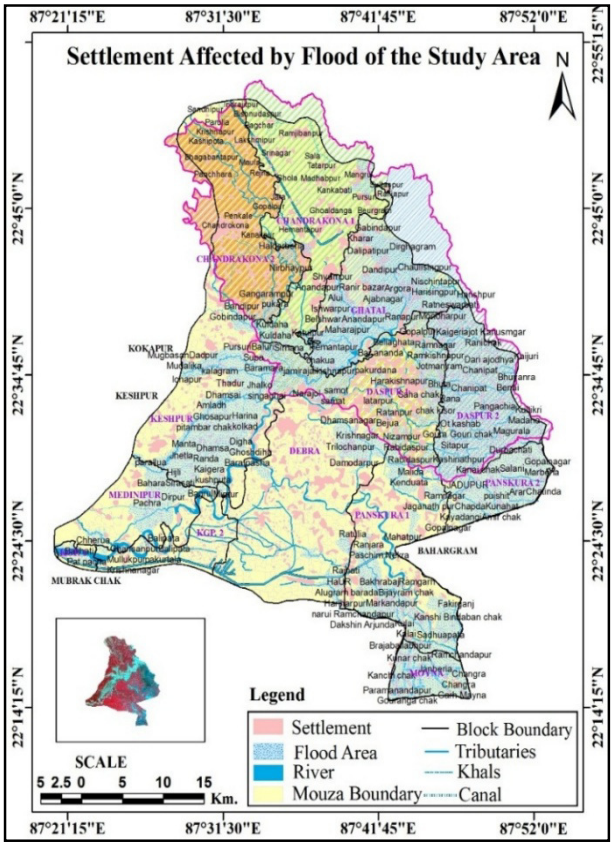

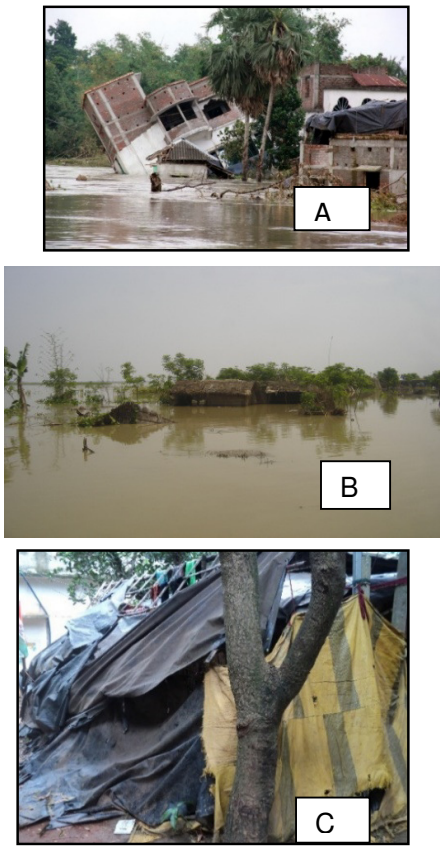

Fig-3: Impacts of Flood on settlement area

Fig: 3-A,B,C shows different flood affected houses.

Table-2 describes the flood experience of the surveyed households, impact of flood and losses and damages of floodplain occupants. A number of houses have already collapsed, families have been sheltering in relief camps or on the roadside for the last 8 to 10 days. Most of the people have displaced in temporary accommodations on upstairs of relatives houses, or road side camp with children and elder people of their family until their home was being repaired.

Impact on Health Facilities:

During flood, the water gets polluted, people have to suffer from water borne diseases. Again people can not move steadily to hospital as transport system is damaged. So, it is essential to make the health care facilities available at every door step. Most of the family members fell sick during and after flood. They suffer from water borne diseases such as fever, dysentery, cholera and snake bites etc. Even they suffer from psychological trauma. Existing medical facilities, available in Ghatal block, mainly from hospital, health centers, allopathic doctors, homeopathic doctors and quacks. Temporary medical camps are set up during and after flood but that arrangements are not sufficient enough. Health care facilities (permanent) are not intensive here in the study area. Fig 3 shows that in some places health care facilities are located more than 4 km apart. It is revealed that it is hard to get access of the health care facilities by covering more than 4 km during flood. So it is essential to set up mobile medical camp that will reach the facilities to every village. Survey data reveals that remote villagers always do not get the hospital facilities

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immediately and health center facilities because cut off road network. They mainly depend, at that time, on quack.

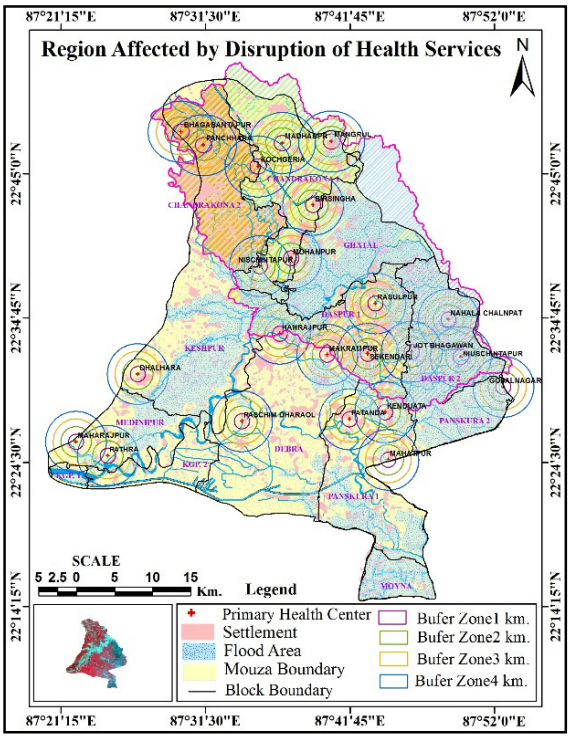

Fig- 4: Health centers are under flooded area. Fig-5 A,B The diarrhea patients admitted in Ghatal hospital and medicines distributed by boat in flood affected villages.

Table-3: Patients admitted in Hospitals and Local Health Centers

Year	July	August	September	October
2018	214	166	97	92
2019	149	61	49	53
2020	154	123	57	81

Source: Ghatal Super specialty hospitals and local health centers

Table3, reflects the no of patients admitted in Ghatal Hospitals and Health centers during flood and after flood retreat in year 2018, 2019 and 2020 in the month of July, August, September and October. Most of them admitted for water born diseases like Cholera, Diarrhea and fever etc.

Impact on Educational System:

Extension of education is also affected mostly by frequent flood **(Norton, 1997).** So that time, the schools are remained closed almost for one month time and take even more time to start again after the complete recovery. Students are also remain irregular in school because they are engaged in recovery of their houses, damages and livelihoods. Childrent have to travel more than 2 km to reach school in water logging situation; that is not possible. In maximum cases, school buildings are used as relief camps. During the flood period most of the schools are either waterlogged or used as flood shelter. So there is no regularity in educational system in this area.

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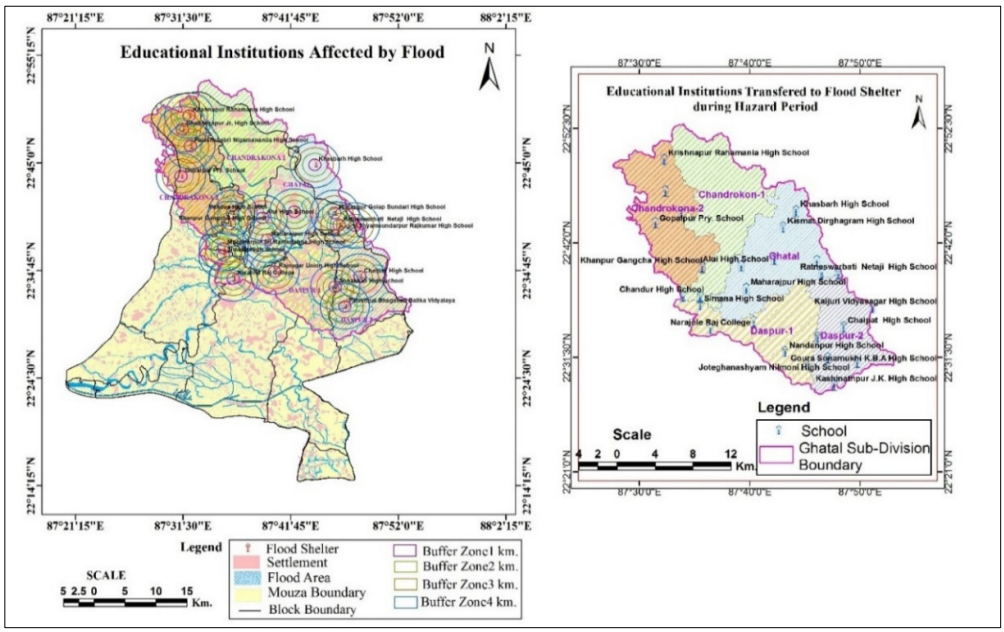

Fig-5: Educational centers transfer to flood shelters

Fig- 6: Students are walking in water logging road

Survey shows that, flood damages the school infrastructures (Library books, class rooms, toilets, common facilities, furniture etc). The others which are not used, remain closed due to inaccessibility. The students are to suffer as part of their syllabi can not be completed and thus there is a knowledge deficiency, that affects proper understanding in the advanced classes. Sometimes this knowledge gap makes them handicapped academically. The economic damage by a flood sometimes restricts the students from continuing study available at every door step. Some of snior villagers identified flood as the most remarkable threshhold event in their lives that affected their academics and limited other opportunities for development. A huge number of cases of dropout just after a major flood. Interaction with students, facing public examination in X and XII class, revealed their anxiety and helplessness as a major period of academics are badly affected. Such students who are there in relief camp can not concentrate to their study as they to survive first. The students who appeared public exams in major flood years blamed hazard for sub standard result. Some of senior villagers identified flood as the most remarkable threshhold

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event in their lives that affected their academics and limited other opportunities for development. A number of houses have already collapsed, families have been sheltering in relief camps or on the roadside for the last 8 to 10 days. Sometimes depressions, frustration of adults, children and elder people were leading to traumatizing effects and mortality victims. Some local organizations, agencies come into contact for recovery process after hazards but mishandling and unscientific instructions make some recovery gaps for the residents.

Impact on Transport Facilities:

Communication network into villages from main roads has been paralyzed. Boats are the only mean of communication to the marooned villages (**news. Oneindia.in, 2007**). Water flows with huge turbulence across the roads that hamper movement along main roads also. Everyone has to use boat for communication and that facility is very limited as waterways are not used at its optimum level in rest of the year. More emphasis has to be given for development and use of waterways throughout the year as a reliable alternative transport means. The un-metal roads are greatly damaged in water logging situation. Even the metal roads along Medinipur -Ghatal routes are submerged at few locations (fig -8, A-E).

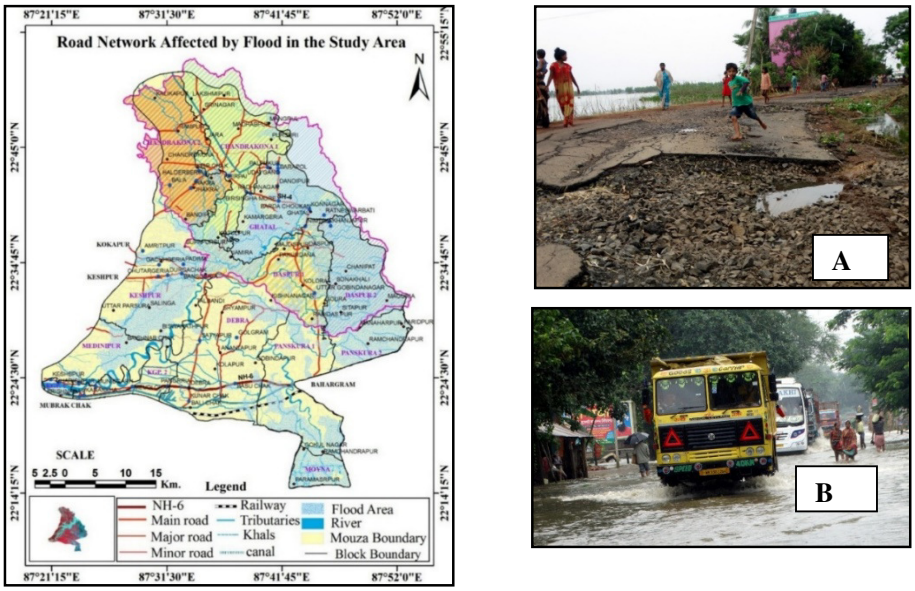

Fig 7: Transport network affected by flood.

Fig: 8-A, B, C, D, E Different types of sufferings due to disconnection of road network.

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Table-4: The relation between year wise (last ten years) magnitude of flood, area coverage and losses.

Year / Category	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Flood magnitude in cumecs	1098.72	1119.74	912.60	943.90	973.78	1005.43	993.90	1168.45	949.89	992.00	1006.83
Area coverage(km^2)	917.28	908.52	912.23	918.35	925.10	850.00	715.23	923.17	867.85	832.32	928.35
No of affected mouza	117	187	108	117	126	275	140	327	196	179	
No of total Population	797515	797515	1047679	1047679	1047679	1072357	1072357	1072357	1072357	1072357	1072357
No of affected population	175191	164500	182200	178516	194000	293927	206659	390623	159332	140500	88516
Percentage of Affected population	21.97	20.62	17.39	17.04	18.52	27.41	19.27	36.42	19.97	13.41	17.57
Affected Houses (Fully)	7992	6210	8120	7738	7621	16613	4147	21178	5831	14151	7738
No of School Affected	117	121	110	93	114	109	97	168	102	113	107
Loss of human lives	75	7	23	29	10	04	02	08	13	33	29
No of Tube well damaged	361	343	342	320	330	386	372	438	332	348	320

Source: District Collector ate Office at Paschim Medinipur, WB.

Table-4 reflects the year wise damages and losses from 2010-2020 at every annual flood occurrence in that area. Therefore to modify the susceptibility of flood damage and disruption in Lower reach of Shilabati river basin, people responses depend on some strategies which are implemented through some emergency plans. They use definite code for housing in the flood plain specially, who enjoy assistance from Govt, financial institutes or NGO for either building or reconstruct houses. Floodplain users have taken some personal measures before monsoon flood period. Villagers keep the rice and wheat and other dry foods in a safe place which is constructed in high elevation from ground above average flood level. They keep storing of food and fuel (rice, fried rice, kerosene and fuel woods etc.) for crisis period on elevated surface for use in marooned situation. Villagers arrange to construct bridges (bamboo) for maintaining transport during emergency season. Villagers adopted some alternative land use practices for reducing loss from crop failure. They usually harvest paddy before onset of monsoon and during monsoon they harvest fish on that land. Very recently most of the frequently flooded lands are permanently transferred to fishery. Local people specially the owners of the fishery take initiatives to monitor the condition of embankment and arrange for strengthening and repairing of embankment if required. The flood affected people move valuables items to higher locations such as ornaments, money, family photo albums, certificates, tax records, insurance policies and household inventories, property records from the lower level of their home. They also move hazardous materials to higher locations.

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Conclusion

Survey reveals that floodplain users are suffered from huge losses and damages almost every year by frequent flood. Protections have to be initiated with active community participation and making the flood shelters with food storage and roof top water harvesting. Some construction regulations should be maintained by the elevating of base height of houses, roads, school buildings and by setting the sanitary and wells at elevated platform to avoid the contamination during flood season. Flood hazard problems must be evaluated in the context of the technical, financial and legal capabilities of all affected parties to carry out their responsibilities. Ex ante preparation for flood and capacity building has to be ensured for reduction of sufferings and speedy recovery. Village level flood shelter with food storage and roof top water harvesting has to be initiated with active community participation. So to get protection from these floods, some construction regulations should be maintained by the elevating of base height of houses, roads, school buildings and by setting the sanitary and wells at elevated platform to avoid the contamination during flood season. Efficient management should include the diversion of flood water before it enters into the critical area and construction of detention storage at the mouth of major tributaries may store some flood discharge. Some proactive measures should be undertaken through arrangement of training for village level personnel and students for rescue and evacuation and learn to live with floods. A strong coordinated initiatives of Govt authorities, different NGO and communities may help people to adjust with flood that will effectively reduce sufferings of people. Some Water Conflicts Forum is mandatory for capturing, understanding and disseminating knowledge around water based challenges, proposes to initiate interaction between individuals who are intrinsically linked with floods and a wide ranging inquisitive audience wanting to know about floods in that area.

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References

1. Antwi.et.al (2015): Community vulnerability assessment index for flood prone savannah gro-ecological zone: A case study of Wa West District, Ghana in Weather and Climate Extremes 10(2015)56–69 published by ELSEVIER Journal31 October.
2. Asare-Kyei, D, Forkuor, G & Venus, V (2015): 'Modeling Flood Hazard Zones at the Sub-
Benito, Gerardo & Hudson, Paul. (2010) Flood Hazards: The Context of Fluvial. CARE International, London.
3. CARE, (2010): Adaptation, Gender and Women's Empowerment, CARE International Climate Change Brief,
4. Census of India. (2011). Data from the 2011 Census, including Cities, Villages and Towns (Provisional)", Census Commission of India.
5. Das, K. T., DasGupta, I. (2010): December ,Forecasting of Damage by Disaster, Disasters in West Bengal, An Interdisciplinary Study, published by Microdis, Integrated Health Social and Economic Impacts of extreme events, Evidence, Methods and Tools Funded by the European Commission, Jadabpur University , Kolkata, India. Pp 98-102.
6. Duncombe, J. (2019), Devastating floods hit India for the second year in a row, *Eos, 100,* https://doi.org/10.1029/2019EO131673. Published on 26 August 2019.

 ©IJSRED: All Rights are Reserved

7. Eklavya Prasad, Partha Jyoti Das and KJ Joy en.gaonconnection.com › floods-2020-the-need-for-cri...18 June, 2021.
8. Gaurav, Kumar & Sinha, Rajiv & Panda, Prafulla. (2011). The Indus flood of 2010 in Geomorphology. 10.1017.
9. Kale, V.S. (1998): Monsoon Floods in India, A Hydro-Geomorphic Perspective, In V.S. Kale (ed) Flood Studies in India, Geological Society of India, Bangalore, India, Memoir41. Pp 229-256.
10. Kulkarni, A., Sabade, S.S. and Kripalani, R.H. (2006): Intra-Seasonal Vagaries of the Indian Summer Monsoon Rainfall, Research Report No, RR114.
11. Malinowski, R, Groom, G, Schwanghart, W & Heckrath, G (2015), 'Detection and Delineation of Localized Flooding from WorldView-2 Multispectral Data', Remote Sensing, vol. 7, pp. 14853-14875.
12. Mallinis, Giorgos & Emmanoloudis, Dimitrios & Giannakopoulos, Vasileios & Maris, Fotis & Koutsias, Nikos. (2011). Mapping and interpreting historical land cover/land use changes in a Natura 2000 site using earth observational data: The case of Nestos delta, Greece. Applied Geography. 31. 312-320. 10.1016/j.apgeog.2010.07.002.
13. National Research Council (NRC), "Earth Science and Applications from Space: National Natural Hazards. 28. 1-33. 10.1023.
14. Norton, W. (1997). Human geography and behavior analysis: An application of behavior analysis to the evolution of human landscapes. The Psychological Record, 47, 439–460.
15. Sanyal, Joy & Lu, X.X. (2004). Application of Remote Sensing in Flood Management with Sewell, K and Graham, T., 1969. Human response to floods In: R, J. Chorley, eds., Water, Earth andMan, Princeton Press London U.K, 431-451
16. Singh, Dhruv & Awasthi, Amit. (2011). Natural hazards in the Ghaghara River area, Ganga
17. Singh, V.P. (2009). Applied Hydrometeorology, Heidelberg: Springer
18. Subbarao, I and James J.J (2008): Improving the utilization of recovery services following catastrophic flooding, Disaster Medicine and Public Health Preparedness pp-132-133. in Flood Hazards, Impacts and Responses edt. by Lamond et. al. pp.53-71
19. Tunstall, S.M. and Parker, D.J. (1999) Flood Warning Research Audit. Report to the Environment Agency. FHRC: Middlesex University: Enfield Union of Geological Sciences, 7-12.
20. www. environment. agency. gov.uk. (2012): Floodplain Zoning.
21. www. news.oneindia.in, (3.10.2007): Flood Control Master Plan.
22. www.thestatesman.net, (2.8.2011): Ghatal Master Plan.
23. www. wikipedia.org › wiki › 2017_West_Bengal_floods.
24. www. india.mongabay.com floods-across-the-co Floods across the country highlight need for a robust flood management structure. by. Hridayesh Joshi on 13 August 2020.

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