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FOCUS ON BETTER PLANNING FOR FLOOD DISASTER RECOVERY IN WEST BENGAL: A GEOGRAPHICAL ANALYSIS

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ABSTRACT

The United Nation defines a disaster as a serious disruption of the functioning of a community or a society. Generally people think disaster management is an emergency relief period and the post disaster rehabilitation. But the successful disaster management planning must enlace the situation that done through pre, during and post disasters. The present paper explores the better plans for some flood prone districts in West Bengal. As India is a mother land of several mighty rivers and their tributaries, therefore floods occur in different part of the country mostly in every year. Although flood hazards are not a new phenomenon in this state but till the era of 21st century, West Bengal is unable to minimize the fatalities of flood hazards in greater extent due to lack of modern management plans and policies. Secondary sources of data and imagery were utilized from West Bengal Disaster Management Department, Disaster Services to show the extension of flood prone zones and damages during 2011 to 2017 in West Bengal. West Bengal has been traditionally susceptible to the flood disaster because of its unique geo-climatic conditions and locations. Almost all the districts are affected by flood from July to October except relatively scarce in Darjeeling in North Bengal and Bankura & Purulia in South Bengal. According to the Irrigation Department, of West Bengal, forty two percentage of the total geographical area and sixty nine percentage of its net cropped area have been identified as flood prone area. In this regard the successful and better disaster management planning must encompass with preparedness, early warning, response, relief and restoration phases.

Keywords: Disaster Management, Susceptible, Flood hazards

INTRODUCTION

The Disaster Management Act, 2005 (India) defines disaster as “a catastrophe, mishap, calamity or grave occurrence in any area, arising from natural or man-made causes, or by accident or negligence which results in substantial loss of life or human suffering or damage to, and destruction of, property, or damage to, or degradation of, environment, and is of such a nature or magnitude as to be beyond the coping capacity of the community of the affected area”. The UN

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defines disaster as “the occurrence of sudden or major misfortune which disrupts the basic fabric and normal functioning of the society or community”. The World Health Organisation (WHO) defines disaster as “occurrence that causes damages, economic destruction, loss of human life and deterioration of health and health services on a large scale, sufficient to warrant an extraordinary response from outside the affected community area”. The United Nations Development Programme (UNDP) defines “Natural hazard is any natural event which possesses any threat to the natural environment and human population, while disaster can be a serious disruption of the functioning of the community or a society, it essentially involves widespread human, material, economic or environmental losses and impacts that exceeds the ability of the affected community or society to cope using its own resources’’. On a large scale, a disaster can be portrayed “as a condition or event of significant destruction, disruption or distress to a community” (Modh 2006). Disaster becomes high when hazards affect large population critically. It can occur anywhere any time, actually it is unpredictable. From the occurring to control period it can vary several ways with cause, frequency and risk, duration of impact, speed of onset, scope of impact, destructive potential, predictability, human vulnerability and control. Disaster can be natural, man- made, and technological. There are some direct and indirect relationship between natural calamities and their consequences (*table 1*).

Table 1: Inter-relationship between natural calamities and their consequences

Consequences	**Natural Calamities**			
	Flood	Cyclone	Earthquake	Drought
Loss of life	*	*	*	
Injury	*	*	*	*
Epidemiological threat	*	*		
Loss of crops	*	*	*	
Loss of housing	*	*	*	
Damage to infrastructure	*	*	*	
Disruption of communication	*	*	*	
Disruption of transport	*	*	*	
Panic	*	*	*	
Break down of social order	*	*	*	
Short-term migrations	*		*	
Permanent migrations				#

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Loss of marketing/ Business	*	*	*	#

Source: Modified from "Citizen's Guide to Disaster Management", Modh (2006)

Note: (- Direct consequences, #- Indirect Consequences)*

India is prone to various hazards due to its geo climatic locations. About 56 percentage land area is prone to earthquake, 28 percentage area is susceptible to drought, 12 percentage land is vulnerable to flood, and 8 percentage land is prone to cyclone. Calamities like earthquake and landslides occur quite suddenly and their impact is limited in terms of time and space while floods and cyclones occur with some indicators of warning although their impact continue with long period of time. But a sense of preparedness and ability to respond quickly can reduce loss of life and property in greater extent.

The state West Bengal is crowned by the mighty snow-white Himalayas in North and frothy sea in South. The unique physiographic feature i.e extensive network of rivers and their tributaries from Northern part flowing towards Bay of Bengal in South with huge volume of water make the state susceptible to flood especially in monsoon period. According to 2014 Flood Report of West Bengal, about 42.3% of total area of the state is vulnerable to floods.

MATERIALS AND METHODS

Flood management and risk reduction is a vision and a way of thinking and acting which related to human habitants and natural environment that can secure the resource and environment for future. The present study is carried out through qualitative method of research which helps at gaining a deep understanding about the specific events of flood to provide an explicit rendering of the structure, order and broad pattern for a better understanding through empirical experience and truthful reporting.

Study plan

Thepaper aims to analysis the method of representing a conceptual framework that identifies the significant aspects of managemental planning during and after a flood event in West Bengal. The whole study is divided into two parts; first we highlighted major historical flood events, area affected and damages, concomitantly some recommended plans are suggested in second part. Some applicable figures are drawn based on theoretical method to apply on spatio-temporal scale in the conceptualization of Governmental and stakeholder responsibilities to mitigate losses during flood hazards.

Objective

The key objectives of the present study are;

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- To identify areas in the district those are prone to flood disasters.
- To highlight and recommend the management plan for flood to reduce natural and public resources.

Data Source

No any special techniques, statistical methods and software were used in the present work. There was an effort made to emphasize flood hazards and measures of damages in West Bengal based on secondary sources of data. The secondary data were collected from different open and Governmental sources, District Disaster Management Plans, Govt. of West Bengal, Bengal Flood Report, Govt. of West Bengal, Published books and articles, magazines, websites, memos, transcripts of conversations, annual reports etc. in order to identify the districts those are prone to floods.

Study area

West Bengal is a state of eastern India, between the Himalaya Mountain ranges in north and the Bay of Bengal in the south. Its capital, Kolkata (formerly Calcutta), retains architectural and cultural remnants of its past as an EIC trading post and capital of the British Raj. West Bengal is located between 85˚ 52′ E to 89˚ 50′ E longitude, and 21˚ 30′ N to 27˚ 10′ N latitude (*Fig1*). The state has a total area of 88,752 Km2. West Bengal's climate varies from part to part and the tropical savana climate seen in the southern portions and humid subtropical in the northern portion with the highest day temperature ranging between 38 °C - 45 °C. West Bengal receives the Bay of Bengal branch of the Indian monsoon which moves in a north to west direction. Monsoons bring rain to the whole state from June to September. The main river in West Bengal is the Ganges, which divides into two branches. One branch enters Bangladesh as the Padma, while the other flows through West Bengal as the Bhagirathi River and Hooghly River. The Farakka barrage over the Ganges feeds the Hooghly branch of the river by a feeder canal, and its water flow management has been a source of lingering dispute between India and Bangladesh. The Teesta, Torsa, Jaldhaka, and Mahananda rivers are in the northern hilly region. The western plateau region has rivers such as the Damodar, Ajay, and Kangsabati.

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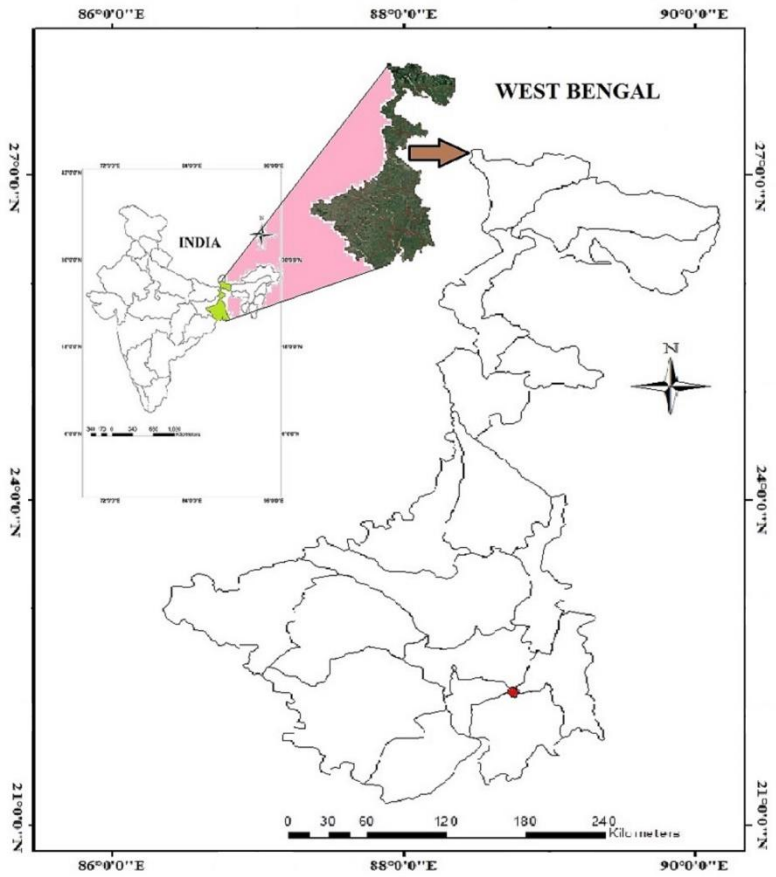

Fig. 1: Location map of the study area

RESULT AND DISCUSSION

Nature of Floods in West Bengal

Flash Floods

It is defined as floods which occur within six hours of the beginning of heavy rainfall and usually associated with cloud bursts. Major flood producing rivers beyond the state jurisdictional limits, viz Teesta, Torsa, Jaldhaka, Kaljanietc from Sikkim and Bhutan are mainly responsible for disastrous flash flood in North Bengal. In case of flash floods, warning for timely evacuation may not always be possible.

River Floods

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Such floods are caused by precipitation over large catchment's areas. These floods are normally built up slowly or seasonally and may continue for days or weeks as compared to flash floods. During heavy rainfall the catchment area of Ganga River in Uttar Pradesh and Bihar creates heavy pressure of water in the downstream of the Bhagirathi River, as a result floods occur in adjacent districts of West Bengal.

Coastal Floods

Some floods are associated with the cyclonic activities like Hurricanes, tropical cyclone etc. During last few years the deltaic region and the coastal part of Southern Bengal has been affected from flood due to high tidal surge with strong cyclones and storms.

Flood History in the State

The state has a long recorded history of flood (*table 2*);

Table 2: Historical flood events and damages in West Bengal

Occurring Period	Damages
1986	Flooding due to heavy rains in some areas of Kolkata, Hooghly, Howrah, Parganas and Medinipore.
1988	Monsoonal rains caused flooding in areas of Balurghat and Dinajpur lying under the purview of the Ganges and Churani rivers.
1991	Flash floods caused damage 35,000 houses.
1995	Flood triggered by heavy rains caused erosion, severe agricultural damage and outbreak of diseases.
1998	Monsoon rains caused flooding of the Ganges River.
1999	Tropical cyclones caused destruction of an estimated number of 1500 villages. Floods due to brief torrential rains affected areas of Kolkata, Burdwan and Birbhum.
2000	Besides flash floods triggered by incessant torrential rains, disaster is also accredited to the opening of sluice gates of dams. The fatalities counted to the tune of 1262, besides affecting millions of people.
2002	Flood occurred in Jalpaiguri, Cooch Behar and Jalpaiguri in North Bengal due to monsoonal rains. Flash floods swamped ten villages, causing four deaths and 11,000 displacements.
2003	Monsoonal rains caused floods affecting the regions of Darjeeling, Jalpaiguri, Malda and Murshidabad.
2004	Heavy monsoonal rains affected several districts.
2005	Heavy rains caused floods in many areas. About 3000 coastal villages were inundated and 60,000 huts and many roads washed away.
2006	The regions of Birbhum, Burdwan and Murshidabad were affected mainly from continuous monsoonal downpour Monsoonal rains and tropical cyclone driven storms in the Bay of Bengal hit India and Bangladesh. West Bengal recorded 50 deaths, 300 were injured and 30,000 mud houses destroyed. Heavy rains left large parts of Kolkata city under water;

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	Subsequently 2000 people were evacuated from the city.
2007	Heavy rain from tropical depression in the Bay of Bengal caused flooding leading to 51 deaths, and affecting 3.2 million people.
2013	Heavy rainfall & water release from various dams by DVC led to widespread flooding in the districts of Paschim&PurbaMedinipur, Howrah, Hooghly, Burdwan and Bankura Causing 17 deaths, 8790 villages affected, and affecting 2.1 million people.

Source: West Bengal Disaster Management Department (WBDMD)

Flood in West Bengal during 2017

The Northern Districts of West Bengal experienced flood in the month of 9th to 14th August in 2017. The affected districts are Alipurduar, Coochbehar, Dakshin Dinajpur, Jalpaiguri, Malda, and Uttar Dinajpur (*Fig. 2*). The main reason behind Floods in the Alipur Duar and Cooch Behar and Jalpaiguri districts is due to the excessive rainfall in the catchment areas of the Torsa and Raidak-I&II River. The affected blocks of these Districts are Alipurduar I & II, Falakata, Kalchini, Kumar-Gram, Madarihat- Birpara, Coochbehar I & II, Mathabhanga I & II, Dinhata I & II, Tufanganj I & II, Haldibari, Mekhliganj, Sitai, Sitalkuchi, Rajganj, Sadar, Maynaguri, Dhupguri, Mal, Matiali, Nagrakata. The Flood occurred in the districts of Uttar Dinajpur, Dakshin Dinajpur and Malda is due to the excessive rainfall in the catchment areas of Kosi River Basin and the Mahananda River Basin.

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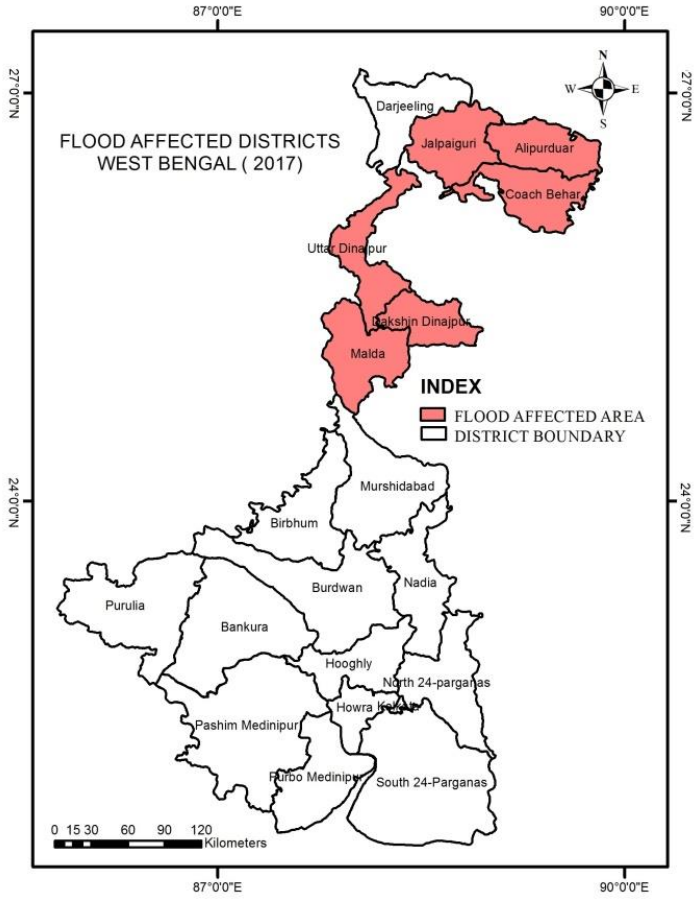

Fig. 2: affected districts of flood 2017

The affected blocks of these three Districts are Chopa, Gopalkher I & II, Islampur, Karandighi, Rajganj, Hemtabad, Kaliyaganj, Itahar, Balurghat, Kumarganj, Hili, Tapan, Harirampur, Kushmandi, Banshihari, Gangarampur, Chanchol I & II, Kaliachak I & II, Manikchak, Old Malda, Habibpur, Harishchandrapur I & II, Ratua I, Gazole, Bamongola. The total numbers of population 353328, 1300634, 1025445, 178546, 364043, 1200000 were affected in Alipurduar, Coochbehar, Dakshin Dinajpur, Jalpaiguri, Malda and Uttar Dinajpur respectively (*table 3*). The total cropped areas were damaged 3489 ha. 184910 ha. 59473.790 ha. 44289 ha.and 1069 ha. in Alipurduar, Coochbehar, Dakshin Dinajpur, Jalpaiguri and Malda respectively. The fully and partially damaged houses were found in all districts except Uttar Dinajpur. The highest numbers of fully damaged houses were found in Dakshin Dinajpur (41123). In case of cattle loss Coochbehar (77) had accounted highest number. The highest number of human lives were lost in Dakshin Dinajpur (10) followed by Coochbehar, Alipurduar and Jalpaiguri. The large numbers of relief camp were constructed in Coochbehar (517) followed by Dakshin Dinajpur, Alipurduar,

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Uttar Dinajpur, Jalpaiguri and Malda. The highest numbers of persons (61905) were served by relief camp in Dakshin Dinajpur.

Table 3: Affected scenario of 2017 flood in West Bengal

Districts	Affected Blocks	P.A	C.D	H.D		C.L	H.L.L	R.C	P.R.C
		No.	Area (Ha.)	Fully	Partially	No.	No.	No.	No.
Alipurduar	**(a)**	353328	3489	608	5688	-	5	162	16435
Coochbehar	**(b)**	1300634	184910	16758	57686	77	9	517	147204
Dakshin Dinajpur	**(c)**	1025445	59473.79	41123	60599	13	10	359	61905
Jalpaiguri	**(d)**	178546	44289	20	5541	14	4	91	24400
Malda	**(e)**	364043	1069	779	12092	-	-	26	24957
Uttar Dinajpur	**(f)**	1200000	-	-	-	-	4	160	35000

Note: P.A- Person Affected, C.D- Crops Damaged, H.D- House Damaged, C.L- Cattle Lost, H.L.L- Human Life Lost, R.C- Relief Camp, P.R.C- Person in Relief Camp

*Affected Blocks **(a)** AlipurduarI&II,Falakata,Kalchini,KumarGram,Madarihat-Birpara, **(b)**CoochbeharI&II,MathabhangaI&II,DinhataI&II,TufanganjI&II),Haldibari,Mekhliganj,Siti,Sitalkuchi**,(c)**Baurghat,Kuarganj,Hili,Tapan,Harirampur,ushmandi,Banshihari,Gangarampu**,(d)**Rajganj,Sadar,Maynaguri,Dhupguri,Mal,Matiali,Nagrakata**,(e)**ChancholI&II,KaliachkI&I,Manikchak,OldMalda,Habibpur,HarishchandrapurI&II,RatuaI, Gazole,Bamongola**,(f)**Chopa,GopalkherI&II,Islampur,Karandighi,Rajganj,Hemtabad,Kaliyaganj, Itahar.*

Flood Zone in West Bengal (2011 – 2017)

Looking towards the year wise flood events in West Bengal, we considered 7 years flood affected areas and zones (*Fig 3*). The fig. shows the flood affected zone in West Bengal during 2011 to 2017. The most flood affected areas during 2011 were Murshidabad, Nadia, Burdwan, Hooghly, Howrah, and North& South 24 Parganas. The flood of 2011 was caused of heavy shower throughout the monsoon period. The flood inundated areas during 2013 were West & East Medinipore. Although in 2014 there was less flood affected zone except Coochbehar and Alipurduar. Again a disastrous flood occurred during 2015 from Northern part of Murshidabad to Southern part of Bengal including both Medinipore. The responsible causes of flood 2015 were heavy rainfall; broken dam or levees in the catchment area of Damodar basin and opening of several passing lock gate in inundate areas. During 2016, Murshidabad, Nadia, Burdwan, Hooghly, Howrah & East Medinipore were again flooded due .surely during the month of August and September 2017, a catastrophic flood occurred in districts of North Bengal including Alipurduar, Coochbehar, Dakshin Dinajpur, Jalpaiguri, Malda, Uttar Dinajpur and some parts of

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Murshidabad Later the water of flooded areas also inundate the southern portion of Bengal due downstream flowing.

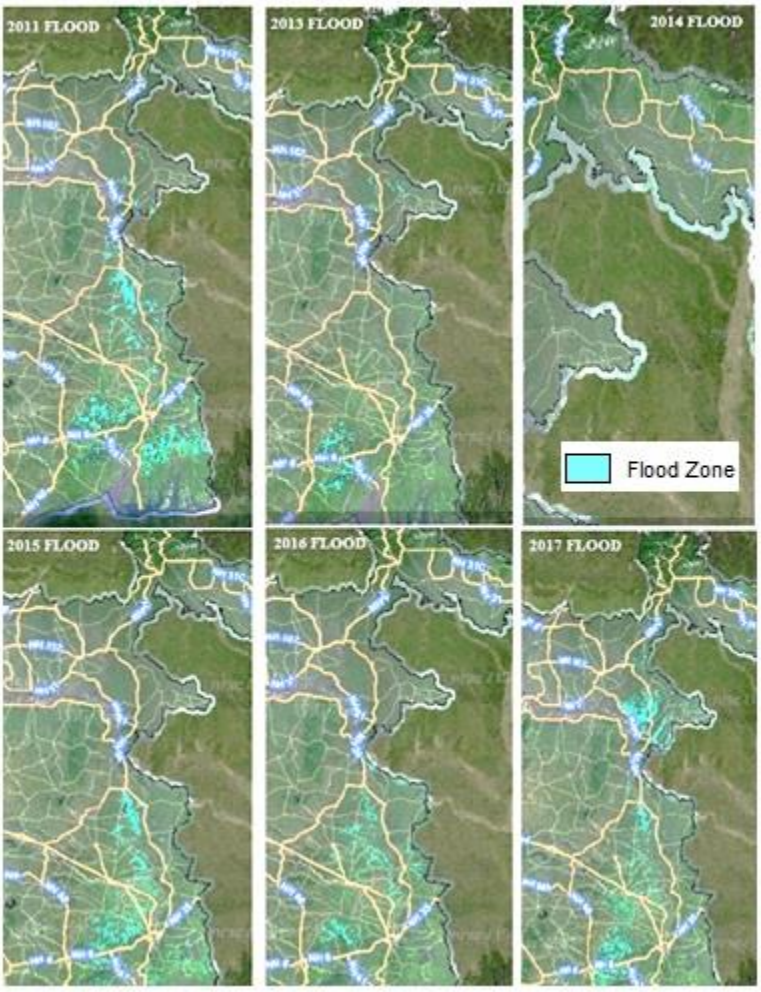

Fig. 3: major flooded zones in West Bengal (2011-2017)

Source: Disaster Services (NDEM Public)

Flood Management Planning

Floods can be serious catastrophes and they are one of the most common hazards in West Bengal, especially in coastal and river catchment areas. Floods can be caused by a variety of factors, including a sudden accumulation of rain, rising water level of rivers, tidal surges and dam failures. In case of West Bengal, the flood disaster is highly correlated with heavy and sudden rain and dam failure. Disaster management requires multi-disciplinary and proactive

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approach including pre-flood plan and post-flood management plan (Fig. 4). Therefore, it is keen important to put a plan in place for dealing with flood in an organized way with all the stakeholders who well aware of their duty in responding or preparing for disasters.

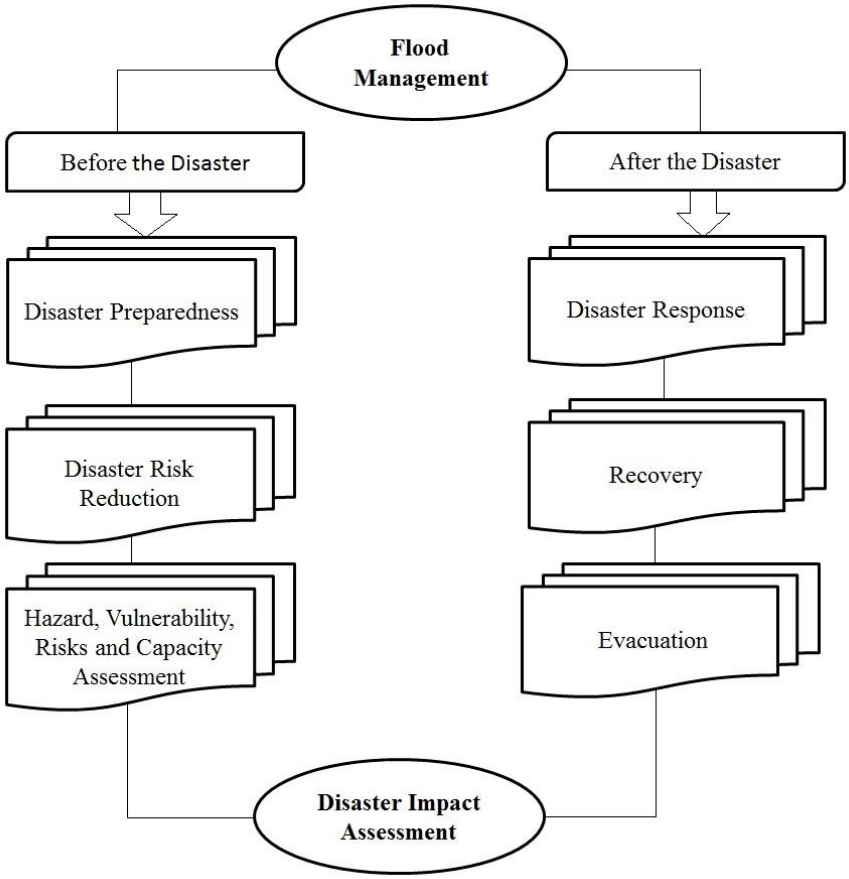

Fig. 4: Flood management plan for impact assessment

NDMA (National Disaster Management Authority),SDMA (State Disaster Management Authority) and DDMA (District Disaster Management Authority) are working together on an effort aimed at improving the way people prepare for and respond to severe weather. This paper is designed to help workers prepare plan for floods, and to provide information about hazards those planners may face during and after a flood event.

Workers who have to respond to flooded areas face the greatest risks from floods, but all workers can help protect themselves by preparing evacuation plans and learning about the hazards commonly associated with floods.The DDMP process is thereby bringing legitimacy to the entire process. The entire process was divided into three phases as Pre-disaster activities, during-

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disaster activities and post-disaster activities which were mainly focused on the following parameters;

- Disaster Preparedness
- Disaster Risk Reduction
- Hazard, Vulnerability, Risks and Capacity Assessment.
- Disaster Response
- Recovery and Evacuation

Disaster Preparedness

The Preparedness phase provides information on making an evacuation plan, emergency kitssupply and flood watches and warnings. This action can be as developing efficient response mechanism and procedures, rehearsals, developing long-term and short-term strategies, public education and building early warning system. This planning information will help the workers ensure that they are ready to evacuate in an orderly manner before rising waters impact. During the preparedness phase, Government, organizations, individuals, develop plans to save lives, reduce disaster damage and enhance disaster response operations.

To know the damage extent special emphasize is also paid on building resilience to deal with disasters by enlightening managing mechanisms and enhancing existing and diversifying to new source of livelihoods to decrease potential risks that poverty throws at communities. The preparedness plan should include the following activities:

- Effective Communication System
- Preparedness by General Staff of the department and associated all the stakeholders.
- Procurement, Inventory, Transportation & Distribution Management
- Setting up of Civil Defence
- Establishment of Emergency Operation Centre (EOC)
- Identification of Stakeholders for Disaster Response
- Early Warning System (EWS)
- Awareness, Training & Capacity Building programme
- Emergency Support Functions
- Crowdsourcing and Media Management

Preparedness minimizes hazards adverse effects through effective precautionary measures that ensure a timely appropriate and efficient organization and the delivery of response and relief action.

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Disaster Risk Reduction

Disaster Risk Reduction plan is a theoretical framework of components considered with the potentialities to minimize vulnerabilities and disaster risks throughout a society, to avoid or mitigation and preparedness the adverse impacts of hazardous events, with common context of sustainable development (*Fig. 5*).

Fig. 5: theoretical framework of DRR

Disaster risk reduction (DRR) is an organized approach to identifying, evaluating and reducing the risks of disaster. It aims to decrease socio-economic vulnerabilities to disaster as well as dealing with the environmental and other hazards that generate them. Here it has been strappingly influenced by the mass of research on vulnerability that has appeared. It is the responsibility of development and relief agencies alike. DRR is very wide-ranging: Its scope is much broader and deeper than conventional emergency management. There is potential for DRR initiatives in just about every sector of progress and caring work.

Hazard, Vulnerability, Risks and Capacity Assessment

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Hazard, Vulnerability, Risks and Capacity Assessment (HVRCA) is to enhance the understanding of the district administration and other stakeholders on the priority areas that need attention when it comes to disaster risk reduction and thus to sustaining previous developmental achievements by National Disaster Management Authority (NDMA). To assess the HVRC effectively, first of all it need to identify the type of hazards, its periodical overview and direction. Therefore, predict and monitor its vulnerability and potential risks over social, Environmental and Economical point of view and finally, establish a set up for capacity building. The inter-relationship between Hazards, Vulnerability and Risks are shown here (*Fig. 6*).

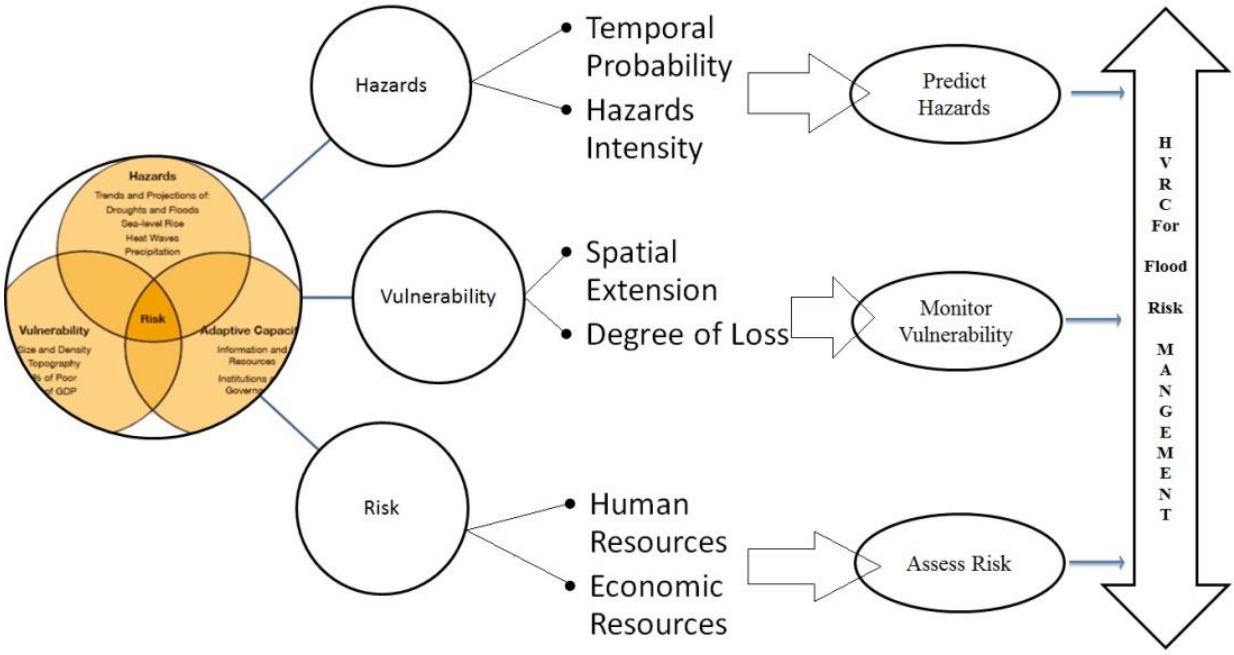

Fig 6: Inter-relationship between Hazards, Vulnerability and Risks of flood events

Disaster Response

In the aftershock of a flood, workers may be involved in a variety of response and recovery operations. The following are general plan that may be applicable to workers involved in assessing and/or cleaning up the damage to their worksitewho have the proper training, equipment and experience (*Fig. 7*). Response or Recovery provides useful details on the hazards to avoid when flooding has occurred.

The response of emergency management includes actions focused on limiting injuries, loss of life, and damage to property and the environment that are taken in advance of, during and immediately after a hazards event. Response is the most complex of the four functions of

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emergency management, since it is conducted during the period of very high stress, in a highly time-constrained environment and with limited information. During response, waving confidence and unnecessary delay trigger tragedy and destruction. Following are some recommended steps of response for flood hazards;

- Situations that will activate the plan
- Understanding
- Emergency functions and who will perform them
- Specific evacuation procedures, including routes and exits
- Ways for office for workers, customers and visitors
- Equipment for workers
- Review the plan with workers

Fig 7: major works under recovery stage

Flood disaster recovery & Evacuation

Disaster recovery (DR) involves a set of policies, tools and procedures to enable the recovery or continuation of vital technology infrastructure and systems following a natural or human-induced disaster. Disaster recovery focuses on the IT or technology systems supporting critical business functions as opposed to business continuity, which involves keeping all essential aspects of a

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business functioning despite significant disruptive events. Disaster recovery is therefore a subset of business continuity.

As the emergency is under control, the affected people are capable of venturing a large number of activities aimed at reinstalling their lives and infrastructural support. Activities of the recovery continue until all system return to betterment. Both long-term and short-term recovery measures include reviving vital life-support systems to minimum operating standards, temporary housing, public informations, health and safety education, reconstruction, counselling programme and economic impact studies (*fig 8*).

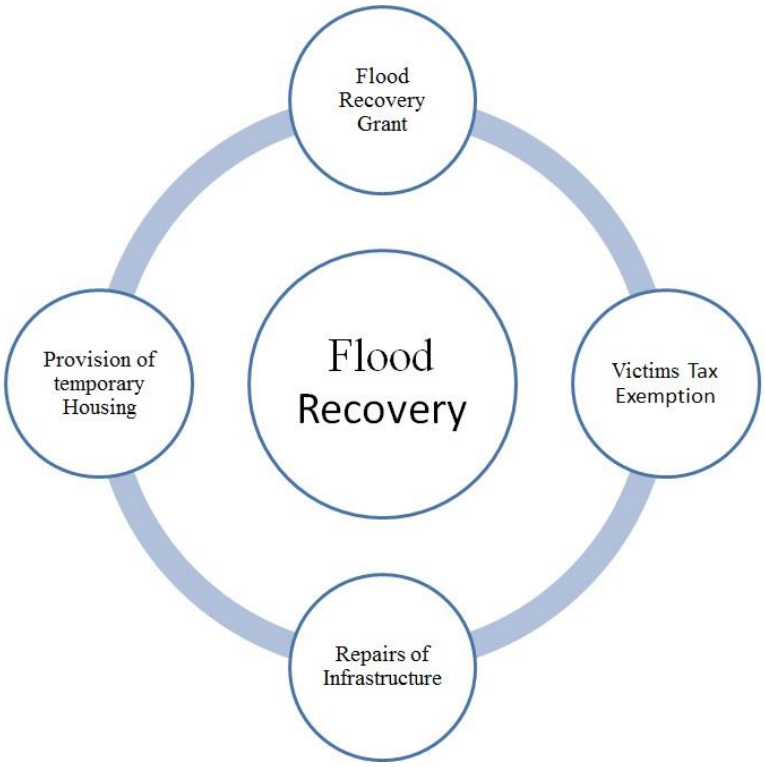

Fig 8: four steps of flood disaster recovery & evacuation

Flood management cycle

Flood management aims to reduce, divert or avoid the potential losses from hazards, assure prompt and appropriate assistance to victims of disaster and achieve rapid and effective post disaster recovery. The flood management cycle portrays the on-going process by which government and civil societies plan for and minimize the impact of disaster, respond during and immediate after a disaster and to recover the post disaster situations. Appropriate action at all points in the flood management cycle lead to greater preparedness, effective warnings and

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reduced vulnerability of disaster during the next repetition of the cycle. The complete flood disaster management cycle includes the shaping the public policies and plans that modify the causes of disasters and either minimize or mitigate their adverse effects on human health, property, infrastructure and environment.

The Flood Management Cycle (FMC) includes the whole activities and measures taken before, during and after the flood with the purpose to avoid a disaster, reduce its impact and effectively recover from its losses. The key stages of FMC are drawn based on flood background (*Fig 9*).

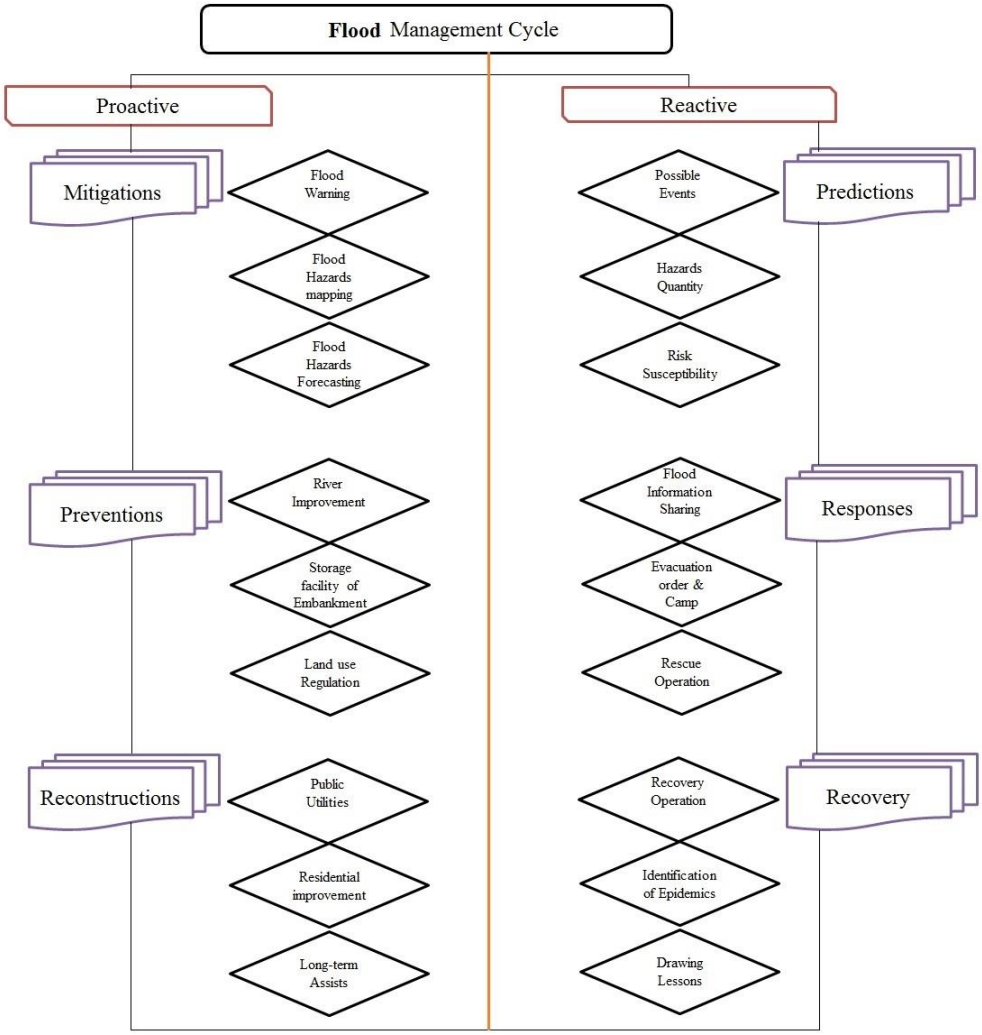

Fig 9: Flood Management Cycle (FMC)

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CONCLUSION

A flood happens when water surpluses or inundates land that's normally dry. This can happen in a multitude of ways. Most common is when rivers or streams overflow their banks. Excessive rain, a broken dam or levee, rapid ice melting in the mountains, or even an unfortunately placed beaver dam can overpower a river and send it spreading over the adjacent land, called a floodplain. The state West Bengal is capped by the mighty snow-white Himalayas in North and fizzing sea in South. The unique physiographic feature i.e. extensive network of rivers and their sub-streams from Northern part flowing towards Bay of Bengal in South with huge volume of water make the state susceptible to flood especially during monsoon season. The paper highlights selected year wise flood events in West Bengal from 2011 to 2017. The result shows that the year 2011, 2015 and 2017 were most disastrous in term of both natural and human resources. Heavy rain in July and August 2017, the state of West Bengal was affected by severe flooding. The floods were reported to have caused more than 50 deaths and thousands of homeless. This study further emphasize on zone wise distribution of flood from 2011 to 2017 through satellite imageries. The results also prove that the year of 2011, 2015 and 2017 were most devastating in term of damages and losses. During 201, southern portion of Bengal were most affected but during 2015, central part of Bengal were severe affected and in 2017, the Northern part were found in most catastrophe situation. The paper also recommends applicable planning strategies for flood management based on theoretical background with special emphasize on Disaster Preparedness, Disaster Risk Reduction, Hazard, Vulnerability, Risks and Capacity Assessment, Disaster Response and Recovery and Evacuation from flood affected areas.

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