FLOOD AND FLOOD PLAINS OF WEST BENGAL, INDIA: A COMPARATIVE ANALYSIS

INUNDAÇÃO E INUNDAÇÕES DAS PLANÍCES NA BENGALA OCIDENTAL, ÍNDIA: UMA ANÁLISE COMPARATIVA

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ABSTRACT
All around the globe, sea levels were rising, providing a further reminder of global connectedness and a future in which flood hazards would worsen and El-Nino become a phenomenon known to many. New technologies were constantly emerging, particularly in the media ,information ,space and communication sectors drawing some of the occupants of the 'global village' much closer together and making 'disaster news' more immediate and graphic. Technological advances challenged the power of institutions; governments could no longer so easily restrict their citizens' access to information or pursue their policies in isolation. Before 90's there was no such use of remote sensing measures in India. So till now the study of flood, floodplain, its type, causes and its comparative analysis though empirical records can introduce the destructive scenario in West Bengal. Proper and scientific study of floodplain and its scientific comparative analysis proves its significance in India and helps to suggest the sustainable management of flood in the state.
Keywords: Flood, Floodplain, Flood Hazards, Sustainable Management, Global village

RESUMO
Em todo o mundo, os níveis do mar foram subindo, proporcionando mais um lembrete de conectividade global e um futuro em que os riscos de inundação iria piorar, e El-niño tornou-se um fenômeno conhecido por muitos. Novas tecnologias foram surgindo constantemente, principalmente nos meios de comunicação, informação, espaço e a comunicação foi puxando alguns dos ocupantes da "aldeia global" muito mais próximos, tornando "notícias desastre," mais imediato e gráfico. Os avanços tecnológicos desafiou o poder das instituições, os governos já não podia tão facilmente restringir o acesso aos seus cidadãos a informação ou prosseguir as suas políticas de forma isolada. Antes de 1990, não havia tal uso de medidas de sensoriamento remoto da Índia. Então, até agora o estudo de inundação, várzea, seu tipo, causas e sua análise comparativa de registros empíricos pode introduzir o cenário na Bengala Ocidental. O estudo adequado e científico da planície de inundação e sua análise comparativa comprova sua importância na Índia e ajuda a sugerir a gestão sustentável das enchentes no estado.
Palavras-chave: Inundação, Várzea, Riscos inundação, Gestão sustentável, Aldeia Global.

INTRODUCTION

The rivers of the south-eastern part of the Indian Peninsula are monsoonal in nature. The rivers are subjected to severe floods during the monsoon season. In the last few decades, several large-magnitude floods (peak floods between 10,000 and 80,000 m^3/s) have been recorded. In general, floods caused by precipitation from Bay of Bengal depressions include the peak flood of record. Comparative analyses of the systematic, historical, and palaeo-flood records indicate that, in recent decades, the frequency of high-magnitude floods has increased significantly. Hydraulic estimates reveal that high flows are capable of bedrock erosion and transportation of coarse material. Floods in the peninsular region are responsible for colossal loss of human life, crops, and property. To understand flood hazards and environmental change it is imperative that engineers and hydrologists utilize historical and paleoflood records to improve risk analyses as well as to estimate probable maximum flood on rivers such as these in a highly flood-prone region (Kron, 2005) of West Bengal.

LOCATION

West Bengal is a state situated in the eastern part of India, which shares its international border with Bangladesh, apart from Nepal and Bhutan. The state also shares ethno-linguistic similarity with Bangladesh. It stretches from Himalayas in the north to the Bay of Bengal in the south. West Bengal stands surrounded by Assam and Sikkim in the northeast, Orissa in the southwest and the states of Jharkhand and Bihar in the west. The exact co-ordinate location of the state is 27°13'15" and 21°25'24" north latitudes and 85°48'20" and 89°53'04" east longitudes. The total area of the state is 88,752 sq km (34,267 sq mi) amongst which 22% is prone to flood every year.

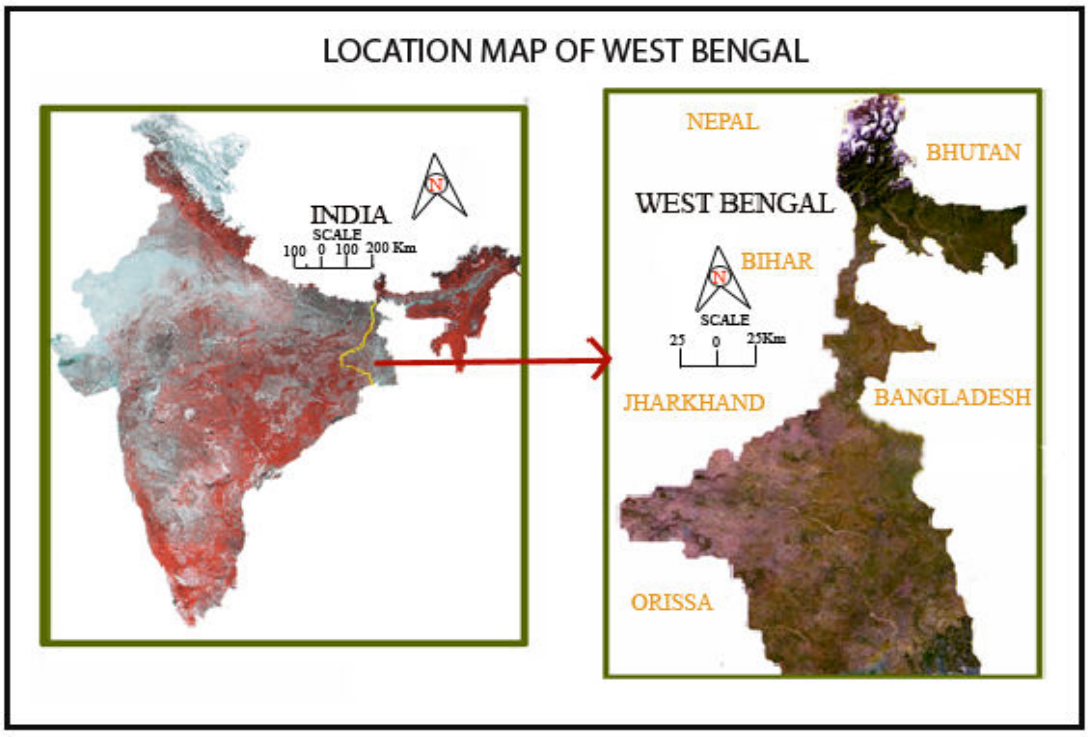

Fig.: 1: Location of West Bengal in India

Flood Charateristics:

The concept of Floods and floodplains are explained briefly as follows:

A flood (in Old English *flood,* a word common to Teutonic languages; compare German *Flut*, Dutch *vloed* from the same root as seen in *flow, float*) is an overflow of water,an expanse of water submerging land, a deluge. In the sense of 'flowing water', the world is applied to inflow of the tide, as opposed to the outflow or 'ebb'.

Flooding is a natural and recurring event for river or stream. Statistically streams will equal or exceed the mean annual flood once every 2.33 years (Leopold, et.at 1964). Flooding is the result of heavy and continuous rainfall exceeding the absorptive capacity of soil and the flow capacity of rivers, streams and coastal areas. This causes a watercourse to overflow its banks on adjacent lands.

V. T. Chow defined flood as "a relatively high flow which overtakes the natural channel provided for run-off" Ward (1978) defined flood as "a body of water which rises to overflow land which is not normally submerged".

Types of Flooding:

Two types of flooding can be distinguished –

a) River flooding b) Coastal flooding

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River flooding:

Land–borne floods or river floods occur when the capacity of stream channels to conduct water is exceeded and water overflows banks. Floods are natural phenomena and may be accepted to occur at irregular intervals on all streams and rivers, settlement of floodplain areas is a major cause of flood damage.

Coastal Flooding:

Storm surges can be described as an abnormal rise in sea water level associated with hurricanes and other storms at sea. Surges result from strong on –shore winds and /or intense flow pressure cells and ocean storms. Water levels is controlled by wind , atmospheric pressure, existing astronomical tide, waves and swell, local coastal topography and bathymetry, and the storm's proximity to the coast.

Main causes:

Monsoon rainfalls can cause disastrous flooding in some tropical countries, such as Bangladesh due to their extended periods of rainfall. Tropical cyclones have number of different features which together, can cause devastating flooding one is waves of upto 8 meters high, caused by the leading edge of the hurricanes when it moves from sea to land. Another is the large amount of precipitation associated with tropical cyclones. The eye of a hurricane has extremely low pressure, so sea level may rise a few meters in the eye of the storm. This type of coastal flooding occurs regularly in Bangladesh. Under some rare conditions associated with heat waves, flash floods from quickly melting mountain snow have caused loss of property and life. Marine Earth quakes and plate movements under the sea causing Tsunamis have a disastrous effect, flooding almost entire coastlines.

Characteristics of Floodplain:

Floodplains are, in general, those lands most subject to recurring floods situated adjacent to rivers and streams. Floodplains are therefore "flood-prone" and hazardous to development activities if the vulnerability of those activities exceeds an acceptable level.

Floodplains can be looked at from several different perspectives: "to define a floodplain depends somewhat on the goals in mind. As a topographic category it is quite flat and lies adjacent to stream. Geomorphologically, it is a landform composed primarily of unconsolidated depositional material derived from sediments being transported by the related stream; hydrologically it is best defined as a landform subject to periodic flooding by a parent stream. A combination of these characteristics perhaps comprises the essential criteria for defining the floodplains" (Schumdde, 1968).Simply, a flood plain is defined as "a strip of relatively smooth land bordering a stream and overflowed at a time of high water" (Leopold, 1964).

Table: 1: STATE-WISE GEOGRAPHICAL AREA UNDER FLOOD

States	Geographical (in M.Ha.) Area	Area liable to flood almost every year [Area in M.Ha.]
Andhra Pradesh	27.51	1.39
Assam	7.84	3.15
Bihar	17.39	4.26
Gujrat	19.6	1.39
Haryana	5.57	0.23
Jammu & Kashmir	22.22	0.08
Karnataka	19.18	0.02
Kerala	3.89	0.87
Madhya Pradesh	44.34	0.26
Maharastra	30.7	0.23
Manipur	2.23	0.08
Meghalayan	2.24	0.02
Orissa	15.57	1.4
Punjab	5.04	3.7
Rajastan	34.22	3.26
Tamilnadu	13.01	0.45
Tripura	1.05	0.33
Uttar Pradesh	29.44	7.34
West Bengal	**8.88**	**2.65**
Delhi	0.15	0.05
Pondicherry	0.05	0.01
INDIA		33.52

[Source: Rajya Sabha Unstirred Question No. 3034. & Rajya Sabha Unstirred Question no1783]

Floods and floodplains in India:

India is prone to various hazards among them flood is one of the most dangerous and can be explained by following data:-

70% of the cultivable area is prone to draught
60% to Earthquake
12% to flood and
8% to cyclone [Source: - EM-DAT: the OFDA/CRED. India disaster data base 1900-2004]

Out of 12% of the flood prone area in India, about 9% is spreaded over north India as follows-

Northern India is prone to flooding due to presence of the River Ganga and its tributaries. Not only that, monsoon provides ample rain to this region which helps the glacially fed and perennial Ganga to cause flood during rainy season. The flood prone region of West Bengal is situated to the North Eastern part of this vast Ganges Floodplain.

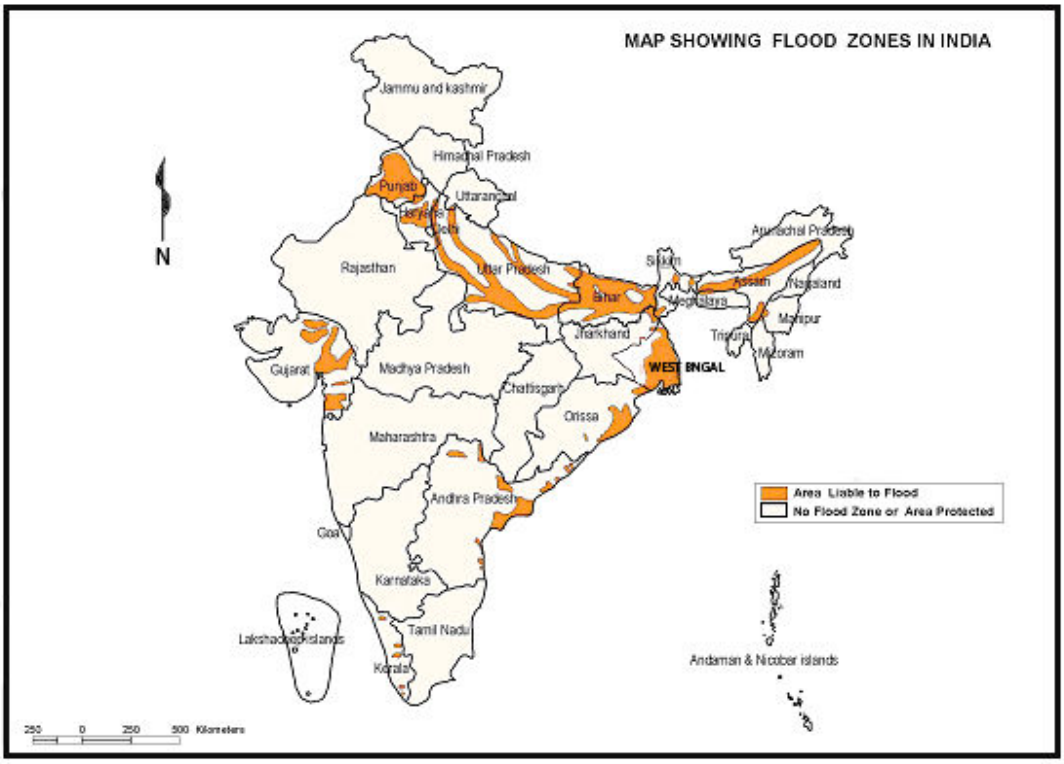

Fig.: 2 Flood Zones in India
Source: **Central Water Commission, Ministry of Water Resources, India**

Table: 2: RECORDS OF LARGE FLOODS IN WEST BENGAL

Period	**Description**
18-20/10/1985	Caused by tropical cyclones
22/09/1986-10/10/1986	Flooding due to heavy rains in some areas of Kolkata, Hooghly, Parganas and Midnapore
23/08/1988-09/15/1988	Monsoonal rains caused flooding in areas of Balurghat and Dinajpur lying under the purview of the Ganges and Churani rivers.
03-24/07/1990	Flooding due to monsoonal rain.
14-15/09/1991	Flash floods caused damage 35,000 houses
08/07/1993-13/08/1993	Flooding observed in Jalpaiguri district.
26/09/1995-02/10/1995	Flooding triggered by heavy rains caused erosion, severe agricultural damage and outbreak of diseases.
10-24/07/1996	Flooding due to monsoonal rains.
01/08/1997-01/08/1997	Flooding due to monsoonal rains.
05/07/1998-02/09/1998	Monsoon rains caused flooding of the Ganges river
11/07/1999-03/08/1999	Flooding due to monsoonal rains.
24/10/1999-12/11/1999	Tropical cyclones caused destruction of an estimated number of 1500 villages. Floods due to brief torrential rains affected areas of Kolkata, Burdwan and Birbhum.

02/08/2000-01/2000	Besides flash floods triggered by incessant torrential storms,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.
31/07/2001-01/09/2001	Monsoonal rains caused flooding Kolkata.
21/06/2002-28/08/2002	Flooding in Jalpaiguri, Cooch Bihar and Jalpaiguri in north Bengal due to monsoonal rains. Flash floods swamped ten villages, causing four deaths and 11,000 displacements
11/06/2003-10/10/2003	Monsoonal rains caused floods affecting the regions of Darjeeling, Jalpaiguri, Malda and Murshidabad.
20/06/2004-07/10/2004	Heavy monsoonal rains affected several districts.
21-28/10/2005	Heavy rains caused floods in many areas. About 3000 coastal villages were inundated and 60,000 huts and many roads washed away
07-27/07/2005	Heavy monsoon rains triggered flash floods and landsilides
24/06/2006-03/08/2006	The regions of Birbhum, Burdwan and Murshidabad were affected mainly from continuous monsoonal downpour.
18/09/2006-05/10/2006	Monsoonal rains and tropical cyclone-driven storms in the bay of Bengal hit India and Bangladesh. West Bengal recorded50 deaths, 300 were injured and 30,000 mud houses destroyed. Heavy rains left large parts of Kolkata city under water, subsequently 2000 people were evacuated from the city.
03/07/2007-22/09/2007	The hazard affected Kolkata and several other districts. Eighty-three deaths were reported, and millions of people were marooned in 3000 villages in coastal areas of the state.
22/09/2007-08/10/2007	Heavy rain from tropical depression in the Bay of Bengal caused flooding leading to 51 deaths, and affecting 3.2 million people

Source: The Dartmouth Flood Observatory Global Archive Of Large Flood Events, 2008

Floods and floodplains in west Bengal :

West Bengal, a part of the Ganga delta has a long recorded history of flood. It is because the major part of land of the state is formed by the Ganga- Padma river system through the delta building process. Flood is an adjunct being the main carrier of sediments, the bulk of fluvial deposit, in huge volumes. At present 42.3% of the total area of the state is susceptible to flood spread over110 blocks in 18 districts. Among those districts which are very significantly flood prone can be shown as follows-

Table. 3: SIGNIFICANT FLOOD PRONE DISCTRICTS IN WEST BENGAL

Name of the flood prone districts	**Area (Hectors)**
Burdwan	1,70,000
Birbhum	3,82,500
Murshidabad	5,34,100
Nadia	3,90,000
Hooghly	2,54,900
Midnapore	78,000

[Ref: Paschimbanga, flood –2000: Information and Broadcasting Division, W.B]

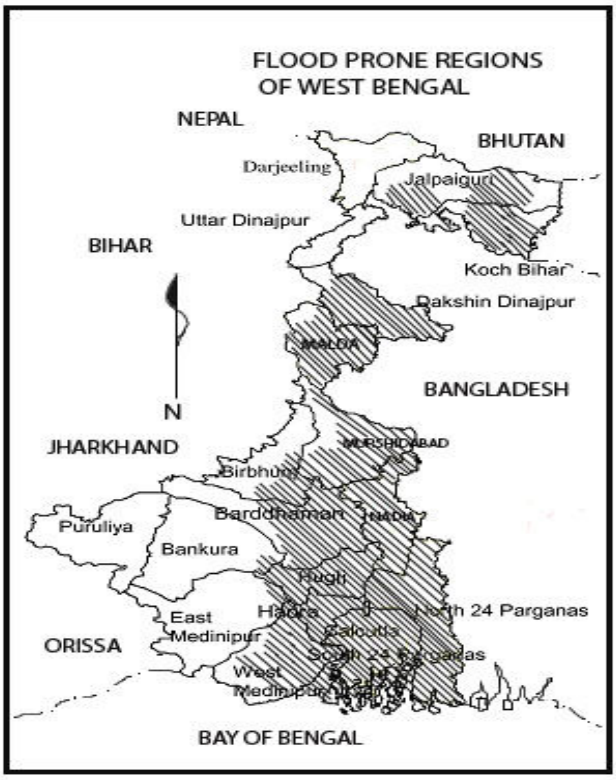

Fig.3: Flood-prone Regions of West Bengal

Among the mostly affected districts, Murshidabad is most prominent due to its vulnerability and location. Almost each and every year this district suffers from flood and creates landforms common to flood prone regions.

Impact of flood in the State within last fifty years:

In the state only five years could be identified as flood free years within last fifty years(1959 to 2009), when only less than 500sq.km of area were inundated. After last 1959 major flood, the state suffered consecutively in 1978, 1985, 1998, 1999 and 2000. In terms of loss of property and life, the 2000 flood was almost comparable to 1978 flood. It had another grim feature not recorded in our living memory. Seventy two hours of continuous and concentrated rainfall over the western river basin areas of Bhagirathi viz. from the Pagla-Bansloi to the Ajoy, generated so huge flood volume that all embankments on the eastern side of the Bhagirathi were almost washed away and the whole of Nadia and larger part of Murshidabad were flooded and remained under water for a long period. In this transbasin transfer of flood people were caught unaware and all sorts of speculative ideas was propagated [Chandan Roy (2000): 'Flood and Role of The People Perspective of West Bengal', Chief Engineer, Irrigation and Water Development, Government of West Bengal].

Sustainable Management of Flood:

Flood is such a natural phenomenon that is uncontrolled and to some extent unpredictable. Man has been toiling for ages to control flood but all in vain. Geologically southern part of West Bengal, is a part and parcel of Ganga-Brahmaputra delta, prone to flood almost each and every year. Flood damages all the geonomic aspects of the state and led to get poverty, illiteracy, starvation death and migration etc. In this state flood can be managed sustainably by different physical and socio-economic measures amongst which river channel improvement, proper and scientific reservoir control, construction of new barrages, lock gates, embankments, removal of human encroachment along the river side, flood warning and forecasting, stoking of essential services along with proper flood plain planning are indispensable .

CONCLUSION

The study explains that the West Bengal floodplain is one of the most destructive floodplain in India. Owing to be the part of Ganga-Brahmaputra river's delta, the southern part of West Bengal is frequently affected by flood with unmanageable discharge. So proper and scientific management of flood and floodplains of West Bengal can reduce the damage of the state and can give the relief for human civilization.

REFERENCES

KRON W. **Flood Risk = Hazard • Values • Vulnerability,** Water International, Volume 30, Issue 1, Routledge publication, DOI: 10.1080/02508060508691837, pp.68, 2005. http://portal.worldwaterforum5.rg/wwf5/en-us/Panels/High-Le.

LEOPOLD, WOLMAN, MILLER**. Fluvial processes in Geomorphology**, Eurasia publishing House (Pvt).Ltd.pp.317-322, pp.337-357,1964.

CHOW V.T. **Handbook of Applied Hydrology**, McGraw-Hill Company, New York, Sec-25, pp.1-124,1964.

CHOW V. T., MAIDMENT, MAYS. **Applied Hydrology**, International Edition, McGraw Hill Book Company, pp.380-394, pp.517-527, 1988.

CHORLEY R.J., SCHUME S.A. & SUGDEN.D.E. **Geomorphology**, Methuen, London, pp.32-131,1984.

IRRIGATION AND WATERWAYS DIRECTORATE. **Kandi Area, Flood Protection Scheme, Report, Estimate and Drawing**, Investigation and Planning Circle –1, Govt. of West Bengal, Kolkata, March 1992.

O' MALLY L.S.S.**; Rivers of Bengal**, Bengal District Gazetteers, pp.1-25, pp.97-154, and pp.177-204,1914, Reprint, 1997.

PARUA P.K**. Reason of Ganga River Bank Erosion and Management: A Discussion**, Sechpatra, Monthly News Paper, Irrigation and Water Ways Directorate, Kolkata, pp.3,June 2000.

RAY CHANDAN. **Floods And Role Of The People Perspective Of West Bengal**, Chief Engineer Irrigation And Waterways Dept. Govt of West Bengal, 2004. www.unescap.org/…/Flood%20and%20role%20of%20people.doc.

STATE INTER AGENCY GROUP. **South Bengal Flood: A Rapid Multisectoral Assessment**, United For Humanitorian Response, Directorate of disaster Management, Govt of West Bengal, Kolkata, 2009. www.iagwest**bengal**.org.in/.

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