"DRAINAGE PROBLEMS AND CONSEQUENT FLOOD HAZARD IN LOWER CATCHMENT OF KALIAGHAI-BAGHAI-KAPALESWARY RIVER SYSTEM: A STUDY ON ITS NATURE, CAUSES, HUMAN RESPONSES AND MANAGEMENT"

Synopsis

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“Drainage Problems and Consequent Flood Hazard in Lower Catchment of Kaliaghai-Baghai- Kapaleswary River System: A Study on its Nature, Causes, Human Responses and Management”

Synopsis

The river Kaliaghai which originates in the highlands of the Jhargram Police Station in the Paschim Medinipur district of West Bengal is an important tributary of the river Haldi which meets the river Hooghly at Haldia about 100 Km downstream of Kolkata. In fact, the combined flow of the Kaliaghai and Kangsabati is known as the River Haldi. The river Kapaleswary and Baghai are two main tributaries of the Kaliaghai. The Kaliaghai-Kapaleswary-Baghai drainage basin covers an area of 2145 sq km spread over two districts of the state of West Bengal i.e.Paschim Medinipur and Purba Medinipur.

The lower parts of the basin comprising of 1576.25 sq km of low lying terrain historically suffers from flood and tidal inundation. In absence of adequate irrigation facilities, the inhabitants of this flood prone basin mainly depend upon Kharif crops. Recurrent floods deprive them of the even a single crop in most of the years. Prevention of flood and tidal inundation and removal of drainage congestion which may extend to several weeks, are very important to the economic well-being of the inhabitants of the basin.

Flood hazard in a basin depends upon the hydrological response of the upstream basin area. The upstream basin area may produce different amounts of run-off for a given rainfall based on its hydrologic response. Hydrological response of a river basin is defined by the production of run-off against a given rainfall, which in turn is characterized by basin geomorphology. Similarly, the hydrological responses of the rivers to the rainstorm events are also important in flood studies. Hence, Geomorphological approach to flood hazard analysis and flood management has assumed considerable significance in applied geomorphology. In many cases, flood management projects have been found to fail due to lack of sufficient input of geomorphological understanding. The present work deals with geomorphological perspectives of the recurring flood events in lower Kaliaghai flood basin of Purba and Paschim Medinipur districts, West Bengal. Particular emphasis has been given to the 2008 flood, damaging effects of which has beaten all the past experiences in memory.

The area under study has been experiencing extensive inundation due to flood during monsoon, resulting in large scale losses of agricultural crops, houses, lives etc. along with many accompanied problems. High and medium intensity floods during last forty years. Major flood events occurred in 1961, 1962, 1964, 1969, 1973, 1974, 1979, 1984, 1986, 1990, 1993, 1997,1998,2001,2002,2003, 2004,2005, 2007 and 2008. The natural slope being very low, and the area being interspersed with number of wetlands, basins, ex-zamindary embankments, roads, railway lines etc. giving rise to drainage congestion and floods due to breaches along embankments. Construction of Borobandhs (13 nos.) for irrigating insignificant expanse of agricultural area, fishing ponds with embankments surrounding them beside the river embankments making them inaccessible for maintenance, fishing ponds and agriculture on river valley etc. have made the rivers nonfunctioning. All these have added fuels to the situation. Siltation in the river bed is another problem. Kaliaghai the depth of siltation increased about 2 m – 4 m since 1974. This has been augmented by construction of Bandhs across the river during boro cultivation. Encroachment of river bed by agricultural plots, settlements, tree plantations, and many other uses, has made the rivers incapable of draining large volume of water during monsoon. Channelization of Kaliaghai along a ditched canal under Kaliaghai Project and subsequent shallowing and narrowing of that canal are the other problems of the area. The pressure of high-tide water is another problem in this area. At its confluence with Kaliaghai the River Chandia takes the shape of a bottle-mouth causing the water pressure to be multiplied during high-tides which frequently breaks the poor embankments of the Chandia River. The depth of the bed of Kapaleswary at its mouth is gradually declining due to siltation, therefore the banks are overflowed and broken and flood occurs.

Objectives of the present study are to pursue out the natural and anthropogenic causes of flood in the study area; to assess the nature of flood in spatial as well as temporal context and also to appraise the economic losses of agricultural crops, fishes, livestock, houses, lives, property; and other associated hazards suffered by the local people and also to assess the positive impacts of the floods. It has also been tried to find out options for managing the flood situation of the area and to suggest management strategies from environmental point of view.

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Assessment of riverine floods needs a time series of discharge measurement. The flow rate or discharge of a river is the volume of water flowing through a cross-section in a unit of time and is usually expressed as m^3 s^{-1}. It is calculated as the product of average velocity and cross-sectional area but is affected by water depth, alignment of the channel, gradient and roughness of the river bed. Precipitation event has several distinct and independent characteristics which can be quantified in terms of duration (length of time in hours over which precipitation occurs); depth (amount of precipitation in mm occurring throughout the storm duration); frequency (recurrence interval of events having the same duration and volume); intensity (depth divided by the duration). To establish the relationship between average intensity, duration, and frequency, Intensity-Duration-Frequency (I-D-F) curves based on historic rainfall data for the observation stations within the basin have been constructed. The storm distribution curves have been derived from the Rainfall data for areas less than 500 square miles, for durations of the storm events, and for frequencies 25 and 50 years. The storm distributions are based on the generalized rainfall depth-duration-frequency relationships collected for rainfall events lasting even 8 days. Empirical relationships, however, have been developed from which complex hydrographs have been derived. 6 hours Synthetic Unit Hydrographs have been obtained by using watershed parameters and storm characteristics to simulate natural hydrographs. . Rainfall runoff and stream flow data have been compiled within the watershed and are analyzed and a unit hydrograph is generated to better predict the response characteristics to various storm events. In this study, the velocity distribution in the river cross-section has been investigated in detail. Measurements have been taken across six cross sections- five in the River

Kaliaghai and one in River Kapaleswari. Along the River Kaliaghai, velocity profiles have been drawn at Langalkata (two profiles), Mohammadpur, Asnanghat and Dheubhanga. Similarly, along Kapaleswari River one velocity profile has been studied along the cross section taken at Narayanbar.

Factors of flood hazard in lower catchment of Kaliaghai- Baghai - Kapaleswary Rivers include rainfall elevation, slope, drainage density, road density and land use type. To evaluate the flood hazard the some factors have been regarded to be the most influential - they were rainfall, elevation, slope, drainage density and land use. Of these the highest weight was given to rainfall, followed by elevation, slope, drainage density, road density and land use. Each factor was divided into five sub-factors with a separate rankings value. The weighted hazard ranking was evaluated by multiplying its weight by its ranking value for the related sub-factor. The total estimated hazard, obtained by adding the weighted flood rankings of all the sub-factors, was further categorized into five very low, low, moderate, high and very high. The same weighting and ranking techniques have been applied to prepare flood risk map and for mappings flood hazard areas.

The entire course of Kaliaghai exhibits three geomorphologically different segments. From its source to Baghai confluence, the river has traversed being guided by regional slope. Then it enters into a saucer-shaped central basin and continues to flow across the basin until it joins River Chandia. The lower Kaliaghai course is dominated by inflow and outflow of tidal water rendering the course segment an estuarine character. The river basin can be categorized into three different sections in the region on the basis of micro-topography, surface gradient, siltation rate, tidal floods at the estuary sections and local basin sub-basin structures.

Section-1: Kaliaghai- Baghai upstream Section: From Dudhkundi to Bakhrabad; Moderate to high slope areas; total length is 46 km; areas under of the sub-basins under this section hold an area of 570 km^2.

Section-2: From Bakhrabad to Dehati: Moderately slopping areas; Total length is 20 km; areas of the sub-basins under this section holds 75 km^2 area.

Section -3: From Dehati to Dhewbhanga: Low land flat surface; Total length 43 km; Areas of the sub-basins under this section amounts to 1,100 km^2 area.

The flood problem of nine blocks in the Kaliaghai- Kapaleswary-Baghai riverine complex has emerged as a response to the adjustments in flow and sediment regimes under above mentioned topographic modifications. In addition to absolute mismatch between sediment load and power of Kaliaghai, estuarine influence that reaches upto Langalkata (to the west of Kaliaghai-Chandia confluence), has caused the river to become incapable of flushing out all the sediments. As such, enormous sedimentation near Langalkata has been manifested in the form of bar formation along with a reversal in channel bed gradient. Cumulative effects of all these factors have led the Kaliaghai channel to arrive into a new adjustment through revival of its earlier course along Rasulpur estuary. The situation becomes episodic in years of high intensity monsoon rainfall in the upper catchment of Kaliaghai. Furthermore, incapability of Kaliaghai to drain out water received from its tributaries (Baghai, Kapaleswary and Chandia) causes spilling of water and breaching of embankments and consequent devastating flood. Bottleneck like narrow outlet at the mouth of River Chandia is also another factor that frequently causes breaching of its embankment and the water finds a slope-guided straight course to Kaliaghai inundating the villages on its way.

Besides the above natural adjustments, human activities have also been found to be responsible for introducing changes in the river environment which facilitate the flood situation to pick up momentum. River channelization through straightening, construction of levee and embankments etc. have changed the channel phase. A primary morphological response to the change in flow regime is a decrease in channel capacity, brought about principally by reduction in channel width by setting up of embankments on both the sides of river Kaliaghai and its tributaries. As a result, the rivers fail to accommodate and distribute sediments within the protective areas between embankments. Landuse change in the form of forest clearance for agriculture has caused sediment overloading in the rivers. Accelerated valley floor sedimentation has been increasingly responsible for lessening the recurrence interval of high magnitude floods, vertical accretion of floodplain throughout the drainage system due to increased runoff and extensive bank erosion even along the tributaries. Thus removal of natural vegetation has largely increased the catchment sensitivity to extreme climatic events. River flow has also been constricted by occupying valley floor for agricultural plots, fish farm ponds etc.

There are six stream gauge stations in the River Kaliaghai and Kapaleswary. These are located at Bakhrabad, Dehati, Amgachia, Narikeldah and Kalimandap in Kaliaghai River Narayanbarh in Kapaleswary River. Rain storm with its distribution has been studies considering the influence area of each rain gauge station of the study area. Estimation of station wise storm record for the month October 2003 for four rain gauge stations, and for the month October 2005 for four rain gauge stations and for the month June 2008 in four rain gauge stations. The gauge reading in the five stations of Kaliaghai River and Kapaleswari River, during 2008 flood shows that the height of the gauge reading did not rise instantly after rainfall, but it rose after few hours. It is noticed that highest rainfall, though ends within the 96 hours after the rain started, but the gauge reading did not increase up to 144 hours. As for Amgachia the height of water-level was 4.60 m. after 48 hours the rain started, but the height rose to 7.34 m after 144 hours. The FDL of the river at this point was 5.97 m. and the FDL at Dehati station was 7.83 m. The gauge reading at Dehati was 5.80 m after 48 hours and 7.25 m after 144 hrs. The FDL of Kalimondap was 5.25 m where the gauge reading was below 3 m up to 48 hours of rain and rose to 3.25 m after 144 hrs. The FDL at Bakhrabad station was 9.62 m where the gauge reading was 6.40 m after 48 hrs and 7.75 m after 144 hrs. The water level rose to 13 m at Bakhrabad after 144 hrs the rain started.

It can be concluded that the levels of flood water rises quickly at the upper part of the basin in comparison to the lower section of the river course. During every rain storm event flood water level attained a maximum at Bakhrabad due to narrowness of the stretch. At Amgachia the lag time is much more but flood water level goes well beyond FDL (Full Drainage Level) due to shallowness of the river stretch as a result of siltation.

The concentrated storm of rainfall (June 2008) has produced a single peaked, skewed distributed hydrograph at Poktapole. The rising limb is very steep in appearance and extends between 0 hrs and 24 hrs. It signifies a high slope of the terrain and saturated antecedent moisture condition. In this stretch of river lag time is only 24 hrs. River discharge attains a peak of nearly 45 m^3/sec within 24 hrs only. Narrowness of the valley width is responsible for quick rise in flood water level. As a result, flood water flows over bank at great velocity to flow both banks in the form of flash flood. Therefore, this section of River Kaliaghai is highly sensitive to rainfall. Depletion of discharge started after 30 hrs and the recession limb is moderately slopping. The crest segment is highly peaked representing the stay of flood water for relatively shorter time (24 hrs only). Flood water gets drained within 96 hrs after it reaches its peak.

Average velocity of the river water ranges between 0.5 and 1.0 m/sec. The high velocity cores in most of the cross sections have been found to occur along the central part of the flow regime. The top and bottom layers are faster than the bottom layer. With increasing distance from the bank, the flow velocity increases. Similarly, with increasing depth the flow velocity decreases in response to interaction between water flow and the bank or bed. However, the river water flows along a narrow course along the bed where the depth of the bed is the maximum.

Rivers like Kaliaghai, Baghai, Kapaleswary, Chandia, Kangsabati are directly responsible for flood Moyna Block under Tamluk subdivision, Egra-I and II, Pataspur –I and II and most of the area of Bhagawanpur-I Block under Egra subdivision, some parts of Bhagawanpur-II Block under Contai subdivision, Narayangarh Block under Kharagpur subdivision and the major part of Sabang Block are flooded almost every year for the last forty long years. In this respect, the river Subarnarekha is also responsible indirectly. Though all the mauzas of the above noted blocks are not flooded, but a major portion of the blocks often go under water. The rivers like Kaliaghai Kapaleswary, Chandia, Kangsabati are directly responsible for flood in the lower basin of Kaliaghai-Baghai-Kapaleswary and its sub-basins but some areas like Moyna basin, Dubda basin Barachouka basin are flooded due to logging of rain water. The Kaliaghai flows from the margin of Narayangarh block and join the river Baghai just after a bridge near the meeting point of Sabang, Pataspur and Narayangarh block at Sialmara. The Kaliaghai carries water of the whole catchment area of Baghai and Kapaleswary to the sea. But there are many morphological inconveniences that hinder the drainage of huge water through Lagalkata Mohana. The valley of River Baghai is all the way narrow and shallow without proper embankment. This river causes flood in Egra subdivision. The Gram Panchayets like Dubda, Munjusri, Basudebpur, Deshbandhu and Vivakananda are mostly flooded by the water of Kaliaghai and Baghai. The Dubda basin is a low land area. Even in non flood years this basin suffers from rain water flooding.

The flood affected areas in the upper catchment experienced a short term but colossal impacts. Due to suddenness and unforeseen strength of the event people were readily exposed to high energy flood and could not save their assets and livestock. But the flood water drained out within three days, while in the lower catchment flood water did not come suddenly and people could save assets and livestock. But the flood water in upper reaches drained out within three days. While in the lower catchment, vast area became inundated by over spilling of water and breaching of embankment. Water could not find any way to be drained out and became stagnant for more than a month. Hence, people suffered primarily from the long term effects of the flood. They had to temporarily settle on the embankments with all their belongings; depend on flood relief; suffer from epidemics, scarcity of drinking water, loss of agricultural crops etc.

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The flood risk map shows that most of the G.P. of Bhagawanpur-I and Egra-I fall in very high risk zone during flood time other then Bhagawanpur-II and some mouzas of Egra-II are in the high risk zone. Pataspur-I and Moyna are moderately risky zone. Some mouzas of Narayangarh Sabang and Pataspur-II fall in the low to very low risk zone.

The catastrophic flood of 2008 shows that, the excess flood water flows along the south-eastward slope of the region to reach the Bay of Bengal. Thus the south-eastward course of river Rasulpur can transport the flood water to the sea very easily. The river, Kapaleswari is to be excavated and the embankments on both sides are to be made wider. The bend of Kaliaghai on its way between Kaptipur and Golpata is to be straightened. The water flow from the south of the Baghai River should not be stopped or prevented. On the other hand a cannel should be made and the excess water to be channelized to the Bay of Bengal through the Dubda basin from the place near Singda Bridge. High embankments are to be made on both sides of the river. The Bamunda canal of Barachowka basin is to be excavated. A lock gate is to be set before the water flow of Deuli debouches in to Kaliaghai River.

The charge of maintenance of the Zamindar dams is to be handed over to the Irrigation Department of the Government of West Bengal. According to the project of 1970, the households and landlords should get arrear dues arose out of acquiring their lands for Kaliaghai Project implementation and the inhabitants of the swamp areas are to be helped by means of rehabitation.

All sorts of shrubs, dwellings, bricks kilns, tiles kilns, low dams are to be removed from the river bed of the Kaliaghai and the Kapaleswari Rivers. In the

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river bed of the Kaliaghai there is a large pond named 'Salmara Jala'. This tank is open in all sides and its water is not properly used. As such, bank of this pond is to be heightened on its four sides to project the tank. This tank is required to be used to control flood by enhancing its capacity of holding water. Fish can be cultured in the tank and its water may be used in farming.

Unlawfully occupied landholders are to be removed immediately. All political parties should take a decision in this respect and to make arrangement for their rehabitation. The executive department of the District and Block level should take effective steps in this regard. In the villages of the flood affected areas where there is no School building, a multi-storied building is to be set up for providing shelters to the flood victims.

A flood control committee can be constituted involving experienced persons in the villages; and heads of schools and clubs, Panchayets, Police Department, public representatives. This committee should take initiatives to conduct rescue, relief and rehabilitation operations in association with the Government departments. The saplings for some high yielding paddy cultivation are to be supplied by the Government and Panchayet authorities from the seed beds duly prepared by them to the farmers after the removal of flood water.

Taking the above perspectives into account this is reasonable to state that, the key to handle flood hazards in this area lies in managing the fluvial environment as a whole. Another most important issue is that there is a need for developing strong social network, capable social organizations, improved information collection and dissemination system, sufficient physical infrastructure, good governance, smart distribution system, cordial social relations and awareness among the communities. Once developed, these elements of social resources can successfully be mobilized to ensure social security.