ISSN: 0474-9030

Vol-68-Issue-1-January-2020

Accumulation of Run-Off and Sediment from Tributaries Create Flood Situation A Case Study at Lower reach of Shilabati River Paschim Medinipur: West Bengal

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Abstract:

Proper analysis of temporal aspects of flood discharge is necessary for understanding the nature of water and sediment accumulation in floodplain and its time for concentration. Attempt is also made to understanding the nature of concentration of runoff at lower catchment by of simultaneous concentration from the major tributaries. Lower time of concentration and lower lag time show the potentiality of sudden discharge leading to flood situation. Shilabati watersheds have many subareas that contribute runoff to a single outlet. Some important sub watershed parameters are drainage area (A), where the volume of water is generated from rainfall and tributary length (L). These two parameters help to determine the time for concentration of runoff and sediment in channel. Another important physiographic parameter is channel slope or gradient which reflects the rate of change of elevation along the channel. Slope measured are used to calculate the time of travel to reach the runoff at main channel. Runoff concentration time and weighted curve number is measured after **(SCS, USDA), 1990**. Hydraulic radius is consistently decreased down valley. The processing of sediment data and the average concentration of sample sediment at the lower reach are determined.

Introduction:

The dynamics of river systems for many years has been based on the River Continuum Concept. According to this, rivers exhibit gradual downstream changes in hydrology and geomorphology which in turn, implies gradual changes in biological processes and ecosystem function **(Vannote et al, 1980).** Tributaries were recognised as no more than sites of disturbance to the downstream continuum but over time it has become increasingly apparent that the influence of tributaries is sufficiently disruptive to define what has been termed a river 'dis-continuum' **(Ward and Stanford 1983, Perry and Schaeffer 1987**). This discontinuity concept in which rivers are viewed as networks with tributary confluences constituting nodes linked together by intervening reaches of the river main stem. Floods in the main channel resulting from overtopping or controlled releases of water from dams can remove large amounts of sediment from confluences and transport this downstream **(Rice et al. 2008).** The concept was further developed in the network dynamics hypothesis, which considers river networks as populations of channels and their confluences. Upstream effects (the zone of interference) include lower gradients, wider channel, increased bank erosion, more woody debris and finer substratum, while downstream effects (the zone of mixing) include steeper gradient, coarser substratum, deeper pools, formation of bars and greater frequency and intensity of disturbance **(Benda et al. 2004).** The magnitude of effect of a tributary depends on the ratio of its flow to that of the main channel **(Poff and Zimmerman 2010).** The important parameters of the drainage basin are the catchment shape, size, reach of the channel, width, depth, slope, hydraulic radius of the cross sections etc (**Sen, 1993**). The present study has focussed on understanding flow and mixing regimes at tributary and main stream confluences and the relationships between sediment transport, morphology. Six main tributaries (Joypanda, Betal, Donai, Tangai, Kubai and Parang) and other 74 small tributaries

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ISSN: 0474-9030

Vol-68-Issue-1-January-2020

join the Shilabati River. During storm period these tributaries pour huge amount of runoff and sediments which concentrate at the mouth of river Shilabati and creating flood.

Problem:

The downstream part of river Shilabati have laid in the lowland with extremely gentle gradient. Abnormal rainfall have entered into channel as a flood way during the summer monsoon or cyclonic storm surge period and ultimately accumulated near the mouth area and remain as a water logging condition up to 10-15 days. The recurrence of flood and potential flood threat in every year is really an economic, social, geomorphic as well as hydrological problem which is reflected by the damages of lives, property, crops, infrastructure and transport and communication which deteriorate the socio-economic development of the concerned area.

Methodology:

Topographic maps are used to measure elevation changes on that watershed or channel slopes. Gradient = [(Source height in m-Mouth height in m)/ Length in m]……..1 **(Sen, 1993).**

Lag time is calculated by method proposed by **(Schwab, 2005).** Time of concentration, lag time and time to peak are three important parameters of temporal aspects of hydrograph and stream discharge that defines the potentiality of flood.

$[T_C = L^{0.8} [(1000/CN)-9]^{0.7} / 4407 (S_g)^{0.5}]$---------2 **(SCS,USDA,1990)**

$T_L = 0.6 \times T_c$ ----------3 **[Schwab et. al. 2005]**

$T_p = D/2 + T_L$ ----------4 **[Schwab et. al. 2005]**

Hydraulic radius = cross sectional area (m^2) / wetted perimeter (m)……..5 **(Raghunath, 1995)**. Filtration method is used to determine the suspended sediment concentration after **(Morgan, 2005).**

Study Area:

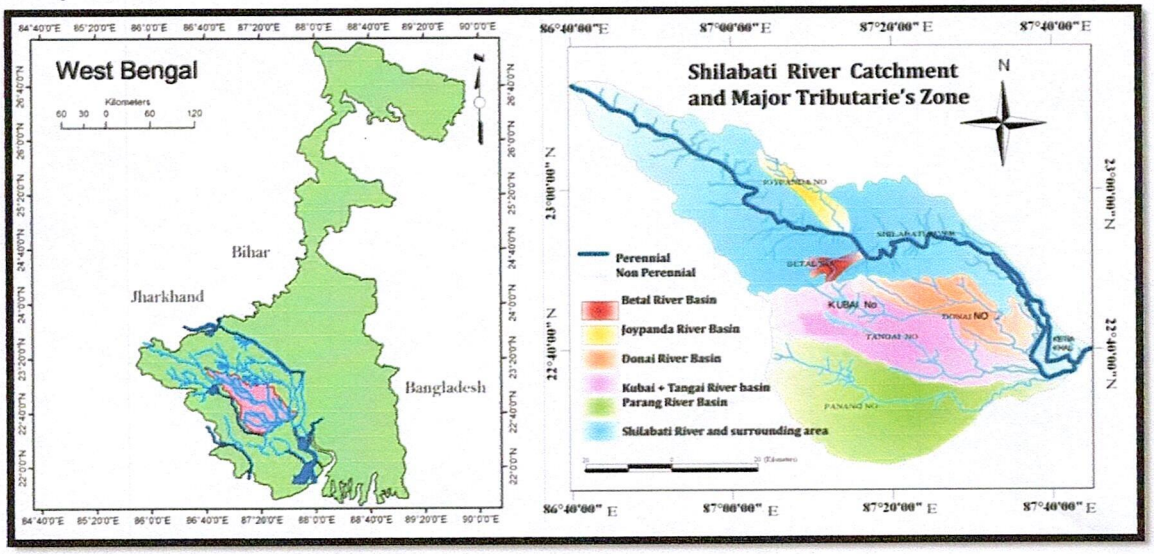

Fig:1

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 (concerned Toposheets no. 73I/12, 73J/16, 73N/1, 73N/5, 73N/6, 73N/9, 73N/10,

ISSN: 0474-9030

Vol-68-Issue-1-January-2020

73N/11, 73N/2). The lower catchment extends between $22^0$30'–$22^0$55'N and $87^0$30'- $87^0$45'E and faces the fury of flood almost annually.

Nature of Concentration of Discharge from Tributaries

Some important characteristics of main six tributaries and others are given in table- 1.

Sl no	Name of tributary	Area in sq km	Altitude zone	Total hydraulic head of tributary	Length of tributaries in km.	Gradient along main channel	slope distribution in tributaries in %		
							Below 4degree	4degree-8degree	Above 8degree
1	Near Shyampur	1.5	180-160	0	0.2	0		100%	
2	Near Haridih	2	180-160		0.1	0	50%	50%	
3	Near Uttarbard	1.5	160-140	0	0.2	0	25	50	25
4	NearGuniyada	12	160-140	20	13	1.54	30.7	30.7	39.86
5	Near Guniyada	2	160-140	0	2	0	50	50	
6	Near Salanpur	2.5	140-120	20	3	6.67	60	40	
7	Near Gundlugyra	2	140-120	20	2	10	50	50	
8	Near Padulara	1	140-120	20	1.25	16			100
9	Near salui Pahari	4.5	140-120	20	5.5	3.64		23	77
10	Near Kadia	12	140-120	20	10	2	25	33.3	58.3
11	Near Khattagram	8.5	140-120	20	6	3.33	23.53	52.94	23.53
12	Near Dulalpur	7.5	120-100	20	7.5	2.67	33.4	40	26.6
13	Near Patrachali	11.5	120-100	20	10	2	47.82	26.09	26.09
14	Nearmayur Nachnia	1	120-100	0	0.5	2		100	
15	Nearmayur Nachnia	0.5	120-100	0	0.25	0		100	
16	NearDhabjaminipur	3	120-100	0	3	0	8.3	41.67	50.33
17	Near Baradanga	1	120-100	0	1	0	100		
18	Nearkashibedia	2	120-100	0	2	0	100		
19	Near keapathar	1	120-100	0	0.5	0.87	42.86	14.28	42.86
20	Near keapathar	1	120-101	0	0.5	0.87	42.86	14.28	42.86
21	Near keapathar	1	120-102	0	0.5	0.87	42.86	14.28	42.86
22	Near keapathar	1	120-103	0	0.5	0.87	42.86	14.28	42.86
23	Near Erodihi	14	120-100	20	23	0.87	42.86	14.28	42.86
24	Near Shyampur	10	120-100	20	7.5	2.67	30	30	40
25	Near Bhagra	23	120-100	20	22.5	0.89	21.74	21.74	56.52
26	Near Ashberia	1	100-80	0	1	0	100		
27	Near kechanda	1.5	100-80	0	1.25	0	50		50
28	Near Ashberia	6	100-80	0	8.5	0		33.33	66.67
29	Near Dhansantra	8.5	100-80	20	7.5	2.67	29.41	47.06	23.53
30	Near Shyambazar	14.5	100-80	40	15.5	2.58	24.15	34.48	41.37
31	Near Beldanga	3	100-80	0	3	0	33.33		66.67
32	Near Banbeda	1	100-80	0	1	0	100		
33	Near kuchaipal	2.5	100-80	0	2	0	20	40	
34	Near Bramandiha	3.5	100-80	0	3.5	0	57.14	42.86	
35	Near Dabar	3.5	100-80	0	2	0		100	
36	Near Dabar	1	100-80	0	1	0	100		
37	Near Suresdanga	1	80-60	20	0.5	0	50		50
38	Near Suresdanga	1.5	80-60	20	1.5	0		100	
40	Near khakrakandi	1	80-60	0	1	0			100
41	Near khakrakandi	1	80-60	0	0.8	0	23.43		50
42	Near khakrakandi	0.5	80-60	0	0.5	0		100	
43	Near Patharkura	8.5	80-60	20	6.5	3.07	11.77	35.29	52.94
44	Near Golbathan	6	80-60	40	8	5	18.14	23.53	58.33
45	Murajhora	25.5	80-60	60	32.5	1.85		13.73	86.27
46	Near kapaskheria	2.5	60-40	0	4	0	20	40	40
47	Near Junkaria	6.5	60-40	20	5	4	61.54	15.38	23.08
48	Near Bardi	14.5	60-40	20	10	2	48.28	31.03	20.09
49	Near Ramnagar	1	60-40	0	1.5	0	50		50
50	Near Daldaria	5.5	60-40	20	5	4	54.55	27.27	18.18
51	Near Daldaria	1	60-40	0	1	0	75	25	
52	Near Jaleswar	2	60-40	0	2.5	1.14	61.22	22.45	16.33
53	Near Majura	24.5	60-40	20	17.5	2.35	33	34	33
54	Near Pithabakra	12	60-40	20	8.5	0	40		60
55	Near Neckratapal	2.5	60-40	0	3	0.73	58	34	8
56	**Jaipanda n**	121	60-40	40	70.5	0	66.67	33.33	
57	Near Bhatmoudi	1.5	60-40	0	1.5	0.4	20	40	40

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