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A Study on the Relationship between Siltation and Flow Parameter of a Typical Alluvial River - Studied Open Channel Flow Bhogdoi River

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Abstract**—** *The tendency of a river to change its course is the common feature of a river. This causes various problem to agricultural land, habitation, hydraulic structure etc located on the river banks. Soil erosion is one of the major threats to the society and it affects the economy of the state. It occurs when grains or assembly of grains are removed from the bank face by the flow. Due to strong forces of lift and drag exerted on the bank by flow, it detaches and removes soil from the intact soil. In our state as the mighty Brahmaputra river passes through the heart of Assam, therefore the affect of soil erosion is very horrible. From the earlier time various method are taken to eliminate soil erosion. The aim of this project is to record periodical observation of a tributary flowing into the river Brahmaputra to check its different properties i.e. the amount of silt carried, velocity during the period, discharge of the section, cross sectional properties and to study its various aspects to enhance some solution.*

Keywords**— *Cross Section, Discharge, Silt Carried, Soil Erosion, Velocity.***

I. INTRODUCTION

Assam is a state full of natural resources and agriculture where many people are engaged in agriculture. Since Brahmaputra and its tributaries are flowing through Assam, soil erosion is a very common phenomenon on those areas. Soil erosion is a naturally occurring process that affects all landform. In agriculture, soil erosion refers to the wearing of the field's upper layer by force of water. Due to erosion, detachment, deposition and movement of soil take place. It is also observed that due to the bank erosion certain villages, fertile agricultural lands and roads are facing the threat of existence. The extent of loss to the bank erosion varies from year to year depending on the severity of flood in the state.

The aim of this project is to find the discharge, velocity, silt carried, shape parameter and study its various aspects, to prevent or minimize soil erosion.

1.1 THE STUDIED REACH: BHOGDOI

The Bhogdoi River is a sub-tributary of Brahmaputra. Its geographical location is 26º43'11.2" N latitude and 94º16'49" E longitude. It originates from long samtang of Mokukchung (Naga Hills) and is falling down at Kakadonga River in North West of Jorhat flowing for 162.5 km all the way through the Jorhat town.

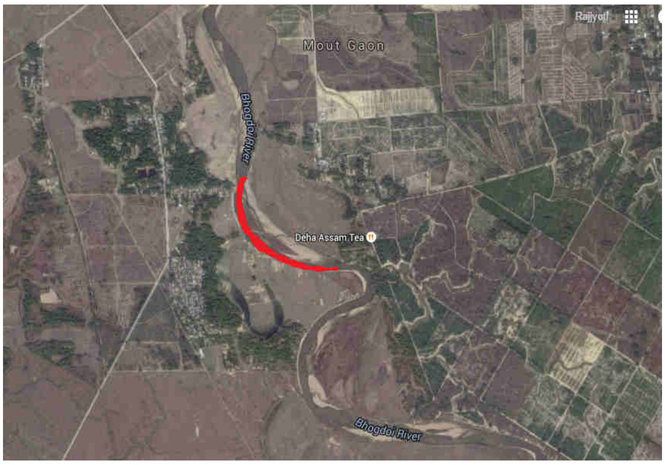

Fig.1: Google image of project site

II. MATERIALS AND METHOD

1. The entire section is first divided into 8 sections, each measuring 50m at the straight and 25m at the meandering portion.
2. The depth and cross section along with various flow parameter of the river is calculated.
3. At each section the depth of the flow is measured in 3m interval along the cross section.
4. The velocity of the flow is measured with the help of a float and a stopwatch.
5. For the calculation of silt, water is collected from a depth equal to one third of the flow depth.
6. Calculation of area in each cross section is done with the help of AutoCAD Software.
7. Sieve Analysis is done to find the shape parameter co-efficient of uniformity C_u and co-efficient of curvature C_c.

$$Cu= \frac{D60}{D10}$$

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$$Cc = \frac{D30^2}{D10 \times D60}$$

Where, the diameter D_{10} corresponds to 10% of the sample finer in weight on the Grain Size Distribution Curve. The D_{10} is called effective size.

D60= Grain diameter (mm) corresponding to 60% finer than.

D30= Grain diameter (mm) corresponding to 30% finer than.

III. RESULT AND OBSERVATION

A river reach as shown in the map has been studied over a period of 8 months for different hydrodynamic parameters. The summaries of observation are tabulated as under:

3.1.A. Graphical Representation of Field observations over a time of Eight months:

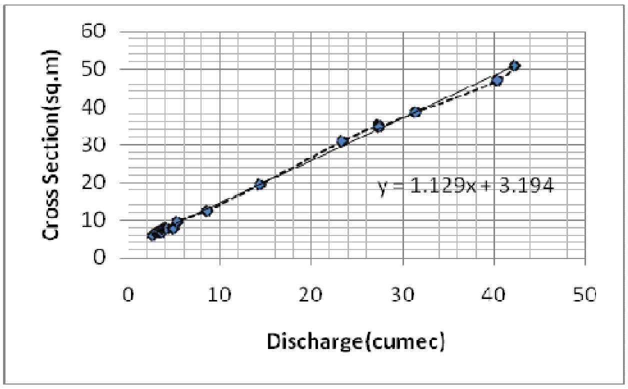

Fig.2: Graph of River Cross Section with Discharge

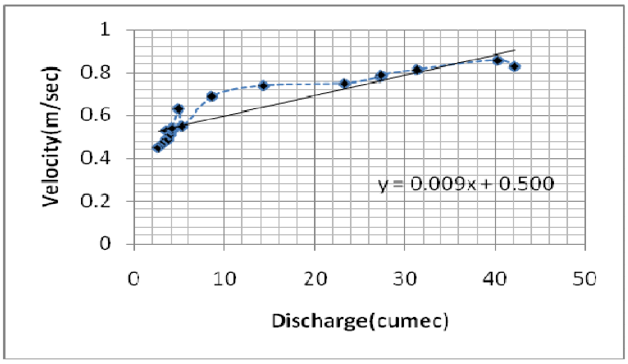

Fig. 3: Graph of Velocity of flow with Discharge

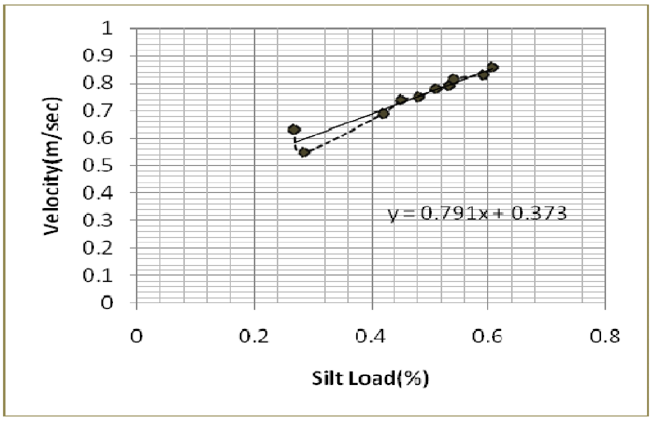

Fig. 3: Graph of Velocity of flow with Silt load

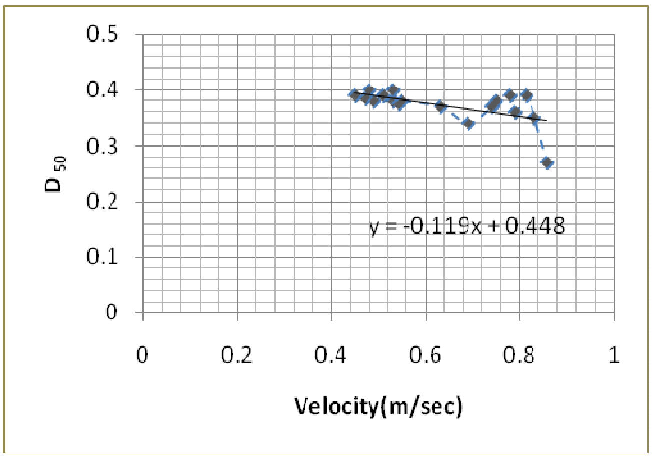

Fig. 4: Graph of D_{50} with Velocity

3.2.B. Sieve analysis of the river bed materials collected during field observations:

Table 1: Sieve Analysis

Date	C_u	C_c	Soil type	Silt factor (f)
06/09/2015	1.93	1.44	Poorly graded Fine sand (SP)	0.914
20/09/2015	1.73	1.047		1.099
04/10/2015	1.69	1.07		1.099
11/10/2015	1.83	0.93		1.085
25/10/2015	1.625	0.78		1.07
01/11/2015	1.77	0.81		1.026
15/11/2015	1.74	0.98		1.07
06/12/2015	1.75	0.89		1.078
20/12/2015	1.64	0.94		1.085
10/01/2016	1.68	0.857		1.085
24/01/2016	1.83	1.127		1.113
07/02/2016	1.956	0.99		1.099
21/02/2016	1.72	1.013		1.113
06/03/2016	1.75	1.0158		1.092
27/03/2016	1.708	1.0406		1.099
03/04/2016	1.78	0.95		1.085
24/04/2016	1.88	0.945		1.041
01/05/2016	1.722	1.12		1.041

Where C_u is Co-efficient of uniformity, C_c is Co-efficient of curvature and f is the silt factor

i.e. $f=1.76\sqrt{D_{50}}$

3.3.C. Summary of Field observations over a time of Eight months:

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Table 2: Field Observation

Date	Avg. Depth of flow(m)	Avg. area of cross section (sq. m)	Avg. velocity of flow (m/sec)	Avg. Discharge of section (cumec)	Avg. volume of flow (cu.m)	Avg. silt collected in % of volume of water	Volume of silt carried within the section (cu.m)
06/09/2015	1.11	46.96	0.8578	40.28	14088	0.606	85.37
20/09/2015	0.93	38.53	0.814	31.36	11559	0.54	62.42
04/10/2015	0.84	35.1	0.78	27.38	10530	0.51	53.7
11/10/2015	0.813	30.93	0.75	23.32	9279	0.48	44.53
25/10/2015	0.505	19.39	0.74	14.35	5817	0.45	26.18
01/11/2015	0.36	12.5	0.69	8.625	3750	0.42	15.75
15/11/2015	0.251	7.82	0.632	4.94	2346	0.267	6.26
06/12/2015	0.24	7.78	0.542	4.217	2334	Very less	0
20/12/2015	0.221	7.74	0.49	3.79	2322	Very less	0
10/01/2016	0.235	7.95	0.53	4.21	2385	Very less	0
24/01/2016	0.191	6.844	0.53	3.62	2053.2	Very less	0
07/02/2016	0.1805	7.94	0.51	4.04	2382	Very less	0
21/02/2016	0.187	7.103	0.48	3.4	2130.9	Very less	0
06/03/2016	0.183	6.78	0.471	3.19	2034	Very less	0
27/03/2016	0.162	5.94	0.45	2.67	1782	Very less	0
03/04/2016	0.222	9.68	0.55	5.324	2904	0.284	8.25
24/04/2016	1.086	50.8	0.83	42.164	15240	0.591	90.06
01/05/2016	0.785	34.67	0.79	27.39	10401	0.532	55.33

IV. CONCLUSION

In this study, an attempt has been made to find out different hydraulic parameter of the studied tributary. From the above mentioned seasonal information and graph it can be conclude that:

1. Fig. 1 shows that as discharge increases cross sectional area also increases. This is quite obvious from the fact that increased c/s area causes more volume of flow. Thus the field observations get well with the theoretical concept.
2. Fig. 2 shows that as velocity increases discharge also increases. This observation is also well supported by theoretical concepts.
3. Fig. 3 shows that silt load and velocity are proportional to each other. This observation can be explained from the fact that as velocity of flow increases, more and more portion of the bed load will be converted from contact load to suspended load. Thus the volume of silt carried in the flowing water increases.
4. Fig. 4 shows a trend that D_{50} decreases as the velocity increases. This is quite obvious from the fact that as velocity increases, the heavier bed material will be carried by the flow of water. Hence the average size of the bed material eventually gets reduced.

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