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Assessment of Plan Form Development using Protective Materials around an Island

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Abstract*: As per recent survey of different survey portals, it is nearly proved that the most dangerous threat of nature is soil erosion and changes of plan form development in river topography. There are many reasons behind this degradation such as difference in climate, changes in direction of wind and water, man made changes of river path etc. In this project, we tried to locate the changes in plan form development due to erosion and deposition of soil after using protective materials. So this project was carried out to study the detachment, transportation and deposition of cohesion less uniform and non-uniform sediments as well as run-off around an island made of silty clay material having protection material as gravel and stone.

***Index Terms*: Climate change, Detachment of soil, Protection materials, Erosion and deposition.**

I. INTRODUCTION

Now a day, the most challenging work is the assessment of soil erosion mapping which is directly connected with ecological cycle of our society. As Changes in land forms as well as plan form of river occurred, the physical properties of soil components transforms from parental property to metamorphic property. Salinity of soil, saturation rate, bulk density, liquid limit, root zone capacity of crops all are hampering due to the errors in prediction of Soil erosion mapping.

We can improve our ecological environment by different approaches as well as we can provide the society a better lifestyle by creating the diversity of river configuration .In this project we noticed how river flow effect the erosion and deposition around an island .We studied in which way soil particles are carried by stream and their movement in fluid by whole project .This project is done by interpretation and numerical method as well as graphical method to clarify the properties of actual river like resistance , also the velocity is measured using A.D.V and the discharge is measured by V notch manually to check the deposition and erosion of soil particles around the natural water bed.

II. OBJECTIVES

In our previous work we have already quantify the amount of eroded soil using different types of Island (S Ghosh et al, 2018). In this project we have tried to locate the zones of soil erosion as well as the pattern of changes in plan form due to erosion and deposition of soil using protective materials. So the key objectives are as follows,

- Characterization of plan form development during stages of river flow.
- Erosion and Deposition characteristics of soil around an island in a natural stream.

In this paper we have presented the final stage of the project the prevention assessment of the island using gavel and stone chipping as well as the graphical presentation of plan form development around the island after prevention work.

III. SETUP AND METHODOLOGY

The experiments were executed in the experimental setup constructed at National Institute of Technology, Durgapur with the help of Department of Science and Technology. The laboratory consists of a flume 20 m long, 4 m wide and 10 m deep. A cemented bottom and glass wall were established on both side with a grid of 5 x 5 cm up to a height of 55 cm from the bottom of the flume for the measurement of Flume bed. Experiments were done at several slopes of bed in the flume. The input in the flume was provided by an upstream reservoir feed by two no of 10" mild steel pipes. There were two no of Kirloskar pumps of 7.5 HP each to regulate the water to the MS pipe from the Primary storage reservoir. The input supply of upstream was regulated with the help of a valve provided in the inlet pipe. There was a rectangular escape channel to recycle the water from downstream to primary reservoir, which was 41.2 m long, 1 m wide and 0.6m deep. The ultimate water level and discharge through the flume was controlled by a motor operated sluice gate at the final end of the flume. The schematic diagram of the setup is shown fig 1.

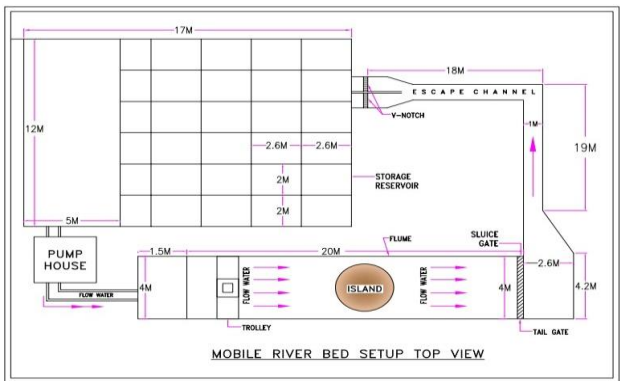

Figure 1: Experimental setup

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Earlier, we already quantified amount of erosion and specific deposition for different discharge. In final stage, we used gravel and stone as bouldering materials of island and repeat the experiment again for different discharge to assess the pattern of erosion from the island as well as the changes in plan form development of river bed.

IV. MEASUREMENTS

A. Signal to Noise Ratio Measurement

SNR (signal to noise ratio) is one of the most important parameter to measure velocity profile of soil particles which collects the record of total numbers of moving particles (Welvaert M, Rosseel Y ,2013).

B. Discharge measurement in downstream

The measurement of discharge (upstream and downstream) are regularly monitored by ADV (automatically) and a right angled V notch (manually) (Rennie, 2002).

C. Measurement for the Velocity Distribution

Readings of velocity profiles in X, Y, Z directions are recorded automatically by a fully functional hand held flow tracker. Also the measurement of ground water contributions is periodically recorded. (Kostaschuk, 2005)

D. Measurements of Eroded Soil Parameter

Experiments of determination of soil physical properties, we have used well quipped soil laboratory to classify the eroded elements of different types of soil after using same protection materials.

E. Measurement of Plan Form Parameters

The changes of plan form development were regularly monitored and recorded through changes in grid reading the flume.

Figure 2: Island in the flume (without protection)

Figure 3: Grid lines in the flume

Figure 4: Discharge in V notch

IV. SAMPLE OF DATA COLLECTION

Column1	Column2	Column3	Column4
	x(cm)	Y(cm)	Z(cm)
STATION (1)	215	0	19
	215	40	15
	215	80	14
	215	120	14
	215	160	15
	215	200	15
	215	240	14
	215	280	13
	215	320	15
	215	360	15
	215	400	17
STATION(2)	430	0	18
	430	40	13
	430	80	13
	430	120	12
	430	160	14
	430	200	12
	430	240	12.5
	430	280	14
	430	320	16
	430	360	19
	430	400	19
STATION(3)	645	0	19
	645	40	12
	645	80	9
	645	120	10
	645	160	13
	645	200	14
	645	240	14
	645	280	15
	645	320	15
	645	360	16
	645	400	17
STATION(4)	860	0	18
	860	40	15
	860	80	17
	860	120	16.5
	860	160	21
	860	200	34
	860	240	30
	860	280	19
	860	320	14
	860	360	17
	860	400	17
STATION(5)	1075	0	17

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	1075	40	10
	1075	80	10
	1075	120	12
	1075	160	7
	1075	200	11
	1075	240	11
	1075	280	12.5
	1075	320	12
	1075	360	11
	1075	400	14
STATION(6)	1290	0	11
	1290	40	9
	1290	80	6
	1290	120	5
	1290	160	6
	1290	200	5
	1290	240	5
	1290	280	7
	1290	320	7.5
	1290	360	9
	1290	400	12
STATION(7)	1505	0	11
	1505	40	4
	1505	80	6
	1505	120	6
	1505	160	5.5
	1505	200	7.5
	1505	240	8
	1505	280	10
	1505	320	10
	1505	360	10
	1505	400	12

Table 1: Plan form development readings of 1st day, 3rd stage experiment (protection work)

VI. RESULTS AND GRAPHICAL DEVELOPMENT:

We have collected consecutive data of 6 days by continuously increasing the rate of flow from minimum to maximum, and collect all the corresponding data including grid coordinates to produce smooth and clear surface plot to observe the changes in plan form development after gravel and stone chipping.

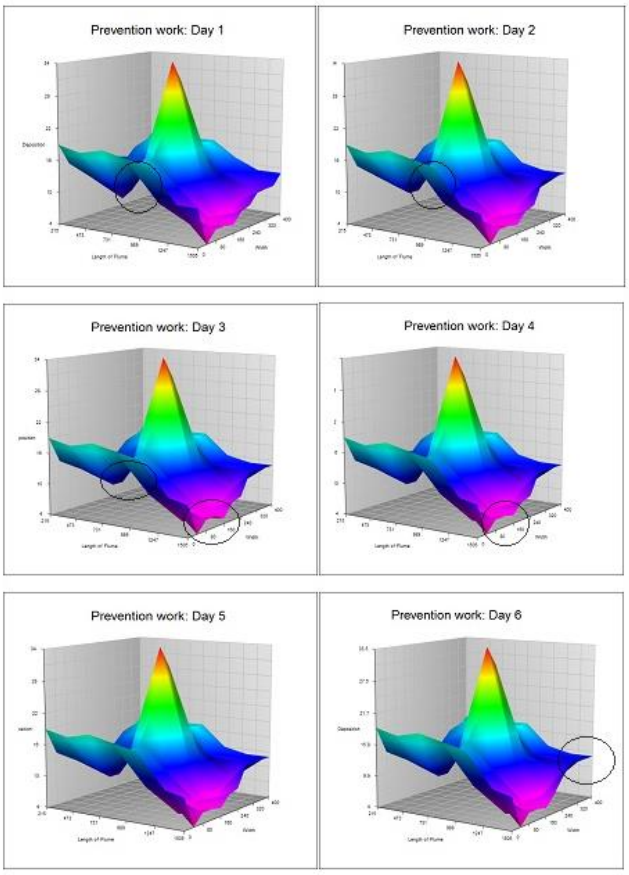

Figure 5: Change in development from 1st day to 6th day (Surface plot at -56^0 views)

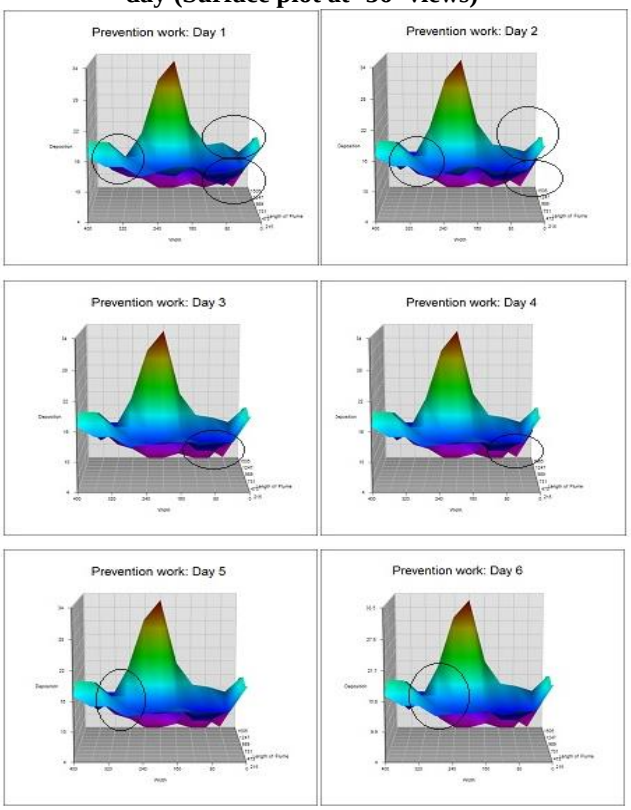

Figure 6: Change in development from 1st day to 6th day (Surface plot at 180^0 front views)

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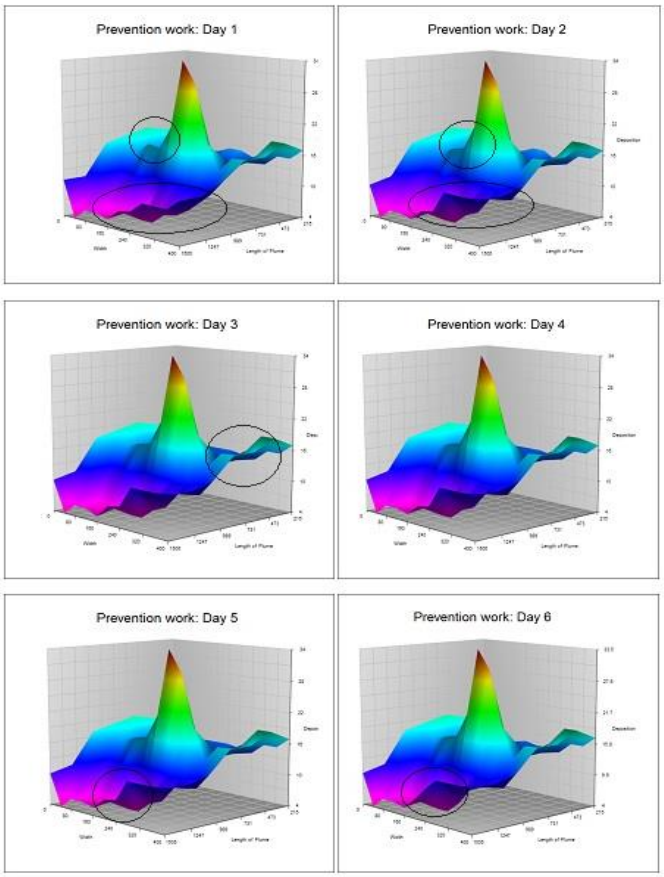

Figure 7: Change in development from 1st day to 6th day (Surface plot at 47^0 views)

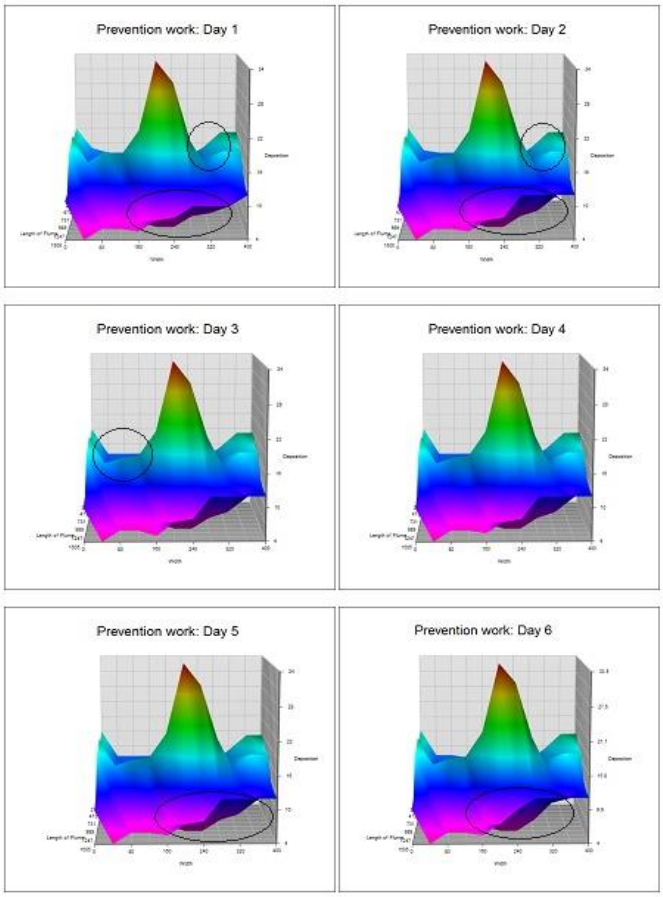

Figure 8: Change in development from 1st day to 6th day (Surface plot at 0^0 back views)

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VII. CONCLUSION

Using stones and gravel materials as protection layer we observed that there were no changes in the shape and size of island which we have constructed in the middle of flume, but there are some changes in morphology and plan form of the river bed during the experiment which we have already shown in figure 5 to figure 8.

We have collected the sample of those particles of soil which were moving with flow from upward to downward movement. Surprisingly the laboratory analysis shows that the particles were mostly fine sand mixed with some silt particle.

Also we have observed that the changes in morphology and plan form development was much higher in inundate condition (day 5-6) than full flow condition (day 3-4).

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