Systematic Approach for Solving Flood and Erosion Problem of Assam: A 100 Days Programme

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INTRODUCTION

Severity of the flood and erosion problem of Assam does not need any introduction. While integrated river basin planning, watershed management, construction of flood control reservoir in suitable location in the tributaries, flood diversion by parallel canal like Ganga canal are long term measures and need to be initiated without farther delay, taking immediate measures for erosion control and controlling embankment failure can help reducing worst flood hazard faced by the people almost every year. This paper focuses on the immediate measures that can be taken up for reducing flood risk and mitigating flood hazard faced by the state. Like correct diagnosis of the actual disease is the first step for right treatment of a patient, understanding actual causes of bank erosion and embankment failure in specific location is essential. Keeping in mind the objective of this workshop, a systematic approach for proper diagnosis of the problem is presented with a well-defined initial programme of 100 days.

Process of river bank erosion:

River bank erosion occurs because of following processes:

1. Depending on the orientation of flow-direction of a river both direct current and secondary current may attack the river bank and can erode the bank materials of the vertical face of the river. Because of the presence of secondary current in a bend of a meandering channel or a curved side-channel of a braided river, the lower part of the bank generally gets eroded and the upper part eventually collapse due to lack of support. This calls for need of a cover material that can absorb the high dynamic force of water and wave and can protect the bank from repetitive impact of high speed current. To have safe deeper channel formed by the secondary current in the outward curvature bed need to be protected by launching apron along with toe protection.

2. During flood recession period, due to sudden draw-down condition, a river bank having relatively less permeable soil like loamy soil or silty clay, may collapse as the saturated weight of the soil disturbs the slope stability. Any additional weight on the bank will add to the disturbing force (and hence disturbing moment) and will promote slope failure. For such situation a cover that can allow free seepage, of water without taking soil particle, is necessary. To increase the restoring moment a strong toe protection is always helpful.

3. Another possibility is failure due to seepage. Seepage occurring from country side to the river side, during and after flood recession, takes the finer bank materials along with it below the pheratic line. Thus the lower part of the bank collapses because of piping. This eventually may cause failure of the upper part due to lack of support. Such failure is more in a situation where water bodies exist in the country side near the river, as these lead to continuous seepage for longer period. Such piping failure can be prevented by using filter material at the downstream side, along with lateral horizontal filter and the bank can be rebuilt.

4. Many a time, any kind of protecting measures can be taken away by out flanking of the protected portion. To avoid this, a deflecting spur (wooden, vegetative, or boulder depending on the dimension of the river) can be placed at up-stream of the protected portion with proper orientation**.**

Process of embankment failure:

Embankment can also fail for various reasons.

1. Failure due to piping occurs when the seepage line (phreatic line) from the river side to the county side emerge in the county side face of the embankment or through the toe of the embankment at county side. With progressive removal of soil particle it leads to piping and water emerge through that. With increase in the size of piping passage the embankment as a whole collapses suddenly and rushing water with high shear stress cause lateral expansion of the breach till the resisting shear stress of wet soil equals the drag force of the emerging water. If identified in the initial stage, this kind of failure can be controlled by impounding water by putting artificial barrier at county side where emerging water will get impounded and with equal water level on river side and county side, seepage will stop.
2. Presence of rotten roots of trees, or wholes made by termite, rats etc. expedite the failure process explained in the above point.

3. Rain cut on the embankment side, reduces dimension of the embankment and without having regular maintenance, the section of the embankment become insufficient to resist the water pressure and failure occurs. This kind of progressing failure can be control by proactive repairing and proving proper water drain at required intervals.

4. Failure can also occur due to over topping. If the flood exceeds the design flood or if due to excessive sedimentation in the bed, carrying capacity of the channel gets reduced, then overtopping may occur. The water flowing over the embankment causes surface erosion in the top of the embankment and generate a small channel, which expand because of high shear stress of the emerging water and leads to failure of the embankment.

5. Due to progressing erosion of the river bank, if the river reaches the toe of the embankment, then the embankment will obviously fail.

Prevention measures:

Depending on the cause of failure appropriate prevention measures need to be taken for preventing the failure. Sometimes failure occurs due to multiple causes. A judicious combination of soft (vegetative) measures, hard measures (traditional structural measures), and some innovative practices (geofebric, plastic net, geonet, natural fibers sheet etc.) can be used for controlling failure. Performance of preventive measure can be tested by using mathematical model study. Details of possible measures are not presented in this paper as these measures are always case specific.

100 days programme:

First 2 Days: An orientation programme for engineers of all divisions for information collection following the steps given below. This can be organized by Water Resources Department and *B.P.Chaliha Chair Professor* at IIT Guwahati.

Next 8 days: Engineers of Water Resources Department can identify the erosion effected area and potentially week embankments in their respective division/subdivision. In fact, this is almost known to them, they need to put the GPS location, lentgh, site name etc., so that these can be mapped properly.

Next 30 days: Cause of bank erosion and cause of embankment failure need to be identified with proper documentation. Parameters, like channel curvature, existence of water bodies on the county side, type of bank material, presence of protection measure, if any, time of failure, i.e, during rising or recession of flood, etc. will have to be collected, so that actual cause of failure can be analytically established. While departmental engineers will have to do the actual information collection work for different parameters, we will provide a comprehensive table for data collection, so that final data matrix comes out and the cause of failure can be established.

Next 30 days: Collection of information about actual damage and loss caused by the failure or the estimated damage due to potential failure. Social analyst also needs to be involved in this phase. Both tangible and intangible losses need to be included and proper quantification of intangible losses can be attempted with proper justification.

Next 20 days: Surprise visit and verification by peer reviewers (Engineers from different division with public representative), so that any possible mistakes can be avoided

Next 10 days: Two separate data sheet, one for embankment failure and the other for erosion prone area need to be developed. Prioritization of the sites and taken up for project implementation in phase manner.

Actual prevention measures will have to be planned immediately after completion of these 100 days with help of capable organization and academic institutes including IIT Guwahati.