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Geotextile bag revetments for large rivers in Bangladesh

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ABSTRACT

Since the late 1990s, riverbank revetments constructed of sand-filled geotextile bags (geotextile bags) have been developed in Bangladesh in response to the lack of traditional erosion-protection materials, particularly rock. After independence in 1971 and the related loss of access to quarries, rock was replaced by concrete cubes, but those are expensive and slow to manufacture. Geotextile bags on the other hand, first used as emergency measures during the second half of the 1990s, can be filled with local sand and therefore provide the opportunity to respond quickly to dynamic river changes.

Geotextile bags also provide the potential for substantial cost reduction, due to the use of locally available resources. The use of the abundant local sand reduces transport distance and cost, while local labor is used for filling, transporting, and dumping of the 75–250 kg bags. Driven by the need for longer protection, the idea of using geotextile bags for permanent riverbank protection emerged in 2001. Eight years of experience have enabled systematic placement of geotextile bag protection along about 12 km of major riverbanks at a unit cost of around USD 2 M per km. By comparison, concrete-block revetments cost around USD 5 M per km. In addition, there are strong indications that geotextile bags perform better than concrete blocks as underwater protection, largely due to their inherent filter properties and better launching behavior when the toe of the protected underwater slope is under-scoured.

This article reports the outcome of the last eight years of development work under the ADB-supported Jamuna-Meghna River Erosion Mitigation Project (ADB, 2002), implemented by the Bangladesh Water Development Board. Besides substituting geotextile bags for concrete blocks as protective elements, the project involved development of a comprehensive planning system to improve the overall reliability and sustainability of riverbank protection works.

1. Introduction

1.1. Background

Bangladesh is one of the most densely populated countries of the world (more than 1000 persons per km^2), with few natural resources. At the same time it is one of the most disaster-prone areas with an average of about 6 major disasters annually. The country is largely situated on the fertile delta of four great rivers: Ganges, Brahmaputra, Padma and Meghna. These rivers flow through alluvial plains built up over million of years from sediments mainly derived from the unstable southern slopes of the Himalaya. The rivers are characterized by (i) very high discharges, in the order of 100,000 m^3/s in severe floods, (ii) local flow velocities exceeding 4 m/s at exposed points, (iii) deep scouring, locally exceeding 70 m in depth, (iv) great lateral instability with bank erosion rates in some places exceeding 1 km per year, and (v) an absence of rock sources for riverbank stabilization.

In this environment riverbank protection was attempted over a long period, with only limited success. A major impediment was the high cost of concrete blocks. This often limited the length of the protective works to a few hundred meters, while erosion problems commonly affect lengths of several km. In 1999 riverbank erosion became critical alongside two large irrigation projects: one situated on the right or west bank of the lower Brahmaputra (called Jamuna in Bangladesh), and the other on the left or east bank at the confluence of the Upper Meghna with the Padma – which carries the combined flow of the Brahmaputra and Ganges (ADB, 2002). In terms of average annual discharge the Brahmaputra is classified as the fifth largest river of the world, while the Padma is the third largest, only surpassed by the Congo and Amazon (Schumm and Winckley, 1994).

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