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Monsoonal sediment flux and the hydro-morphodynamic characteristics of the lower Karnaphuli river of Bangladesh

Md. Yeasir Arafat, Md. Enamul Hoque, Shyamal Karmakar, Ha-mim Ebne Alam, Kazi Tawkir Ahmed, Md. Nizam Uddin

University of Chittagong, Bangladesh

Abstract

The lower Karnaphuli River is one of the most significant segments that hold the largest seaport of Bangladesh, supporting the country's major economic activities. But sedimentation due to considerable catchment area and river morphology are the significant issues in the proper functioning of the port. This investigation has encompassed estimating the total sediment flux and the hydro-morphodynamics of this segment of Karnaphuli River during the monsoon season of 2020 when the stream discharge reaches its maximum. The suspended sediment concentration was measured using a modified depth-integrated pressure difference sampler, and the bedload transportation was measured using a 250 mm mesh net mounted in a Helley-Smith bedload sampler from six points of two cross-stations. The study followed the standard methods and equations to calculate the hydrodynamic parameters of the river channel. The study revealed that the average suspended sediment transport rate was around 1940.31 m^3/s with a sediment concentration of 813.98 mg/L. The average bedload transport rate was found around 0.82 kg/s-m in downstream station, and the bedload transport rate of upstream station was 0.52 kg/s-m, where the river is 31.2% narrower than the downstream. The average daily total sediment load was about 0.529 million tons in the lower channel. The average bed shear stress was 2.14 $N/m^{2,}$ and the critical bed shear stress was 0.165 N/m^2. The considerable concentration and transport rate of suspended sediment confirm it to be the primary transport mode contributing about 91% of the total load averagely. The value of total sediment yield per day in monsoon indicates it to be the controlling factor of the annual sediment budget and the morphology of the channel basin. The findings of bed shear stress and critical bed shear stress may direct the mobility of bed particles, indicating possibility of erosion in the lower channel.

Keywords

Sediment flux, Suspended load, Bed load, Hydrodynamics