ABSTRACT

From the dawn of civilization, the importance of the Hooghly estuary has been indissolubly coupled with the economy and the culture of India. It is an important link between the Hooghly–Bhagirathi River System and the Bay of Bengal, evolved as a constituent of the world's biggest fluvio-marine delta Ganges-Brahmaputra-Meghna (GBM), within the geographical boundary of India.

The Hooghly estuary comprising the dynamic delta lobes with the alluvial flood plain was formed by the rivers Bhagirathi-Hooghly, Mayurakshi, Ajoy, Damodar, Silabati, Kangsabati, Rupnarayan, Kaliaghai-Haldi and Rasulpur. The precipitation all over the estuary dislodges clastic sediments resulting in the sediment-laden river flow, which interacts with salinity and tidal flow in the Hooghly estuary and goes to the Bay of Bengal.

Exceptionally high sediment movement and water discharge have made the Hooghly estuary a zone vulnerable to land erosion and accretion due to dynamic water circulation. During the monsoon, huge quantities of sediment are transported by the rivers and the tributaries. Part of this sediment load is deposited in the indentation zone of terrain and the river bed and the remaining part is flushed into the Bay of Bengal. In the dry season, the sediments are relocated and deposited mainly within the estuary or near the coast. A net accretion rate of about 50.0 million cubic meters per year has been observed in the outer Hooghly estuary during the last 175 years.

Three main factors have controlled the evolution of the Hooghly estuary: (1) the regional geology providing the structural framework (2) the different physical processes which influence it, and (3) the eco-biology of the living bodies that inhabit it. The present study is an attempt to understand the geological history, the sedimentary processes and the geomorphological transformation of the estuary on the basis of hydrological measurements, remote sensing applications and GIS analysis. New information on tidal circulation salinity processes and climatic parameters has been presented. The surface water flow and the rate of sediment transport in the Hooghly estuarine system have been analyzed using mathematical model simulations. On the basis of this model, a forecast of the morphological evolution of the Hooghly estuary in the future has been made.

A mathematical model of the Hooghly estuary, using software MIKE (Danish Hydraulic Institute, Denmark), and satellite imageries, has been developed for the estuary management. A cheap methodology for the bathymetric mapping of the Hooghly estuary from the satellite image has also been developed.

Keywords: Hooghly estuary, geology, tectonics, lithology, isotope-tracer, tidal bore, salinity, geomorphology, erosion, accretion, remote sensing, reflectance, bathymetry, hydrodynamics, sediment transport, MIKE-module.