Journal of Hydrology (2007) 332, 381–395

available at www.sciencedirect.com

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Hydrologic monitoring and analysis in the Sundarbans mangrove ecosystem, Bangladesh

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Received 28 July 2005; received in revised form 20 July 2006; accepted 25 July 2006

KEYWORDS
Hydrological monitoring;
Mangrove ecosystem;
Mathematical modeling;
Sundarbans;
Bangladesh

Summary The unique habitat of the Sundarbans mangrove ecosystem is dependent upon the hydrological regime. Therefore, a comprehensive study to understand the hydrologic behaviour and the changes that have taken place due to anthropogenic activities in and around the area is fundamental to the management of natural resources and environment. In the past, ad hoc and uncoordinated efforts were made due to the inherent inaccessibility and high cost of data collection. The present article documents the results of the hydrologic monitoring, modelling and analysis in the Sundarbans. The study results show that the annual maximum tidal range has increased by about 0.75 m in the eastern and central parts during the last two decades. About 60% area remains in higher salinity condition (>20 ppt) for at least 1.5 months in a year. Organic pollution in the waterways is within the Environmental Quality Standard (EQS) of Bangladesh with the average Dissolved Oxygen (DO) of 5.99 mg/L. Total Ammonia, Nitrate (NO_3–N) and Phosphate (PO_4–P) level are present in sufficient quantity for the aquatic life to survive and are within EQS limit. Lead and Chromium occasionally exceed EQS limit especially along the large barge routes in the western part. The data and information presented in the paper will serve as a baseline for future hydrological and environmental studies.

Introduction

The mangrove-dominated Ganges delta — the Sundarbans — is a complex ecosystem comprising one of the three largest single tract mangrove forests of the world (Blasco, 1975). Shared between two neighboring countries, Bangladesh and India, the larger part (62% of the total mangrove ecosystem) is situated in the southwest corner of Bangladesh between latitudes 21°27′30″–22°30′00″ North and longitude 89°02′00″–90°00′00″ East (Fig. 1). The western boundary of the Bangladeshi Sundarbans follows the Harinbhanga–Raimangal–Kalindi river system and abuts with the Indian

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doi:10.1016/j.jhydrol.2006.07.016

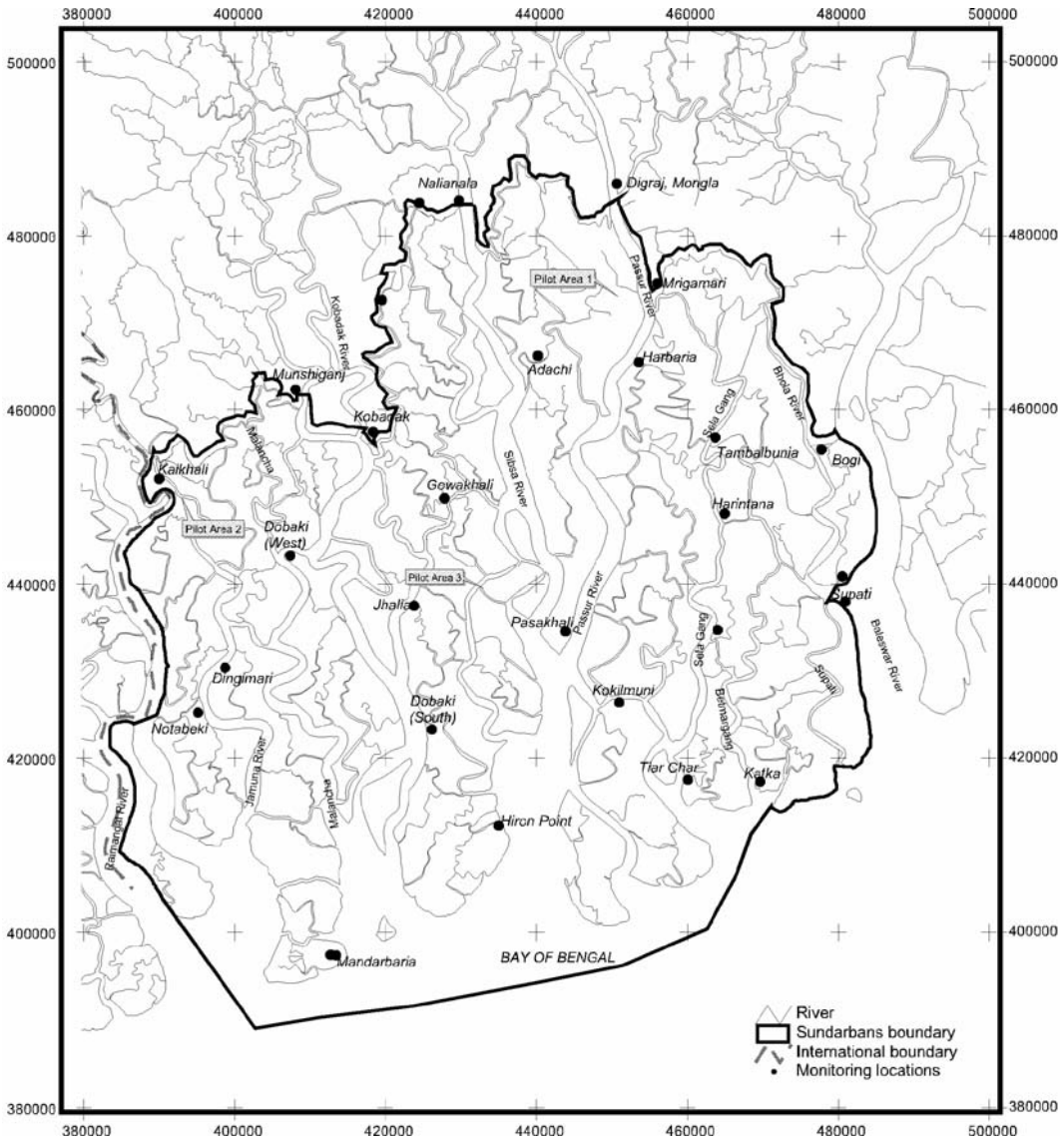

Figure 1 Study area location.

Sundarbans. To the south the forest meets the Bay of Bengal; to the east it is bordered by the Baleswar River and to the north there is a sharp interface with intensively cultivated land. The natural drainage in the upstream areas, other than the main river channels, is impeded by extensive embankments and polders. The total land area is 4143 km^2 (including exposed sandbars — 42 km^2) and the remaining water area of 1874 km^2 encompasses rivers, small streams and canals. Rivers in the Sundarbans are meeting places of salt water and freshwater. Thus, it is a region of transition between the freshwater of the rivers originating from the Ganges and the saline water of the Bay of Bengal.

In terms of biodiversity, the Sundarbans contrasts the other large mangrove forests for its extraordinarily diverse wildlife and has been designated as a UNESCO's World Network of Man and Biosphere Reserve since 2001. The forest also has immense protective and productive functions. Constituting 51% of the total reserved forest estate of Bangladesh it contributes about 41% of total forest revenue and accounts for about 45% of all timber and fuel wood output of the country (Food and Agriculture Organization, 1995). A number of industries (e.g. newsprint mill, match factory, hardboard, boat building, furniture making) are based on the raw material obtained from the Sundarbans ecosystem. Various non-timber forest products and plantations help sustain considerable employment and income generation opportunities for at least half a million poor coastal population. Besides production functions of the forest, it provides natural protection to life and properties of the coastal population in cyclone prone Bangladesh.

However, despite the fact that the Sundarbans is mostly free of permanent human habitation and retained a forest closure of about 70% according to the Overseas Development Administration (1985), forest inventories reveal a decline in standing volume of the two main commercial plant species — Sundri *Heritiera fomes* and Gewa *Excoecaria agallocha* — by 40% and 45%, respectively between 1959 and 1983 (Forestal, 1960; Overseas Development Administration, 1985). Also, despite a total ban on all killing or capture of wildlife other than fish and some invertebrates, there