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Ecological degradation of the Yangtze and Nile delta-estuaries in response to dam construction with special reference to monsoonal and arid climate settings

Zhongyuan Chen[1], Hao Xu[2], Yanna Wang[1]

[1]East China Normal University, China. [2]Ningbo University, China

Abstract

This study reviews the monsoonal Yangtze and the arid Nile deltas to understand the process-response between river-basin modifications and delta-estuary ecological degradation under contrasting hydroclimate dynamics. Analysis shows that the Yangtze River has had a long-term stepwise reduction in sediment and silicate fluxes to estuary due to dam construction since the 1960s, especially the Three Gorges-Dam (TGD) closed in 2003. By contrast, the Nile had a drastic reduction of sediment, freshwater and silicate fluxes after the closure of Aswan High Dam (AHD) , 1964. Seasonal rainfall in the mid-lower Yangtze basin (below TGD) complements riverine materials to its estuary, but little is available to the Nile coast below HAD in the hyper-arid climate setting. Nitrogen (N) and phosphate (P) fluxes in both basins have increased because of overuse of N- and P-fertilizer, land-use change, urbanization and industrialization. Nutrient ratios (N:P:Si) in both delta-estuaries have been greatly altered, in the context of the optimum of Redfield ratio (N:P:Si = 16:1:16). This has led to ecological regime shift evidenced by a long-term change in phytoplankton communities in the Yangtze estuary, where silicious algae tended to lose dominance since the end of 1990s, when more toxic dinoflagellates began to emerge. In the Nile estuary, such regime shift is indicated by the post-dam dramatic reduction in zooplankton standing crop and fish landings until the early 2000s when biological recovering due to anthropogenic sources. Although the Yangtze has had higher human impacts than the Nile, N concentrations in the Nile estuarine waters have surpassed the Yangtze. However, eutrophication in the Yangtze is much more intensive than the Nile, leading to the likelihood of more acidic water. The comparative insights of this study should be incorporated into future integrated coastal management of these two important systems.

Keywords

altered nutrient ratio, riverine flux, bio-transformation, post-dam consequences