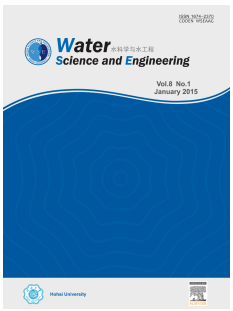
Accepted Manuscript



Effect of water-sediment regulation and its impact on coastline and suspended sediment concentration in Yellow River Estuary

Hai-bo Yang, En-chong Li, Yong Zhao, Qiu-hua Liang

PII: S1674-2370(17)30108-4

DOI: 10.1016/j.wse.2017.12.009

Reference: WSE 122

To appear in: *Water Science and Engineering*

Received Date: 25 April 2017

Accepted Date: 28 September 2017

Please cite this article as: Yang, H.-b., Li, E.-c., Zhao, Y., Liang, Q.-h., Effect of water-sediment regulation and its impact on coastline and suspended sediment concentration in Yellow River Estuary, *Water Science and Engineering* (2018), doi: 10.1016/j.wse.2017.12.009.

Effect of water-sediment regulation and its impact on coastline and suspended sediment concentration in Yellow River Estuary

Hai-bo Yang [a, c], En-chong Li [a], Yong Zhao [b, *], Qiu-hua Liang [d]

[a] *School of Water Conservancy and Environmental Engineering, Zhengzhou University, Zhengzhou 450001, China*
[b] *State Key Laboratory of Simulation and Regulation of Water Cycle in River Basin, China Institute of Water Resources and Hydropower Research, Beijing 100038, China*
[c] *State Key Laboratory of Hydraulic Engineering Simulation and Safety, Tianjin University, Tianjin 1011598, China*
[d] *School of Civil Engineering and Geosciences, Newcastle University, NE1 7RU, UK*
Received 25 April 2017; accepted 28 September 2017

Abstract

Implementation of the water-sediment regulation (WSR) scheme, mainly focused on solving the sedimentation problems of reservoirs and the lower reaches of the Yellow River, has inevitably influenced the sediment distribution and coastal morphology of the Yellow River Estuary. Using coastline delineation and suspended sediment concentration (SSC) retrieval methods, this study investigated water and sediment changes, identified detailed inter-annual and intra-annual variations of the coastline and SSC in the normal period (NP: 1986 to 2001, before and after the flood season) and WSR period (WSRP: 2002 to 2013, before and after WSR). The results indicate that (1) the sedimentation in the low reaches of the Yellow River turned into erosion from 2002 onward; (2) the inter-annual coastline changes could be divided into an accretion stage (1986 to 1996), a slow erosion stage (1996 to 2002), and a slow accretion stage (2002 to 2013); (3) an intra-annual coastline extension occurred in the river mouth in most years of the WSRP; and (4) the mean intra-annual accretion area was 0.789 km^2 in the NP and 4.73 km^2 in the WSRP, and the mean SSC increased from 238 mg/L to 293 mg/L in the NP and from 192 mg/L to 264 mg/L in the WSRP.
Keywords: Coastline; Suspended sediment concentration; Water-sediment regulation; Remote sensing; Yellow River Estuary

1. Introduction

The Yellow River, well known for having the second largest sediment load river in the world (Milliman and Meade, 1983), passes through various regions where climatology, geology, and geomorphology vary spatially. The characteristics of a high concentration of sediment and different sources of water and sediment have caused many difficulties in Yellow River basin management in terms of water science and engineering (Yu, 2002), including for water resources allocation under the ever-increasing pressure of water demand for irrigation, industrial and urban uses, and delta wetland environments (Jia et al., 2006; Yang et al., 2009; Yang et al., 2013); maintenance of the operating life of reservoirs with decreasing capacity due to sedimentation (Chamoun et al., 2016; Guo et al., 2015; Ran et al., 2013); and the alleviation of flood risk due to the high riverbed level of suspended rivers (Bai et al., 2016). Under the influence of human activities and natural factors, the Yellow River has been in an unstable water-sediment condition since the 1970s (Xu, 2003). With a goal of maintaining Yellow River health and establishing a harmonious water-sediment relationship, some techniques, including joint reservoir operation and sediment evacuation and agitation, are used in the water-sediment regulation (WSR) scheme, in order to create a man-made flood peak and allow turbidity venting to scour river channels downstream and wash away the reservoir sedimentation (Li and Sheng, 2011). Since 2002, the implementation of WSR has efficiently reduced deposition, diminished the riverbed downstream, increased the flow capacity and sediment transport, and improved the wetland environment of the Yellow River Estuary (Xu and Si, 2009; Li and Sheng, 2011).

Although the effect of WSR, mainly focused on solving the sedimentation problems of reservoirs and the lower reaches of the Yellow River, has been validated partially (Miao et al., 2016; Kong et al., 2015a), a large quantity of water and sediment discharge into the sea over half a month has inevitably induced many attendant problems (Kong et al., 2015b; Xia et al., 2016; Wang et al., 2017). The integrated management of the basin, channel, and estuary has to be studied (GWP, 2000; Campbell, 2016). In the WSR period (WSRP), compared with the normal period (NP), the Yellow

This work was supported by the open fund of the State Key Laboratory of Hydraulic Engineering Simulation and Safety (Grant No. HESS-1705), the National Natural Science Foundation of China (Grant No. 41101561), the Scientific and Technological Project of Henan Province (Grant No. 162102410066), and the China Institute of Water Resources and Hydropower Research (Grant No. IWHR-SKL-201701).
*Corresponding author.
E-mail address: zhaoyong@iwhr.com (Yong Zhao).