



Changes of incoming runoff and sediment load in the Lower Yellow River and its influence on channel erosion and deposition

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Based on the field data of the Lower Yellow River from 1950 to 2017, this paper analyzes the changing course of incoming runoff and sediment load in the Lower Yellow River and its Influence on Channel erosion and deposition. The result shows that with the construction of large amount of hydro-projects, severe aggravation of human activities, sharp increases of water supply for industry and agriculture, and reduction of rainfall, etc., the conditions of incoming runoff and sediment load have been obviously changed, the average annual incoming runoff and sediment load at Huayuankou Station declined gradually in the past nearly seventy years, the average annual incoming runoff dropped from $47.2 \times 10^9 \text{m}^3$ in 1950s to $23.5 \times 10^9 \text{m}^3$ in 2000s, the average annual sediment load dropped from $1.507 \times 10^9 \text{t}$ in 1950s to $0.103 \times 10^9 \text{t}$ in 2000s. The sediment concentration of flow has been increased, the discharge hydrograph has been evened, the flood frequency and peak discharge have been dropped, the ratio of runoff in flood and non-flood seasons has been changed, in flood seasons it has been dropped from 59% in 1950-1985 to 42% in 1986-2010.

The Lower Yellow River is notorious for its enormous deposition. In 1950s, the annual deposition amounted to $0.4 \times 10^9 \text{t}$ and the channel was raised by 0.1m/yr, and now, the difference between the ground elevation inside and outside the embankments are 4-6 m with the maximum of 10 m; It is so-called the “suspended river”. After 1970s, the sub-embankments were constructed along the low floodplains and it restricted the scope of flow activity, after that, all the deposition occurred inside the sub-embankments and caused the bed elevation higher than those outside the sub-embankments. Due to the influence of the sub-embankments, a “second suspended river” was formed upon the suspended river. In 1985-1999, an unusual dry hydrological series happened in the Yellow River basin, the average annual runoff of this period was 67% of the long-term average in 1950-1999, and the medium and minor floods with high sediment concentrations came often, so much more incoming sediment silted in the main channel inside the sub-embankments. The deposition in the main channel accounted for 72% of the total. The Lower Yellow River became much more atrophied. Since the impoundment of the Xiaolangdi reservoir in October, 1999, some new phenomena have appeared in the Lower Yellow River. The Lower Yellow River unavoidably suffers from erosion in 2000-2017 and the whole erosion of the river amounted to $2.82 \times 10^9 \text{t}$.

Further research shows that, in addition to the influence of incoming runoff and sediment load, the discharge hydrograph also affects Channel erosion and deposition. One of the most important way to decrease channel sedimentation is adjusting the process of water into the Lower Yellow River by regulating Upstream Reservoir.

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