Research on the influence of flow-sediment variation on cross-section configuration change in Ningxia-Inner Mongolia reach of the Yellow River

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Report outline

1. Overview and Brief Introduction
2. Flow and sediment variation in reach
3. Variation of cross-sectional morphological characteristic parameters
4. Response of Cross Section Morphology to Variation of Water and Sediment Conditions
5. Main conclusions
Overview and Brief Introduction

• **Yellow river**
  • The second longest river in China, about 5464 km
  • Less water and more sediment, high sediment concentration
  • braided river, presented in the shape of "Ji"

• **Ningxia-Inner Mongolia reach**
  • The lower Reaches of Upper Yellow River, about 990 km
  • There are eight hydrological stations
  • Some river courses are wide and shallow, the flow is scattered and the section is unstable.
Flow and sediment variation in reach

- **Water and sediment inflow in different periods**
  - Water inflow decreases in flood season, especially peak flow decreases significantly
  - Medium-low flow duration is lengthening
  - The discharge in non-flood season is increasing, and the discharge tends to be uniform during the year.

Table 1  Statistics of incoming water and sediment in different periods of Xiaheyan station in Ningxia-Inner Mongolia reach

<table>
<thead>
<tr>
<th>time interval (1951-2004)</th>
<th>Water quantity/Billion m³</th>
<th>&gt;2000m³/s Average days</th>
<th>sediment amount /Billion t</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>non-flood period</td>
<td>flood period</td>
<td>Annual</td>
</tr>
<tr>
<td>1951-1968</td>
<td>128.94</td>
<td>209.93</td>
<td>338.87</td>
</tr>
<tr>
<td>1969-1986</td>
<td>149.67</td>
<td>169.13</td>
<td>318.80</td>
</tr>
<tr>
<td>1987-2004</td>
<td>138.30</td>
<td>100.39</td>
<td>238.69</td>
</tr>
<tr>
<td>1951-2004</td>
<td>138.97</td>
<td>159.82</td>
<td>298.79</td>
</tr>
</tbody>
</table>
Variation of cross-sectional morphological characteristic parameters

• **Annual Variation of Flat**
  - it shows an increasing trend. In 1986, it increased by about 750 M² compared with 1965, an increase of about 57.1%.
  - After 1986, the flat beach area of each typical section of Ningxia-Inner Mongolia reach decreased in varying degrees.
Variation of cross-sectional morphological characteristic parameters

• Annual Variation Process of Flat Width-depth Ratio
  • Before 1986, the ratio of width to depth of flat beach increased.
  • After 1986, the width-depth ratio of flat beach in cross-section shows an obvious increasing trend.
Response of Cross Section Morphology to Variation of Water and Sediment Conditions

- **Response of Flat Area to Annual Water Volume**
  - The flat beach area of each typical section increases with the increase of annual water volume, but the increase degree of each section is different.
  - If the annual water volume is smaller, the sediment transport capacity of the river will decrease more obviously, and the channel siltation will intensify, which will lead to the shrinkage of the main channel and the obvious reduction of the cross-section area.
Response of Cross Section Morphology to Variation of Water and Sediment Conditions

- **Response of width-depth ratio of flat beach to incoming sediment coefficient**
  - The width-depth ratio of flat beach in each typical section increases with the increase of sediment coefficient. The change of section shape is small.
  - The width-depth ratio of typical section in Inner Mongolia reach increases greatly with the increase of sediment coefficient. Section shape tends to be wide and shallow.
Response of Cross Section Morphology to Variation of Water and Sediment Conditions

• Response of the sediment delivery ratio to the average incoming water and sediment

• The sediment delivery ratio of each reach of Ningxia-Mongolia River decreases with the increase of the sediment discharge coefficient of the inlet stations in flood season.
Main conclusions

• The section shape of the section is relatively small, and the river section tends to be stable.

• The section shape of the Inner Mongolia reach becomes more and more shallow with the increase of the annual incoming sand coefficient, and the trend of the cross section is wide and shallow.

• Based on the analysis of the response relationship between sediment discharge ratio and incoming water and sediment, the critical water and sediment boundary conditions are obtained when the river section of Ningxia-Inner Mongolia reach tends to be stable, i.e. when the channel does not scour or silt.
Thank you