Impact of climate change and human activities on stream flow and sediment discharge in the Wei River Basin, China

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1. Background

The middle reaches of the Yellow River flows through the Loess Plateau, is one of the most severely eroded areas in the world due to improper land use and excessive exploitation. Rivers in this region transport a large amount of sediment to the Yellow River.

Wei River, as the largest tributary of the Yellow River, transports 5 billion m$^3$ water and 400 million ton sediment to the Yellow River from 1932 to 1980. But after 1980’s, the sediment discharge has reduced to 200 million t/a. Meanwhile, the stream flow is also reduced to 3 billion m$^3$/a.

We want to know why it was happened—trend or accidental?
We want to know what is the driving factors—climate, human activities, or both?
2. Objective

(a) identified trends and change-points for stream flow and sediment discharge in the Wei River;
(b) analyzed the impacts of precipitation and/or human activities on the changes;
3. Study Area

Drainage area: 26905km²

Drainage area: 45421km²

Drainage area: 62474km²
4. Results

There was no significant trend for precipitation from 1951 to 2009. The stream flow and sediment discharge showed significant decreasing trend (P=0.01) from 1932 to 2009.

For stream flow, 1968 (P=0.01) was the change point year for the Huaxian station.

For sediment discharge, the change point year detected for the Huaxian station was 1981 (P=0.01)
Impacts of precipitation and human intervention on stream flow and sediment discharge

For stream flow reduction, the impact of human activities is 1.5 billion m³/a, the contribution rate is 77%.

For sediment discharge reduction, the impact of human activities is 156 million t/a, the contribution rate is 96%.

Human activities played a major role in both stream flow and sediment discharge reduction in the Wei River basin.
Human activities

- Water extraction and diversion
- Construction of water control projects
- Soil and water conservation programs
Water extraction and diversion

With the rapid economic development, water extraction and diversion has increased dramatically for agricultural irrigation and urban and industrial use. The average annual water extraction and diversion was 0.5 billion m³ in 1950s, and it has grown to 2 billion m³ in 1990s.
Construction of water control projects

The major impact is siltation. From 1960 to 2000, about 1.3 billion ton sediment has been deposited in the lower reaches of Wei River.
Soil and water conservation programs

By 2000, about 34% of the erosion sensitive land was under protection, through implementation of various soil and water conservation measures.

Including 16 370 km$^2$ of terraces, 1 586 km$^2$ of farmland formed by sediment-trapping dams, 14 770 km$^2$ of soil and water conservation forest and 3 734 km$^2$ of grass planting.

All of these conservation measures have been effective for reducing soil erosion, they have also resulted in noticeable changes in stream flow.
5. Conclusion

- Stream flow and sediment discharge show a significant decreasing trend in Wei River.
- Human activities, such as economic development, soil and water conservation, and water projects, appear to be the major factor for it in recent decades.
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