

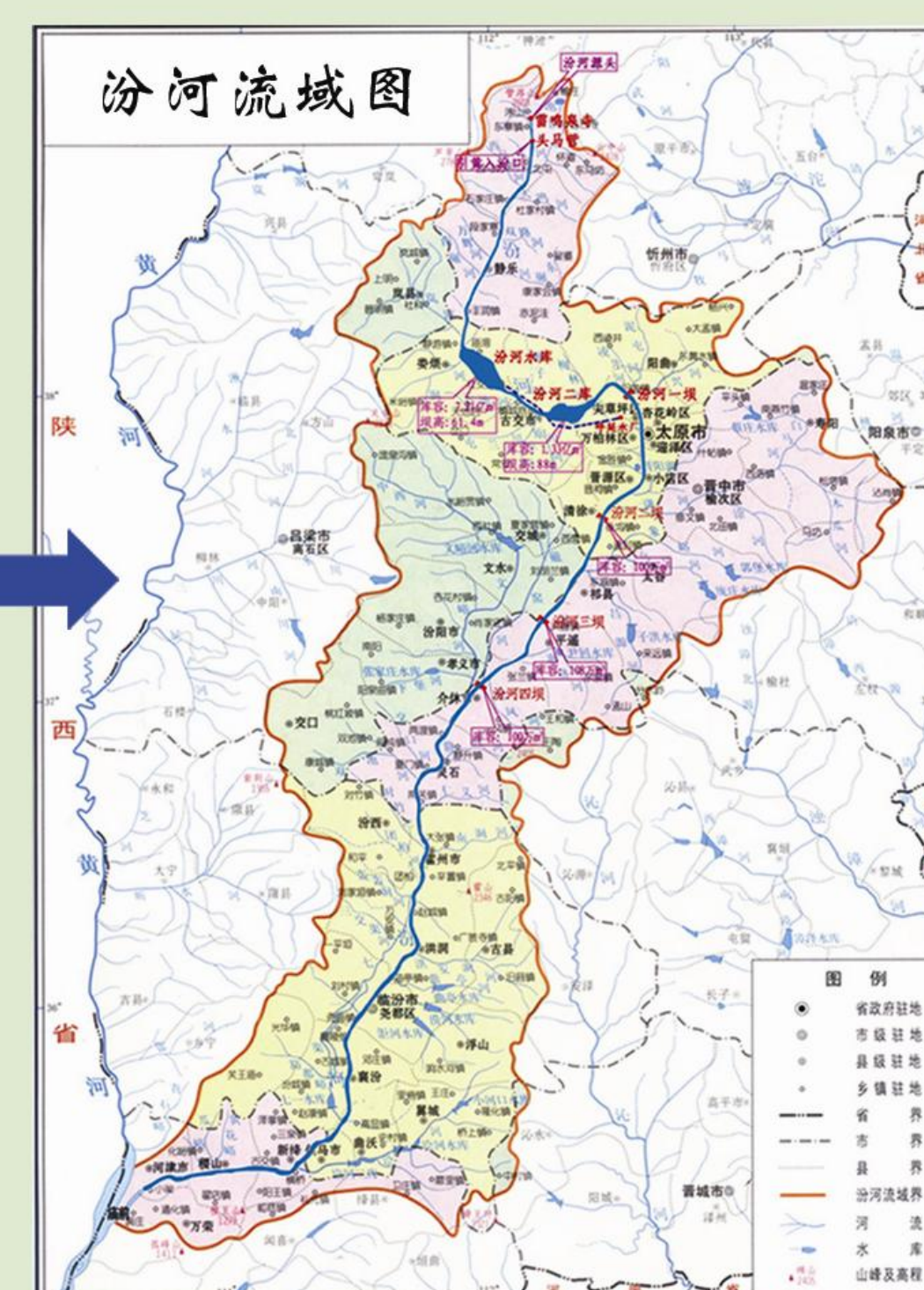
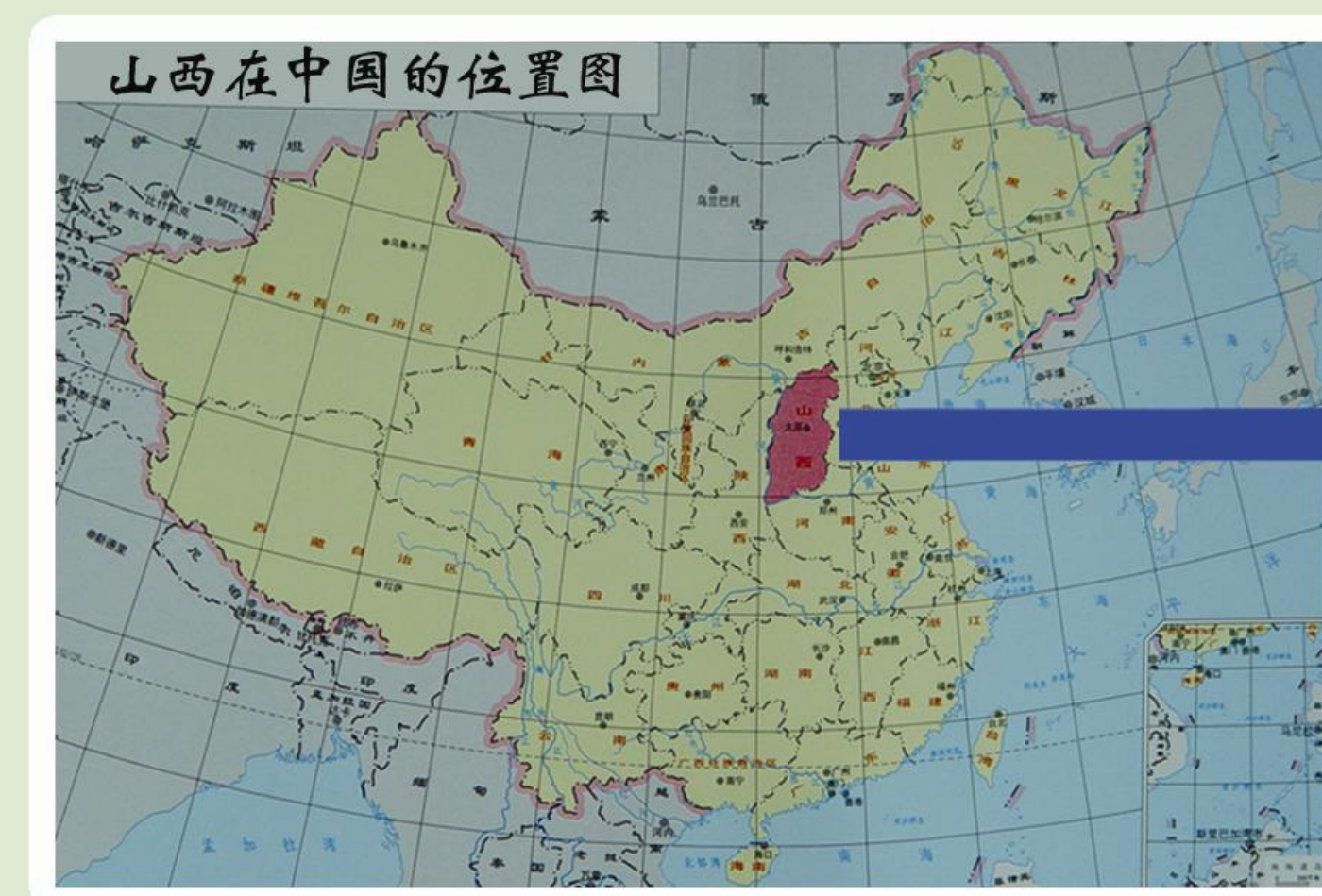
The Fen River Watershed Hydro-Ecosystem Restoration, Shanxi Province, China

Hongji Jia¹, Xinxi Guo¹ and Youcai Jia²

¹Shanxi Provincial Department of Water Resources, China . ²Shanxi Institute of Water Resources and Hydropower Research, China

Abstract

Shanxi Province is located in the western quadrant of North China, the middle reaches the Yellow River and the eastern edge of the Loess Plateau. The total land area is 156,000 km², forming a long, narrow parallelogram from north to south, with encompassing mountains and rivers. The interior landscape of Shanxi can be divided into three major regions — the eastern mountains, the western plateau and the middle basin. Mountains and hills account for over 80 percent of the total area; plains are mainly distributed in the middle basin. Shanxi has a population of 35.7 million. The Fen River is the largest river and runs through the middle basin of the Shanxi. Taiyuan is the capital city and is located at the middle reach of Fen River. Since the 1980s, the Fen River watershed region has experienced a rapid economic growth, coupled with the tremendous water use demands. As a result, a series of water-ecological problems have emerged, such as: groundwater levels dropping drastically, river base flow reducing, even drying out during the dry season, the river being polluted, and aquatic lives reducing dramatically. Entering the new century, the Government of Shanxi Province has realized the importance of environmental protection in order to maintain the sustainable economic developments. A new economic development strategy, namely to maintain the rapid and quality economic growth with the emphasis on water and human harmony, has been promoted province-wide. Given the importance of the Fen River to Shanxi province, the Shanxi Government has been targeting Fen River as a pilot watershed to conduct hydrologic & ecosystem restoration and comprehensive watershed planning. The major components of the Fen River Watershed Restoration project includes, but not limited to: increasing the upstream water conservation by planting vegetation, increasing groundwater recharge, construction of artificial wetlands along existing flooding plains, increasing urban green space and open water surface, inter-basin water transferring, and maintaining the minimum flow for the Fen River base flow. With all of these efforts, the Fen River hydro-ecological environment has improved noticeably. The lessons learned from the Fen River restoration effort will provide us first-hand knowledge and scientific foundation for the other river restorations in the Shanxi Province



Project Location

The Fen River is the largest river in Shanxi and the second largest tributary of the Yellow River. Originating in the Guancen mountains in northern Shanxi at the elevation of 1670 meters, it flows southeast into the basin of Taiyuan, and then south through the central valley of Shanxi before turning west to join the Yellow River at the elevation of 368 meters above sea level. The river is 694 km long and drains an area of 39,417km², 25.3% of the area of Shanxi Province.



The snapshot of the middle reaches of the Fen River – before restoration
River bed is dry out 270 –300 days before 2008

Major Challenges in The Fen River Watershed

- The accelerating depletion of water resources
- Serious ecological degradation
- Unfair distribution of water resources
- Weak water conservancy infrastructure
- Slow water law legislation

The Fen River Watershed Restoration & Protection Plan

- Divert 60 to 70 million cubic meter from the Yellow River to the Fen River Watershed
- Apply Water & Soil Conservation with the focus on increase vegetation coverage & groundwater recharge in the upper reaches of the Fen River
- Conduct hydro-ecologic river system restoration projects in the middle & lower reaches of the Fen River
- Apply strict water conservation, wastewater treatment & discharge, water reuse and groundwater withdraw policy

Major Restoration Projects

I . The Middle & Lower Reaches River Dredging & Flooding Protection Projects(\$158 million)



Dredging the river bed with the Multifunctional and Environmental Friendly Dredger



River bank stabilization

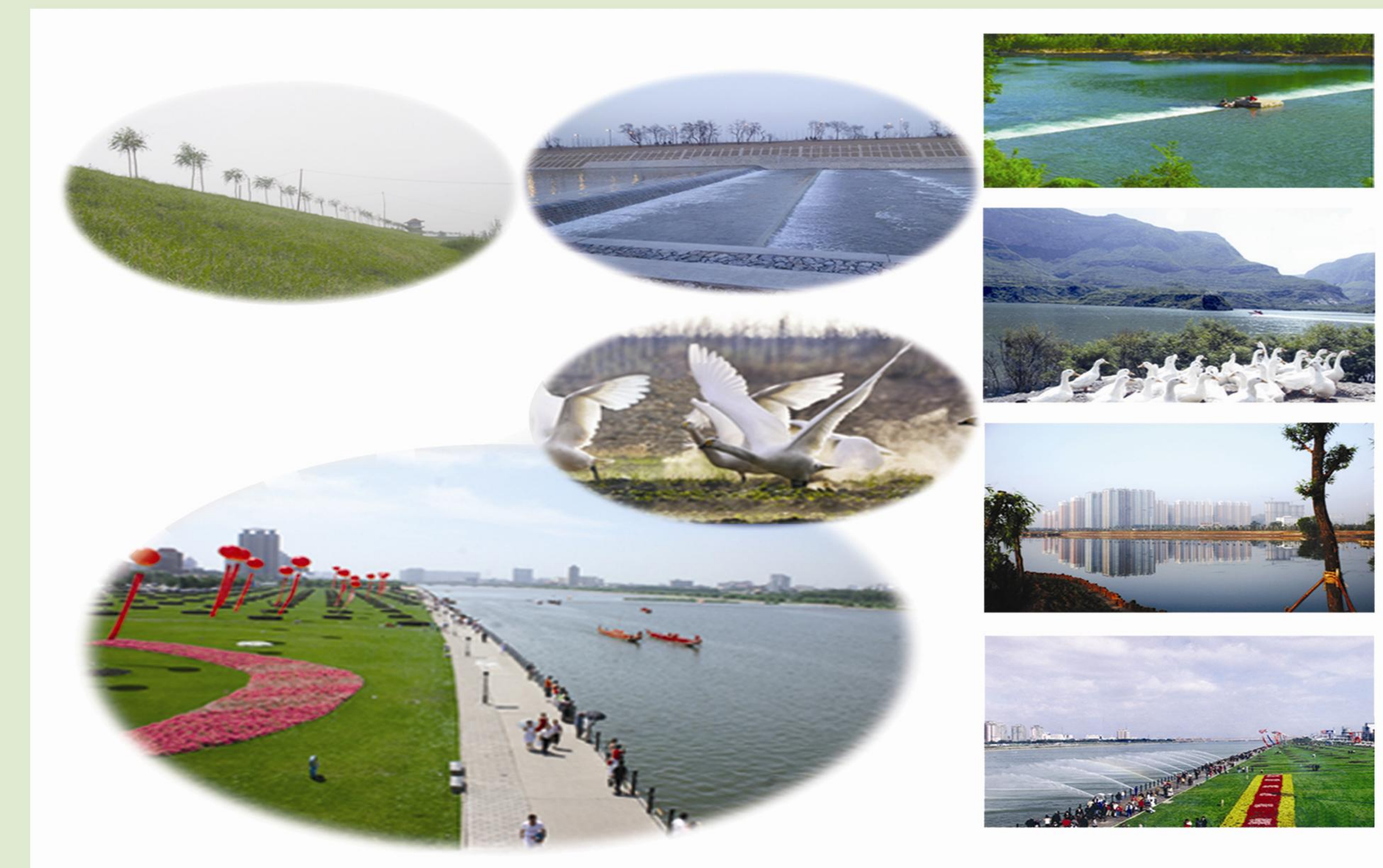
II. Treatment Wetlands Construction (\$40 million)

Seventeen treatment wetlands constructed along the Fen River with the total area of 6.3 million m², which can treat around 120,000 cubic meters water per day. Permeable Reactive Barrier Technology (PRB) are used in the wetland construction to improve the water quality treatment

III .Taiyuan Urban Waterway System (16 million US Dollars)



Built pump station to connect the Fen River with the lakes in recreational parks to increase the water quality of the Lake



Summary

- Before 2008, the Fen River has 280 to 320 days without flow in the river, the Fen River becomes a year-around river again.
- The upper reach of Fen River average monthly flow rate is 16 m³/s and its minimum flow rate is 6 m³/s
- The middle and lower reaches have average monthly minimum flowrate 5 m³/s. The river water surface width increased to 50–60 meters from 20–30 meters. The water quality and the river healthy is steadily improving. The aquatic species increase are increase in the river.
- Regional groundwater level is steadily recovering.
- The lessons learned from the Fen River restoration will be used in the other river restoration projects in Shanxi.

¹Hongji Jia, Deputy Director, Department of Water Resources of Shanxi Province; Xinxi Guo, Deputy Division Director, Department of Water Resources of Shanxi Province; and Youcai Jia² Director, Shanxi Institute of Water Resources and Hydropower Research, China