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Using incentives to coordinate responses to a system of payments for watershed services: The middle route of South–North Water Transfer Project, China

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ABSTRACT

In any scheme of payments for watershed services, the incentive size can directly affect the watershed services which are provided by water-source areas. It is necessary to understand the payments for watershed services in the Middle Route of China's South–North Water Transfer (SNWT) from the perspective of the relations among the central and local governments. The distributions of interests among governments need to be coordinated under the Chinese authoritarian system, which is characterised by a combination of political centralisation and economic decentralisation. This paper analyses the interactions between the central and local governments in water-source areas to determine the watershed service efforts of local governments, using Stackelberg game models. In particular, the potential effects of incentives on payments for watershed services on the middle route are analysed. Numerical simulation is adopted to examine watershed service strategies, both with and without central government coordination of incentives. The results demonstrate the following: First, by designing and coordinating extra incentives, the central government could achieve its maximum interests without causing losses to the local governments. Second, extra incentives could increase the watershed service efforts of some local governments, thereby efficiently improving the water source quality of the Middle Route. Third, local governments with better watershed service capabilities are likely to improve their watershed services under coordination, thereby obtaining extra incentives.

1. Introduction

China's South-North Water Transfer (SNWT) has become the most massive inter-basin water transfer megaproject in the world, costing approximately $20 billion and resettling more than 300,000 people (Ministry of Water Resources, 2002). The SNWT can provide 27.8 billion m^3 fresh water from the Yangtze River Basin in the south to the drier plains in the north by the Eastern and Middle Routes, through 2900 km of canals (Ministry of Water Resources, 2002). The SNWT connects China's four major basins, six provinces and hundreds of millions of water users and polluters (Barnett et al., 2015), affecting almost one-third of China's landmass (Zhang et al., 2009). The Eastern Route (SNWT-ER) was completed in 2013, and the first phase of Middle Route (SNWT-MR) formally started Phase I operation in 2014, six years behind schedule.

Given its task of bringing clean water onto the North China Plain, the Middle Route has created a conflict over water quality and quantity between water-source areas and water-receiving areas (Yang and Zehnder, 2005). As the water-source areas of Middle Route, Danjiangkou Reservoir and its upstream regions include 43 counties in Henan, Hubei and Shaanxi provinces with a watershed area of 95,200 km^2 (Fig. 1), which can provide watershed services of pollution prevention and soil and water conservation (State Council, 2012). The central government has taken a number of measures to ensure the water quality of Danjiangkou Reservoir. One of the most controversial measures for water quality protection is the decision to ban cage aquaculture and turmeric processing in the reservoir area. Sacrifice is certainly evident: turmeric planting and processing (the core industry in Yunxi County, Hubei Province) had to be abandoned to protect water quality, affecting the livelihood of farmers and workers. At the same time, more than 200,000 aquaculture cages had been removed from the reservoir area by the end of 2015 (Pohlner, 2015).

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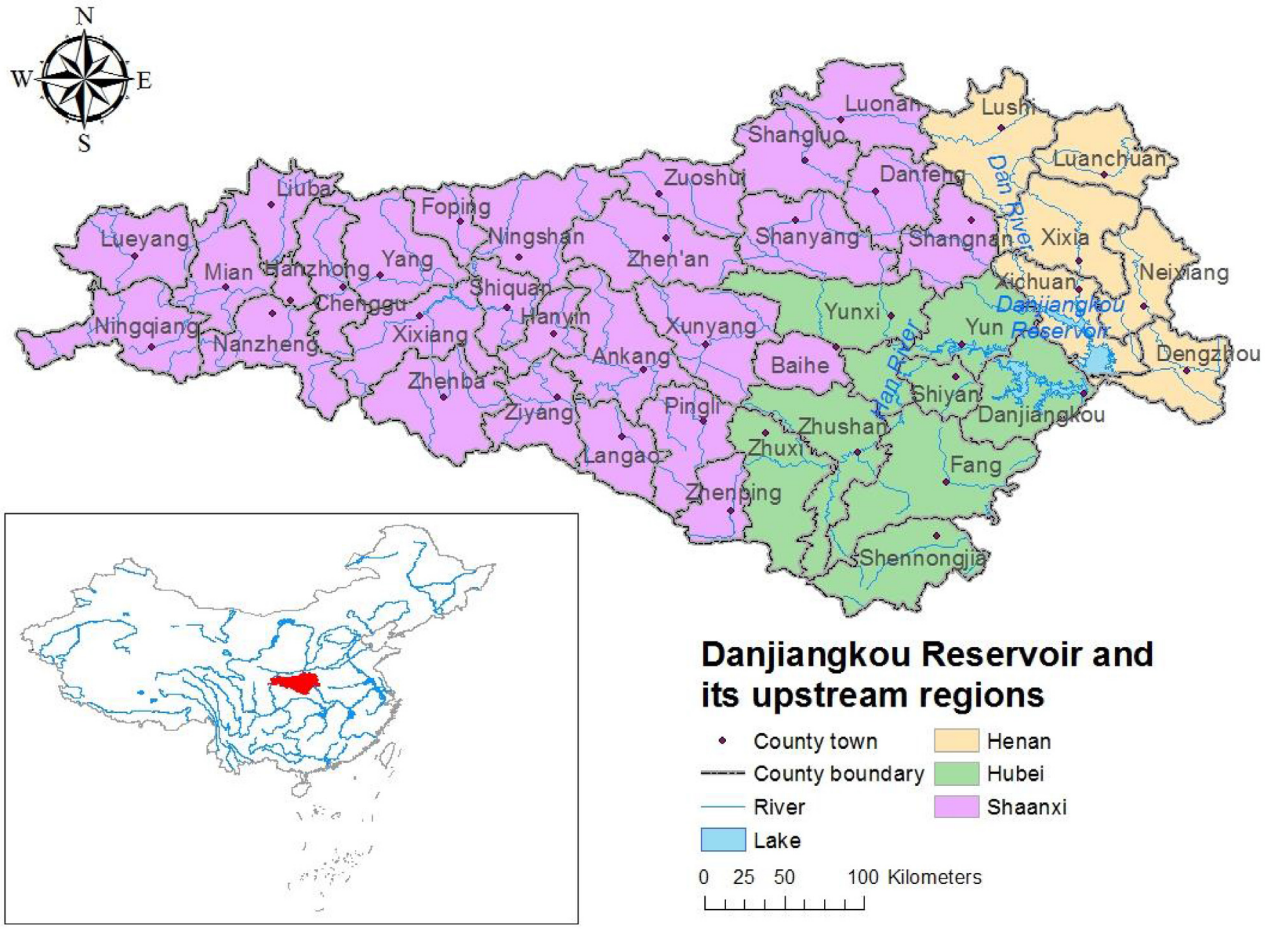

Fig. 1. Danjiangkou Reservoir and its upstream regions. Source: Author's work.

Considering the sacrifice in water-source areas, the central government proposed financial incentives for the water-source areas of the Middle Route through a system of payments for watershed services (PWS), to improve the water quality and mitigate the conflict between water-source areas and water-receiving areas (State Council, 2013). As an essential measure of global environmental management, PWS based on payments for ecosystem services (PES) can provide financial incentives to reduce water pollution in upstream regions (Bennett et al., 2014). PWS allows government agencies to purchase watershed services from landowners in upstream areas to reduce water pollution in downstream areas (Webb and Martin, 2016). China is the world's largest investor in PWS schemes: it invested $11.5 billion in PWS projects in 2013, accounting for 94 percent of global PWS investments (Bennett and Carroll, 2014). China is concerned with ecological services and pollution control related to watersheds, encouraging cooperation between upstream and downstream governments (Zhang and Bennett, 2011).

In Asia, since a poverty alleviation goal is typically included, governments rather than private sectors are generally involved in PWS (Huang et al., 2009). This is true of the Middle Route, with the added complication that the compensation for watershed services (such as water pollution control and soil and water conservation) in the Danjiangkou Reservoir and its upstream regions are incorporated into the overall investment budget of the SNWT project (State Council, 2006), which is mainly from the National Fund for Major Water Conservancy Construction (the National Fund). The National Fund is a government fund established to support the SNWT construction, to solve the follow-up issues of the Three Gorges Project, and to strengthen the construction of major water conservancy projects in Central and Western China. The fund is collected by the Ministry of Finance from the beneficiary provinces of the Three Gorges Project and the SNWT, and turned over to the central treasury (Ministry of Finance et al., 2009). Thus, the central government will pay the local governments in water-source areas for their watershed services from the National Fund through a fiscal transfer mechanism (Ministry of Finance et al., 2009). In a word, the current payments in Middle Route rely on central government decisions, rather than inter-provincial negotiations (Pohlner, 2016).

The Chinese system is characterised by authoritarian politics that combine political centralisation and economic decentralisation (Xu, 2011). Economic decentralisation is regarded as a significant growth driver in China (Blanchard and Shleifer, 2001). Local governments launched fierce regional economic competition to obtain more fiscal revenue from the central government, thus promoting the rapid growth of their regional economies (Qian and Weingast, 1996). Meanwhile, the economic performance of local officials is also positively related to their political promotion probability (Enikolopov and Zhuravskaya, 2007). Local officials strive to develop their regional economies for political purposes, thereby intensifying competition among regions. The current PWS for the Middle Route only considers the game relations between central and local governments, but ignores competition among local governments. If the central government could improve the design of incentives to encourage local governments to provide more watershed service efforts, then water quality may be enhanced through the competition among local governments (Bao and Fang, 2011). However, current water management is characterised by a hierarchical

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