

THE ECONOMICS OF SUSTAINABLE URBAN WATER MANAGEMENT: THE CASE OF BEIJING

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Abstract

A rapidly growing urban population leads to the dramatic increase of water consumption in the world. The water resources available to the human being are limited. Meanwhile climate variability and environmental pollution decrease the quantity of water resources available for human use. It is a significant challenge to provide sufficient water to urban residents in a sustainable and effective way. Facing urban water crisis, researchers point out a paradigm shift in urban water management for sustainable water supply and services. This requires multi-disciplinary approaches, including technical improvements and economic evaluations. Advanced technology can contribute to the solution of problems physically, but it may not ensure sustainable operation of water systems. The obstacles to sustainable water supply and services often are from non-technical problems such as low cost recovery, lack of sound pricing systems and sustainable financing for increasing service coverage. The financial and economic factors could be a large barrier to the operation of water systems.

This research aims to use economics to assess water systems for sustainable urban water management. How to use economics on urban water systems and what contributions can economics bring to sustainable water management are the two main research questions in the thesis.

Since the existing systems are insufficient to achieve the objective of sustainable urban water management, many new systems are being proposed and implemented recently. There are two kinds of water systems: traditional or existing systems, and new or alternative systems. The alternative systems may be technologically feasible to increase water supply or save water consumption, but they may not be financially and economically feasible. Lack of financial and economic viability makes alternative systems less attractive than traditional systems. It is important to know whether the new systems can operate long term and whether the new systems are suitable alternatives

to existing systems if one wants to promote sustainable urban water management.

The thesis carries out economic and financial analysis of traditional and alternative urban water systems. A comparative analysis between the traditional and alternative water systems is presented. Through the comparative analysis, the thesis shows whether the alternative system is an economically viable alternative to the traditional system. The case of Beijing is chosen for the study. The main technological measures of water saving in Beijing include wastewater reuse and rainwater harvesting. There are centralized and decentralized wastewater reuse systems. Centralized wastewater reuse systems represent the traditional systems while decentralized systems represent the alternative systems. Groundwater is the main and traditional water resource for agricultural irrigation, and rainwater harvesting is an alternative method to get more water.

The main economic method in the thesis is cost benefit analysis, which is an accepted method to evaluate the environmental projects. Additionally, the thesis employs the methods of linear programming and rough set analysis. In the cost benefit analysis, the concern of different stakeholders having different viewpoints is taken into consideration. Accordingly, an integrated financial and economic analysis is carried out, in which financial analysis is implemented from the point of view of individual participants, while the economic analysis is from the point of view of society. The financial analysis aims to judge whether the individual investor could afford the water system, and the economic analysis is to determine the contribution of the water system to the development of society.

The research shows that the alternative water systems are economically feasible while they are not financially feasible. However, the traditional water systems are both economically and financially feasible. Comparing the economic and financial feasibility between the traditional and alternative water systems, the traditional water systems are better than the alternative systems. It implies that the new water systems are not viable alternatives to the traditional water systems because the new systems are not financially feasible.

Through the case of Beijing, the thesis demonstrates how to use economics in managing urban water systems. This is the first integrated and quantitative analysis of the economic, environmental and social effects of new water systems. The economic, environmental and social effects are all determined by monetary values, which is rare in the existing literature.

The thesis shows that economics contributes to identifying the non-technical problems in water systems and can help decision makers to make choices that are consistent with the long-term well being of the community. Three practical contributions of the research are as follows. 1. Using economics to identify and quantify the effects of water treatment systems on economics, environment and society; 2. Using economics to discern the factors that significantly hinder long term plant operations; 3. Using economic tools to learn the advantages and disadvantages of different water systems from an economic perspective. The theoretical contribution of the research is that it proves the importance of considering the viewpoints of different stakeholders in the cost benefit analysis. Doing cost benefit analysis from different stakeholder perspectives can provide complete and accurate information for helping decision makers to choose the most suitable alternative.