ABSTRACT

Beijing Municipality, the capital of China, has been suffering from severe water shortage, which is defined as 'absolute scarcity', the most severe level, by the well-accepted benchmark of UNDP. The ascending frequency of water scarcity has provided Beijing Municipality the impetus for wastewater reclamation and reuse. Up to year 2013, 60.9% of total treated wastewater has been reused, taking up 22% of total water supply in Beijing. Most of the recycled wastewater in Beijing is treated by centralized wastewater reclamation plants, while a small portion comes from decentralized on-site treatment facilities. Users of recycled wastewater in Beijing include industry, agriculture irrigation, environmental replenishment, green space irrigation, road sweeping, car washing and toilet flushing. Most of the wastewater reuse activities in Beijing are considered as non-profitable services and carried out by state-owned companies under the strict instruction of government plan.

Quite a few studies have focused on the issue of wastewater reclamation and reuse, including end-of-pipe technology; risk and impact assessment; management and process control; and other studies. Nevertheless, studies on the distribution structure of recycled wastewater at city level, the basic unit of recycled wastewater generation, are rare. The view at city level is significant because city, instead of other administrative entity, provides the practical view on the future development of wastewater reclamation and reuse. The most relevant study was found inaccurate in its framework setting and

results due to the rapid socio-economic development, thereupon an improvement is needed.

By defining three scenarios based on different socio-economic conditions, this study examined three structures of recycled wastewater distribution in Beijing and their economic performance. Linear programming is applied as core methodology in this study, which contains physical constraints and economic constraints. Recycled wastewater demand from each user is estimated, as well as the wastewater reclamation capacity and cost. Results show that agriculture irrigation possesses the highest demand for recycled wastewater, whereas its reclamation cost, as well as the cost for environmental replenishment, are the lowest. The total profit of each scenario and the government plan are compared, which shows its sensitiveness to the distribution structure. Two conclusions are revealed by the results. 1) Agriculture irrigation has a dominant position in the structure of recycled wastewater distribution in Beijing and mitigation of its demand is a practical approach in developing an economically viable distribution system. 2) A slight deviation of demand estimation will lead to considerable disparity in the estimation of total profit. Therefore, a careful estimation of demand is extremely important. Accordingly, suggestions for the development of recycled wastewater distribution are proposed.

Key words: recycled wastewater distribution, demand estimation, capacity estimation, cost estimation, scenario analysis