

Restructuring water industry in China: towards sustainable urbanization

Zou Ji, Zhou Jing-bo

Institute of Environmental Economics, Renmin University of China, Beijing 100872, China. E-mail: zoujit@public.bta.net.cn

Abstract In its urbanization course, China is faced with a scarcity of water resources in terms of both water quantity and quality. The development of water industry is a fundamental way to alleviate water shortage. Influenced by the traditional planned economy, China's urban water industry has been mainly owned and run by local municipal governments. Their tight fiscal budgets have led to very inadequate investments in water industry and thus, caused a slow development of water industry. In this case, restructuring urban water industry is very important. Based on the discussion concerning the trend of demand for and supply of urban water resources, this paper explores such strategic issues as water industry organization and integrated approaches addressing water scarcity. These are followed by a discussion of introducing market mechanism for restructuring water industry.

Keywords: water resource, restructuring water industry, investment, water price, government's role.

1 Introduction

Industrialization and urbanization are two main aspects of economic development. China has been undergoing these courses. In the process of Chinese urbanization, the proportion of urban population in total population increases from 25.81% in 1988 to 29.92% in 1997 (SSB, 1990; 1998). Meanwhile, a lot of water-intensive industries developed rapidly in and around urban areas. Under the pressure of urbanization and industrialization, more and more cities are faced with the challenge of water shortage and pollution. Of the 668 cities, more than 300 cities are proved to face water shortage¹, including 100 cities with serious problems of water shortage (NEPA, 1996). Most of river sections nearby cities have been seriously polluted. Therefore, the water scarcity is reflected in terms of both quantity and quality. The existing urban infrastructures, e.g., water supply system, wastewater treatment plants and pipelines, are inadequate to meet the needs of urban development. There is a large capital gap for investment in urban water infrastructure construction. For addressing the gap between demands for and supplies of urban water resources, what strategic issues should be considered in the Chinese context? Does the existing mechanism for the development of water industry work well? Should institutional and policy reform be undertaken? If they are needed, what direction should these reforms go towards? What are the main components of the institutional and policy reforms associated with urban water resource management? This paper is intended to explore main aspects of these problems. Section 2 discusses the trend of demands for urban water resources and describes the gap between the demands for and supplies of urban water resources. Section 3 expounds such strategic issues as concepts on water resources and water industry compatible with sustainability and integrated approaches for alleviating water stress. In Section 4, the above is followed by discussions of introducing market mechanism for restructuring urban water industry in China. Ownership of water companies, investment, water price, and government's roles are elaborated in this section. Conclusions are made in Section 5.

2 Demands for and supplies of water resources in urban areas

Accompanied by the increase of urban population and income, both demands for and supplies

¹In this paper, the authors also use the word "water stress" to present the implications of both water quantity shortage and water quality degradation simultaneously.

of water resources in urban areas rise dramatically. The statistical data show that the amount of annual urban tap water supply increased from 8.83 billion tons in 1980 to 46.61 billion tons in 1996 and 49.66 billion tons in 1995. The annual per capita residential use of tap water rose from 46.8 tons in 1980 to 75.9 tons in 1996. The statistical data also present that 94.9% of urban population are served with tap water in 1996 (SSB, 1990—1997). Regarding the natural water bodies, water shortage happens in the form of underground water decrease in many northern cities and more flow-breaks of rivers in northern regions; for southern regions, the quality degradation of natural water bodies is the main problem (Zou, 1997).

Based on the available cross-sectional data by provinces for the year 1996, the water demand function is regressed as shown in Equation (1).

$$w = 250.55 + 0.02xy - 133.12xP - 70.54xD. \quad (1)$$

(8.7832) (4.5285) (-4.5989) (-5.0473)

$N = 28$ Adjusted $R^2 = 0.6868$

The regressed equation in logarithm form is as follows:

$$\ln(w) = 0.63 \times \ln(y) - 0.51 \times \ln(P) - 0.30 \times D. \quad (2)$$

(95.9366) (-4.7686) (-4.1353)

$N = 28$ Adjusted $R^2 = 0.6147$

The symbols, definitions, and measurement units of variables in Equation (1) and (2) are summarized in Table 1. All the coefficients in both Equation (1) and (2) are statistically significant. All the two equations indicate the relationship between water use, income, water price, and geographic feature² in per capita terms. They show that urban residential use of water per capita has a positive correlation with per capita income and an inverse correlation with water price. The per capita use of water in northern cities, where more serious water shortage exists, is systematically lower than the one in southern cities. This is illustrated by the negative coefficient of the dummy variables. The two estimated equations are consistent with the Demand Theory in microeconomics. Equation (2) presents that the income elasticity of water demand is 0.63 and price elasticity of water demand is -0.51.

Table 1 The definitions and measurement units of variables in regression

Variable	Definitions	Measurement units
w	Daily urban residential use of tap water: per capita	L/(day·person)
y	Annual disposable income per capita for urban households	Yuan, 1996, current price, comparable among observations
P	Computed water price	RMB Yuan/ton
D	Dummy variable for geographic difference by region	$D = 1$ for northern provinces; $D = 0$ for southern provinces.

The policy implication of the above econometric analysis is that (a) urban demands for tap water will continue to rise along with the increase of per capita income; and (b) the change of water price has significant effects on water demands, although Chinese economy has still been undergoing a market-oriented transition. Given the inevitable increase of absolute urban population in the coming decades, total demands for residential water use are expected to rise dramatically. In addition, the course of industrialization may also cause a high increase of industrial water use, if new water-saving technologies and processes cannot be widely adopted in a deep degree (i. e.,

²Northern and southern cities are divided by Yangtze River in the Central China. In general, southern cities have much more water resources than in northern cities in quantity terms

under a business as usual scenario).

In short, the gap between the demands for and supplies of urban water resources risks being enlarged and finally makes the undergoing urbanization not sustainable.

3 Some strategic concerns for sustainable water policies

For addressing urban water shortage and degradation of water quality, both demand-side and supply-side measures should be considered, given the context within which: (a) market mechanism has had little effect on the water resource conservation and the mitigation of urban water shortage; (b) government has been the only investor in water infrastructure construction and the principal manager for water industry; (c) divided-management institution makes it difficult to conduct one integrated and self-consistent strategy for all the interactive components of water sector. In order to meet the challenge of water stress in many cities, institutional and policy reforms are needed. The design of these reforms refers to at least two strategic concerns: one is the concept on water resources and water industry, which is consistent with the idea of sustainability; another refers to the integrated approaches related to curbing water stress in urban areas.

3.1 Comprehensive water resources

According to the conventional understanding, water resources refer to directly supplied water only. Industrial wastewater and municipal sewage are generally not believed as water resources. Wastewater, however, should be regarded as a kind of water resources within the context of sustainable development. This is because that the effluents of wastewater may influence ambient water quality and thus determine the feature of water resources downstream. In addition, wastewater may be used in recycle with treatment. In some sense, the use of recycling water saves a lot of water resources over time and should be regarded as another important source of water resources. Therefore, there are at least three kinds of water resources: original water body, municipal water supply from water plants, and recycled treated wastewater. These three kinds of water resources are interactive. The quality of original water resources determines the treatment cost of water supply, i.e., tap water cost; the amount and pattern of tap water use influence on the treatment load of wastewater; and the effectiveness of wastewater treatment has effects on water body as receiver and thus, influences on water quality downstream. The interactions between different kinds of water resources call for the concept of comprehensive water resources. This concept of comprehensive water resources is consistent with the requirement of sustainable development.

3.2 Integrated water industry

On the basis of the concept of comprehensive water resources, the concept of integrated water industry may be developed. The integrated water industry covers most of the businesses related to water, including such components as water body conservation, tap water supply, and wastewater transport and treatment (Zou, 1997). The past decades showed that these interactive components of water industry have been divided into several fragments. Different government ministries or departments are responsible for managing different components of integrated water industry in China. Water conservancy authorities, environmental protection bureaus, and municipal infrastructure construction authorities are in charge of water body conservation, water pollution source management, and construction and operation of tap water plants and municipal sewage treatment plants respectively. This divided management structure causes such administrative problems as information exchange and cooperation among different government departments or bureaus, coordination for developing integrated plans and implementing different programmes, as well as possible policy conflicts among different independent authorities. Those may be likely to increase administrative costs and decrease efficiency. Under different supervision and direction of

different authorities, water industry is difficult to conduct an integrated strategy and plan. However, the development of integrated water industry should be greatly promoted in order to meet the challenge of water stress in many cities in China and make urbanization sustainable.

3.3 Integrated approaches addressing water stress

The problems of urban water resources are linked with many other aspects. Land use, e.g., suburban land use for agriculture, development of industrial zones, and resident district construction for housing, may determine location and amount distribution of water end-use. Amount of water demands in a city depends on both the size of this city and its industrial structure. Road construction and maintenance are always accompanied by construction of underground pipeline. Afforestation in and around cities may change stock of underground water, and so on. Therefore, integrated approaches should be taken to solve the urban water problem. The integrated approaches refer to developing and implementing a master plan covering all main aspects related to water resources, such as land use, control of population size for special cities, industrial structure adjustment, city infrastructure construction, and afforestation, and so on. Water supply and demand should be a prior consideration and integrated with all the main dimensions in the master plan. Correspondingly, an integrated water management structure is called for. In this way, the effectiveness of urban water resource policies may be improved.

4 Introducing market mechanism

Restructuring the existing water sector in China by introduction of market mechanism may be helpful to allocate more social resources into integrated water industry and accelerate the development of integrated water industry. Capital sources or ownership and water price are two important concerns related to restructuring.

4.1 Ownership and investment in water industry

Water industry has been dealt with as a public sector and run only by government in China. In the past, the capital source for investment in water infrastructure was mainly from fiscal expenditures of local governments. Since the late 1970s, local governments have channeled wider financial sources for water investment, including bilateral official development assistance (ODA) and favored loans from international multilateral financial institutions. Although wider financial sources and the recent rise of water price make water industry a little better off, the overall financial situation is not satisfactory. In this case, the capital investment and operational costs in water industry become a heavy fiscal burden of local governments that have weak fiscal ability to invest in water industry. On the other hand, the loss-making situation in water industry is certainly not attractive for domestic and foreign private investors to invest in water industry. The lack of investments in water industry makes water industry underdeveloped in a long term.

The key point here is to integrate capitals from different sources to meet the huge demands for investments in water industry. One of the restructuring options for capital integration is to establish stock companies in water industry. In addition, syndicated loans and securities are also important alternatives for fund raising for investments in water industry. These means that a mix-ownership will be developed in water industry. In those ways, more financial resources may be linked more closely with investments in water industry. The main capital sources for urban water industry may include: (a) government investment and subsidies based on fiscal expenditures; (b) long-term loans from development banks and syndicated loans; (c) corporation investments; (d) foreign capitals, including ODA and foreign direct investment (FDI) in such form as build-operate-transfer (BOT), and so on; (e) domestic and international indirect investment by issuing securities and selling shares. It is possible to attract private and foreign capitals to invest in water industry. Because water industry is faced with a relatively stable demand for water service in a long-term,

investments in water industry appear to be relatively safe though profits may not be very high. This kind of investment is attractive to safety-loving investors in some sense. In addition, there is a great potential to develop direct and indirect non-governmental investments in water industry. Chinese government has encouraged foreign investors to invest in infrastructure construction. Meanwhile, a lot of private capitals exist in international capital market and are searching for investment opportunities. If the investment conditions can be improved in the area of water industry, it is possible to attract some of foreign investments in water industry in China. Domestically, there is a huge potential of private direct and indirect investments in water industry in the context of high individual saving in China. Saving deposits of residents in state banks amounted to 4627.98 billion RMB Yuan (around US \$ 564 billion) in 1997, accounting for 60.8% of GDP in 1997 (SSB, 1998). Although most households in China might consider to use these saving deposits as a fund for housing, child education, parts of medical care and unemployment insurance, and retirement pension, it is still possible to allocate some of them into water industry through direct and indirect investment. The problem is that it is necessary to create some favored conditions for making profits in water industry in order to attract more investments into water industry. The adjustment of water price and favored conditions in loan and taxation are some of the measures to promote both public and private investments in water industry.

In the context of mixed ownership, the role of government investments in water industry should be redefined. The main function of public expenditure in water industry should be mainly concentrated on linking more capital resources with investments in water industry and creating attractive investment conditions, e.g., favored tax and subsidy conditions.

4.2 Water price

Water price has been under the control of government. Multi-track system applies to water price management in China. This means that different water prices apply to different water users. For example, households, agriculture, and power sector enjoy relatively low water price, while higher water price should be paid for commercial and industrial uses of water. Water price varies by areas and sectors.

In the past, lower water price was actually subsidized. Governments have offered subsidies for water use and made compensation for water industry's loss. The recent years have seen that this kind of subsidy has been diminishing and water prices rise gradually in many cities. For most cities, however, the existing water prices are not high enough to fully offset the costs of water conservation, tap water treatment, and wastewater treatment, given that the costs of wastewater treatment and water source conservation are reflected in the calculation of tap water price (Zou, 1997).

A case study in Jinan Municipality, capital of Shandong Province, shows that households in this city pay only 36 RMB Yuan per capita per year for tap water supply based on water price of 0.60 RMB Yuan per ton. This accounted for only 0.9 percent of salary income and 1.1 percent of living expenses in Jinan in 1994. An increase in the price of water of 30 percent was being considered in Jinan to cover the costs of sewerage and sewage treatment. This proposed 30 percent increase in the price of water will produce an additional 19 million RMB Yuan per year for Jinan Municipality. The additional water fees were being used partly to compensate the operating costs of the wastewater treatment plant. Based on this 30 percent increase in the price of water, households' average expense in water use may account for 1.2 percent of salary income and 1.43 percent of living expenses (Spofford, 1996).

From the data presented above, it appears that an increase in the existing water prices as 30% or a little more has limited effects on the structure household expense. The distribution effects of the increase in water price, however, should be considered carefully. The necessary needs for

water, which apply to both the poor and the rich, should be met. This suggests that subsidy water price may be adopted only for the necessary water use on the basis of a standard quota, whereas relatively high charges should be imposed on the excessive or luxurious use of water.

4.3 The role of government

In the context of market economy, the role of government in the development of water industry may be summarized as follows: (a) the policy goals of government should be to promote the development of water industry on the one hand, and to satisfy all the society members' necessary needs for safe water on the other hand. The benefits of both investors in water industry and consumers of water resources should be properly protected; (b) one of the important roles of the government in the development of water industry is to provide direct financial supports through government investments, subsidies, and differential tariff; (c) government should control water industry, which is one of the basic sector for the whole economy, through controlling holdings and pipelines; and (d) government plays a central role in developing and implementing laws, regulations, standards, and plans.

5 Conclusions

Water stress has existed in terms of both water quantity shortage and water quality degradation in the context of China's rapid urbanization. The existing distortion of water price may aggravate water resource scarcity. The low water price is not beneficial to slowing down the increase of water use and speeding up the rise of water supply. Therefore, water price distortion should be gradually diminished. Case studies indicate that the rise of water price from the existing level has relatively weak distributional effects on urban households' living expenditures. Meanwhile, it can either provide incentives for water consumers to save water or improve investment conditions for investors to make profits in water industry. Restructuring water industry in China is necessary for speeding up the development of water industry. The mixed ownership-oriented reform is important to widen capital sources for more investment in water industry. Private and foreign investments should be encouraged. Holding company and government concession for BOT may become the main forms to integrate different capitals. Local governments will still play a central role in the development of water industry and can keep water industry under their control by controlling holdings in holding companies in water industry or managing pipelines while non-governmental capitals flow into water industry.

Acknowledgment—Helps from Professor Zhang Xiangshu and Mr. Jiang Mingqing are gratefully acknowledged.

References

- NEPA, 1996. The 9th five-year plan and the 2010 long-term goals of national environmental protection, National Environmental Protection Agency (NEPA), State Planning Commission (SPC), and State Economic and Trade Commission (SETC), Beijing: China Environmental Science Press
- State Statistical Bureau (SSB), 1990—1997. China statistical yearbook. Beijing: China Statistical Publishing House
- State Statistical Bureau (SSB), 1998. A statistical survey of China 1998. Beijing: China Statistical Publishing House
- Spofford Jr. Walter O, Ma X, Zou J, Smith K, 1996. Assessment of the regulatory framework for water pollution control in the Xiaqing River basin: a case study of Jinan Municipality, final report to the World Bank. Washington, DC: Resources for the Future
- Zou Ji, 1997. Water resource policies for sustainable urbanization in China, a paper prepared for seminar on environmental and economic policies towards sustainable cities in APEC, organized by China APEC Environmental Protection Center, September 17—20, 1997, Beijing