

CORPORATISATION OF URBAN WATER SUPPLY AND WASTEWATER TREATMENT FACILITIES IN CHINA

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1. Introduction

1. Rapid economic growth and accelerated urbanisation of the population in China has placed intense pressure on the capacity of urban environmental infrastructure to cope with existing and projected demands. Investment in water supply and centralised wastewater treatment has increased over time but it still falls short of the required sum. The main reason is that such projects usually require large amounts of financing for their development as well as on-going expenses associated with operations and maintenance. Indeed, a number of wastewater treatment facilities that have been built have not been put into operation because of the inability to meet these latter expenses. Against this background, the development of a coherent and cost-effective environmental financing mechanism in China is urgent if urban water supply and wastewater treatment goals are to be met. In this context, the corporatisation of enterprises responsible for providing water and wastewater treatment services in urban areas is one approach that merits consideration. This paper discusses the associated challenges and opportunities of implementing such an approach in China.

2. Urban Water Supply and Wastewater Treatment in China: Existing Situation

2.1 Context

2. China has only 26% of the world's per capita water resources, distributed unevenly in spatial terms. This is reflected in the disparity of water resource distribution between the southern and northern parts of China, which are divided by the Yangtze River. The vast area south of the Yangtze River is rich in surface water resources and it accounts for 81% of the country's total water resources. There are relatively few large industrial activities located here and it has a smaller number of large and medium-sized cities than the northern part. In contrast, the area north of the Yangtze River has only 19% of the country's total water resources, there are fewer surface water resources and more of both industrial activities and large and medium-sized cities. Of the 668 cities in China more than 300 are short of water resources while 108 suffer serious shortages. Cities in the north and south are vastly different in terms of their water resource distribution and this gives rise to great variation in the exploitation of the resource: the former use ground water resources more while the latter rely principally on surface waters.

3. Ground water use by cities in the north of China has been particularly intense, to the extent that many face problems of water shortage through over-exploitation of the resource. This problem has

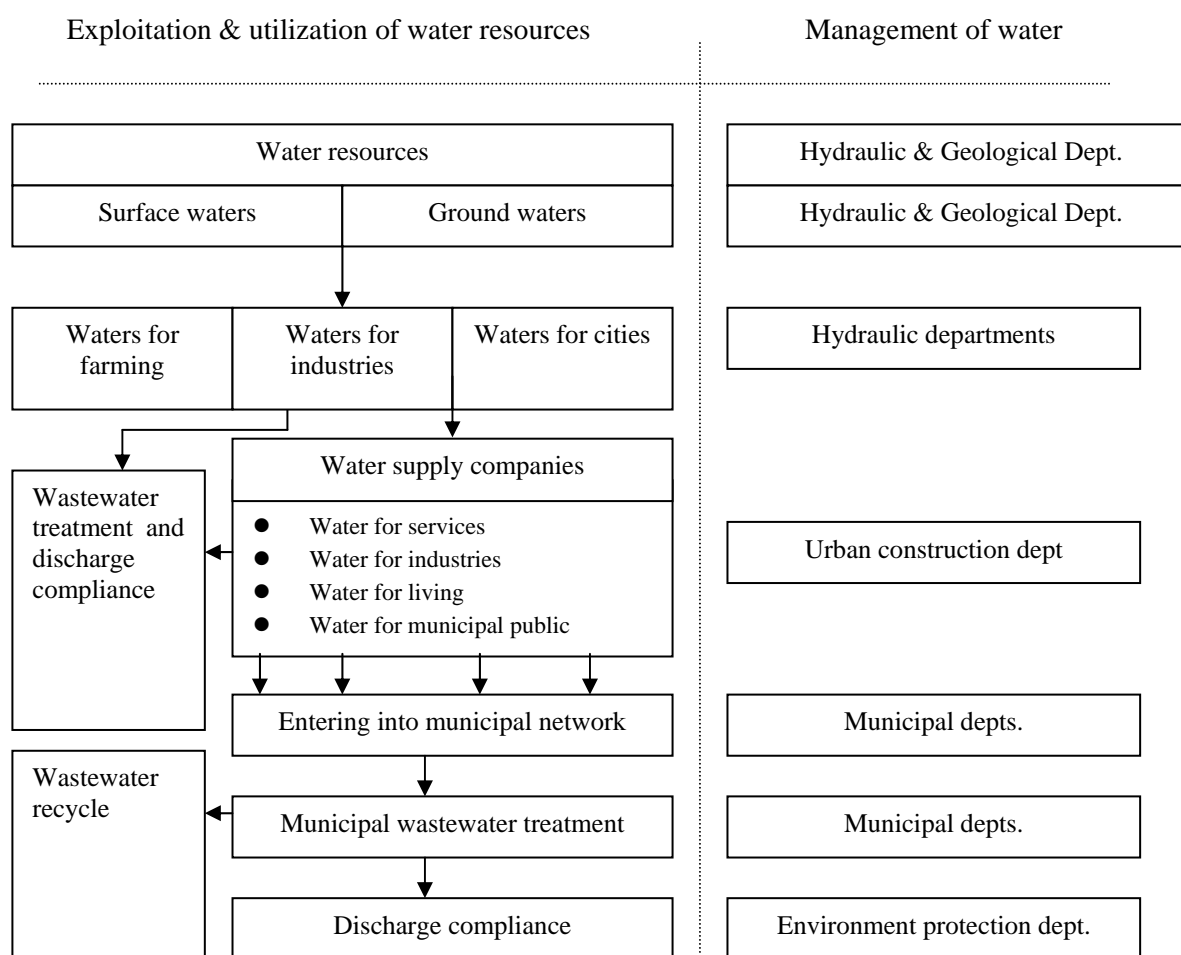
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surfaced in cities such as Beijing, Dalian, Jinan, Taiyuan, Tangshan, Tianjin, Shijiazhuang and Yantai. Water pollution problems are also common. For example, household and industrial wastewater in cities has been inadequately treated before discharge with the result that an estimated 90% of the water in urban areas throughout the country is polluted to some degree.

2.3 Institutional Arrangements

4. The contemporary Chinese system for water resource management involves multiple institutions and is very complicated. As shown in Figure 1, ground water and surface water are managed separately by irrigation/water-conservancy institutions and geographical institutions. Irrigation and water conservancy institutions manage water used in agriculture and industrial production. Urban water supply is the responsibility of urban construction institutions. The environmental protection departments of municipal administrations control wastewater discharge and treatment. Water resource management in China might this be characterised as “multiple dragons governing waters”. The complex system does not support the integrated and sustainable management of water resources and is in need of overhaul.

Figure 1: Institutional Arrangements for Water Resource Management in China



5. In this context, the government is embarking on a series of reform measures in the water sector aimed at the establishment of a coherent organisational framework. Following the creation of the Shenzhen Administration for Water Affairs, more than 400 county-level administrations for water affairs have been set up nation-wide. The Shanghai Administration for Water Affairs was established in June 2000 and is the first provincial-level institution in the country to undertake integrated water resource management. This is a breakthrough in China.

6. The existing situation of multiple institutions responsible for aspects of water resource management will be remodeled so that one institution is overall in charge for each administrative area. Institutionally, this will be through the establishment of water affairs administrations. Under this model, integrated planning, control and allocation of water resources will be undertaken to help prevent floods, drain waterlogged fields, provide for water storage and supply, drainage and irrigation needs, ensure ecological protection, promote wastewater treatment and recycling and ground water recharge. The new arrangement would also support better co-ordination in the permitting process for the abstraction and discharge of water, the setting of prices for water resources use and the management of water quality and quantity issues. Overall, much is expected of the reform in resolving administrative overlap and policy contradiction so that integrated management of water resources can hopefully move beyond intent to reality.

2.3 *Urban Water Supply*

7. After 1990, urban water supply capacity increased significantly in China. Statistics show that the daily capacity of water supply in cities increased from 1.42×10^8 cubic meters in 1990 to 2.10×10^8 cubic meters in 1998. This represented an increase of 47.6%. And per capita daily water consumption increased from 175.7 liters in 1990 to 241.1 liters in 1998, an increase of 37.2%. The ratio of water supplied as potable water increased from 89.2% in 1990 to 96.0% in 1998. Investment in fixed assets for urban water supply increased by 6.5 times between 1990 and 1998, reaching 9.48 billion yuan in the latter year. Figures 2 and 3 show the annual increase in urban water supply capacity and investment in fixed assets for urban water supply respectively. Fundamental changes have taken place concerning the structure of urban water supply. Before 1995, the proportion of water supplied by individual operators was higher than from water utilities. Since 1995, however, daily water supply from the latter has surpassed that provided by the former. By rationalising the number of players supplying water, both distribution and management have been improved.

Figure 2: Annual Increase in Urban Water Supply Capacity, 1990-1998

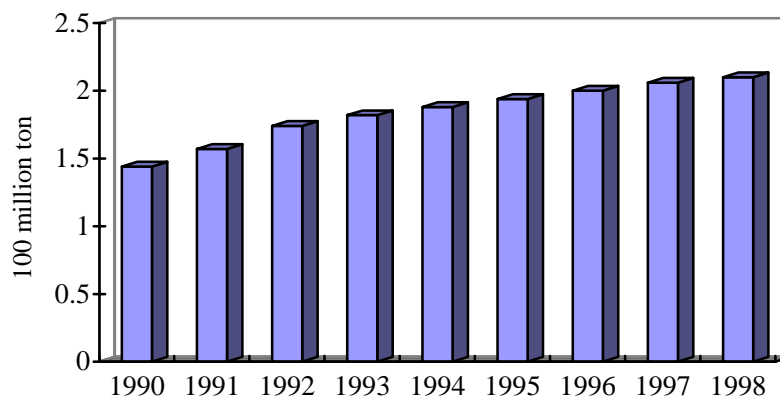
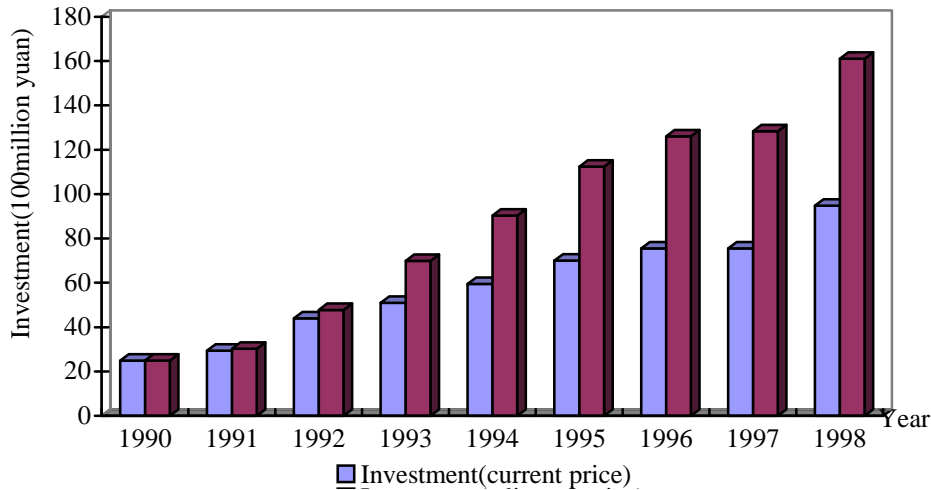


Figure 3: Investment in Fixed Assets for Urban Water Supply, 1990-1998



8. Although the inflow of investment has greatly increased water supply capacity, further efforts are needed to alleviate serious water shortages. Historically, the construction of urban environmental infrastructure has lagged other projects because of chronic underinvestment in the sector and the priority placed on the rapid development of the national economy in the 1980s. In addition, the amount of investment required to finance large engineering works such as urban water supply systems is considerable and there are long lead times involved. Also, in a planned economy the supply of potable water was considered a public good and not one amenable to charging. It was politically infeasible to implement the user pays approach to recover the costs of constructing, operating and maintaining urban water supply infrastructure. As a result, many water supply utilities incurred significant losses in their operations and received subsidies from the government to keep them functioning. For example, in the period between 1986 and 1997 annual total profits of these utilities fell from 0.51 billion yuan to -0.47 billion yuan. The average annual decrease was 0.09 billion yuan. Between 1991 and 1997 government subsidies to urban water supply utilities were as high as 2.81 billion yuan. In 1997 alone, total financial losses nationwide of urban water supply utilities could have been as high as 1.23 billion yuan if government subsidies are considered as financial losses.

9. Facing water shortages in the cities, the strategic option is to tap new resources and at the same time to improve the efficiency of existing uses. Demand-side management measures to be implemented include:

- allocating water resources among various competing users according to an overall resource management plan, with particular emphasis on the needs of urban, industrial and agricultural users;
- promoting water conservation in cities and the achievement of water use goals by rewarding those who economise on water use and fining those who exceed their quotas;
- strengthening efforts to research, develop and disseminate water-saving technologies and practices; and
- raising the price of water, which to date has been too low to act as an incentive for users to modify their behaviour.

2.4 Urban Wastewater Treatment

10. Wastewater in cities usually refers to household sewage and parts of industrial wastewater. In 1998 the discharge of wastewater in China's cities totaled 35.79 billion cubic meters, of which household sewage amounted to 16.29 billion cubic meters or 45.5 %.

11. There has been a rapid increase in investment in fixed assets for wastewater collection and treatment. For example, in 1998 this type of investment was 9.53 times higher than that in 1990. In addition, its proportion to the overall amount of investment in China increased from 0.21% in 1990 to 0.54% in 1998. Sewage collection networks in cities have been improved continuously and the total length increased to 119,738 km in 1997. The momentum of investment in this sector reflects the government's priority on accelerating the improvement of the urban environment and its efforts to realise this goal.

12. Although the total number of urban wastewater treatment facilities still remains at a low level, there has been a relatively rapid increase in their daily treatment capacity. This increased more than four-fold between 1990 and 1998, rising from 277.3×10^4 cubic meters to 1583.3×10^4 cubic meters (see Figure 4). The ratio of urban wastewater processed also increased from 16.2% to 29.9% (see Figure 5).

Figure 4: Increase in Urban Wastewater Treatment Capacity, 1990-1998

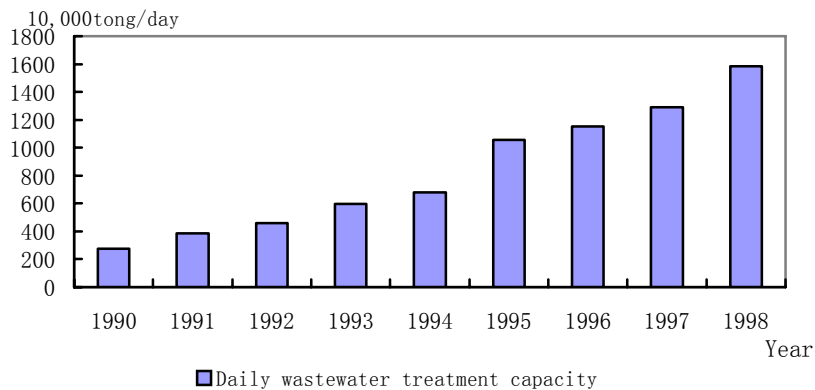
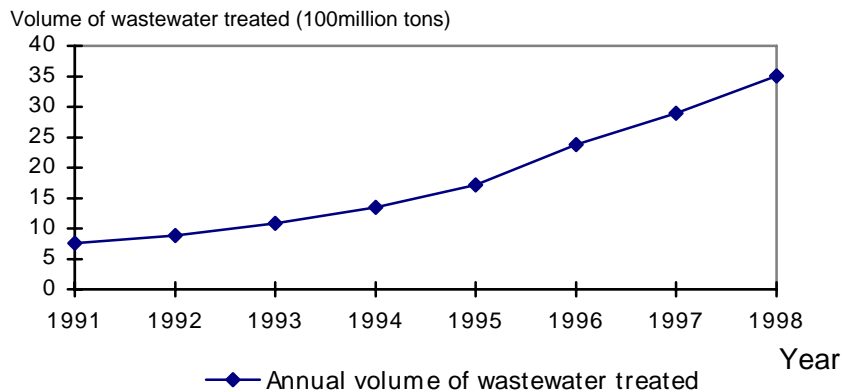


Figure 5: Annual Volume of Urban Wastewater Treated, 1991-1998



13. Despite these positive developments, wastewater treatment in urban areas remains inadequate and the number of centralised wastewater treatment facilities less than needed. In addition, urban water supply has increased far more quickly than wastewater treatment capacity. For example, between 1990 and 1998 the annual average daily capacity of urban wastewater treatment plants increased by 110×10^4 cubic meters while the figure for urban water supply in the same period was 850×10^4 cubic meters, or almost 8 times higher. If this trend continues it will have important implications for sustaining both water quantity and quality.

14. The development and on-going operation of urban wastewater treatment facilities has been constrained because government financing is insufficient to meet the demand. The main problems are:

- under the planned economy, urban wastewater treatment was considered a “non-productive public welfare good”. Government financing was the principal means of funding the construction, operation and maintenance of treatment facilities. This created a heavy burden on the central government budget and progress in building new plants was very slow;
- there has been great disparity between the construction of urban wastewater treatment infrastructure and the need for such facilities. The ratio of wastewater processed to the total quantity produced remains low in China’s cities. Investment to build new treatment plants has been inadequate while existing plants struggle to fund their operations and maintenance costs, with the result that many are inoperable;
- with the acceleration of urban development and the increased volumes of wastewater discharged there is greater urgency to build new or extend existing treatment plants.

15. Recognising these problems, in the 9th five-year plan covering the period 1996-2000 the State Council required all cities, and especially those that had a non-agricultural population of more than 500,000, to use all means available to consolidate funds for building wastewater treatment plants so that the problems of polluted water and a degraded aquatic environment in urban areas could be addressed. In addition, the Ministry of Construction, the State Environmental Protection Administration and the Ministry of Science and Technology jointly issued the “Policy for Technologies to Support Urban Wastewater Treatment and Pollution Prevention and Control” which proposed that by 2010 the average wastewater treatment ratio should be at least 50% for all cities and towns in China, and 70% for selected major cities. In the 10th five-year plan and the longer-term economic and social development plan now being drafted the construction of more urban wastewater treatment plants has been emphasised.

3. Urban Water Supply and Wastewater Treatment: Investment and Management Issues

16. Urban authorities in many Chinese cities have tended to emphasise water supply and overlook wastewater treatment. As a result, water supply has traditionally received more investment, the construction of plant been more robust and the management been of a higher standard. In contrast, wastewater treatment in China is notorious for its inadequate investment, poor operational and maintenance funding and weak management.

3.1 Urban Water Supply

3.1.1 Investment and Management Issues

17. Urban water supply utilities are an important component of municipal environmental infrastructure. They rely mainly on government financing for their construction and management. The funds are mainly sourced from the levy imposed on urban construction and maintenance projects and income collected by public utilities in cities, plus other financial sources. A recent development has been the collection of fees from those connected to the supply network.

18. Water supply infrastructure in every city is built with government financing and their operation and management is the responsibility of a specific utility. The relationship between the government and the utilities needs to be clarified so that the rights and responsibilities of each party are clearly specified and concepts such as return on investment, accountability and minimum service requirements are understood and applied. In this context, the government's functions include:

- affirming the status of the water supply utilities and authorising them to manage the assets of the supply system;
- establishing the utilities as enterprises with responsibility for their management, the generation of profits and growth in customer base. In the transition phase some administrative support might be provided;
- pricing of water. Because of the present monopoly in the supply of water it is important for the government to set clear "rules of the game". According to the "Regulations for Urban Water Supply" the pricing of water shall be determined on the principle that household charges should generate a small profit whereas water used in production and commercial activities shall be priced at an appropriate rate;
- maintaining a supervisory oversight role to ensure that the water supply utilities meet their service obligations. This includes developing and enforcing criteria on water quality, water pressure, reliability of supply and timeliness of service.

19. Water supply utilities are responsible for the provision of water to urban areas, the prudent management of assets and conformance with the relevant national and sub-national legislation. Economic efficiency and the generation of profits are key criteria guiding their operations. They are charged with the development and management of water supply facilities that meet existing and projected needs, the provision of quality services to residents and the city as a whole and ensuring that water quality and quantity demands are satisfied.

20. Conventionally, water supply utilities in China were managed as state-owned enterprises. With the reform of these enterprises a priority for the government, the management approach applying to water supply utilities is changing. It is suggested that a long-term contract could be signed between the government and the utilities that define their respective responsibilities and rights and which shift the emphasis from the current administrative management to a more flexible approach.

3.1.2 Improving the Management of Urban Water Supply: The Shenzhen Example

21. In the past urban water supply was managed in the same way as other state undertakings, i.e. as a state-owned operation with strong administrative intervention. Losses were offset by the provision of government subsidies. Despite the utilities now having the authority to generate profits, there remain many that operate at a loss because of constraints on their pricing policies in relation to the level of local economic development, e.g. in poorer provinces.

22. To promote improvements in the efficiency of urban water supply the government has refined the “rules of the game” applying to the water utilities. The balancing of profit and social welfare remains an important concern of the government, however, as does the responsible oversight of a monopoly situation. An example of the new way of thinking is the city of Shenzhen. The city government there promulgated the “Regulations for Water Supply and Use in the Shenzhen Special Economic Zone” to strengthen reform of the water supply utility. The regulations explicitly defined the responsibilities and rights of, and benefits for, the utility, the city government and consumers. The Shenzhen Bureau of Water Affairs was designated the main agency in charge of water supply and use in Shenzhen city, including responsibility for the assurance of water quality and strategic planning for new water supply. The regulations also provide the framework for regulating water prices. And the profit of water supply utilities from the pricing of water is limited to a range of 8%-10% of their net assets.

23. The Shenzhen experience has been positive. A clear basis for regulating water prices was established and at the same time the operations of the water supply utility were undertaken in accordance with market-based principles. In particular, a corporate management structure was set up with assets clearly identified, autonomy in administrative functions and decision-making provided and responsibility for managing profits and losses assigned. New internal management and supervisory systems were established to give effect to this structure.

3.2 Urban Wastewater Treatment

24. Two factors underlie the lack of progress in addressing urban wastewater treatment issues: insufficient investment; and ineffective management and operations systems. To accelerate the construction of wastewater treatment plants in cities and to achieve the set objectives, a number of trials have been undertaken in several cities focused on improving performance in these two areas.

3.2.1 Investment in Urban Wastewater Treatment Facilities

25. As one category of urban environmental infrastructure, centralised wastewater treatment facilities in China comprises the sewage collection network and plant(s) for the treatment and disposal of wastewater. Traditionally, these facilities were regarded as public good investments and were financed and built solely by the government. In general their funding was insufficient to meet the increase in wastewater inputs. Since China launched its economic reform process in the late 1970s there has been an increase in the sources of funding to build urban wastewater treatment facilities. They include:

- the central government, using funds allocated from the budget for the construction of fixed assets. The trend has been for a decline in this source of funding;
- local government, based on revenue collected from local taxes and other sources, including the levy on urban construction projects, charges for the provision of services, fees for water abstraction and wastewater discharge;

- charges collected from users, which may be supplemented by a government subsidy;
- foreign capital, such as loans provided by international financing institutions (World Bank, Asian Development Bank) and bilateral assistance programmes; and
- others, including policy and commercial loans from banks.

26. The majority of urban wastewater treatment plants are funded either by the Chinese government or foreign government loans. After completion, the plants are registered as government institutions and funds for their operation and maintenance are allocated from local and central government budgets. Many of the plants lack a solid funding base to sustain their operation. In response, some cities have begun charging for sewage collection and treatment but the charge rates are too low to support the necessary operational and maintenance costs of the facilities. The implication is that despite a considerable amount of money spent on building the wastewater collection and treatment infrastructure, the lack of funds for their operation hinders prospects for reimbursing loans taken out or a return on the government's investment.

3.2.2 *Reforms in Management*

27. Centralised wastewater treatment by urban utilities is a relatively recent development in China. In the early 1980s, there were only about 20 small-scale wastewater treatment plants nationwide that operated at low levels of efficiency and were totally reliant on the central government for their funding. In the late 1980s, with water pollution becoming a serious problem in urban areas, the need for centralised wastewater treatment was recognised by the government. As a result the government accelerated the construction of wastewater treatment plants by encouraging the inflow of foreign capital, technology and management practices. To date, about 200 plants have been completed with a daily treatment capacity of about 1500×10^4 tons. These plants require more than 3 billion yuan annually to finance their operational costs (based on a treatment cost of 0.6 yuan per ton). Much of the necessary funding is sourced from local government budgets. However, many cities are unable to set aside sufficient funds and it is not uncommon for plants to be unoperated.

28. Market-based approaches are increasingly being used in areas such as water and energy supply in China. We believe that wastewater treatment will also follow this path. For example, the government could "separate the two powers" in the urban wastewater treatment area, i.e. separating the power for building the plant and that for operating it. Another reform might be to entrust the running of wastewater treatment plants and associated facilities to professional companies who would be responsible for all management and decision-making relating to day-to-day operations and returning a profit on the investment. Indeed, this idea is reflected in the development of the Gaobeidian wastewater treatment plant and the management of the facility in Luzhi township, Jiangsu province.

29. In June 2000 the Shouchuang Corporation Group announced that it would invest in the construction and operation of the Gaobeidian wastewater treatment plant. This was an example of an enterprise group involving itself directly in the development of environmental infrastructure in Beijing municipality. In order to treat 100% of the wastewater discharged by the residents of and industrial activities in Beijing the municipal government plans to build 16 wastewater treatment plants, of which the Gaobeidian plant is the largest. It will treat wastewater from the downtown area and eastern suburbs, covering about 9661 ha. When completed the plant will serve a population of 2.4 million and have the capacity to treat one million cubic meters per day. This is about 40% of the city's total wastewater treatment capacity. In addition, the plant will provide 0.3 million tons of purified recycled water daily to urban areas. Of this amount, 0.1 million tons will be used for watering green open spaces and for cleaning

streets in parts of the downtown area while the remaining 0.2 million tons will be piped to the Beijing No. 1 Heat and Power Plant.

30. The Luzhi township government in Jiangsu Province has implemented a commercial approach in the management of its wastewater treatment plant. The practices adopted demonstrate that such an approach can be effective in addressing the existing problems facing urban wastewater treatment facilities in China. Box 1 provides further information on this initiative.

3.2.3 *Building Urban Wastewater Treatment Plants using Foreign Capital*

31. A major source of financing for the construction of wastewater treatment facilities has been foreign capital. The municipal government is responsible for repaying loans taken out to finance the construction of the wastewater treatment facilities. Many city authorities have used funding from the World Bank, the Asian Development Bank (ADB) and bilateral co-operation programmes to support the construction of their wastewater treatment plants. This is the case for cities in Tianjin and Liaoning provinces for example.

Box 1: Commercial Management of the Luzhi Township Wastewater Treatment Plant

Luzhi township actively promotes centralised treatment of its wastewater. It has built a treatment plant capable of processing 6000 tons of wastewater that is managed along commercial lines to deliver a professional and profitable service. Key details are:

- the local Township General Corporation of Farming, Industries and Commerce invested 4.2 million yuan to finance the construction of the plant;
- the plant treats wastewater discharged by industrial enterprises as well as from households;
- initially the wastewater treatment charge was 1.20 yuan per ton for discharges from the printing and dyeing mills, 0.8 yuan per ton for household discharges and 1.5 yuan per ton for discharges from the food processing industry. Subsequently the charges were set in accordance with the expenditures of the discharge sources;
- the wastewater treatment plant operator is responsible for levying and collecting the charges.

In implementing a commercial approach in the management of its wastewater treatment plant, the Luzhi township authorities have focused on following issues:

- clarifying the character and corporate structure of the management body, including responsibilities for independent auditing of accounts and managing profits and losses;
- establishing clear management and operations systems, including the authority to impose charges for wastewater treatment and ensuring that all relevant standards are met;
- managing the plant in a professional, efficient manner to achieve goals of water pollution reduction and lowering the marginal cost of treating wastewater; and
- strengthening the service role of the facility in order to attract more clients.

The Luzhi township model has essentially followed practices used in other parts of the world for this type of facility and applied them to local circumstances.

32. At present the municipality of Tianjin has two plants for treating wastewater. They are the Jizhuangzi and Eastern Suburbs wastewater treatment plants, with a daily treatment capacity of 0.26 and 0.4 million tons respectively. The cost per ton for treating wastewater is about 0.45 yuan. Total costs for

building the two plants was 288.31 million yuan. There are plans to build a further three wastewater treatment plants, as shown in Table 1.

33. Funds for operating the existing wastewater treatment plants are appropriated from the central budget as well as charges levied by local government for wastewater discharge. The municipality of Jianjin began charging in November 1997, setting a price of 0.2 yuan per ton of wastewater discharged. The annual revenue collected from charges can be as high as 0.12 billion yuan. In 2000 the charges were raised as follows: 0.4 yuan per ton and 0.6 yuan per ton respectively for residential and industrial wastewater discharge. In addition, a progressive pricing scheme will be implemented. A household of three persons has a annual quota of 8 tons of discharge without charge after which there is a step-wise increase in the amount to be paid.

Table 1: Existing and Planned Wastewater Treatment Plants in Tianjin Municipality

| Name of wastewater treatment plant | Year of construct. | Daily treatment capacity (million tons/day) | Cost (million yuan) | Source(s) of financing |
|---|--------------------|--|---------------------|---|
| Jizhuangzi | | 0.26 | 86.72 | Government of China |
| Eastern Suburbs | 1990 | 0.4 | 201.59 | Loan by France: 59.67 million Francs |
| <ul style="list-style-type: none"> • Xianyang Rd. • Expansion of Jizhuangzi & Southeastern suburb sewage pipeline network | To be decided | <ul style="list-style-type: none"> • 0.45 • 0.54 | 0.215 | Loan by Japan: US\$60 million Loan by ADB: 0.74 billion yuan Allocation by local government: 0.9 billion yuan |
| Beicang treatment plant and pipeline network | To be decided | <ul style="list-style-type: none"> • 0.1 • 20 km. of pipe-line | 0.371 | ADB: US\$26.20 million Allocation by local government: 0.154 billion yuan |
| Shuanglin | To be decided | 0.2 | | Application for loan from the World Bank submitted |

34. A number of cities in Liaoning province in Northeast China, such as Shenyang, Jinzhou, Chaoyang, Huludao, Yingkou and Tieling, are to implement centralised treatment of household and industrial wastewater. The total investment required could be as high as US\$544.66 million (see Table 2).

Table 2: Cities in Liaoning Province using Foreign Capital to Build Wastewater Treatment Plants

| City | Capacity of sewage water treated (million tons per day) | Cost (million US\$) |
|----------|---|---------------------|
| Shenyang | 0.5 | 264.9 |
| Jinzhou | 0.2 | 37.86 |
| Chaoyang | 0.2 | 40 |
| Huludao | 0.2 | 24 |
| Yingkou | 0.35 | 145 |
| Tieling | 0.12 | 32.9 |

35. Considering the fact that the return on these projects is usually low repayment of loans made by foreign investors is likely to rely on higher charges imposed on wastewater treatment and government contributions (subsidies).

36. Both the Tianjin municipality and Liaoning province examples show that foreign funds account for a large proportion of the total financing of wastewater treatment plants. This is also true for the country

as a whole. Foreign-sourced funds are essentially loaned in the name of the local government, acting as an intermediary, instead of being handled as a direct contract between lender and borrower.

3.2.4 Private Sector Involvement in the Operation of Urban Wastewater Treatment Plants

37. In order to bridge the huge amount of government investment required in building urban wastewater treatment plants and to distribute the high cost of operating the facilities, the Shenyang municipal authority sold its treatment plant at an approved price to the Shenyang Company for Environmental Protection Equipment and committed it to carry out the routine operation and management of the plant. The municipal authority issued a policy concerning charging levels and actively helped the company apply for loans as well as subsidising its interest repayments. The company operates as a commercial entity and is listed on the stock exchange (see Box 2).

Box 2: The Involvement of the Shenyang Company for Environmental Protection Equipment in Operating an Urban Wastewater Treatment

The Shenyang municipal authority invested 0.6 billion yuan in the construction of the northern wastewater treatment plant, which has a daily treatment capacity of 40×10^4 cubic meters. The plant requires 40 million yuan to cover its annual operating costs. The municipal authority entrusted the Shenyang Company for Environmental Protection Equipment, a locally listed company, with responsibility for the operation and management of the plant. In addition, it provided to the company more than 100 million yuan from the charge revenue it had collected from users of the wastewater facility. Of this sum, 40 million yuan was dedicated to cover plant operating costs. The remaining 60 million yuan was provided in the form of a share issue. The Shenyang Company for Environmental Protection Equipment is responsible for building new wastewater treatment plants and will use the profits from the sale of the share issue to finance this. If the municipal authority provides 600 million yuan in the course of 10 years it is estimated that a three-fold increase would be possible by transforming this sum into shares, i.e. about 1800 million yuan. This money would be used to finance the construction of two new wastewater treatment plants. Each of these new plants would have a daily treatment capacity of 50×10^4 cubic meters and recycle about 40% of this volume for use in industrial processes. The annual saving in water resources could be as high as 7000×10^4 cubic meters. The remaining treated wastewater could be used for non-potable uses in the urban area as well as irrigating farmland and public open space on the shores of the Huaihe River. The treated solids could be used as fertiliser and used in farming. The plants would be managed and operated along commercial lines by the Shenyang Company for Environmental Protection Equipment.

38. Under the jurisdiction the State Environmental Protection Administration (SPEA), the Shenyang Company for Environmental Protection Equipment is the first to be listed on China's stock exchange. At the same time, it is the manufacturer designated by SPEA for the production of environmental protection equipment. The company makes full use of its dominance in the market, not only by becoming the major player in managing the wastewater treatment plant in Shenyang but also by extending the scope of its operations. For example, it has contracted out a pilot project for treating 0.1 million tons of wastewater in southern Shenyang and the treatment of 0.5 million tons of wastewater in southern and western Shenyang as well as the operation of the wastewater treatment plant at Malanhe River in the city of Dalian. All these projects demonstrate both that experience in operating such facilities according to commercial principles is growing and the opportunities for public-private sector partnerships in the operation and management of urban environmental infrastructure.

4. Consolidating Market-based Approaches in Managing Urban Water Supply and Wastewater Treatment Plants

39. One of the important goals in China in managing urban water supply and wastewater treatment plants is to consolidate the use of market-based approaches. Some water supply utilities already operate as corporatised entities. The financing, operation and management of urban wastewater treatment plants is moving towards greater use of commercial principles to ensure a return on investment and recovery of costs.

40. Consolidation of progress to date requires innovations in management systems and changing attitudes among managers. It is also important to establish framework conditions that make it attractive for private investors to become involved as partners in the construction and operation of projects. This requires that the relationship between the government and investors is clearly specified and their respective rights and responsibilities defined.

4.1 Encouraging Investment

41. Under the planned economy urban infrastructure was always considered a non-productive public good financed by government at different levels. There has long been a view that the construction and operation of urban wastewater treatment facilities is a government responsibility. For example, a city's infrastructure for environmental protection was planned, budgeted, built and managed and operated by the government. Despite the inadequacy of government financing, there is not yet a strong understanding of the different options that could be tapped to increase investment in urban wastewater treatment infrastructure.

42. Drawing lessons from overseas experience and the role of market-based mechanisms for infrastructure operation and management, there is much potential for revising the traditional perspective that urban wastewater treatment is a purely public-funded responsibility. As a service it should be seen as an economic activity just as any other and for which its use can be charged. In addition, the relationship between the service provider and the government should be clearly specified as well as the financial, environmental and social responsibilities of the former in operating the service.

43. At present, water supply in Chinese cities is implemented more or less along commercial lines. There are fewer examples of this for urban wastewater treatment utilities but where they exist they provide good models. Many obstacles impede increased private investment in both areas and they need to be addressed if further progress is to be made on public-private partnerships.

44. In encouraging multiple sources of investment the key issue is to realise the principle of "whomever invests will benefit". There are a number of options that wastewater treatment plants could follow to improve their operations. China is similar to many other countries in that the cost of constructing urban wastewater treatment plants has traditionally been borne by the government. A fundamental difference, however, is that in a number of western countries the management of the plants is carried out by private companies with the government retaining regulatory oversight of service quality and access and pricing structures. And the companies are authorised to implement the user pays principle through charging, which provides a stream of revenue for re-investment.

45. China is still considering how best to consolidate its brief experience with this approach. For example, charges for wastewater treatment have been introduced but their low level means there is insufficient revenue to support the operational costs of the treatment plants. Policies need to be strengthened and designed to better reinforce each other. Greater efforts also need to be made to encourage domestic and foreign investment.

46. During the 10th five-year plan period (2001-2005) the rate of wastewater that is treated is expected to increase to 50% and the daily treatment capacity to rise to 40 million tons. Achieving this goal requires 100 billion yuan of investment. Without a solid framework for investment by the private sector this target will not be attained.

4.2 *Improving the Pricing of Water*

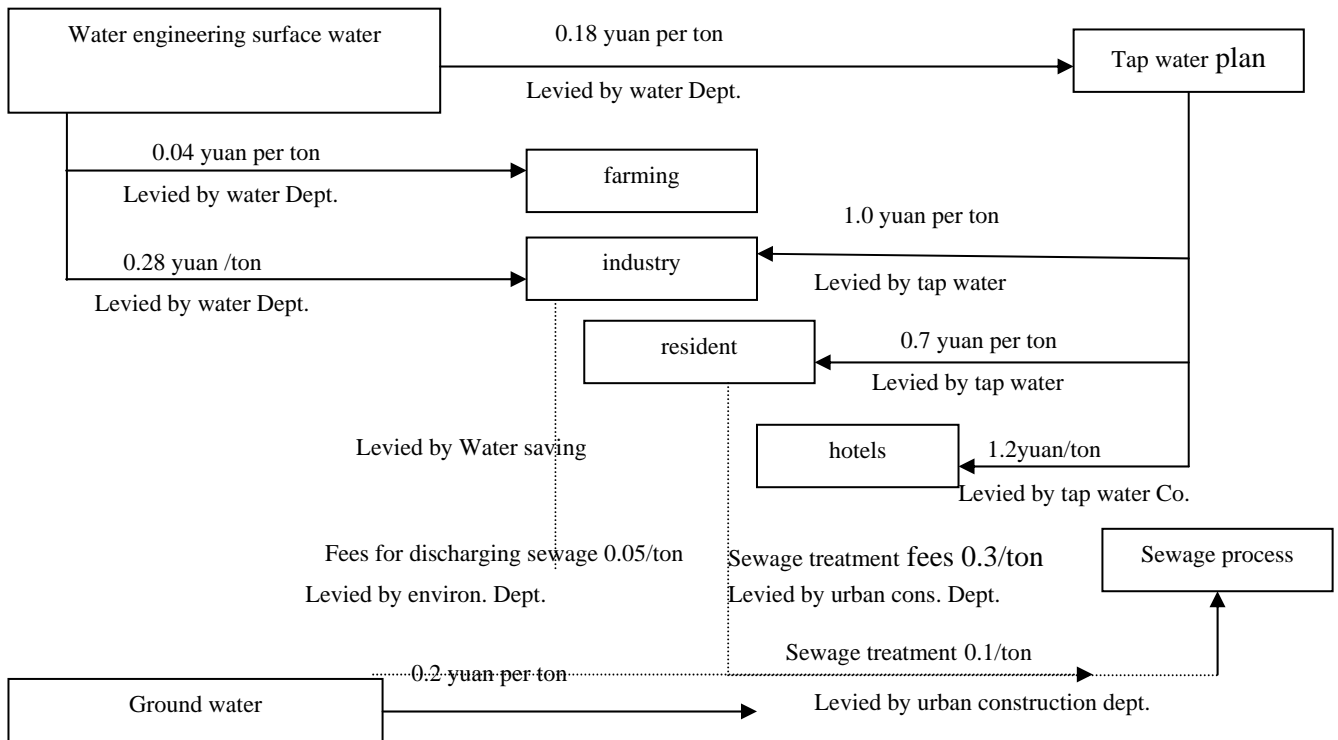
47. Water pricing, including water supply and wastewater collection and treatment, is an important aspect of improved water resource management in China. Current problems associated with wastewater treatment in Chinese cities, such as the inadequacy of investment, the slow rate of construction of new facilities and insufficient funds to cover operational costs are all related to the problem of water pricing. Applying the user pays principle in a meaningful way would be an important step forward. Nonetheless, it must be recognised that water pricing has always been a very sensitive issue in China. On the one hand it relates to issues such as public welfare and the income structure of the population. On the other hand it relates to public perceptions, especially about the role of the state and social justice.

48. Prices for water use must take these considerations into account. At the same time the notion that water is a free good needs to be changed. Water supply and wastewater treatment should be seen as services and an appropriate price charged for their use. Profits could be used to upgrade services. This view should, however, be balanced against the social and environmental responsibilities of the utilities. In addition, water supply and wastewater utilities have a monopoly in the market and in this respect government oversight is essential to check any abuses.

4.2.1 *Charging for Water Use*

49. Many municipal government departments impose charges for water use. Figure 6 shows the different types of water services that can be charged in Beijing municipality. A similar pattern applies in other cities. Charges include those levied by water conservancy departments, potable water supply departments, urban construction departments (for wastewater treatment) and environmental protection departments (for the discharge of industrial wastewater).

Figure 6: Charging for Water Use in Beijing Municipality



50. As Figure 6 shows there is a variety of items related to water use that is charged for in China. The key issue is how to rationalise the pricing structure and how to use the collected revenue in an effective manner. Revenue collected by the various charges is used in the following ways:

- water resource charges levied by water conservancy departments are used for the construction and maintaining of water conservation facilities;
- potable water charges imposed by potable water supply companies are used to fund the maintenance of the supply network;
- wastewater treatment charges levied by urban construction departments are used to finance the construction of new treatment plants and for operating these facilities.

51. All the charges listed above, except for the water resource charge, are all closely connected with urban water supply and wastewater treatment infrastructure. In this context, rationalisation of water pricing is a major aspect of enhancing prospects for investment in and operation of such facilities.

4.2.2 Rational Pricing of Water

52. Water prices should be set using appropriate equations. It is difficult, however, to define the average social cost of water supply and wastewater treatment so that it is necessary to set up a clear procedure and methods for determining the costs and expenditure involved in providing these services. This provides the foundation for determining water prices.

53. Utilities that supply water and undertake wastewater treatment incur fixed and variable costs at a given period of time, varying with the level of production and technologies and social-economic conditions. Different cities in China vary in terms of the cost structure of their water supply and wastewater treatment utilities. This reflects differences in geography, size of population, distribution of water resources, industrial structure, level of economic and technological development and the technology used by the utility (and its condition). Common national criteria for assessment are difficult to define. In terms of a given utility, the most feasible method is to have a group of experts from local government departments of technology, economics, labour relations, finance and prices and auditing analyse actual costs and expenditures. The costs for potable water supply and wastewater treatment can be checked against the actual conditions in the utilities. This should also be a means for checking water prices. Table 3 shows the price of water supply in a number of large-sized cities. There is a striking difference among them.

54. Government involvement in water pricing is essential to provide regulatory oversight and policy guidance. This also requires that the government recognise the profit component in the prices set by the utilities. The problem is how to determine an acceptable profit level for investors and which can act as an incentive to attract more investment. It was proposed in the “Regulations for Urban Water Supply” issued by the State Development Planning Commission and Ministry of Construction in 1998 that water supply pricing should ensure that the profit derived by utilities should be in the range of 8%-10% of their net assets. A profit level has yet to be defined for wastewater treatment utilities but it will be decided following discussions between governmental institutions and investors and with reference to the conditions of the market.

Table 3: Water Prices in Selected Large Cities in China

| City | Most recent change in pricing | Original water price (yuan per ton) | Current price of water (yuan per ton) |
|-----------|-------------------------------|-------------------------------------|---------------------------------------|
| Beijing | Nov. 1999 | 1.30 | 1.60 |
| Shanghai* | 1998 | 0.68 | 0.88 |
| Guangzhou | July 1996 | 0.50 | 0.70 |
| Lanzhou | 1999 | 0.55 | 0.65 |
| Harbin | 1997 | 0.75 | 1.00 |
| Tianjin | Nov. 1999 | 0.98 | 1.40 |
| Shenzhen | June 2000 | | 1.50 |
| Jinan | Oct. 1999 | 1.14 | 1.55 |

* A hearing about water prices was held on 23 June 2000. It is proposed to raise water prices to 1.51 yuan per cubic meter (Xiaojing Mei, personal communication).

4.2.3 *Establishing a Uniform Mechanism for Charging*

55. In China, water supply is artificially separated from wastewater management and inhibits integrated water resource management. Urban water supply and wastewater treatment utilities are managed by potable water and wastewater companies respectively which come under the jurisdiction of two different government agencies: the public utilities bureau and the urban construction bureau. The government attaches great importance to water supply in the development of cities but at the same time there has been a relative neglect of wastewater management. As a result, wastewater discharge in urban areas are not well controlled or treated. This affects water quality and is a serious threat to water resource management in some cities. There is an argument to be made for considering urban water supplies and wastewater treatment as parts of the same water resource system.

56. Cost recovery is more accepted in urban water supply than it is in wastewater treatment. Utilities managing the latter are finding it difficult to meet their operational and maintenance costs because of this disparity. In developed market economies a holistic approach to water supply and wastewater management is common. Expenditure associated with the latter are often considered as one component of urban water supply costs and incorporated into an overall charge. This integrated approach provides valuable lessons for China.

4.2.4 *Promoting Private Sector Management Principles*

57. By itself, the government is unable to finance the necessary investments in urban water supply and wastewater treatment plants that are necessary. Partnerships with private sector actors are necessary as is the adoption, where appropriate, of management principles that guide their activities, e.g. efficiency and return on investment. Indeed, much can be achieved simply by separating management and operational functions from administrative ones in water supply and wastewater utilities.

58. In order to accelerate urban wastewater treatment and solve problems associated with the non-charging or under-charging of users, the State Development Planning Commission, Ministry of Construction and State Environmental Protection Administration jointly issued in 1999 a regulation to reinforce charging for urban wastewater treatment. The regulation provides for the commercial operation of utilities, with sole responsibility for profits and losses, paying taxes and accounting of income and expenses. In addition, charges for wastewater treatment shall be levied simultaneously with water use charges set by urban water supply utilities. Equal shares of the collected revenue is distributed monthly to the two types of utility to fund their operational and maintenance costs. Those cities that have not yet built their own wastewater treatment plants can set charges after approval from their local people's government. The funds are to be used to extend the sewage collection network and to help build new treatment plants within three years. The regulation also stipulates that the rationale for the charge level is to be checked to ensure that profits are within the range specified.

59. Taking account of the current conditions facing urban wastewater treatment plants in China, its relationship with other sectors and the experience of other countries, a number of options for the commercial management and operation of these plants can be identified:

- investment by the government to finance plant construction and entrusting management and operations to private companies who apply the user pays principle;
- taking out loans to build the plant and entrusting management and operations to private companies who charge users according to the cost of treatment;

- implementing a joint venture investment by the government and private investors with management carried out by a corporate body; and
- using the build-operate-transfer (BOT) approach.

60. Whatever model is followed the principle of user pays should be followed. The utility will have overall management authority and responsibility for profits and losses, ensuring environmental requirements are satisfied and social/community obligations met. Adoption of private sector management principles of efficiency and effectiveness could help reduce the costs of treatment per unit of pollution, generating economic, social and environmental benefits.

61. It remains difficult to levy wastewater treatment charges at a level that would meet all costs. We suggest a gradual step-wise process may be more feasible. For example, existing operational wastewater treatment plants could progressively reduce their reliance on government sources of finance and at the same time increase their charge rates. Within several years they should be able to meet their operational costs and eventually become self-financing. For those cities that have just commissioned new wastewater treatment plants they immediately levy charges on users so as to raise awareness that pollution control is not cost-free. The accumulated revenue could be used for improving the existing facilities and for building new treatment plants.

5. Closing Remarks

62. Significant advances have been made in urban water supply and wastewater treatment in China, although progress in the former has outstripped that of the latter. The reason is that water supply services have a relatively sounder basis for investment and operation. Urban wastewater treatment plants face problems of inadequate investment and insufficient funds to cover their operational costs. Existing wastewater treatment has been financed mainly by the government and the use of multiple investment sources has not yet been explored in great detail. An important measure for reform to improve wastewater treatment in cities is to set up market-based mechanisms for investment and to implement private sector management principles in their operation. The user pays principle should be used to underpin a focus on cost recovery.

63. The preferred direction for urban water supply and wastewater treatment in China should be to promote investment from multiple sources, to ensure the utilities providing these services provide benefits to the whole community and that they operate efficiently and effectively on the basis of market principles.

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