Introduce Market Mechanism into Urban Water Management Establish Public-Private Partnership

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Abstract
Weihai as a coastal city in China enjoys the preferential policies and unique location, the urbanization and economy developed very fast, that also causes severe environmental pressure especially for the water. Weihai introduces market mechanism into the water management, using discharge fee, pricing, BOT, polluter pay principle, encourage the water saving, solved the fund shortage problem, established a public-private partnership, though the GDP, urban population and developed urban area grow very fast, but the water quality remains the same as before.

Keywords: market mechanism, water pricing, BOT, polluter pay principle, public-private partnership

Background
Weihai is located in the eastern tip of Shandong Peninsula of China, opposite to the Liaodong Peninsula, the Korean Peninsula and Japanese Islands across the sea. Weihai has a history of over 600 years. It had been a small frontier town till the 1980s with a population less than 70,000.
In 1987, Weihai was founded as a prefecture level city. Three lower level cities are under its jurisdiction; the total area is 5436 square kilometers, with a population of 2.47 million. Weihai has 986km coastline with attractive beaches, beautiful landscape, numerous historic sites and a pleasant climate. The GDP was only 3.4 billion yuan in 1987, mainly from fisheries and light industries, the environmental quality is one of the best in China, and these make Weihai a famous tourist city.

When China began to open up and move on to the current fast track to development, Weihai as a new developing coastal city, enjoys many preferential policies and a unique location, this lead to a rapid development for the city and economy. In 2007, compared with the foundation of Weihai city in 1987, the developed urban area grew from13.1 to 109.0 km²; the urban population grew from 233,000 to 632,000; GDP grew from 3.42 billion yuan to 158.35 billion yuan. The GDP growth rate is 21 % annually. The rapid development also brings high pressures on the environment, especially the water quality.

Shandong peninsula is a water shortage area; the annual precipitation in Weihai is 770mm. Because Weihai is a hilly land, most of the rainwater runs into the sea immediately, and there is no river transfer water from inland to Weihai, the annual available water resource is only 548 m³ per capita, just about 1/4 of the China’s national average, which itself is only ¼ of the world average. This means that the water resource per capita in Weihai is only 1/16 of the world. But along with the rapid development of urban and industry, the water demand increases rapidly. In the central city, the supplied running water was 6.90 million tons in 1987, increased to63.30 million tons in 2007. Making the situation even worse, the scarce water resource face severe pollution because the increased wastewater discharges from human and industrial activities.

During 1999 and 2000, Weihai experienced a severe drought; the precipitation was 316 and 460 mm, only about 1/2 of the annual precipitation. The water level in the reservoir, the water resource of the city, dropped to the bottom, the whole city faced a severe water shortage problem. To ensure the residents’ daily water supply, the government limited the water use of the factories; some big water consuming factories even were shut down. In the spring of 2001, before the rainy season came, the whole city especially the mayor was greatly alarmed. The rains finally came when the city had only 7 days of water left in the reservoir!

After this critical test, we thought about the water issue carefully. What are the problems? How can we solve them? The mayor held several meetings focused on the water issue. He directed the water resources, environmental protection, urban construction and industry administration departments to carry out investigation, present their suggestions and discuss these with each other. We found: yes, Weihai is a water shortage area; that is God gives us. We cannot change it. What we can do is increase the water use efficiency; protect the water environment, keep all the water clean enough for use; explore new water resources. To achieve this goal, introduce the market mechanism into the water environment management, establish public-private partnership is the key instrument.
Description of the initiative
The initiative focus on the follow area:

Collect pollutants discharge fee, force the industrial structure reform
In Weihai, 2/3 of the running water is consumed by industries and the same percent of wastewater discharged from industries accordingly. So reform of the industrial structure, establishing water saving industries in Weihai, is the key to solving the water shortage and water pollution problem.

In China, we have a policy, if the factories discharge pollutants into the air, water body or soil, they should pay the pollutants discharge fees to the government. The discharge fee calculated according the concentration and volume of the pollutants. But in practice, in most of the cases, because the local government leaders pay more attention on the economic development than the environmental protection, and the local environmental protection agency lack the technique and supervision force, this policy has not been carried out thoroughly. Before 2000, the situation is almost the same in Weihai. After the initiative, the mayor pay more attention on the environment; invested 8 million RMB, established a automatic-continuous air quality monitoring system, installed 30 on line water quality monitoring equipment on main wastewater discharge points; recruited 16 university graduated students, stressed the supervision force, that makes the environmental policy be carried out more thoroughly. In 1999, the collected pollutants fee was only 2.5 million; in 2007, it reaches 16.8 million, 6.7 times than 1999. The enforcement of the environmental protection law forces the factories to choose clean production, clean process, then improved the industrial structure.

In China, most of the town level cities have pulp & paper mills and ethanol factories. They use grain stems to produce paper and use sweet potatoes to produce alcohol. In some area they are the main contributors of the government revenue. But these industries consume a lot of water, discharge a lot of water pollutants, and create problems for water environment. Before 2000, Weihai has 4 pulp & paper mills and 4 ethanol factories; they cause a big pressure on the environment. We monitor their water discharge and collect discharge fee stringently, makes them no much profit, combine with the national and provincial industrial policies, these mills and factories were gradually be shut down. By 2000, only one pulp & paper mill was left. In 2001, we made the decision to shut down the last one. Now in Weihai only allow use recycled paper to produce paper. This decision can save 3 million ton water a year, reduce the same mount of wastewater discharge and improved the water environmental nearby very much.

These years, because the preferential policy and advantage environment, many investors came Weihai to open factories or do business. During the approval process, the relative departments of Weihai municipal government insisted on the principal of non-pollution and efficient water use, and refused to issue permits to polluting industry though it might make a big contribution to the local revenue. During the last 7 years, we rejected about 230 projects with total investment about 120 million USD.

Now the main industries in Weihai are electronics, garment, machinery manufacture, medicine, food processing and service. This kind of industrial structure consumes less energy and water resources, making the development more sustainable.
Using pricing mechanism, encourage water saving

Before 1978, China had a centrally planned economic system. After China open up to the outside of the world, it began to conduct economic reforms, gradually changing the centrally planned system to a market system. During the planned economic period, salaries were very low, but the residents enjoyed subsidies for most of their living cost. The government owned companies allocated apartments to their employees, charging only a very small rent. The government also subsidized food and water. All the investment for water supply came from the government revenue, the price charged for the residents covered only a small part of its real cost. In this case, there was no motivation for the residents to save the water in order to saving their money.

After the economic reform, China follows market principle, began let the beneficiaries pay the cost. In order to stimulate public saving water, we gradually raise the water price. In 1999, the water price for the residents was only 1.20 yuan per ton, now is 2.85 yuan that including 1.70 yuan for water supply, 0.8 yuan for sewage treatment and 0.35 yuan for water resources. We also use the progressive pricing mechanism that means the more water you consume, the higher of the water price is. For example, if a house uses more than 12 tons per mouth, the price of the water will be double than 12 tons below. This mechanism is designed to protect the poor and punish the waster. In 1999, the water price for factories was only 4.00 yuan per ton, now is 6.85 yuan that includes 5.00 yuan for water supply, 1.10 yuan for sewage treatment, 0.35 for water resources and 0.40 for other cost.

Now in Weihai, at the household level, most people use water saving equipment, change the screw tap to one action tap, use urinals with a volume of less than 6 L. Some householders even store the water after washing hands and vegetables then use it for flushing the urinal.

For industries, more factories use clear product process. The water is recycled, reused as much as possible. Some factories even take the sewage treatment plant as their water resource; use the treated wastewater as cooling water or for other purpose. From 2002 to 2005, the 3 heating & power stations in the central city invested 150 million RMB, changed the heating system from supplying steam to circulated hot water that can save 1.5 million ton water every year. Now the industrial water reuse rate is 93.14%.

The entire municipal infrastructure maintenance, like irrigation of grassland and trees, road wetting, use recycled water. In municipal engineering, most of them use rainwater from reservoirs and pools nearby. In down town of Weihai, along the coastline, there are several large parks with grass and trees. Here we constructed pipelines under the ground and connected the parks with a sewage treatment plant, use treated water to irrigate the grass and trees. With this project alone we saved 0.16 million tons fresh water in 2007.

Using BOT method, absorb private company invest in the sewage treatment plant

In the early 1980s, after a careful study from both the environmental and economic aspects, we found that compared with the individual sewage treatment system, the district sewage treatment system has many advantages. It costs less, has higher efficiency, is easier to administrate and the environmental quality is better. So Weihai government decided to use the district sewage treatment system. According the urban development, landscape, sewage discharge volume and water environment, we made a plan for sewage collection and treatment plants construction, let the municipal administration bureau to construct the sewage treatment plants accordingly. We do not demand the factories and hotels build their own
treatment facilities, except those factories, like electroplate plants, whose wastewater is not suitable for the biochemical treatment method.

The No1 sewage treatment plant began to operate in 1985; that was also the No1 in Shandong Province. At that time one could count on his fingers the total number sewage treatment plants in China. Its capacity is 15000 t/d, total investment is 12 million RMB. The No2 sewage treatment plant began to operate in 1995, with a capacity of 80,000 t/d, investment is 120 million RMB. The first phase of No3 sewage treatment plant began to operate in 2000 with a capacity 10,000 t/d, investment is 50 million RMB.

When we constructed the No1 sewage treatment plant in 1985, No2 sewage treatment plant in 1995 and the first phase of No3 sewage treatment plant in 2000, all the investment came from the government revenue. When we expanded the No2 and No3 sewage treatment plants in 2005 and 2006, we used the BOT (Build, Operation then Transfer) method, absorbing private investment in the city’s infrastructure. The expansion of No2 sewage treatment plant invested by a company headquartered in Beijing. It takes care of all the design, construction and operation, the capacity is 40,000 ton per day; the total investment is 62 million RMB. The beneficiaries pay the sewage treatment fee, 0.91 yuan per ton. After 25 years of operation, the company will transfer the plant to the local government with zero payment. The expansion of No3 sewage treatment plant is done by a company headquartered in Qingdao. The capacity is 40,000 ton per day, total investment is 61 million. The beneficiaries pay 0.93 yuan per ton. Its operation period is 25 years. After that time, the plant also will be transfer to the local government with zero payment.

Using the BOT method, the government does not have to spend money, but solved the sewage treatment problem properly. In 1999, the sewage treatment rate in Weihai was 59.99 %, increased to 83.56 % in 2007.

Follow the polluter pay principle, collect sewage treatment fee
Before 2005, in most of the cities in China, the running cost of the sewage treatment plants was covered by the government; it was free of charge for both residents and factories that is a big burden for the local government. In some cities, the local government constructed the sewage treatment plant under pressure of environment with the assistance of central government, but can not afford the running cost, so they just lay the sewage treatment plant there, only operating when the investigation team came. In 2005, the central government of China issued a regulation, orders all the cities must collect the sewage treatment fee, gradually raises it, till covers the running cost and the property depletion.

Weihai is the pioneer of sewage treatment fee collection. In 2000, the Weihai government issued a regulation to collect a sewage treatment fee from beneficiaries, 0.40 yuan/t for enterprises, and 0.20 yuan/t for residents. In 2006, we raised the treatment fee to 0.8 yuan/t for resident, 1.1 yuan/t for factories. Now the sewage treatment cost in Weihai is about 0.9 yuan/t. In this case, the sewage treatment fee collected can almost balance the cost.
The collection rate of the sewage treatment fee is another problem. In some cities the residents and factories refuse to pay the sewage treatment fee, they argue the amount they discharged, because usually there is no meter for the sewage, and in most of the cities the responsibility of water supply and drainage are belong to different government departments, it is difficult for the drainage staff to prove it. In order to improve the water management efficiency, in August 2003, Weihai reformed water management system, established Weihai Water Affairs Group. Weihai municipal government gives all the responsibility and power for both the water supply and drainage to this group. Now the responsibility is clear and the work efficiency is higher. The Water Group collect wastewater treatment fee with the water supply fee together, if no special reason, from how much water consumed, they can calculate how much sewage have discharged. If somebody refuses to pay the sewage treatment fee, he cannot get the running water. So the sewage treatment fee collection rate is almost 100%.

**Using market mechanism, encourage new water resource exploration**

In Weihai urban area, the population and industry have developed very fast, and this trend will continue for some time. Water shortage is a strategic bottleneck for the development of Weihai. Water saving alone cannot solve the problem in long term. We must explore new water resources to meet the demand of development.

Before the initiative takes place, because the running water price was low, the other water alternative resources can not compete with it, so the factories have no motivation to explore new water resources. After the initiative, the running water price for industrial usage has been raised from 4.00 yuan to 6.85 yuan, that give the chance for water alternatives.

Weihai is a coastal city; we have 986 km of coastline, the longest of any city in China. Desalination is one of the alternatives. Before 1999, we only use seawater for industrial cooling. There were no desalination stations because the cost is higher. But during the 1999-2000 drought, the water means survival or death for some factories, and after the running water price raise and the desalination technology improvement, the cost of the desalination almost can compete with the running water, desalination stations began emerging.

The first desalination station in Weihai was constructed by Huaneng Weihai Power Station in 2001. This power station is the biggest water consumer in Weihai. During the drought season, it faces high pressure, which led them to find an alternative in constructing a desalination station. The capacity is 2500 tons per day, the investment was 18 million yuan RMB, and the running cost is about 7 yuan RMB per ton. The second desalination station was constructed in 2002; it was built by the Weihai Water Affairs Group. This station is constructed on an island, to solve the drinking water problem of the residents on the island. Its capacity is 500 tons per day; total investment is 8 million yuan RMB. The third desalination station was constructed in 2003 by a fishing company, to solve the water shortage problem for the nearby area. Its capacity is 5000 tons per day, total investment is 40 million RMB.

Another alternative is reuse treated wastewater. Now we have three sewage treatment plants in the central city. Most of the treated wastewater is discharged into sea directly. This is a waste. In 2003, the Weihai Water Affairs Group constructed a water purification plant, using a third treatment method, deeper treat the water discharged from the second treatment plant, makes it meets the standard for most of washing, irrigation, cooling and engineering. The capacity is 10,000 tons per day, and investment is 30 million RMB. They sale the treated
wastewater at 1.00 yuan per ton, that much cheap than the running water, so most tree and
glass land irrigation use this water, some factories use it for cooling and washing, some office
and residents buildings use it for toilet flushing.

In recent years, some cities try to store rainwater for industrial and municipal usage. That is a
new idea for us. We began to do some investigation and feasibility study in this area.

Strength environment education
In order to stress the public participation in water management, we pay much attention on
environmental education. We set up an environmental program on TV and radio; a column in
the newspaper Weihai Daily; publishes environmental information, environmental law and
good practices. We disclose the environmental information, established a website,
www.whep.gov.cn, where the public can get the environmental regulations, standards,
statistics and environmental qualities. We opened the mayor’s mailbox, mayor’s hotline 12345,
and environmental hotline 12369, to answer questions and receive complaints about the
environment. Whenever we want increase the water price, we held a public hearing, consult
with the public, collect their opinions, after reach a general agreement, then make the decision.

Housewives are the important players in the
water environment management. We
encouraged local communities to organize
housewives to participate in various
environmental activities, to share their
experience on water saving, visit the
reservoir and sewage treatment plants and
increase their awareness of the water
environment.

Impact
Since the initiative of water environment management began, the effect is obvious. In 2007,
compared with 1999, the supplied water increased from 43.67 million tons to 63.30 million
tons; the industrial water reuse rate increase from 89.62% to 93.14%; the sewage treatment
rate increased from 59.99% to 83.56 %. Though the urban population and GDP grew very
rapidly as mentioned, but the water environment remains good quality. All the rivers, the sea
water, the supply water resources can meet the national standard.

Weihai received the awards of 1st National Sanitary City, National Model Cities for
Environmental Protection, National Garden City, and National Excellent Tourist City. Weihai
has twice got the International Award as the Best Practice for Comprehensive Management of
the Living Environment by UN-HABITAT in 1996 and 2000; got the UN-Habitat Scroll of
Honor Award in 2003; got the name of Eco-City from the National Environmental
Administration of China in 2006.

Replicability
Most of the cities in China face the same problems as Weihai, water shortage, environment
pollution and lack funds. The initiative in Weihai is the pioneer in China, the experience in
Weihai is a very good show case for other cities. After the No.3 Sewage Treatment Plant BOT
project completed in October 2006, until now, there are 90 delegates, 300 visitors come from
other cities visited the plant. Experts from UN ESCAP and IGES are also interested in
Lessons Learned
There are some issues that still need to be improved in the water environment management in Weihai, mainly are:

The pollutants discharge fee. China created the regulation for pollutants discharge fee collection in 1982, emended the regulation two times later, increased the fee rate and scope. The pollutants discharge fee is a good mechanism, that encourage the company to save the resources, decrease the pollution. But now the rate of the fee is a little bit low, in some cases can not cover the damage it caused; and the enforcement of the regulation is weak. So we need to increase the fee rate and scope again and stress the enforcement, let it has the punishment effection.

Public participation. Public participation in environmental protection in China is just beginning. Though the item has appeared in some environmental laws and regulations, only a few are in practice. Public participation in water environment management in Weihai still in a primary stage, they still lack the knowledge, the information, and especially organization.

Using the market mechanism. Several years ago, all the cost for the water environment management came from the government revenue, these years we introduced the market mechanism into this area, but we are still in the early stage and lack experience. BOT is a good option to cover the needed investment. But there is no law to follow until now in China. If there are some disputes, it will be difficult to solve them.

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