

# Water Resource Management in the Fen River Basin (II)

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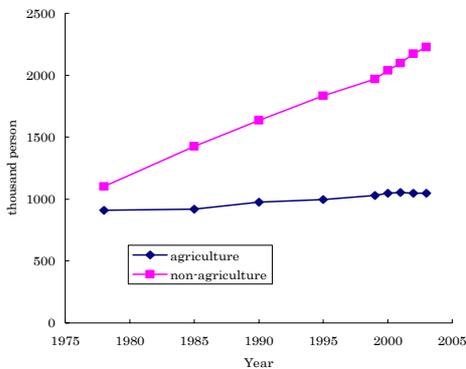
## 1. Introduction

This is a follow-up report of Imura (2005). The previous report overviewed water resource management in Taiyuan City. This report mainly focuses on the present situation of water usage for each sector of the urban area in the city.

## 2. Socio-economic characteristics and water resource in Taiyuan City

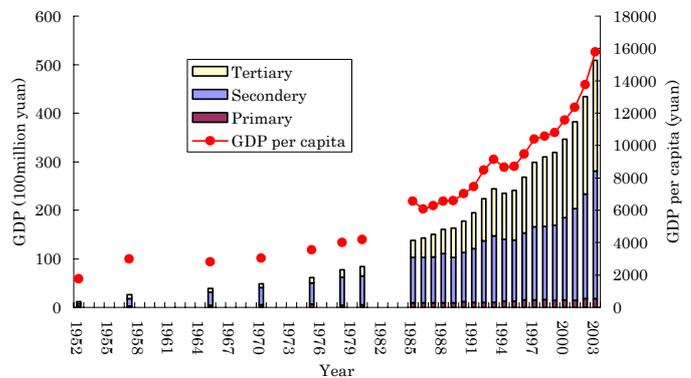
Taiyuan is the capital city of Shanxi province. The total population in Taiyuan City was about 3.3 million in 2003, of which 32% were agricultural population (Fig1). There has been almost no change in the size of agricultural population since middle of 1970s, where as the non-agricultural population size has doubled from 1976 to 2003. The GDP of Taiyuan City was about 50 billion yuan in 2003, with only 3.5% shared by primary industry, 51.7% by secondary industry and 44.8% by tertiary industry sectors (Fig 2). The GDP per capita in 2003 was 15,877yuan, which accounted for 1.7 times of national average, 2.1 times of average of Shanxi province and 63% of Beijing.

Fig 3 shows the amount of water consumption by sectors. Regarding agriculture and industrial sectors, there has been almost no change in the amount of water consumption since 1994, however, domestic usage has increased. Fig 4 shows the water resources for Taiyuan city. The surface water is only 10% of total water resources. Therefore, the city heavily depends upon the ground water.



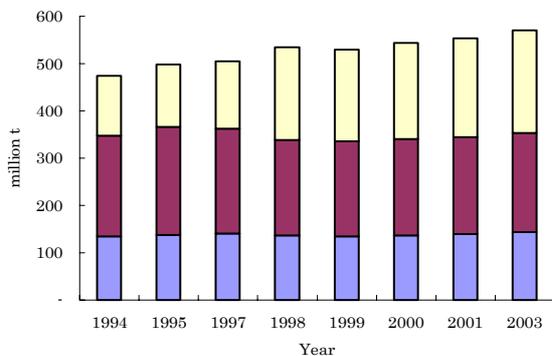
**Fig. 1 Population of Taiyuan City**

Source: Taiyuan City statistical yearbook



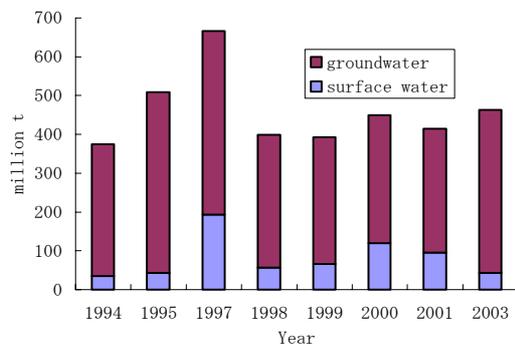
**Fig. 2 GDP of Taiyuan City**

Source: Taiyuan City statistical yearbook



**Fig. 3 Water consumption by sectors**

Source: Shanxi provincial statistical yearbook



**Fig. 4 Water resource in Taiyuan City**

Source: Shanxi provincial statistical yearbook

### 3. Water management in Taiyuan City

Field studies were carried out two times (during February and September 2005) in order to clarify the water usage in an urban area of Taiyuan City in the Fen River basin. The main findings were as follows.

#### (1) Water saving regulation

In Taiyuan City, "Command and Control" (CAC) type regulation has been taken an important role for water management. In 1982, Shanxi provincial government enacted *Shanxi Water Management Ordinance*, which marked the beginning of the full scale water conservation activities in the province. Taiyuan City passed the *Water Saving Administrative Law* in 1985, followed by the *Taiyuan City Water Saving Ordinance* in 1997. This ordinance was amended recently in 2004 and the regulation is further tightened. It requires, all newly constructed or improved buildings must be installed with water saving equipments; and if water is used in excess of the allocated amount, a water-fee from 2 to 10 times higher than the usual rates will be charged. Furthermore, if there is a case of over use of water for over 3 months without any countermeasures, the municipal government can stop supplying water to the user.

#### (2) Effects of Wanjiashai Water Diversion Project

As there is a shortage of surface water, Taiyuan city heavily depends on ground water. Since end of October 2003, the Wanjiashai Water Diversion Project is being introduced to divert water from the mainstream of the Yellow River to the Fen River. Table 1 shows the changes of the source of tap water and water fee before and after the project. However, the effects of this project are mixed.

After introducing the project, there has been a reduction in the intake of groundwater from 0.5 million t/day to 0.29 million t/day in Taiyuan city. In addition to that, the city has closed 219 wells for the conservation of underground water. This policy resulted in the rising of the ground water level from 10m to 15m in some places during last two years.

On the other hand, the cost for diverting water from the mainstream of Yellow River is 2.28 yuan/t causing Taiyuan city to raise its water price. However, the raised water price is being ineffective to cover the additional cost and resulting in a deficit of 200 million to the water supply company. Taiyuan city is going to re-revise the water price by the end of 2005 but it is difficult to raise the fee drastically as water is an essential commodity.

**Table 1 Comparing water source and water fee in Taiyuan city**

		Before Nov 2003	After Nov 2003
Source of water	Ground water	0.5 million t/day	0.29 million t/day
	Yellow River	-	0.21 million t/day
Cost of water from Yellow River (yuan)		-	2.28 /t
Water fee (yuan)	Water resource fee	0.1 /t	0.5~0.6/t
	Domestic water	1.75/t	2.45/t
	Industrial water	2.7 /t	3.3/t

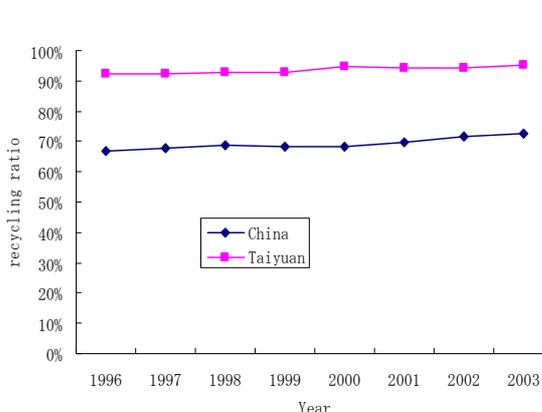
Source: Interview (Environmental Bureau of Taiyuan City on Sep 2005).

#### (3) Water conservation in industrial and service sector

Taiyuan city has been paying much attention to promote water conservation, such as recycling of water in order to control the increasing demand. The average recycling rate of industrial water in China was about 73% in 2003. But, Taiyuan City has kept the rate

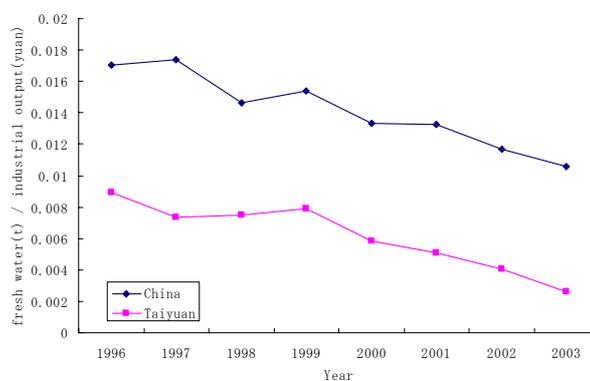
of water recycling over 90% since 1996 and achieved 95% in 2003 (Fig 4). Moreover, the fresh water consumption per unit of industrial output has been decreasing (Fig 5). It means that efficiency of water use in the production sector has been improved.

There is no statistical data on the present situation of water conservation for the service sector in Taiyuan City, though this sector also encourages water conservation. In case of industrial water, the charge is set at the total water cost not exceeding 2% of the total production cost. Therefore, the water price itself does not have strong effect on water conservation. However, in the case of service sector, the municipal government has set a relatively high price for water consuming service industry. For example, the water price for public bath is 15 yuan/t which is equivalent to about 4.5 times of industrial water (Table 2). According to the interview for a public bath company, total water cost is about 10% of the total cost. Therefore, the company promotes recycling of water in order to reduce the total cost of water.



**Fig. 4 Recycling ratio of industrial water**

Source: China environmental statistical yearbook



**Fig. 5 Fresh water consumption per unit of industrial output**

Source: China environmental statistical yearbook

**Table2 Selected company's water use in Taiyuan City**

Company	A	B	C	D	E	F
Industry	Food (vinegar)	Coal Mining	Cokes	Iron	Machinery (heavy-equipment manufacturer)	Service (public bath)
Type of company	xiangzhen company	state own	state own	state own	state own	Private
Industrial output (yuan)	180 million (2004)	432 million (2004)	900 million (2004)	29,000 million(2004)	0.18 million(2003) 0.28 million(2004) 0.40 million(2005)	-
Number of Employee	1,200	6,000	650	-	8,000	-
Annual production	0.1 million t	3.6 million t	0.9 million t	4.6 million t	-	-
Water consumption for production (upper:industrial water (new take), lower:recycled water)	78,000t/year (Ground water)	300t/day	3,000-4,000t/day 102,560t/day	80,000t/day(2004)	1.8 million t/year(2001) 1.3 million t/year(2005) 23.7 million t/year	8000t /month
Water use fee (yuan)	(only water resource fee)	0 (using spring water)	3.3/t	3.3/t	4.5/t	domestic water 3.75/t water for bath 15 /t restaurant 4.5/t
Share of water cost for total cost	7%	-	0.85%	-	(negligible)	10%
Emission of waste water	-	700t/day	(only domestic water)	0.15 million t/day	0.4~0.5 million t/year	-
waste water treatment	volume - use - cost (yuan) -	300t/day water sprinkling 0.6/t	1,440t/day cleaning of cokes 10t	0.13~0.14 million t/day cooling water 0.5/t	0.9~1.0 million t/year cleaning 1.32t	1,500~2,500t/month lavatory -
Water recycling ratio	-	-	over 95%	95%	92%	-

Source: Interview (September 2005).

#### (4) Water use in household sector

In order to investigate the present situation of water usage in the household sector, a questionnaire survey was conducted during September 2005 in Taiyuan city. Out of total 350 distributed copies 288 were collected. The collection ratio is 82.3%. The Main findings are as follows.

First of all, average household water consumption is about 5t/ month. This result is consistent with the interview responses from the Environmental Bureau of Taiyuan City. An average household water consumption per day per person is about 50ℓ and represents only 20% of Tokyo household water consumption (Fig 6). Secondly, with the water usage, almost all people take shower without using bathtub, and they take shower around three times a week (Fig7). Third, around 40% households reuse water after taking shower for flushing toilets (Fig8). It seems that the water saving regulation has an impact on the recycling of water for the households. With regard to peoples' attitude towards volume of water supply, 37% people answered “relatively unsatisfied” and 6% people answered “unsatisfied” (Fig9). These results imply that the household water consumption is limited by the availability of water supply.

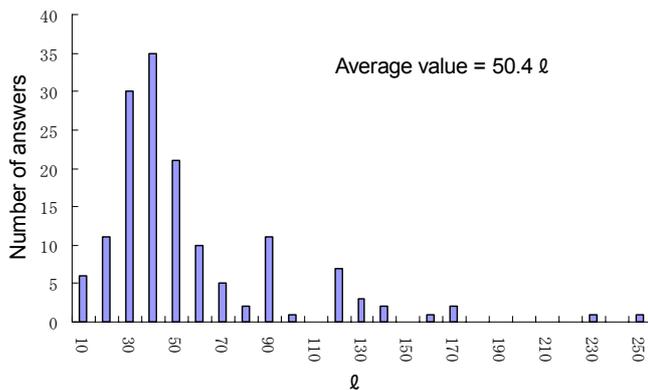


Fig.6 Daily per capita residential water use



Fig.7 Times of taking bath/shower and using washing machine

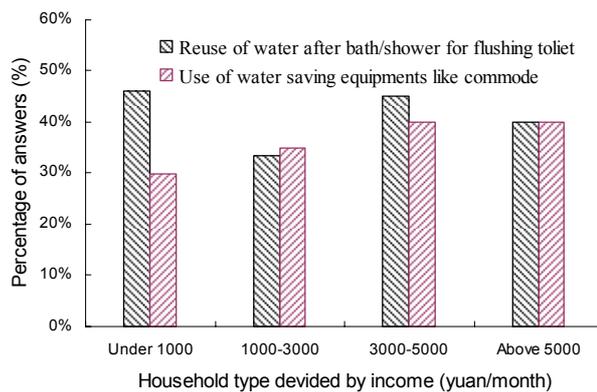


Fig. 8 Water saving and reuse

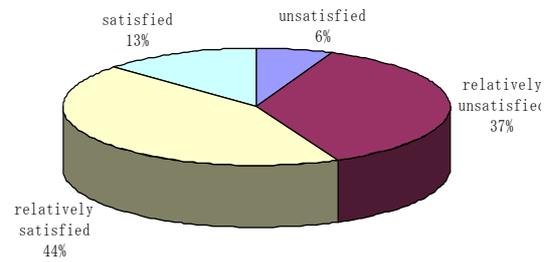


Fig. 9 Peoples attitude for volume of water supply

#### 4. Conclusion

Taiyuan city has promoted severe CAC regulations in the background of the “absolute lack of water”. As a result of this policy, industrial sector has achieved top level of recycling ratio of industrial water in China. The service and household sector is also

encouraged to water saving activities.

However, it seems that there is room for improving water circulation in the social level as the disposal ratio of domestic water in Taiyuan city is about 60% only. It is also necessary to verify the validity of the water distribution between the sectors and between the regions.

It is prudent to clarify all social costs and benefits that pave the path for further study of an ideal means of water distribution.

***Reference:***

Imura H., 2005: Water resource management in the Fen River Basin, *Yellow River studies News Letter*, 4, pp.2-7.