Study on Household Water Use Issues in North China

--Case Study of Taiyuan City, Shanxi Province--

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Introduction

In recent years, household water use is gradually becoming the center in Chinese deomestic water supply planning and management. But little is known about the household water use in contemporary China due to the transition of planned economy to market economy and enhancement of management on water conservation.

In order to well understand the characteristics of household water use in China, firstly an analytical model based on nationwide data was established and analyzed by using panel and cross-section data. Then Taiyuan City, the capital city of Shanxi province in North China was selected for case study. Both the analytical analysis and empirical investigation showed that China government achieved a good result in controlling household water use by implementing strict laws and regulations on water conservation. And through the investigation, first-hand information about water consumption pattern, water reusing/conservation, people's response to water quantity and quality, and etc. are obtained in Chinese context.

Analysis of statistical data related to household water use in China

Since 2000, China government has issued a series of laws and regulations on water resources and conservation, such as "Notice about the Elimination of Behindhand Products in Dwelling House", "Water Law of PRC (revised)" and etc. These laws/regulations requested that all the newly-built projects must install water-saving equipments such as non-cast-ion water faucet, water saving closet and etc.

Many studies have been conducted on household water use in developed countries. But most of them focused on water demand and consumption issues from the economic point of view. As a result, determinants such as water price, household income, life style were found to be the most important variables influencing household water demand (Nakazawa, 1991; Fernando et al., 2003).

In China case, because of strict regulations on water conservation, how will household water use change correspondingly? How is the relationship between household water use and those determinants suggested to be important in previous studies? In order to well understand the household water use in China, we setup the following analytical model for analysis.

$$\ln Q_{it} = \alpha_1 \ln Pop_{it} + \alpha_2 \ln Income_{it} + \alpha_3 \ln Wr_{it} + \alpha_4 \ln Wm_{it} + D_{it}$$

where Q is the annual deomestic water use; Pop is the urban population with access to tap water; $Income$ is the urban annual per capita income; Wr is the annual water resources; Wm is the washing machines owned by every 100 households in urban; D is the regional dummy variables. The variable of water price is not included in this model because of the unavailable of

provincial data. And according to previous study, the effect of water price on household water demand was not obvious.

All the data are provincial data and taken from China Statistical Yearbook 2000-2005 and China Water Resource Bulletin1999-2004. The observation number is 30 (Tibet is dropped due to data limitation). The model was analyzed with panel data by using fixed effect model and analyzed with cross-section data by using OLS methodology year by year. The results are listed in table 1. And the major finds are as follows.

Tab. 1 Estimates with panel data and cross-section data from 1999-2004

Variables		Panel data (Fixed-effect model)		Cross-section data (OLS methodology)					
		With *Wm*	Without *Wm*	1999	2000	2001	2002	2003	2004
Pop	coefficient	0.57**	0.53**	1.00***	1.01***	1.04***	0.98***	0.97***	0.94***
	t statistic	2.54	2.46	18.03	18.64	17.58	16.63	16.58	14.80
Income	coefficient	0.23	0.27*	0.38*	0.54**	0.19	0.53**	0.77***	0.61**
	t statistic	1.65	1.98	1.77	2.34	0.86	2.71	2.98	2.50
Wr	coefficient	-0.07	-0.07	0.02	0.04	0.08**	0.07***	0.08**	0.07*
	t statistic	-1.52	-1.51	0.75	1.41	2.71	2.85	2.24	2.00
Wm	coefficient	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	t statistic	0.67		-0.20	0.16	-0.62	0.25	-0.08	-0.21
R^2		0.67	1.00	0.95	0.96	0.95	0.96	0.95	0.94
Adjusted R^2		0.65	1.00	0.94	0.95	0.94	0.95	0.94	0.93

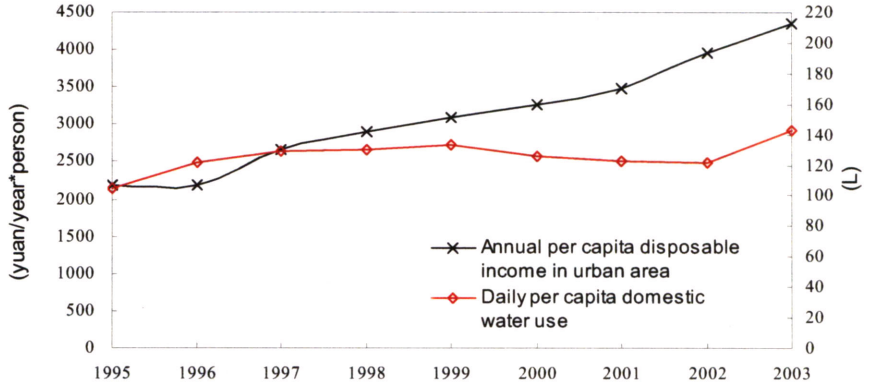
***Significant at 99% confidence; **Significant at 95% confidence; *Significant at 90% confidence.

- In each model, the variable of washing machine (*Wm),* which represents the life style, is statistically insignificant at 90%. The reason may be the small change of the number during the 6 years so that no significant responses are observed.
- In panel data analysis, population with access to tap water and income level has positive influence on household water use. But their elasticities are only 0.53 and 0.27 respectively. The reason may attribute to the success of strict regulations on water conservation.
- In cross-section data analysis of each year, household water use and population with access to tap water has a linear relationship. The coefficient of income is significant at different confidence except 2001. The maximum elasticity is 0.77 in 2003 and minimum is 0.38 in 1999. The result is consistent with previous studies (Shen Dajun et al., 1999). The variable of water resources becomes significant from 2001 because of water shortage and recognition of water conservation works especially from 2000. It is becoming a non-neglectable natural factor influencing household water use in China.

Case study of Taiyuan, North China

In order to validate the findings from analytical study, and to understand the detail about water using pattern, water conservation/reusing and etc. Taiyuan, the capital city of Shanxi province in North China was selected for empirical investigation. The reasons are not only because of its rapid economic development in recent years but also and more important because of its severe water shortage. The annual per capita disposable income in urban area of Taiyuan kept increasing form

1536 yuan in 1990 to 4354 yuan in 2003. While the daily per capita household water use kept increasing until 1990 and then decreased after 2000. (Fig.1)



The income was the constant price of 1990
Source: "Taiyuan Statistical Yearbook" (CSP, 1991-2004), "Shanxi Fifty Years" (CSP, 1999)

Fig.1 Per capita income and deomestic water use in Taiyuan 1995-2003

One important reason may be the great efforts made by local government on water conservation. Since the 1980s, several strict regulations were put into effect on water saving. In 2002 Taiyuan was nominated as one of the top 10 water conservation cities in China. During the investigation, we conducted questionnaires on the local residents in September 2005 and totally 288 copies of valid questionnaires were collected. The major findings are as follows.

The average daily per capita household water use was 50.4L (Fig.2).

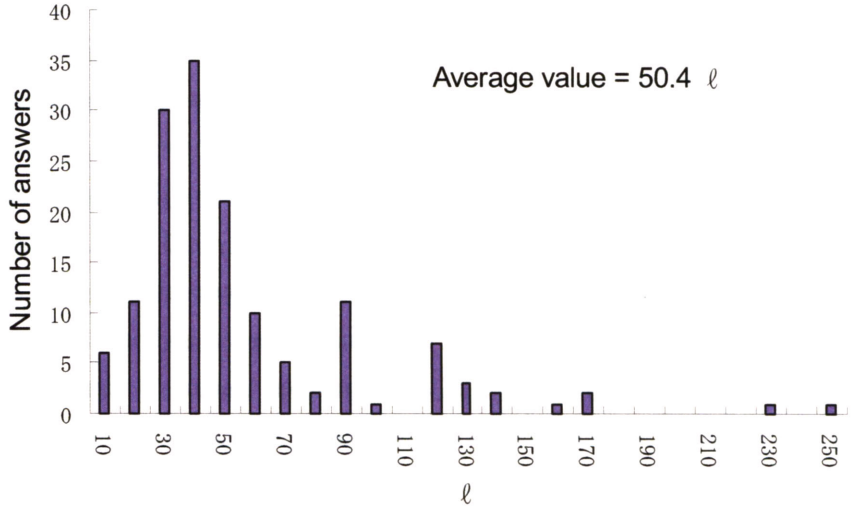


Fig.2 Daily per capita household water use

As for people's attitude toward water quantity and quality, household water use in 85% households kept nearly unchanged even if the water price increased in recent years (Tab. 2). And 68% of people thought the quality of tap water was just so so or unsatisfactory (Tab. 3).

Tab. 2 Household water use compared with last few years

Household water use compared with last few years	Increased	Decreased	Nearly no change
Percentage of answers	6%	9%	85%

Tab. 3 People's attitude toward tap water quality

Attitude for tap water quality	Satisfied	Relatively satisfied	Just so so	Relatively unsatisfied	Totally unsatisfied
Percentage of answers	3%	29%	50%	12%	6%

According to the result in Fig. 3, averagely 41% households reused the water after bath or shower for flushing toilet and averagely 36% households installed the water conservation equipments like water saving commode. The rate of reusing bath/shower water for flushing toilet in low-income families was relatively larger than high-income families. But it was reversed for using water conservation equipments in households.

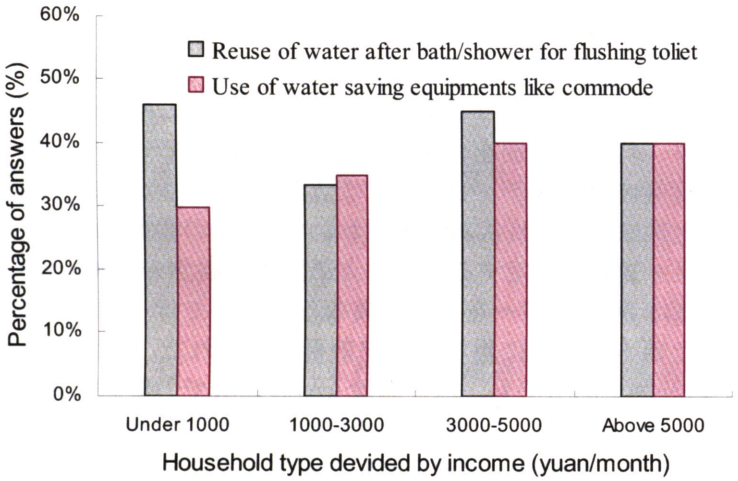


Fig. 3 Water conservation and reuse in Taiyuan

- The household water consumption level in Taiyuan City was only about 50 *L/person/day*. It may caused by life style, people' s effort in saving water and implementation of strict laws/regulations on water conservation.
- The water conservation measures have been widely practiced in different household types in Taiyuan. But the rate was below 40% now, there still has room for improvement.
- People in Taiyuan concerned more about water quality in their daily life when comparing with water quantity. So not only the water quantity but also the problem of water quality should be paid much attention in future.

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