A Study of Influencing Factors on Water-Saving of Enterprises

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Abstract: Water is a kind of scarce and valuable resource. Water-saving is not only important for the sustainable development, but also crucial for environment protection in China. Enterprises account for a big part of water consumption, and improving its water-saving performance has great economic and social values. This paper attempts to make a comprehensive analysis of enterprises' water-saving performance and its influencing factors based on survey data Jiangning District in Nanjing. Our findings indicate that good management system can significantly improve water-saving efficiency of an enterprise as well as capital scale. We also find that water-saving efficiency is greatly influenced by nature of ownership, as well as government regulation and social supervision. The results also show that the enterprise should pay more attention to its domestic water consumption, which significantly influences its water-saving performance.

1. Introduction

China is one of the countries with the highest degree of water resources stress among the major economies in the world. There are too many people and too little water, and the distribution of water resources is uneven in time and space. China ranks sixth in the world in terms of total water resources, but the amount of water resources per capita is only 25% of the world's per capita level. The distribution of precipitation areas is extremely mismatched with the distribution of population, cultivated land, mineral resources and other resources. The area to the north of the Yangtze River accounts for 63.5% of the total land area, while water resources only account for 19% of the country's land area. The northwest inland takes up 35.3% of the country's land area and only 4.6% of its water resources. Since the 1980s, the country's total water consumption has been growing steadily, reaching a record of 618.4 billion cubic meters in 2013, with an average annual growth rate of more than 1%. Problems such as shortage of water resources, serious water pollution and deterioration of water ecological environment have become increasingly prominent, which has become the main bottleneck affecting and restricting sustainable economic and social development.

In order to cope with the impending water resources crisis, some managers and scholars put forward the idea of "building a water-conserving society" at the end of the 20th century, which started the social water-saving practice. Water saving is the use of administrative, technical, economic and other management means to strengthen water management, improve water use efficiency and effectiveness, reduce sewage discharge, so as to protect and improve the ecological environment and promote the sustainable development of economy and society. After 20 years of water-saving work, the water use efficiency has been greatly improved. The water consumption per ten thousand yuan of GDP (calculated by the price in 1998) decreased from 683 cubic meters in 1998 to 124.1 cubic meters in 2018, with a decrease rate of 81.8%. The water consumption per ten thousand yuan of industrial added value decreased from 329.9 cubic meters in 1998 to 76.7 cubic meters in 2018, with a decrease rate of 76.8%. At present, however, there is still a gap between China's overall water use efficiency and the international advanced level. Water shortage is widespread in agriculture, industry and cities, and water ecological environment is deteriorating. More than 90% of urban waters are polluted to varying degrees. Water saving is still a long way to go.

Industrial water-saving can not only improve water efficiency and effectiveness, but also reduce sewage discharge, which is of great significance to protecting ecological environment and improving pollution-induced water shortage. Therefore, it is of great importance to understand the

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water-saving performance of enterprises and its influencing factors. This paper tries to make a comprehensive study about influencing factors on water-saving performance of enterprises based on a survey data from Nanjing. Besides hardware such as water-saving technology, our research found that software such as management also plays an important role on water saving for enterprises. Our study can shed some lights on the understanding of an enterprise's water saving performance as well as its influencing factor, and provide some suggestions for improving the water-saving management system, so as to improve the water efficiency and effectiveness and promote the construction of ecological civilization.

2. Literature Review

There are three strands of literature related to our study as follow:

2.1 Environmental Protection

With the development of human economy and society, environmental problems have become increasingly prominent. How to coordinate the relationship between economic development and environmental protection has increasingly become an issue that domestic and foreign scholars pay close attention to. In terms of theoretical research on environmental protection, foreign scholars first constructed a theoretical system of environmental economics, emphasizing the value of environmental resources and the cost of environmental pollution, and proposed corresponding measurement methods and solutions. Its main research areas include assessing the losses caused by environmental pollution and the benefits of environmental governance, formulating a polluter-paying system and the amount of transfer of pollution indicators (Fang and Zhang, 2011). Other scholars enriched the concepts related to environmental protection such as "circular economy", "ecological economy" and "green economy" from the perspectives of the possibility of realization and market value (Qi, 2005; Fang, 2010). The specific research fields of environmental protection involve environmental pollution issues such as water pollution and air pollution. Among them, in the field of water pollution, the existing literature mainly focuses on the analysis of the current situation of water pollution, pollution methods, and treatment countermeasures (Voeroesmarty et al., 2010; Zheng et al., 2016; Han et al., 2018).

2.2 Water Resources Protection

Water resources are the basic element to maintain human survival and development. In the face of water shortages and serious water pollution, research on water resources protection has important practical significance. The existing literature mainly studies from the following two aspects:

The first is the study of the value of water resources protection. Sun et al. (2018) use green GDP accounting based on the value of water resources assets to examine the relationship between economic development and water resources and the effect of water pollution control. Zang et al. (2019) built a water resource welfare performance indicator system based on the logic behind the ecological welfare performance to measure the sustainable use of water resources in 31 provinces and municipalities in China. Liu (2019) constructed an accounting model for maximizing economic benefits of regional water resources and minimizing water shortages based on the carrying capacity of water resources. Yang et al. (2020) carried out a quantitative assessment of the value of natural resource assets supplied by water resources based on the ecological compensation standard of the selected capacity value and natural resource asset value accounting.

The second is the study of water resources protection measures. Nie (2013) made recommendations from the perspective of resource prices. By studying the relationship between innovation and energy input and energy prices, he found that higher energy prices would lead to reduced emissions reduction innovation investment and increased production innovation, as well as reduced energy demand and consumer surplus. Chen and Wang (2018) and Zhang (2020) pointed out that water resource tax can promote water resource conservation, protection and rational utilization, but the current water resource tax reform has problems and needs to be further improved to lay the foundation for water resource tax legislation. In addition, measures include the

development of new water-saving technologies, the development of alternative water sources, and the strengthening of water-saving publicity (Kuang and Huang, 2013; Zhang et al., 2019).

2.3 Performance of Enterprise Water Saving

Enterprises are important participants of water resources conservation and protection, especially for companies in high water-consuming industries such as thermal power, steel, and petrochemicals (Liu, 2007). With the shortage of water resources and the country's increasing water and drainage requirements, how to use water resources more effectively has a major impact on corporate benefits. In the study of measures to promote water conservation in enterprises, Sakari (1994), Alejandro et al. (2006), Marrouch, and Sinclair (2012) analyzed pollution taxes, and investigated the effects of pollution taxes and financial subsidies on reducing corporate environmental pollution. The role of pollution tax, the dynamic changes of pollution tax and related standards, the formulation and location of pollution tax. Zhou et al. (2006) made a research on the basis of a questionnaire survey of industrial enterprises in North China and pointed out that formulating water plans and raising water prices can improve the water-saving effect of enterprises. They also selected two typical enterprises with large differences in water consumption of 10,000 yuan output value for verification. Johanna and Till (2013) proposed that companies may abuse emissions trading schemes and allowance markets, causing market distortions.

Compared with existing literature, our study tries to make a comprehensive evaluation of water-saving efficiency of enterprises and its influencing factors. Moreover, we attempt to use detailed survey data about enterprises to verify whether non-technical factors such as management system within enterprises could also help to improve water saving, which can help to understand enterprises performance on water-saving and make better policies on water conservation.

2.4 Theoretical Analysis of Influencing Factors of Water-Saving of Enterprises

Water saving in enterprises is not only a technical problem also an economic problem. On the one hand, enterprises need a certain amount of investment to implement water saving and increase their operating costs; On the other hand, water saving can also benefit enterprises. Its influencing factors can be divided into technical factors and non-technical factors. Technical factors mainly show whether enterprises have advanced technology or complete water-saving facilities in water saving. Non-technical factors are mainly reflected in the environment, water-saving management system and domestic water-using enterprises in the region where the enterprises are located.

2.4.1 The Influence of Industry and Enterprise Scale.

The influence of industry nature and characteristics on water saving mainly comes from the dependence on water resources, and enterprises can be divided into high energy consumption industries and low energy consumption industries. As a high energy-consuming industry, because of the high utilization rate of water resources in production, the cost of using water resources occupies a large account in the production cost. If we do not pay attention to the saving of water resources, it will naturally bring the burden of higher cost to enterprises and directly affect the economic benefits of enterprises. Therefore, high energy consuming industries pay more attention to the utilization of water resources, and the water saving effect is more obvious. On the one hand, in order to save water, high energy-consuming enterprises have adopted a series of water-saving measures, resulting in obvious water-saving results. On the other hand, because of limited water consumption, low energy consumption industries ignore the problem of water saving.

The influence of enterprise scale on water saving is self-evident. For the same type of enterprise, the larger the enterprise is, the greater the energy is consumed, the greater the demand for water resources utilization. The production cost increases with the enlargement of the enterprise scale. In order to obtain profits, from the perspective of cost control, enterprises will inevitably choose to save water resources. After saving water resources, the increase of profits of enterprises also promotes enterprises to continue to increase investment in water-saving resources, forming a virtuous circle of improving efficiency and saving water resources. At the same time, with the promotion of enterprise scale, it will also get abundant capital guarantee, improving water resources

saving equipment, upgrading water resources saving technology, and investing in more advanced water saving equipment.

2.4.2 The Impact of Water-Saving Technology.

Enterprises that use advanced technology for water treatment can recycle water resources and improve the recycling rate. The consumption of water resources in production and life of enterprises has a close relationship with water-saving technology. Advanced water-saving technology has a direct impact on the saving and reuse of water resources in enterprises. In order to save costs and reduce production costs, enterprises will actively seek effective ways to save costs.

After accurate accounting and calculation, if a set of advanced water-saving equipment is newly installed, its investment will be far lower than the income brought by water saving in the short term, then the enterprise will definitely choose advanced technology and improve the water-saving equipment, so that the enterprise can save water resources while improving the income. If the new water-saving equipment is installed in the enterprise, the income can reach the cost of equipment investment within 3 to 5 years, and the enterprise will choose equipment investment for comprehensive long-term development, thus achieving the effect of saving water resources. If the equipment selected by the enterprise can't bring in the investment of equipment within 10 years, the enterprise chooses the investment of equipment from the perspective of saving resources out of social responsibility, and the water resources are also effectively saved; From the perspective of cost accounting, water-saving equipment with relatively low investment may be selected, which also saves water resources.

2.4.3 The Influence of Internal Management.

The completeness of enterprise internal management system and the nature of enterprise ownership affects the effectiveness of enterprise water saving.

Influence of enterprise management system on domestic water. Especially in labor-intensive enterprises, with the development and expansion of enterprises, the number of workers has increased one after another, and the domestic water consumption such as toilets and staff canteens will greatly increase. For such enterprises, if there is no strict internal management system, it is difficult for employees to form the habit of saving water, and they will waste water resources at will. For example, in an enterprise with 1,000 employees, because the management is not strict, the employees waste 10 liters of water per person per day for flushing toilets, washing clothes and bathing, which wastes 10 tons of water a day and 3,600 tons of water a year. In 100 enterprises like this, 360,000 tons of water will be wasted a year. On the contrary, saving 10 liters of water per person per day will save 360,000 tons of water a year.

The complete domestic water-saving system of enterprises directly affects the domestic water consumption of enterprises. Clear rewards and punishments for enterprise water saving ensure the effectiveness of enterprise water saving and promote the endogenous power of enterprise water saving. Similarly, the ownership of enterprises will have a greater impact on the water saving of enterprises. For example, in order to improve the efficiency and actively reduce the production cost of private enterprises, including the utilization of water resources, the business owners will definitely try their best to work out a system to save energy and reduce emissions, reduce the cost of enterprises and reduce the cost of sewage treatment, to enhance the social and economic benefits. As a state-owned enterprise, due to the strong capital guarantee and the sense of social responsibility, it is bound to choose to invest advanced equipment to save water resources and reap social benefits as well as economic benefits. As a joint-stock enterprise, for the same purpose as private enterprises, it will also choose to actively participate in energy and emission reduction and save water resources.

The effect of water saving is also affected by the attention of enterprises to water saving. The attention of enterprises directly affects the water consumption of enterprises. In the same enterprise, the attention of management directly affects the water consumption and water-saving effect of the enterprise, and the water-saving enterprise leader must be aware of water-saving.

2.4.4 The Influence of Social Environment.

The environment in the area where the enterprise is located has a direct impact on water saving. Influenced by regional economic development, eco-tourism environment, government water-saving propaganda, water-saving supervision and water-saving incentives, enterprises will inevitably bring significant differences. In areas with relatively developed economy, enterprises can pay more attention to energy conservation and emission reduction and ecological environment protection. On the whole, the effect of water saving is better than that in areas with relatively backward economy. Enterprises in scenic spots with beautiful ecological environment are more active in energy saving and emission reduction than other enterprises. In order to win the reputation of enterprises, they will also choose energy saving and emission reduction to achieve the effect of saving water. Local governments, especially environmental protection departments and water resources management departments, pay attention to water-saving publicity and often send policies to enterprises, and gradually raise the awareness of water saving in enterprises, eventually turning water saving into the conscious demand of enterprises. The government's supervision on water saving and punishment for wasting water resources will also effectively change the habits of production and living water and stimulate the endogenous motivation of water saving. Appropriate water-saving incentive policies ensure that enterprises always save energy and reduce emissions, thus winning social recognition and market.

3. Empirical Analysis

3.1 Data Source and Variable Choice

Based on the theoretical analysis, we attempt to make an empirical analysis in this section to verify the theoretical conclusions above. Nanjing Water Authority conducted a survey about water usage and water conservation of more than 200 enterprises in Jiangning District in 2018. From this survey and Jiangning Statistical Yearbook 2018, we collected a sample data of 179 enterprises.

Improving the water-usage efficiency of enterprises is the main goal of industrial water saving. The water consumption status of enterprises can be considered by four indicators: total annual water consumption, water consumption per employee, water consumption per unit of product, and water withdrawal quantity per ten-thousand-yuan output value. Due to the differences in the scale and nature of production of enterprises, the total water consumption alone is not a good measure of the level of water consumption of enterprises, but water consumption per ten-thousand-yuan output value can be a better measure of how much water resources are consumed by enterprises in the process of pursuing economic benefits. Water is actually a valuable resource, which can be regarded as an input for production. Therefore, measuring water consumption based on the output is a comprehensive assessment, which can better exhibit the true level of the efficiency of water usage of enterprises. Besides, this indicator can also facilitate comparison with the same industry or similar products for water usage efficiency. In the following discussion, we will use this indicator as dependent variable. The smaller it is, the better performance of the enterprise has in water-saving.

Factors affecting the level and efficiency of water usage in enterprises mainly include production scale, production process, water facilities, water management and other factors. In this study, the following factors are selected as the independent variables.

Industry characteristics refer to water usage related to industrial feature. According to the national economy and industry category based on water consumption, the following eight industries are classified as high-water consumption industries, which include thermal power, chemical, paper, metallurgy, textiles, building materials, food, and machinery.Generally speaking, high water consumption industries consume more water in total, due to the special feature of manufacturing technique used in production, or raw materials for products and so on. Here we use a dummy variable to indicate whether an enterprise belongs to one of the eight high water consumption industries.

Registered capital refers to the total amount of capital registered by the enterprise with the registration authority, which is the sum of the capital contributions that the enterprise has already

paid or promises to pay. Enterprises with more registered capital generally means large scale of production and high capacity to adopt advanced technology. Large capital allows the enterprise to achieve a better economy of scale and employ better water-saving technology and facilities, etc. All of these may lead to a higher level of efficiency of water consumption during production.

Ownership of the enterprise is the nature of the ownership of the enterprise, which is determined by the affiliation of the enterprise's investment subject itself. In this paper, enterprises are divided into two categories according to the nature of ownership: state-owned and non-state-owned. The second category includes all private, joint venture and foreign investment enterprises. The nature of ownership may have two opposite mechanisms of impact on enterprises' water-saving performance. State-owned enterprises may suffer from soft budget constraint and insensitive to cost, but private enterprises pay more attentions to water conservation because it is highly related to cost, thus the latter have more incentives to improve water consumption efficiency. However, state-owned enterprises are generally larger in scale and capital, so they may have more capacity on adopting new water-saving technology. At the same time, state-owned enterprises also enjoy more subsidies from the government. Here we use a dummy variable to indicate whether an enterprise is state-owned or not.

Repeat utilization rate of water refers to the ratio of repeated water consumption to total water consumption in the production process within a certain measurement time. Repeat utilization rate can reflect the efficiency of water utilization in the production process of enterprises, when they adopt better processing technology of wasted water. Higher rate of water repeat utilization means higher efficiency of water consumption based on technology.

Secondary water metering ratio is an indicator of sensitivity and metering capability of water meter used by some enterprise. Water supply for enterprises is quite a complicated system, which include many pipes and meters with different levels. First level water meter can only measure the total consumption of the enterprise and there are many secondary water meters within the enterprise. Due the possible leakage and inaccuracy of meters, sometimes the sum of water consumption based on secondary meters is lower than the number from first level meter. The ratio between these two numbers is called secondary water metering ratio, which can reflect the metering status and leakage level of enterprises. Generally speaking, when ratio is close to 1, the enterprises have a better metering system on water consumption.

Comprehensive leakage rate of water facilities refers to the ratio between the amount of water lost per unit of time and the total amount of water used. This rate can also measure the how much water is wasted within an enterprise. Lower level of this rate means the enterprise has a better water-consuming system with less water is wasted due to leakage or other reasons.

Industrial water refers to water consumption specifically for production or manufacturing. Thanks to heterogeneity of production among different enterprises, some of them need to use water in production, such as steeling or papermaking. However, some enterprises don't need to use water as inputs, such as wholesaling and logistics. Here we use a dummy variable to measure whether the enterprise has industrial water consumption.

Domestic water refers to water consumption specifically for non-production activities. Sometimes, some enterprises have need for domestic water in addition to industrial water. For example, there is a canteen within an enterprise to provide lunch or dinners for employees. In China, it is also popular that some enterprises provide staff dormitories within the factory. So, we use a dummy variable to indicate whether an enterprise has domestic water consumption.

Sewage permit refers to the permit issued by the local government, which allow the enterprise to discharge the waste water via specific pipeline into some wastewater treatment plant. The issuance of a sewage permit needs the applicant to go through a series of administrative examination and approval. Therefore, enterprises with a sewage permit have more standardized water conservation and drainage management. According to the relevant regulations, all enterprises that set up a drainage outlet should apply for a sewage permit. It means enterprises without sewage permit will face many restrictions on water consumption. Here we also use a dummy variable to represent whether an enterprise has the sewage permit.

Water-saving management refers to a management system set up for water saving. Besides hardware based on water-saving technology, many enterprises also attempt to set up a complete management system for water-saving, which is also encouraged by government. For example, some enterprises appoint a senior manager to be responsible on water-saving management. They also establish a ledger system to keep a complete record on water consumption and make a water consumption plan in advance with evaluation after. Water-saving propaganda is implemented regularly within the enterprise. Now the government has a standardized evaluation procedure to tell whether the enterprise has established a good water-saving management system. We also use a dummy variable to represent it.

Number of nearby natural attractions refers to the total number of natural attractions with AAA level or above within the same administrative area of the enterprise. Jiangning district is famous for its rich tourist resources with many natural attractions. Therefore, the local government pays a great attention on environment protection. With more natural attractions in the neighborhood, the enterprise faces more government regulation and social supervision for pollution, including discharge of waste water.

In summary, the dependent variables and independent variables with their definitions are listed in Table 1.

Table 1 Variable Definition

Property	Variable name	Variable definition
Dependent variable	*WaterUsage*	water consumption per ten-thousand-yuan output value, which is defined by total annual water consumption divided by total annual production value (m^3/10000 yuan)
Independent Variable	*HighInd*	Dummy variable, marking 1 if the enterprise belongs to high water consumption industry, 0 otherwise
	Capital	Registered capital, measured in ten thousand yuan.
	StateOwn	Dummy variable, marking 1 if the enterprise is state-owned and 0 otherwise
	Repeat	Water repeated utilization rate = repeated water consumption / total water consumption × 100%. Total water consumption = new water use + water reuse
	Secondary	Secondary water metering ratio = the sum of the water consumption of secondary meters / the water consumption of first-level meter × 100%, the value is between 0 and 1.
	Leakage	Comprehensive leakage rate of water facilities, which is a ratio between the annual amount of wasted water and the total annual amount of water consumption
	IndWater	Dummy variable, marking 1 if the enterprise has industrial water consumption, 0 otherwise
	DomWater	Dummy variable, marking 1 if the enterprise has domestic water consumption, 0 otherwise
	SewPermit	Dummy variable, marking 1 if the enterprise has sewage permit, 0 otherwise
	Manage	The ratio of operation revenue to total assets, measuring the operating efficiency of a company (*t-1* year)
	Scenes	The ratio of cash flow from operations to total assets, measuring a company's situation of cash flow (*t-1* year)

Descriptive statistics of all variables are shown in Table 2. The results show that water consumption per ten-thousand-yuan output value is highly diversified. It means some enterprises' water consumption is quite inefficient if measured with output, but some enterprises achieve high efficiency. This great diversity may because of the heterogeneity of enterprises in our sample. Similar results are also observed from registered capital. These two results combined indicate our sample is quite representative with all different enterprises.

Table 2 Descriptive Statistics Of All Variables

Variable	Obs	Mean	Std. Dev.	Min	Max
WaterUsage	179	3.466	7.141	.077	85.959
HighInd	179	.229	.421	0	1
Capital	179	5090.081	10829.507	10	80000

StateOwn	179	.028	.165	0	1
Repeat	179	44.455	40.033	0	100
Secondary	179	99.172	2.128	85.89	100
Leakage	179	.527	1.001	0	8.22
IndWater	179	.028	.165	0	1
DomWater	179	.453	.499	0	1
SewPermit	179	.486	.501	0	1
Manage	179	.486	.501	0	1
Scenes	179	.57	.821	0	2

3.2 Regression Model and Results

To study the influence of different factors on water consumption of enterprises, based on above variables, we set up the following OLS regression model:

$$WaterUsage_i = \alpha_i + \beta_1 HighInd_i + \beta_2 Capital_i + \beta_3 StateOwn_i + \beta_4 Repeat_i + \beta_5 Secondary_i + \beta_6 Leakage_i + \beta_7 IndWater_i + \beta_8 DomWater_i + \beta_9 SewPermit_i + \beta_{10} Manage_i + \beta_{11} Scenes_i + \varepsilon_i$$

where i represents different enterprise and$\varepsilon$is the error term, which is independent identically distributed. Based on our sample, the regression results are summarized in Table 3.

Table 3 Regression Results Of Influencing Factors on Enterprises Water Consumption

	(1)	(2)	(3)
	WaterUsage	*WaterUsage*	*WaterUsage*
HighInd	1.779	1.862	1.910
	(1.27)	(1.31)	(1.29)
Capital	-0.0000576*		
	(-2.34)		
StateOwn	3.241*	3.143*	2.989*
	(2.24)	(2.38)	(2.08)
Repeat	0.0577**	0.0584**	0.0564**
	(2.91)	(2.92)	(3.00)
Secondary	-0.945	-0.946	-0.837
	(-0.99)	(-0.99)	(-0.98)
Leakage	-0.784	-0.846	
	(-0.96)	(-1.01)	
IndWater	-2.256	-2.202	-2.215
	(-0.92)	(-0.87)	(-0.89)
DomWater	5.242**	5.182**	5.368**
	(2.88)	(2.87)	(2.70)
SewPermit	1.926	1.871	1.726
	(1.62)	(1.59)	(1.59)
Manage	-1.411*	-1.444*	-1.362*
	(-2.45)	(-2.51)	(-2.32)
Scenes	-1.542**	-1.463**	-1.393**
	(-2.97)	(-2.92)	(-3.05)
Constant	93.19	92.98	81.74
	(0.99)	(0.99)	(0.98)
N	179	179	179
R^2	0.267	0.260	0.247

Note:***,**,* represent 1%, 5%,10% significant level respectively and t value is showed in parentheses.

Based on the regression results from Table 3, we have the following findings. Firstly, industrial characteristic has no influence on efficiency of an enterprise's water consumption. The coefficient of variable HighInd is not significant, which means it does not matter whether an enterprise belongs to a high-water consumption industry or not. This result is quite reasonable because water consumption here is measured according to the economic value of output instead of the total amount of water use. As we mentioned before, water is a valuable resource and efficiency of water

consumption should be evaluated in a comprehensive way. The present classification of industry only considers the absolute value of total amount, which cannot truly reveal the economic value of water and may lead to incentive distortion. Secondly, capital is important for the improvement of water usage efficiency. More capital means more probability of economy of scale and adoption of advanced water-saving technology. Thirdly, nature of ownership does matter for water consumption efficiency. The coefficient of variable StateOwn is significantly positive, which means state-owned enterprises have a lower water usage efficiency, compared with private or joined venture enterprises. One possible explanation for it is the soft budget constraint leads to a negative impact on water-saving motivation. Fourthly, domestic water consumption has significantly negative impact on an enterprise's water usage efficiency. As we can see from the data sample, about half of enterprises have domestic water consumption. It is now an important part of water usage for an enterprise, but it cannot create direct economic value for the enterprise. Most companies may emphasize on the importance of water-saving technology in production; however, this result shows that planning and management of domestic water consumption is also important. Fifthly, a good management system on water-saving does help. The coefficient of variable Manage is significantly negative, which means the water consumption efficiency is higher with a good management system on water-saving. Sixthly, government regulation and social supervision from environment pressure can push an enterprise to improve water usage efficiency. At last, we also found some surprising results that technology-related variables such as Repeat, Secondary and Leakage seems to have no or even negative impact on water consumption efficiency. One possible reason for it is that most of enterprises in our sample are those who have comparatively good performance in water saving. In other words, they have already employed the potential of saving water by technology hardware.

4. Conclusion and Policy Suggestions

Water is precious resource in China and saving water is extremely important for sustainable development. Higher water-saving efficiency means less water pollution and less resource consumption. Compared with households, enterprises consume more water resource and generate more pollution. Therefore, the government has made great efforts to encourage enterprises to improve water-saving efficiency by adopting better equipment and production process in the last two decades. Besides technology, more and more people realize that good management system is also important for water-saving for enterprises. This paper makes a comprehensive analysis about influencing factors on water-saving performance of enterprises. Our findings show that good management has quite a significant impact on improvement of water-saving efficiency. Domestic water consumption is a big issue for water-saving and need more attentions from enterprises. Moreover, capital scale, nature of ownership and environment supervision can also influence water-saving efficiency.

Based on our conclusion, the following suggestions are proposed.

First, the government should encourage enterprises to set up comprehensive water-saving management system. This study shows that similar enterprises with different levels of water-saving management have a large gap in water use efficiency. For those small or medium sized enterprises, good management system is a more affordable and efficient way to improve water-saving performance. The enterprises should spend more time on staff training about water-saving awareness and habits. Rewards and promotion should also be related to individual employee's performance on water-saving. Good practice of water-saving efficient enterprises should be summarized by the government and spread to the other similar enterprises.

Second, the public supervision saving should be strengthened to effectively promote water saving through external pressure. Wide and active public supervision should be supported to act as a good complement of government regulation. and management of water conservation and establish a joint punishment mechanism for violations of water use widely participated by the public. Possible policies include providing a telephone and network platform for water conservation supervision, encouraging exposure of bad behaviors such as wasting water resources and polluting water environment, and incorporating the violation records of water use units into the credit platform.

Third, the endogenous driving force for public water conservation should be further enhanced. Both production water and domestic water will be specific to the individuals involved in the use of water. It is suggested to further strengthen publicity and education, deepen the awareness of water crisis, enhance the public awareness of water conservation. And transform awareness into conscious behavior, formulate fiscal and taxation incentive policies scientifically. Finally, let everyone in production and life from “we are asked to save water” to “we want to save water”.

At last, water consumption should be measured with a more comprehensive way. Traditional classification of high-water consumption industry is mainly based on the total water usage, which ignores the economic nature of water as an production input. Economic value of outputs from water consumption should be also considered. Promotion of water-saving is not only a social issue, but also an economic problem. A comprehensive evaluation on water-saving efficiency should be made by considering multiple dimensions and enterprise attributes in a scientifical way.

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