Analysis of cooperative game of benefit distribution of contract for water saving in college based on modified Shapley value method

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Abstract. Using Game Theory as a theoretical tool for studying economic behaviors of both parties, a cooperative game model consisting of water-saving service companies and universities is established according to the characteristics of contract for water saving in college. Benefit allocation plan is solved by using shapley value method’s Characteristic which assigns by contribution degree. After further comprehensive consideration of four factors which impact on benefit distribution, a benefit distribution model of contract for water saving in college is established based on modified Shapley value method. Analysis by example shows water saving benefit flows from university to water-saving service company, achieving optimality in the sense of Pareto. The benefit compensation mechanism formed by the model can generate positive incentives for water-saving service companies. This study has practical significance for benefit distribution of contract for water saving in college.

1. Introduction

With the development of the economy, the shortage of water resources is becoming more and more serious. But the water supply and demand situation is getting more tense, and water shortages are already become a hindrance to economic development. Building a water-saving society is must be done. The Ministry of Water Resources has proposed the use of market mechanisms to promote contract water conservation management according to General Secretary Xi Jinping’s guidelines for water conservancy work in the new era. Various provinces and municipalities have also introduced regulations and offices related to water conservation law, it can be seen that water-saving action cannot be delayed. As an important part of large-scale public buildings, colleges and universities are one of the major water users, and the per capita water consumption level is higher than the per capita water consumption level in China [1]. Water waste is a serious problem, but the college water fee is the education fund. In the national budget system, water saving benefits mainly reflect the social welfare sexuality, resulting in insufficient water-saving endogenous power, so the government needs to apply the market mechanism to water saving work and can be formulated by binding indicators - red line of water efficiency, forming a mechanism to promote the college actively enter the contract water-saving market [2]. Due to the difference between colleges and other public water users is that it
includes multiple places with high water consumption simultaneously. For example, teaching buildings, canteens, lawns, bathrooms, etc. Water methods, uses and requirements for water quality vary [3]. Therefore, the water saving reform work is a technical problem for the university itself. This promotes the birth of Contract for Water Saving in College.

The essence of contract water saving is to raise capital. Investing in water saving in advance, paying the full cost of water saving with the water saving benefits obtained, then sharing water-saving benefits and achieve multi-win [4]. Water unit and water-saving service companies agree on water-saving goals in the form of contracts, enjoy water saving benefits [5]. At the beginning of the concept of contract water saving was proposed, there is not yet shaped a perfect management system. Domestic scholars have studied the contract water-saving management mode and operation mechanism [6-8]. After analysis, it is known that contract water saving has a large market in China, but it is difficult to implement. Mainly because there is little research on the benefit distribution mechanism of contract water saving management, and the distribution of water saving benefits of contracts generally draws on the benefit distribution model of contract energy management. As the government vigorously promotes contract water conservation, the economic behavior of contract water-saving market is complicated, and more advanced research methods are needed. As one of the standard analytical tools, Game Theory is widely used in finance, biology, computer science, politics [9]. In the field of contract energy management, Game theory has been successfully applied to the distribution of benefits directly related to economic interests. Zhu Dongshan and others established a model and used Rubinstein's bargaining model to determine the contract energy efficiency share from the perspective of economics, combined with game theory [10]. The SHAPLEY value method has significant advantages in solving the problem of cooperative games. Yin Qingmin and others use the Shapley model to optimize the benefit distribution of contract water saving management, and the water-saving users are the largest beneficiaries, followed by water conservation services companies [11], but they did not consider participation ratio of capital investment with both parties and risk sharing coefficient. He et al combine the contribution degree with the Shapley value to distribute the benefit of the green building contract energy management stakeholders [12]. Xing et al used the AHP-fuzzy comprehensive evaluation method to correct the Shapley income range [13]. From the above scholars research, it can be seen that the research on the benefit distribution of contract energy management tends to be mature, which has certain reference significance for contract water saving management. However, contract water saving management has its own characteristics, and college contract festival Water's service main body has certain characteristics compared with other industrial enterprises. Therefore, it is impossible to transfer the benefit distribution mechanism of contracted energy management.

In view of this, based on the game theory, this paper uses the Shapley value to establish the benefit distribution model, and comprehensively considers the impact of relevant factors on the allocation of water-saving benefits, calculates the correction coefficient, and establishes a more perfect contract water-saving for the characteristics of contract water-saving management. The benefit distribution model balances the benefit distribution of the contractual water conservation core stakeholders.

2. Cooperative game model based on Shapley value

2.1. Prerequisites for cooperative games

In the contract water-saving management of colleges and universities, the government, college sand water-saving service companies have their respective responsibilities. Water-saving external force driven by government, through policies, incentives, total control, and water-saving assessments, the government sets clear water-saving goals for universities, implements supervision and assessment, creates a good external environment and guides social forces to form water-saving service companies [14]. The government plays an external role in contract water conservation management and does not directly participate in contract water conservation projects. Therefore, universities and water conservation service companies are the core participants of the project [15]. According to the idea of
cooperative game, universities and water-saving service companies can reach a binding water-saving contract, agreeing on water-saving goals. Based on the above characteristics, this paper establishes a two-party game model for the game participants by universities and water-saving service companies. The essence of the game is alliance and distribution, and the cooperative game adopts a cooperative approach, and the participating parties can generate cooperation surplus through the alliance [16]. The balance of cooperation, that is, the distribution of water-saving benefits depends on the core interests party strength comparison and strategy combination. It can be said that the remaining cooperation is the result of cooperation and the condition for cooperation [17]. In a game of n players, the set of participants represented by \( N=\{1,2,3,4,...,n\} \), any subset \( S \) of \( N \) is called an alliance, for cooperation game \((N,v)\), \( N \) stands for \( n \) participants. The participants of this article are universities and water-saving service companies, and \( v \) is the utility function, which is the maximum benefit that both parties can achieve through the use of strategies. Therefore, the conditions for participation in the cooperation between the two parties are as follows:

- For the alliance, the overall income is greater than the sum of each member's individual operations. Here, \( S_i \) represents the university, and \( S_2 \) represents the water-saving service company. The two parties participate in the cooperation to create the cooperation surplus. The utility function of the partners meets the superadditivity, see the following formula (1):

\[
v(S_i \cup S_2) \geq v(S_i) + v(S_2)
\]

In the formula: \( v(S_i) \) is a utility function of colleges and universities characteristic function, \( v(S_2) \) is a utility function for water saving service company; \( v(S_i \cup S_2) \) is a utility function for the alliance after the cooperation between the two parties.

- For the inside of the alliance, there are distribution rules that follow the Pareto improvement nature, and each member gets no less than the gains obtained when they did not join the alliance [17]. See the following equation (2):

\[
\chi_i \geq v(\{i\}), \ldots, \sum_{i=1}^{n} \chi_i = v(N)
\]

In the formula: \( \chi_i \) is the i-th participant’s income distribution in the state of alliance; \( v(\{i\}) \) is the income distribution of the i-th participant who fails to reach the alliance status; \( v(N) \) is the remainder of the cooperation.

Among them, \( \chi_i \geq v(\{i\}) \) is based on individual rationality, that is, the benefits of cooperation between universities and water-saving service companies are not less than income from non-cooperation; \( \sum_{i=1}^{n} \chi_i = v(N) \) is based on collective rationality, the sum of the benefits of colleges and water-saving service companies is equal to cooperation remaining; if \( v(N) \) are not all allocated, then the case did not reach the Pareto optimality and could not be accepted by the player. This paper establishes the utility function model of water-saving service companies and universities based on the above constraints, and analyzes and improves their benefit distribution.

### 2.2. Utility function of cooperative game

- Water saving service company utility function

Defining the benefit of water-saving service company during the contract period is the difference between the total project revenue and the total project cost, expressed by equation (3):

\[
P = aI - (C_F - C_V)
\]

Where: \( P \) is the income of the water-saving service company; \( a \) is the proportion of benefit distribution; \( I \) is the total income of the project; \( C_F \) is the fixed cost invested by the water-saving service company during the contract period; \( C_V \) is the variable cost during the contract period, that is, operating costs.

Since the water-saving service company needs to estimate the project's income before the
implementation of the water-saving plan, the contract period is generally several years, so the formula (3) is corrected by the net present value method, as shown in formula (4):

$$NPV_G = \sum_{t=1}^{n} \frac{\alpha_t I_t}{(1+R)^t} - \sum_{t=1}^{n} \frac{C_{vt}}{(1+R)^t} - \sum_{t=1}^{n} \frac{C_{vt}^u}{(1+R)^t}$$  (4)

Where: $NPV_G$ is the net present value of the benefits that the water saving service company companies in the t-th year; $I_t$ is the total water saving benefit of the t-year; $R$ is the discount rate; $C_{vt}$ is the fixed cost of the t-year; $C_{vt}^u$ is variable cost for the t-year.

- University utility function

Due to the nature of the benefit-sharing contract water-saving management, the university does not need to pay any fees during the life of the project. During the contract period, it only needs to enjoy the water-saving benefits proportionally. After the contract period is over, the annual water fee will be preferentially extracted. Part of the benefits are used for the operation and management of water-saving facilities. The benefit distribution discussed in this paper occurs during the contract period, so the university utility function can be expressed by equation (5):

$$NPV_H = \sum_{t=1}^{n} \frac{(1-\alpha_t)I_t}{(1+R)^t}$$  (5)

Where: $NPV_H$ is the net present value of colleges and universities during the project life cycle.

3. Benefit distribution of contract for water saving in college based on modified Shapley value method

3.1. Determination of Shapley value

For the cooperative game $(N,v)$, the set of allocations usually has $2n$, and the calculation is complicated, so the Shapley value method is introduced. For each game $(N,v)$, there is a set of shapley values $\varphi(v) = \left( \varphi_1(v), \varphi_2(v), \cdots, \varphi_n(v) \right)$, among them:

$$\varphi_i(v) = \sum_{S \in V(i)} \frac{|S|(n-|S|-1)!}{n!} (v(S \cup \{i\}) - v(S))$$  (6)

In the formula: $\varphi_i(v)$ represents the average contribution of the i-th participant to the remainder of the cooperation, and the benefits obtained; $S$ is the alliance; $| S |$ is the number of alliances $S$; $SU\{i\}$ is the new alliance formed by the alliance $S$ and the participant $i$.

3.2. Parameter determination method

Because the Shapley value method is based on the contribution of the participants to the collective to distribute their benefits, it both has rationality and individual rationality, and it has certain operability in the distribution of benefits. However, in the implementation of the contract water-saving management project, the proportion of investment, risk sharing, contribution to the project and the degree of execution of the contract have a significant impact on the distribution of water-saving benefits, and the four factors affecting the distribution ratio are shown as follows; so the Shapley value benefit allocation model needs to be revised.

- The proportion of public and private investment

  The proportion of public and private investment here refers to the proportion of funds invested by universities and water-saving service companies, including the principal input and project follow-up operating expenses:technical input and labor input, etc. By clarifying the investment conditions of water-saving service companies, determining the investment ratio of universities and water-saving service companies $a_{11}, a_{12}$.

- Risk sharing

  In the contract water saving management project, the risk commitment ratio can be determined
according to the risk cost of the stakeholder input. Based on the risk factors of domestic and foreign research scholars’ contract water-saving projects, the risks faced by contract water-saving management are mainly divided into the following types of risks: financing risks, operational risks, market risks, and government risks and so on. The analytic hierarchy process is used to determine the risk-sharing coefficient. The proportion of each risk between the university and the water-saving service company is \( x_i \) and \( y_i \). The weights of various types of risks are expressed by \( w_i \). It is assumed that \( a_{21} \) and \( a_{22} \) are the comprehensive risk-sharing coefficients of universities and water-saving service companies, then:

\[
\alpha_{21} = w_1x_1 + w_2x_2 + w_3x_3 + \cdots + w_nx_n
\]

\[
\alpha_{22} = w_1y_1 + w_2y_2 + w_3y_3 + \cdots + w_ny_n
\]

The greater the risk that stakeholders bear, the more they are expected to be allocated the greater the return.

- **Contribution**

Contribution is the sacrifice and contribution made by both parties to solve the unexpected situation [19]. The contribution index can reflect whether the behavior of water-saving service companies and universities has played a positive role in the promotion of the project. The importance of the input factors is the contribution of universities and water-saving service companies which are represented by \( a_{31} \) and \( a_{32} \).

- **Contract execution**

The degree of contract execution is the degree to which universities and water-saving service companies are bound by contracts to maximize collective income and fulfill the substantive content of the contract. The measure of contract execution can be calculated using the indicator-task completion. Determine the mission objectives in advance, and then invite the relevant departments to evaluate the progress of the project, and obtain the contract execution degree of the water-saving service company and the university, \( a_{41} \) and \( a_{42} \).

3.3. **Modified Shapley value**

On the basis of determining the value of Shapley, consider the above four factors affecting the distribution of benefits, and establish a factor matrix \( A \) that affects the distribution of benefits:

\[
A = 
\begin{bmatrix}
\alpha_{11} & \alpha_{12} & \alpha_{13} & \alpha_{14} \\
\alpha_{21} & \alpha_{22} & \alpha_{23} & \alpha_{24}
\end{bmatrix}
\]

In order to ensure the convenience of data processing, the matrix needs to be normalized, the processing formula is as follows:

\[
b_{ij} = \frac{a_{ij} - a_{ij \min}}{a_{ij \max} - a_{ij \min}}
\]

After obtaining matrix \( B \), according to the expert scoring method, the degree of influence of each influencing factor on the distribution of benefits is obtained \( \zeta = [\zeta_1 \ \zeta_2 \ \zeta_3 \ \zeta_4] \), and the comprehensive impact indicators of the interests distribution of universities and water-saving service companies are respectively \( \eta_1 \) and \( \eta_2 \). According to formula (8):

\[
\begin{bmatrix}
\eta_1 \\
\eta_2
\end{bmatrix} = 
\begin{bmatrix}
a_{11} & a_{12} & a_{13} & a_{14} \\
a_{21} & a_{22} & a_{23} & a_{24}
\end{bmatrix} \cdot 
\begin{bmatrix}
\zeta_1 \\
\zeta_2 \\
\zeta_3 \\
\zeta_4
\end{bmatrix}
\]

\[
\begin{bmatrix}
\eta_1 \\
\eta_2
\end{bmatrix} = 
\begin{bmatrix}
a_{11} & a_{12} & a_{13} & a_{14} \\
a_{21} & a_{22} & a_{23} & a_{24}
\end{bmatrix} \cdot 
\begin{bmatrix}
\zeta_1 \\
\zeta_2 \\
\zeta_3 \\
\zeta_4
\end{bmatrix}
\]
Therefore, the adjusted benefit distribution value of colleges and water-saving service companies should be:

\[ W_1 = \varphi(G) + \left(\eta_1 - \frac{1}{2}\right) \times V(S) \]  \hspace{1cm} (9)

\[ W_2 = \varphi(H) + \left(\eta_2 - \frac{1}{2}\right) \times V(S) \]  \hspace{1cm} (10)

The benefit distribution value calculated by the above formula is corrected after considering the four influencing factors. After the amendment, the total income has not changed, but the distribution of benefits has been adjusted among the people in the bureau, and the distribution plan is more reasonable and meets the actual requirements.

4. Case analysis
This case study is the benefit distribution mechanism in the university contract water saving management project.

4.1. Project background
Confirmed by the preliminary pilot work of the Comprehensive Bureau of the Ministry of Water Resources. The H university is the first pilot university in the country for contract water conservation management, H University and GT Water Savings Service Company signed a strategic cooperation agreement in December 2014. The construction was carried out from January to March 2015, and the trial operation was carried out in April. In May, it officially entered the operation and maintenance management period and produced water-saving benefits. The two parties agreed to calculate the benefit according to the water saving rate of 35% of the cap. The contract period is 6 years. The water fee saved in the first three years is owned by GT Water Conservation Company. The water fee saved in the last three years is shared by GT Water Saving Company and H University. Share the benefits, of which GT water-saving company benefit sharing ratio is 80%, 70% and 50%. According to the official website data of GT Water Savings Service Company [20], GT Water Savings Service Company invested 9.58 million yuan in water saving reform funds and paid operating expenses of 700,000 yuan per year. The water consumption of H University in 2014 was 300.53 million tons, totaling 10.668 million yuan. The base year is selected here in 2014. As of December 2018, the project saved a total of 5.74 million tons of water and an annual water saving rate of 50%. As the two parties agreed to distribute the benefits according to the 35% water saving rate of the cap, the analysis of water saving benefit of this case is based on the water saving rate of 35%, and the discount rate is 3.3%.

4.2. Analysis of proportion of benefit distribution of contract for water saving in college based on modified Shapley value method
GT Water Savings Service Company and H University are the core interests of contract water conservation. Firstly determining that their payment functions are \( U_1 \) and \( U_2 \). In the game of contract water saving, GT and H University have their own two pure strategies, \( A, B \): \( A \) means no cooperation, \( B \) stands for cooperation. When both parties choose Strategy \( A \), the two sides do not cooperate, there is no contract water saving project, and its payment function is 0; When GT chooses \( A \) strategy, H University chooses \( B \) strategy, it can't reach cooperation, H University can only choose to undertake the task of water-saving transformation. Compared with professional water-saving service company, its payment function \( U_2 \) must be greater than the payment function \( U_1 \) of water-saving service company; GT chooses \( B \) strategy, H university chooses \( A \) strategy, then there is no contract water saving project; when the GT company chooses the \( B \) strategy, H University chooses \( B \) strategy, the two sides reach a cooperative game. GT company invested money, its payment function is:
After calculation, GT Company needs to invest 13.334 million yuan, and the payment matrix is shown in table 1. According to its payment matrix, it can be seen that in the case of facilitating contract water conservation, cooperation between the two parties can create more benefits.

\[ U_i = \frac{6}{i} C_{F_i} (1 + R)^i + \frac{6}{i} C_{V_i} (1 + R)^i \]  

(11)

According to the utility function of equation (4), the benefits that GT water-saving company can obtain during the cooperation period can be calculated:

\[ NPV_G = \sum_{i=1}^{n} \frac{\alpha_i I_i}{(1 + R)^i} - \sum_{i=1}^{n} \frac{C_{F_i}}{(1 + R)^i} - \sum_{i=1}^{n} \frac{C_{V_i}}{(1 + R)^i} = 354.94 \text{ (ten thousand yuan)} \]

According to the utility function of equation (5), the benefits that H University can obtain during the cooperation period can be calculated:

\[ NPV_H = \sum_{i=1}^{n} \frac{(1-\alpha_i) I_i}{(1 + R)^i} = 314.47 \text{ (ten thousand yuan)} \]

According to the utility function of equation (4), the benefits that GT water-saving company can obtain during the cooperation period can be calculated:

\[ v(G, H) = 669.41 \text{ ten thousand yuan} \]

When GT company is willing to cooperate, and H University is not willing to cooperate, it is impossible to carry out water-saving renovation. There is no contract water saving project, \( v(G) = 0 \); when GT company does not willing to cooperate, and H University is willing to cooperate, at this time. At this time, H University is self-renovating, technical and financial aspects are not comparable to professional water-saving service companies, so the total water saving income can only reach 30%, \( v(H) = 200.823 \text{ ten thousand yuan} \), when both parties are not willing to cooperate, there is no water-saving project. The benefit distribution table of the water-saving core stakeholders is shown in table 2.

| S | G | H | (G, H) |
|---|---|---|-------|
| 0 | 200.82 | 669.41 |

Based on the benefit distribution of the core stakeholders and the Shapley value model, the water saving benefits of GT Water Savings Service and H University can be calculated.

\[ \frac{\left| n! (a-b) - 1 \right|}{n!} = p(S) \]

The calculation parameters are shown in table 3 of the GT Water Savings Service's Shapley parameter table.

The water saving benefit of the GT Water Savings Service Company calculated according to the Shapley value method is:
\[ \phi(G) = (669.41-200.82)/2 = 234.295 \text{ (ten thousand yuan)} \]

**Table 3.** Shapley parameter table for GT water saving services.

| S       | G   | (G, H ) |
|---------|-----|---------|
| V ( S ) (unit: 10,000 yuan) | 0   | 669.41  |
| V ( S-G ) (unit: 10,000 yuan) | 0   | 200.82  |
| | 1   | 2       |
| | 1/2 | 1/2     |

Similarly, the water saving income of H University calculated according to the Shapley value method is:

\[ \phi(H) = 200.82/2 + 669.41/2 = 435.115 \text{ (ten thousand yuan)} \]

From the results of calculating the water saving benefits from the initial Shapley value, H University has the largest water saving benefit, followed by GT Water Savings Service Company. Obviously, there is a discrepancy between the actual situation and the above calculation. The result is not conducive to the widespread promotion of contract water saving, so the above calculation result need to be corrected.

According to the actual situation, the water-saving service company bears the full fee. So the investment ratio of colleges and water-saving service companies is 0:1. Under the premise of collective benefit maximization, the contribution and contract execution degree of universities and water-saving service companies are both 1:1. According to the expert evaluation, the weight of the factors affecting the distribution of benefits is \( \xi = [0.3 \ 0.6 \ 0.05 \ 0.05] \). At the same time, according to the analysis of the risk assessment of similar research, in this kind of project, the risk of the water-saving service company is greater than the risk of the university, so the risk-sharing coefficient of the university and the water-saving service company is 0.25:0.75. According to the above information, the influence factor matrix \( A \) can be obtained:

\[
A = \begin{bmatrix}
\alpha_{11} & \alpha_{12} & \alpha_{13} & \alpha_{14} \\
\alpha_{21} & \alpha_{22} & \alpha_{23} & \alpha_{24}
\end{bmatrix} = \begin{bmatrix}
0 & 0.25 & 1 & 1 \\
1 & 0.75 & 1 & 1
\end{bmatrix}
\]

Normalize the matrix to get the matrix \( B \):

\[
B = \begin{bmatrix}
0 & 0.3 & 0.5 & 0.5 \\
1 & 0.7 & 0.5 & 0.5
\end{bmatrix}
\]

According to formula (8), the comprehensive influence infex \( \eta_1, \eta_2 \) of profit distribution of colleges and universities and water-saving service companies is calculated:

\[
\begin{bmatrix}
\eta_1 \\
\eta_2
\end{bmatrix} = B \times \xi^T = \begin{bmatrix}
0 & 0.3 & 0.5 & 0.5 \\
1 & 0.7 & 0.5 & 0.5
\end{bmatrix} \times \begin{bmatrix}
0.3 \\
0.6 \\
0.05 \\
0.05
\end{bmatrix} = \begin{bmatrix}
0.23 \\
0.77
\end{bmatrix}
\]

Further, according to formula (9) and formula (10), the benefit distribution plan of colleges and water-saving service companies can be obtained:
Obviously, the revised Shapley method is used to redistribute the benefits of colleges and water-saving service companies, and the results have changed greatly. The specific changes are shown in table 4.

**Table 4. Distribution of benefits of core stakeholders before and after the amendment. (unit: 10,000 yuan)**

| Core interest | Before correction | After correction | Trend |
|---------------|------------------|-----------------|-------|
| GT            | 234.295          | 415.04          | ↑     |
| H             | 435.115          | 254.37          | ↓     |

The above result is the optimal solution for the benefit distribution of the contract water-saving project between the water-saving service company and the university. The calculation result of the program is in line with reality, and it can mobilize the enthusiasm of cooperation between the two parties in order to achieve Pareto optimality.

5. Conclusions and recommendations

Contract for Water Saving in College needs to utilize the collective rationality and individual rational thinking mode in cooperative games. In this paper, the Shapley value method is used to calculate the actual water-saving benefit distribution of water-saving service companies and universities. On this basis, four key factors affecting the benefit distribution of contract water-saving management are considered comprehensively, and the revised Shapley value method redistribution section is established. Through this analysis described above, it is known that:

- The conclusion of the contract water-saving management agreement is the result of a cooperative game. The essence of the cooperative game is the distribution of benefits. During the implementation of the project, the water-saving service company undertakes all the capital investment. For the risk sharing, the university mainly bears the political risk. A large number of internal risks are borne by the water-saving service company, and the influencing factors and income distribution are positively related. The water-saving service company should obtain a higher proportion of benefit distribution;

- By correcting the Shapley value method to redistribute the benefits of contract water saving, the benefits of water-saving service companies increased from 2,342,295 yuan to 4,150,400 yuan, and the water-saving benefits of colleges and universities decreased from 4,351,150 yuan to 2,543,700 yuan, water saving benefits transfer from college to water-saving service company. The benefit compensation mechanism formed by this model can generate positive incentives for water-saving service companies, which is conducive to the long-term development of contract water-saving market.

- As far as China is concerned, the potential of the contracted water-saving market is huge, the enthusiasm of the water-saving service company can be mobilized through a fair benefit distribution mechanism. But the enthusiasm of the university for water conservation needs government mobilization, and the government should adopt binding indicators to establish the anti-driving mechanism. Then colleges and universities will actively participate in the contract water-saving market.

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