Identification and behavioral characteristics of stakeholders of Water Diversion Project – based on ‘sustainable supply chain theory’

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ABSTRACT

The South-to-North Water Diversion project, as one of China’s strategic projects, plays an important role in China’s development. It’s been 68 years since the project was conceived, in 2014, the central route project began to supply water. Users along the route are both beneficiaries and project influencers. Their behavior characteristics in the project operation, have become a topic worthy of study. In this paper, based on questionnaire conducted among government departments, enterprises and residents and stakeholder theory, under the theory model of Sustainable Supply Chain (SSC), around the Triple Bottom Line (TBL) including society, economy and environment, the ecological compensation, sewage treatment and reservoir operation management in Xichuan county were investigated and studied. A total of 289 answers were recovered. Through the survey, it is found that: Stakeholders include 15 township governments in Xichuan County, water conservancy project supporting facilities construction companies, ecological industry companies, water supply companies and other enterprises, as well as agricultural growers, rural farmers and non-agricultural residents in Xichuan County. Government stakeholders pursue the development of the overall operation of the project, while enterprises and residents pursue the development of individual economy. Finally, this paper lists the relevant indexes, which provides conditions for behavior evolution analysis and sustainable research of the project.

Key words | questionnaire method, stakeholders, sustainable supply chain, water source of CentralLine Project of South-to-North Water Diversion

HIGHLIGHTS

● It is the research of public welfare water diversion project.
● The stakeholders of water diversion project are identified.
● It combines water diversion project with sustainable supply chain.
● The behavior characteristics of stakeholders are analyzed.
● It lays the foundation for the later behavior game

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INTRODUCTION

This paper takes the water source of the Central Route Project of South-to-North Water Diversion in China as the research object. In terms of benefits, the project has the public goods attribute, since the beginning of water supply on December 12, 2014, 34.8 billion cubic meters of water has been transferred to Henan, Hebei, Tianjin and Beijing, the water supplied has become the main water source in the water receiving area, which directly benefits 120 million people. Due to the water price of water diversion project is relatively low, the comprehensive water price of each entrance such as Nanyang section in Henan Province, south section of the Yellow River in Henan Province (except Nanyang), north section of the Yellow River in Henan Province, Hebei Province, Tianjin City and Beijing City, is 0.18 yuan, 0.34 yuan, 0.58 yuan, 0.97 yuan, 2.16 yuan and 2.33 yuan per cubic meter respectively, the cost base is small, and the growth rate will be relatively small, which has indirect benefits to society, economy and environment, but there is no direct economic benefits, so it is not suitable for techno-economic analysis. In terms of operations, Xichuan County of Nanyang City, the water source, has thousands of ecological forest protection staff, 10,000 mu of savings forest, township ecological economic forest, township sewage treatment plant and National Wetland Park as operation guarantee. The water conveyance channel of the project is 1,432 km long, it flows through many areas and covers a large area of benefit (The editorial department of our journal 2019). Especially, the length of the channel in Nanyang section accounts for the largest proportion of the total length of the main channel, and its benefit area for a single city is the widest. Therefore, this makes the benefit relationship network of the project complex, with more types and quantities of stakeholders (the relevant design is shown in the Figure 1), and the difficulty of benefit coordination is relatively difficult (Gao et al. 2018). In addition, the problem of water pollution still exists in Xichuan County, and the quarrying behavior of residents also occurs intermittently. The difficulty coefficient of sewage treatment in industrial enterprises is high, and the pressure of water quality assurance is high. The utilization of wasteland has certain technical difficulties for the local government and residents.

The stakeholders, as the main body of the project operation, their behavior characteristics have a great impact on the operation of the project. Therefore, the behavior characteristics of stakeholders are studied to ensure that the water source area and the water receiving area along the line have rich water quantity and have high standard water quality, and provide a theoretical basis for the sustainable operation and management of the whole water diversion project system.

At this stage, scholars have done more research on resource allocation (Zhang & Zhang 2017; Li et al. 2018), water price calculation (Interpretation of the adjustment policy of south-to-north water transfer; Wang 2018), safety in operation and management (Fan & Yan 2020), dispatching control (Fan & Yan 2020), and environmental water supply analysis of water diversion project (Fan & Yan 2020), and less research on water diversion project with ‘stakeholders’ as the center. However, at present, the research on stakeholders in other fields has become a hot spot. For example, in the business field, Wu et al. (2020) and Bradley et al. (1999) believe that stakeholders are related to the performance of the company (Bradley et al. 1999; Wu et al. 2020). In the field of management, Kumar et al. (2020) and Ronald et al. (1997) take human behavior characteristics as the basis of management practice (Mitchell & Agle 1997; Kumar et al. 2020). George kassinos et al. (2006) showed that different stakeholders’ characteristics and dependence are related to different environmental performance levels (Kassinis & Vafeas 2016). In the academic research area, de Gooyert et al. (2017), Cairns et al. (2016), Amanda J. Gregory et al. (2020) and Novoa et al. (2016) put forward relevant theoretical framework and analysis methods for analyzing stakeholders (Cairns et al. 2016; Novoa et al. 2016; De Gooyert et al. 2017; Gregory et al. 2019). The above examples provide a feasible path for stakeholders in the field of water diversion project. As the Central Line Project of South-to-North Water Diversion has the public goods attribute, it needs to coordinate the sustainable development of economy, society and environment while meeting the allocation of water resources, which is fully consistent with the Triple Bottom Line(TBL) principle of
‘economy, society and environment’ of sustainable supply chain (SSC) theory. Therefore, this paper will adopt the theory of SSC with TBL principle to explore the behavior characteristics of stakeholders based on the three-dimensional bottom line, and provide reference for the next research plan, that is, to analyze the behavior evolution law of stakeholders. It can enrich the theory system of SSC of water diversion project, and provide a new and reliable theoretical basis for the operation and management of water diversion project.

Figure 1  Schematic diagram of Central Line Project of South-to-North Water Diversion.

Central Route Construction Management Bureau of South to North Water Transfer Project

- South to North Water Diversion Middle Route Water Source Co., Ltd
  - Taocha canal head of Danjiangkou
  - Water
  - Headworks Branch
  - Henan Branch
  - Hebei Branch
  - Beijing Branch
  - Tianjin Branch
  - Water plant companies in various regions
  - Danjiangkou Supporting Construction Management Bureau
  - Henan Construction and Management Bureau
  - Hebei Construction and Management Bureau
  - Beijing Supporting Construction Management Bureau
  - Tianjin Supporting Construction Management Bureau
  - Water users

Supplier: Waterhead companies

Distributor: Waterhead companies

Retailer

Consumer
To sum up, the introduction describes the following points:

(1) The background and characteristics in terms of South-to-North Project.
(2) The purpose and significance of my research.
(3) Other people’s research and my innovation.

In addition, the second part of this paper consists of SSC theory and stakeholder theory, including questionnaire design, distribution, recovery test, and the combination of theory and questionnaire development. The third part is about the identification of stakeholders and behavior characteristics analysis. The fourth part is a summary of this paper, including the summary of innovation and research deficiencies.

This paper studies the behavior evolution characteristics of stakeholders in Xichuan County. Combined with the TBL theory of SSC, this paper discusses the interest demands of local stakeholders from the perspectives of ecological compensation, water pollution control and reservoir operation management, and analyzes their behavior characteristics based on the theory of SSC.

RESEARCH THEORIES AND METHOD

Based on the questionnaire method and stakeholder theory, this paper preliminarily identifies and classifies the stakeholders in the SSC of the project, analyzes the behavior characteristics of various types of stakeholders, and obtains the corresponding indicators, which lays the foundation for the follow-up research on the behavior evolution.

Sustainable supply chain theory

Concept of SSC

With the continuous development of the global economy, all walks of life put forward higher and higher requirements for the response speed and service quality of the supply chain, leading to the negative impact of production activities on society, economy and environment. In response to the call of the national ‘five-in-one’ overall layout, green supply chain and SSC have gradually emerged.

SSC theory originates from green supply chain. In 1994, Drumwright proposed that green organization activities such as purchasing, processing and production of enterprises are closely related to the economic and social benefits of enterprises (Drumwright 1994). In 1997, Elkington proposed that the TBL of sustainable development of enterprises is the natural environment, the collective benefits of society and the economic goals of enterprises (Elkington 1998). After a comparative study, Zhang et al. (2019) found that the SSC theory is an extension of green supply chain theory, which is reflected in the dimension from environmental dimension to social economy dimension (Zhang et al. 2019). In conclusion, SSC theory is the development of green supply chain theory, which focuses on social responsibility consciousness, sustainable economic development and natural environment protection.

The implementation of social sustainable development is to meet the requirements of harmonious coexistence between human and nature. Economic sustainable development is the common core goal of the world. Environment is the carrier of resources, and the sustainable development of environment is the basis of sustainable development of economy. Therefore, the comprehensive benefits of society, economy and environment should be taken as the basic standard to test the sustainability of development.

Characteristics of SSC

SSC is an extension of green supply chain from a macro perspective, including the embodiment of environmental protection and social responsibility consciousness in supply chain management. The SSC pays more attention to the sustainable development of the environment, and takes it as the prerequisite, and takes the sustainable development of economy as the basis, so as to achieve the goal of social sustainable development. It is produced under the conditions of low utilization efficiency and irregular distribution of natural resources. Under the restriction of the TBL, it pursues the ultimate goal of optimal economic continuity, coordination between nature and environment, and social harmony, so as to achieve the comprehensive optimization of the above three and the sustainable development of nature and society.
Stakeholder theory

Classification of stakeholders

Identification and classification of stakeholders is based on Mitchell’s attribute classification. It includes power, legitimacy and urgency. Power refers to the ability of stakeholders to influence relevant decision-making factors. Legitimacy means that stakeholders have the characteristics of being recognized by laws, regulations and the public, they have certain decision-making power, and can give advice, and the decision-making behavior means that the behavior of stakeholders is effective and persuasive. Urgency means that the suggestions of stakeholders can be considered or adopted by decision makers. Stakeholders with all three attributes are classified as definite type, those with one of the three attributes are classified as potential type, and those with two of the three attributes are classified as expected type (Wang 2017).

Definition of stakeholder attributes

Based on the Mitchell attribute classification method (Feng et al. 2019), combined with the specific engineering environment of the Central Route Project of South-to-North Water Diversion, the power, legality and urgency of stakeholders are redefined, so as to identify the core stakeholders of Xichuan County, the water source area of the project.

(1) Power: Also known as influence, which refers to the ability of an individual or organization to influence the relevant factors of decision-making. For example, the enterprises and residents related to the water diversion project, have the ability and power to influence the management and decision-making in the operation of the project.

(2) Legitimacy: It can also be understood as decision-making power, or power owner. It means that an individual or organization has the ability to be recognized by laws, regulations and the public, has certain decision-making power, can put forward suggestions, and has effective and convincing decision-making behavior. For example, the government or institution related to the South-to-North Water Diversion Project has the right to calculate the water price or determine the relevant management business during the operation of the project.

(3) Urgency: It can be understood as the degree of concern, which refers to the degree of adoption of proposals or opinions by decision makers. Such as residents, enterprises and other stakeholders, their suggestions or opinions will be valued by the relevant decision-makers of the diversion project.

Questionnaire survey

Questionnaire design

In order to understand the internal professional problems of water diversion project and make the research more in line with the reality, the water source area of the central route project, namely Xichuan County, Nanyang City, Henan Province, was investigated. Egholm et al. (2020) suggested that the questionnaire design should have an iterative and incremental cycle (Egholm et al. 2020). In this paper, the relevant documents such as subsidy funds, water pollution control and reservoir operation management were obtained from the portal website of People’s government of Xichuan County (Portal website of Xichuan County People’s Government n.d.). Relevant information was captured from official documents. The respondents are taken as primary indicators. Social responsibility awareness, economic sustainable development and natural environment are taken as secondary indicators. Taking the reservoir operation and management, water pollution control, ecological compensation as the fundamental starting point, according to the relevant characteristics of the survey object and other conditions, this questionnaire lists the problems related to water diversion project. Then, according to the corresponding investigation objects and their own factors, the inquiry mode and question form are designed. Considering the logical relationship between the questions in the questionnaire, the resident’s questionnaire is initially formed. The designed preliminary questionnaire was distributed to relevant experts, and the questionnaire was modified by collecting data and consulting experts’ guidance. The questionnaire is designed around the specific management...
business and related projects. The questionnaire absorbs the shortcomings of the preliminary questionnaire, popularizes the questions, and considers the logical relationship of the questions. The connotation of the question should be mapped to the three attributes of the stakeholders. The options should be set according to the relevant data of the official documents, and the final formal version of the questionnaire is shown in Table 1.

**Questionnaire distribution**

The preliminary prediction questionnaire was distributed to relevant experts with suggestions received, and the questionnaire was improved to avoid low-level errors.

The formal questionnaire was distributed through wenjuanxing (a questionnaire APP) and field survey. With the help of students from the townships of Nanyang City and Xichuan County, the online questionnaire was forwarded to the local respondents in line with this study. The field investigation was presided over by Yang Jing, deputy director of Xichuan County Government Office. Leaders from Natural Resources Bureau, Ecological Environment Bureau, Housing and Construction Bureau, Forestry Bureau, Agriculture and Rural Bureau, Science and Technology Bureau, Water Conservancy Bureau, Immigration Bureau and other departments participated in the discussion, and the questionnaire was distributed uniformly. In order to avoid the accumulation phenomenon of questionnaire filling, 10 different links were designed for the questionnaires with the same content, and the upper limit for filling the questionnaire was set to 50. Each questionnaire was set with two yuan gift, and the IP address of each link was limited, which improves the effectiveness of the questionnaire. Each link was sent to residents of two villages and towns. A total of 8 links were distributed to 15 towns and villages. The remaining two links were randomly distributed to Longcheng street, Shangsheng street and all village and township authorities in Xichuan County, which further increased the accuracy of questionnaire distribution.

**Collection and test of questionnaire**

A total of 289 questionnaires were collected, all of which were valid. SPSS was used to test the validity and reliability of 14 items in the questionnaire, as shown in Tables 2 and 3. The KMO value of the residents’ questionnaire is 0.86, and the Cronbach’s alpha is 0.834. The applicability and reliability of the residents’ questionnaire are high. It can further identify the stakeholders among residents in Xichuan County and analyze their behavior characteristics, so as to select indicators for evolutionary analysis.

**IDENTIFICATION AND BEHAVIOR ANALYSIS OF STAKEHOLDERS**

**Identification of stakeholders**

Through expert interviews, it is learned that the township governments of Xichuan County, as the leaders of township residents, are paying real-time attention to the development of ecological industry and sustainable economic development in Xichuan County. Such as the coverage rate of crops, forestry and fruit industry, which has reached more than 50% of the usable area of local towns. The local ecological industry increases the employment opportunities of farmers and improves the level of local economic development. The planting of crops and fruit trees greatly improves the local water quality environment. The local government takes ‘ecology first, water quality first’ as the concept of developing Xichuan County. The above-mentioned government actions meet the requirements of the legal system, reflect the demands of the people of Xichuan County, and reflect the sense of responsibility. Therefore, the township governments in Xichuan County are stakeholders with high legitimacy.

According to the expert interviews, the flood control and irrigation, river management, ecological production, water supply and other water diversion project related enterprises in Xichuan County, have been given different functions, which reflects that enterprises have certain legal attributes. Residents and governments have different requirements for different types of enterprises’ services, which indirectly reflects the emergency nature of enterprises. The management right of the enterprise reflects that the enterprise has the attribute of power. Therefore, the enterprise is a stakeholder who integrates legality, urgency and power.
Table 1 | Formal residents questionnaire

| Item                  | Questionnaires                                                                 | Explanation                                                                                     |
|-----------------------|--------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
| Essential Information | (1) What is your identity? (2) Which town do you live in?                      | (1) Basic information of respondents                                                              |
| First Industry        | (1) Before the water diversion project is put into operation, what is your monthly income range by planting crops or aquaculture? (2) What is the impact of the water diversion project on your crops or aquaculture? | (1) Reflect the government’s guarantee for the life quality of local residents and reflect the economic dimension of triple bottom route (TBL) (2) Reflect the level of local economic development |
| Secondary and Tertiary Industries | (1) Before the water diversion project is put into operation, what is your monthly income range? (2) After the water diversion project is put into operation, what is your monthly income range? | (1) Reflect the level of local economic development                                               |
| Subsidy Policy        | (1) How well do you know about the subsidy policy after the water diversion project in your hometown is put into operation? (2) How much is the annual ‘farmland productivity protection subsidy’ fund in your hometown? (3) How much is the ‘agricultural machinery purchase subsidy’ fund in your hometown? (4) How satisfied are you with the subsidy fund policy in your hometown? | (1) Reflect the cultivated land area and water soil conservation of local farmers (2) Reflect the level of agricultural modernization and economic development |
| Life Impact           | (1) Before the water diversion project is put into operation, what is the range of your monthly water fee? (2) After the water diversion project is put into operation, what is the range of your monthly water fee? (3) After the water diversion project is put into operation, how much will it improve your life quality? | (1) Reflect the improvement of life quality                                                        |
| Engineering Measures  | (1) What do you think is the main cause of local water pollution? (2) What is the annual reduction range of chemical fertilizer and pesticide consumption compared with that before the project operation? (3) How about the operation of sewage treatment facilities in your hometown? (4) How about the construction of warning signs for water source protection in your hometown? (5) How about the operation and management of drinking water safety facilities in your hometown? (6) How satisfied are you with the overall situation of small-scale water conservancy projects in your hometown? | (1) Reflect the improvement of rural environment and farmers’ attention (2) Residents’ satisfaction with the improvement of water pollution (3) Reflect the government’s attention to water source protection (4) Reflect the government’s attention to local water conservancy and its contribution to the construction of small-scale agricultural water conservancy projects |

(continued)
The analysis of the residents’ questionnaire found that after the operation of the water diversion project, 88% of the agricultural growers' consumption of chemical fertilizers and pesticides has been reduced by half, directly reflecting the positive behavior of agricultural growers in protecting the natural environment and water quality, and indirectly reflects that the agricultural growers have a great influence on the water diversion project. The better operation of sewage treatment facilities, the construction of warning signs related to water quality protection and the operation and management of rural drinking water safety facilities indirectly reflect the government’s attention to agricultural growers. 89.3% of the farmers were satisfied with the rural small-scale water conservancy projects or above, which indicated that the agricultural growers had the right to supervise the government work. Therefore, the agricultural growers were stakeholders with power, urgency and legitimacy. 80% of the coverage area of the sewage pipe network reflects the local government’s support and cooperation on the production of rural farmers. The behavior of rural farmers to protect the environment is directly related to the behavior of the government departments to protect the water of Qinghe River. Therefore, the rural farmers have the attributes of power and urgency. Non-farmer households such as individual industrial and commercial

| Table 1 | continued |
| --- | --- | --- |
| Item | Questionnaires | Explanation |
| Non Engineering Measures | (1) What is the coverage of sewage network layout in your hometown? | (1) Explain the degree of residents’ cooperation with the construction of pipe network |
| | (2) How often do the relevant government departments in your hometown organize river cleaning? | (2) Reflect the residents’ response to the local government |
| | (3) The frequency of activities endangering the safe operation of small reservoirs in your hometown? | (3) Indirectly reflect the water pollution degree and environmental awareness of residents |
| | (4) How often do the managers of small reservoirs in your hometown inspect the operation and management of dams? | (4) Indirectly reflect the effectiveness of the government’s management and punishment of these acts |
| | (5) How often do the managers of small reservoirs in your hometown maintain the reservoir projects? | (5) Reflecting the government's sense of responsibility for reservoir protection and operation |
| | (6) How satisfied are you with the performance of your hometown government in flood control? | (6) It shows that the government departments pay attention to the timeliness and effectiveness of flood control work, and pay attention to reservoir operation and people’s property safety |
| Opinions and Suggestions | (1) What economic benefits do you expect from the water diversion project? | |
| | (2) What environmental benefits do you expect from the water diversion project? | |
| | (3) What social benefits do you expect from the water diversion project? | |
| | (4) What other conveniences do you expect from the water diversion project? | |
| | (5) What inconvenience does water diversion project bring to you? | |

| Table 2 | Validity test of resident questionnaire |
| --- | --- | --- |
| KMO sampling suitability quantity | .860 |
| Bartlett sphericity test Approximate chi square | 2224.782 |
| Freedom | 91 |
| Significance | .000 |

| Table 3 | Reliability test of resident questionnaire |
| --- | --- | --- |
| Cronbach’s alpha | Number of Items |
| | 14 |

Through the analysis of the residents’ questionnaire, it is found that after the operation of the water diversion project, 88% of the agricultural growers’ consumption of chemical fertilizers and pesticides has been reduced by half, which directly reflects the positive behavior of agricultural growers in protecting the natural environment and water quality, and
households, enterprise workers, business owners and government employees, have a positive attitude towards the operation of sewage treatment facilities in their hometown, which reflects the government’s attention to the water quality and environment in their hometown. Therefore, the above-mentioned workers have a high emergency attribute.

To sum up, the identification table of water source stakeholders is shown in Table 4.

**Analysis of behavior characteristics of core stakeholders**

While the South-north water diversion project fulfills its life-based obligations, the behavior of its core stakeholders plays a very important role in the operation of the project. In order to ensure the quality of water environment and meet the TBL benefits of society, economy and environment, it is necessary to understand the behavior tendency of stakeholders and analyze the behavior strategies of multiple stakeholders when their own interests, national interests and social interests are involved, that is, whether their behavior is related to the protection of water quality. Based on expert interviews and questionnaires, this paper analyzes the behavior of the core stakeholders in Xichuan County and the water source areas of the central route of the water diversion project, and discusses their internal logical relationship. Among them, the core stakeholders of government refer to 15 township governments in Xichuan County. Enterprise core stakeholders refer to private enterprises such as water conservancy project supporting facilities construction enterprises, ecological industry enterprises and water supply companies. The core stakeholders of residents refer to agricultural growers and rural farmers.

**Government**

Government of the water source area of the project is the advocate and pioneer to increase the TBL benefits of the SSC. The local governments have a wide range of functions, their responsibilities and obligations are different when they are given different powers by law, and different responsibilities and obligations. It is a potential stakeholder with high legal attribute, it plays a guiding role for local enterprises and residents, can make water resources meet the growing needs of local people, coordinate the relationship of local stakeholders, and urge all stakeholders to fulfill their obligations of protecting water quality.

The local government’s ecological industry construction in the water source area can not only improve the utilization rate of the local wasteland, but also have a positive effect on the water quality of the project and the local soil and water conservation. The characteristic industry can be used as the sideline of local residents, so as to increase residents’ income and improve the level of local consumption. It not only improves the quality of life of local residents and the development of enterprises, but also ensures the sustainable development of local economy, which indirectly reflects the requirements of the TBL. The layout of local pipe network by government departments not only provides hardware conditions for water conveyance facilities, but also ensures the social and natural environment. The construction of sewage treatment system improves the water resources and environment of the water source area, and the local government obtains immeasurable indirect benefits from the natural environment factors. The local government’s expenditure on ecological environment protection can promote the local residents and enterprises to protect the ecological environment, but it also faces challenge of the construction costs of tourist attractions, wetland protection, agriculture and forestry planting, fishery, animal husbandry and

| Table 4 | Identification of stakeholders in water source area |
|---------|-----------------------------------------------|
| Interest subject | Identity | Attributes | Type |
| **Government** | Township governments | Legitimacy | Potential Type |
| Enterprises | (1) Water conservancy project supporting facilities construction enterprises | Legitimacy | Urgency Power | Definite Type |
| | (2) Ecological Industries | | |
| | (3) Water supply companies | | |
| Residents | (1) Agricultural growers | Power | Urgency Legitimacy | Definite Type |
| | (2) Rural farmers | | |
| | (3) Non farmers | | |
breeding. The government’s maintenance of the local resource allocation related to the project, including the hardware configuration of the pipeline network and system for flood control, and the software configuration for information network security, has a positive effect on the sustainable development of the local economy, and can bring positive benefits to the society and the natural environment. If the cost is less than the benefit, the government will take actions related to the water quality protection. When the cost overweighs the benefit, if the corresponding measures are not taken, the water quality will be damaged, which will result in failure of achieving the TBL of SSC.

The government is a stakeholder based on the triple bottom line principle. If the government chooses to protect water quality, it can obtain benefits by collecting sewage treatment fees from enterprises. Through the issuance of relevant subsidies, the construction of pipe network, sewage treatment system and ecological industry, a small amount of costs will be generated, and indirect benefits will also be obtained in terms of economic sustainable development benefits and natural environment benefits. If the government does not choose to do so, the sewage treatment fee collected will be reduced, and the cost generated through related construction will be higher, and there will be no invisible benefits.

**Enterprises**

Both private enterprises and engineering construction enterprises related to the operation and management of the project are the performers of the triple bottom line benefits of sustainable supply chain. They are the definite stakeholders with high legitimacy, urgency and moderate power and also the beneficiaries of the project. The former is related to the operation of the project and the use of water, while the latter provides water diversion, project investment and operation, technical support, safety inspection and other services for the project, as well as security service such as facilities maintenance, project recovery, and asset value preservation and appreciation etc.

The private enterprises in the water source area have the functions of sewage treatment and soil & water conservation. The special crops planted by ecological enterprises and the aquaculture of fish, shrimp and hairy crabs have the function of purifying groundwater. Industrial development needs cost input, but it will also obtain business income and the overall benefits from social economic environment. When the operating income overweighs the total investment cost, the enterprise will consciously choose to protect water quality for industrial development. Engineering construction enterprises have the business of supporting project construction, such as flood control of local water diversion project, construction of irrigation project, construction of farmland water conservancy project in Xichuan County. The above construction projects provide value-added services for the project, which are the guarantee basis for the smooth operation of the project. As the main body of paying sewage treatment fees, enterprises will face reduced cost when they have certain emission reduction measures or low-carbon concept and consume fewer resources. Before bidding for ecological industry or related projects, enterprises will compare the benefits of water quality protection with their own investment costs, and then make a decision.

Enterprises are stakeholders based on the principle of economic bottom line. If an enterprise chooses to protect water quality, it can get corresponding benefits in production and operation. Although there are costs in sewage treatment, engineering construction and resource allocation, intangible benefits can be obtained in terms of social responsibility, sustainable economic development and natural environmental protection, which meets the TBL benefits of SSC. Otherwise, the benefits and costs of all aspects of the enterprise need to be re-measured.

**Residents**

As the major beneficiaries of the project in the water source area, farmers have the right and obligation to supervise the project operation. They can give suggestions for the smooth implementation of the project. They are definite stakeholder with high power, moderate emergency and low legitimacy. The water in the project is widely used by residents, in addition to being used for crop cultivation, it is also used for livestock drinking, garden maintenance, fishery and animal husbandry development.

Most of the farmers’ work at the water resource area has the nature of providing eco-environmental compensation
services, that is, sacrificing the opportunity and time to go out for development and putting their energy and cost into eco-environmental compensation. Therefore, farmers are an important part of the compensation subject. For the farmers who meet the requirements of low-carbon operation, the government will give corresponding subsidies for farmland productivity protection. Among the respondents, 83.3% of the farmers will receive subsidies of less than 800 yuan per year, and 76.2% of the farmers have a positive attitude towards the subsidy policy. This is conducive to the formation of a virtuous circle of low cost and high income under the concept of low-carbon production of farmers. If farmers properly treat the sewage generated in the process of production and operation, the water quality can be protected and the cost of sewage treatment borne by relevant governments and enterprises will be reduced, more funds can be used for project maintenance, and finally the water price will be reduced accordingly, so farmers will get some benefits in terms of reduced water price. 88% of farmers reduced the use of fertilizers and pesticides by 50%. The behavior of farmers reducing the use of chemical fertilizers can be compensated by the society and the natural environment.

Farmers are stakeholders based on the principle of economic bottom line. If farmers choose to protect water quality, they will obtain higher benefits from government subsidies, the cost of water consumption will be reduced, and TBL benefits will be met. Otherwise, the benefits of all aspects will be reduced, the cost of water consumption will be increased, and the TBL benefits of SSC will be broken.

To sum up, the behavior characteristics of the government, enterprises and residents are shown in Table 5.

**CONCLUSIONS**

Based on the theory of SSC, this paper improves the research of water diversion project based on the TBL of benefits, and investigates the behavior of stakeholders from the perspective of the operation and management of water diversion project by using methods such as questionnaire, expert interview, etc., so as to understand the behavioral tendency and behavioral logic of the respondents. On the basis of the forecast version, the formal version of the questionnaire is given. The questionnaire design is more rigorous and reasonable. A questionnaire with

| Core stakeholders | Type       | TBL principles       | Behavior characteristics         | Revenue Factors (RF)       | Cost Factors (CF)       | Strategy selection                        |
|-------------------|------------|----------------------|----------------------------------|---------------------------|-------------------------|--------------------------------------------|
| Government        | Potential  | Social Economic Environment | Pursue overall operation     | (1) Sewage treatment fee  | (1) Sewage treatment system | Protect (RF ↑, CF ↓) Unprotected (RF ↓, CF ↑) |
| Enterprises       | Definite   | Economic             | Pursue the development of individual economy | (1) Ecological recharge  | (2) Water subsidy       | Protect (RF ↑, CF ↓) Unprotected (RF ↓, CF ↑) |
| Rural residents   | Definite   | Economic             | Pursue the development of individual economy | (1) Ecological recharge  | (2) Water recycling Revenu | Protect (RF ↑, CF ↓) Unprotected (RF ↓, CF ↑) |
popular problems, perfect content, clear logic and rigorous structure is designed. Finally, the stakeholders of SSC are identified, including 15 township governments in Xichuan County, water conservancy project supporting facilities construction companies, ecological industry companies and water supply companies, agricultural growers, farmers and non-farmers. The government stakeholders pursue the development of the overall operation of the water diversion project, while the enterprise and resident stakeholders pursue the development of the individual economy.

Based on the above main conclusions, this paper draws the following enlightenment:

(1) The main income of the government comes from the tax revenue of sewage treatment of enterprises, and the income is applied to the infrastructure construction of the overall development of urban and rural areas. Compared with the quantitative tangible assets, the indirect benefits brought by the government’s positive cooperation behavior, that is, the actual actions to protect water quality, may have a lower promoting effect on the government.

(2) The main income of enterprises comes from water price, and the formulation of water price is subject to the government. Due to the limited income of enterprises, the probability of protecting water quality may be reduced. It is necessary to formulate relevant mechanisms, such as mandatory protection mechanism or reputation evaluation mechanism, so as to improve the quantity of water that has been protected.

(3) The main income of farmers comes from financial subsidies, and their cost is water charges. Their income has a great correlation with the government, and their cost has a direct correlation with enterprises. If the government gives higher subsidies for water use, the residents' enthusiasm to use water correctly will be improved, and the enterprise's revenue will be relatively increased. The government's income mainly comes from the enterprise's income tax, and the relatively increased revenue will be used for infrastructure construction. Therefore, increasing water subsidy is a potential switch to achieve a virtuous circle.

Through questionnaire survey and expert interview, the theory of SSC and stakeholder theory are penetrated through the entire paper, which provides a theoretical basis for the operation and management of water diversion project. In this paper, the identified stakeholders of SSC of water diversion project can be further supplemented and classified. The analysis of behavior characteristics is limited to the questionnaire survey, and there is still room for further excavation.

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DATA AVAILABILITY STATEMENT

All relevant data are included in the paper or its Supplementary Information.

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