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PPP Mode of Water Pollution Prevention and Control Project Based on BP Neural Network

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Abstract: With the development of economy, environmental problems are becoming more and more prominent, especially the water environment has received extensive attention from the society. As a new type of investment and financing model, the PPP model has obvious advantages, especially in the field of water pollution prevention and control, and has received widespread attention from the society. The purpose of this work is to study the PPP model of water pollution prevention and control engineering based on BP neural network. On the basis of in-depth study of domestic and foreign PPP model literature, combined with relevant successful PPP cases, this paper studies typical cases of water pollution control PPP projects in City A and their corresponding suggestions, identification and demonstration of PPP projects, stages of project implementation and deliver. It is recommended to set up PPP projects of "control units", implement mixed ownership of construction supervision, and adopt the method of "simultaneous projection of cities and counties". The total investment of the project is 726.1945 million yuan, which is mainly used to purchase the fixed assets of the project. Sensitivity analysis of the project shows that if the operating income decreases by 5%, the internal rate of return (IRR) of the total investment will drop to 6.72%, and if the operating cost increases by 5%, the IRR of the project will decrease. The total investment will be reduced to 7.52%.

1. Introduction

With the continuous expansion of cities, urban development is faced with problems such as water pollution and scarcity of water resources. Water environment problems have become a common problem in major cities. At the same time, the quality of water environment governance is closely related to the production and life of citizens, and has attracted the attention of the general public [1]. The essence of the PPP model is to introduce social capital, public services are provided

by the enterprise, the government purchases the service, and the dual roles of the operator and the regulator are switched to the regulator. In this way, the promotion of the PPP model across the country has a wider space, and the PPP model has become an important development guide for government agencies to invest in infrastructure and financial reforms [2].

By entering the keywords of "water pollution" or "water pollution prevention and control" in multiple databases such as CNKI, Chinese scientific journal database, and Wanfang Data, it is found that there are many domestic and foreign studies on water pollution prevention and control. Y Picó discusses the latest techniques and equipment for MP characterization (Raman and Fourier transform infrared spectroscopy and microscopy, pyrolysis and pyrolysis gas chromatography, imaging techniques, etc.) and addresses the multidimensional nature of the problem. The view also summarizes and provides up-to-date data on the source and occurrence, migration and fate of MPs in aquatic ecosystems, and the conditions and factors that influence dispersal. In addition, it describes how technologies and technical tools such as advanced water treatment will help control, reduce or even eliminate MP pollution in the near future [3]. Talabi AO examines groundwater contamination and discusses possible solutions. Pollution sources can be divided into two categories: point source pollution and non-point source pollution. Source-based pollution (eg municipal wastewater treatment plants and industrial applications, concentrated evaporation from shallow aquifers, water source pollution, and rock oxidation at geothermal/volcanic sites) is the only local source of pollution, not source pollution (eg, human land use) land Utilizing changes, chemical reactions of elements in air or water, sources of pollution from agricultural areas to rivers) are characterized by multiple discharge points. Point sources are relatively easy to identify, measure and control. On the other hand, non-point source pollution is difficult to trace to the discharge point, and it is difficult to monitor and control. The incidence of contamination depends on the level of impurities being delivered. Contaminants can be removed by filtration, adsorption, chemical processes, microbial digestion and dilution [4]. It can be seen that the research on water pollution prevention and control at home and abroad mainly focuses on how the government manages and takes measures, what control technologies are available, the analysis of pollution causes, and the impact on human beings.

This paper will conduct a case analysis of the PPP project of water pollution control in City A through the research and analysis of domestic and foreign theories, and draw relevant suggestions on the specific application of the PPP model. In order to solve the problems encountered in the promotion of my country's PPP model, investment status, improve the quality of public services, and provide ideas for local governments to implement PPP projects, to achieve a win-win situation of government-enterprise cooperation, sustainable social development and urban environmental protection. At the micro level, this is a transformation of the operation mode of social capital, the government and investment and financing platforms; at the macro level, the government will carry out reforms to transform the market system and functions.

2. Research on PPP Mode of Water Pollution Prevention and Control Project Based on BP Neural Network

2.1. Structure of BP Neural Network

An artificial neural network is a statistical learning model inspired by neural networks in biology (the way neurons receive stimuli and transmit signals to the nucleus through nerve endings). Nonlinear dynamic systems [5-6].

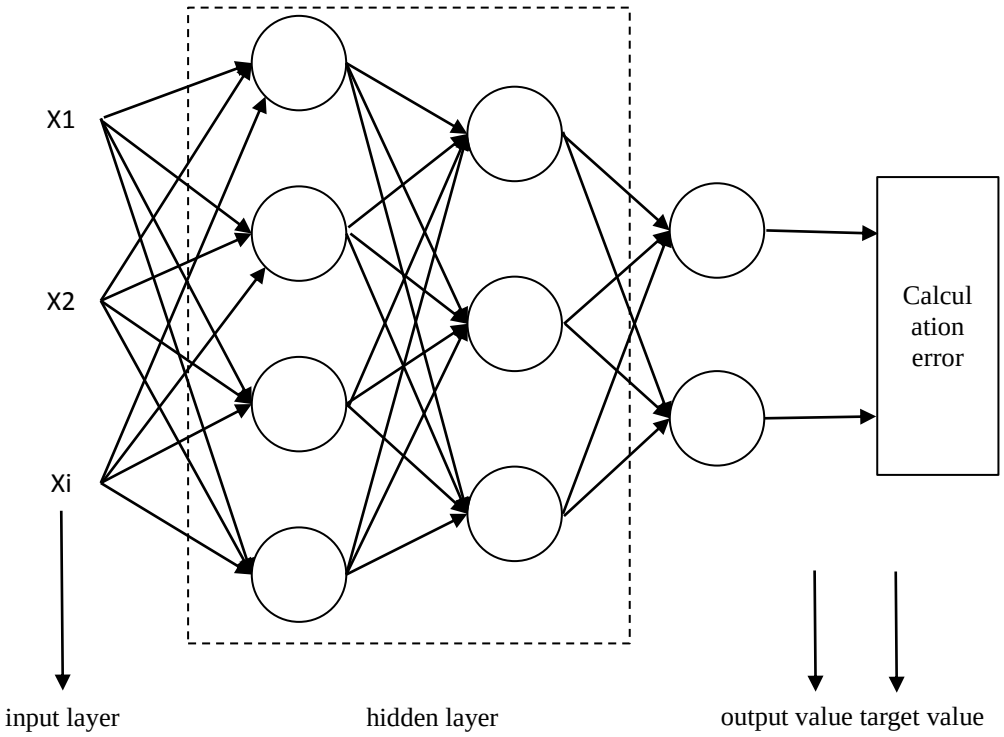

Figure 1. BP neural network model

The structure of the BP neural network model is shown in Figure 1. The first is the forward multi-layer feedforward process: the network randomly assigns initial connection weights and thresholds to each neuron according to the number of hidden layers and hidden layer units set by the user. (also called bias), the input layer data is processed by linear weighting of weights and thresholds as the net input of the hidden layer, and the result of the output layer is obtained after the nonlinear operation of the activation elements of the neurons in the output layer. Then the process is as follows: use the loss function to calculate the total error between the output layer output and the expected result, and then use the loss function to obtain parameters such as the partial derivative and density of the neuron. Each layer is optimized according to a different optimal algorithm, so that you can adjust the parameters to update the guide to reduce the error, set the step size to reduce, and adjust the weights and thresholds to continue to reduce the error until an acceptable level or predetermined Study numbers [7-8].

2.2. Experience in Water Pollution Control

(1) Innovative financing models

On the basis of government investment, expand financing channels, absorb foreign capital or private capital, and realize the diversification of investment subjects and the corporatization of project legal persons. At the same time, the government has increased policy support, and achieved the balance of construction funds by setting aside available coastal land and cooperating with the project company to generate special income and transferring part of the sewage treatment costs [9-10].

(2) Clarify the functional orientation of the river

Different operation directions of rivers determine different management strategies and investment needs, and on this basis determine the water quality goals to be achieved through pollution control. The Outer Qinhuai River has various functions such as flood discharge, water supply and urban landscape, but as an urban river, its main function is to reduce flooding during flood season, and then provide landscape and recreational activities during flood season. Non-flood duration. This move clarifies that the pollution control of the Outer Qinhuai River must meet the water quality requirements, and the control goals are further clarified [11-12].

(3) Combining environmental restoration with improvement of people's livelihood and cultural expression

From the overall governance point of view, a "livable, beautiful and harmonious" living environment has been created for citizens by improving traffic, increasing green space, and improving public services. River-related historical allusions, literary masterpieces and folklore, highlighting the cultural heritage, have become an important way to inherit the historical context of Nanjing[13-14].

2.3. Definition of PPP Mode

As a new type of public service production mode, the PPP model refers to the cooperation between the government and capital to provide the public with better public services and solve public interest problems. In the franchise agreement and conditions, by introducing "market competition and incentive restriction policies", the interests of both parties are fully utilized to establish a long-term partnership [15-16].

The PPP model is a new type of investment, financial transaction and project management model. On the basis of "mutual benefit and win-win, sharing risks and sharing benefits", improve the service level of the public sector to the society. The essence of the PPP model is that the government converts the provided public service investment into social capital investment in construction, management and operation and obtains benefits, and the government grants the rights of the capital part to the franchise or the capital contracting group pays the fees for it. According to the contract, the project materials will be disclosed to the public after the contract is completed. Therefore, PPP projects have a life cycle, which generally includes investment and financing, construction, operation, management, delivery and other links [17-18].

3. Overview of Water Pollution Control PPP Model Projects

3.1. Project Implementation Plan

City A water pollution control PPP project is a large project. In this large project, according to the principle of territorial management, the project is divided into municipal water pollution control PPP projects and county water pollution control PPP projects. Packaged new PPP water pollution control projects, such as Mianzhu, combined water supply and drainage, packaged into a PPP project integrating urban and rural water supply and drainage in City A, and organically combined water supply and sewage treatment.

This project consists of sub-projects in various places, including the construction of 5 industrial park sewage treatment projects and supporting pipe network, the construction of 25 township sewage treatment plants and supporting pipe network projects under construction, and the transportation of all sewage treatment facilities projects. In addition, it also includes black and odorous water bodies and phosphogypsum slag field remediation projects that affect the water

environment quality of the basin, with an estimated total investment of more than 3 billion yuan.

3.2. PPP Project Transaction Structure

(1) Operation mode

According to the principle of territorial management, all parts of City A authorize a government department or government platform as the government party of the project implementation agency according to their own actual conditions, and authorize relevant departments to exercise supervision and management power over the project. The specific authorization can be exercised through government documents, meeting minutes, etc. reflect. The project company will pay the TOT transfer fee to the government and carry out follow-up work.

(2) Transaction structure

The TOT project of this project is planned to be invested in the PPP project department as capital, and the proposed investment will be contributed by the government platform company and social capital in a ratio of 2:8. The capital part of the BOT and ROT expansion and reconstruction projects is planned to be fully funded by social capital. In the end, the contribution ratio of government platform companies and social capital to the entire project is 2:8, and the government accounts for 20%, so the change in the equity ratio is determined according to the actual situation. The difference between the registered capital of the project company and the project capital will contribute to the social capital earned, and the project company will enter the project company through capital increase and share expansion.

3.3. Analysis of Comparative Advantages of Risk Sharing

According to the PPP model, the purpose of all parties involved in water pollution prevention and control activities is to reduce risks and increase benefits. Analysis of the status quo of water pollution prevention and control PPP projects and the comparative benefit analysis of independent investment.

Assuming that the total capital of the partners is 1, the capital invested in the prevention and control of water pollution is I ($0<I\leqslant 1$), the expected return of some business transactions is Wr, and the risk difference is. If the funds are used for zero-risk investment projects, and the risk-free rate of return is Wf (Wr>Wf), the expected return is

$$E(I) = I \cdot W_r + (1-I) \cdot W_f \tag{1}$$

Under the PPP model, it is assumed that the public sector investment amount is Ig and the private sector investment amount is Ip, then I=Ig+Ip.

$$E(I_g) = I_g \cdot W_r + (I - I_g) \cdot W_f \tag{2}$$

4. Case Analysis of Water Pollution Control PPP Projects

4.1. Total Project Investment

The total investment of the project is 726.1945 million yuan, which is mainly used to purchase the fixed assets of the project. See Table 1 for the investment amount of each item.

Table 1. Details of project investment amount (unit: ten thousand yuan)

Name	Private capital	Bank loan	Subtotal
Drainage facilities	18050.68	42500.10	60550.7
Sewage treatment plant	3768.47	8300.20	12068.67
Total	21819.15	50800.30	72619.45
% of total investment	30.05%	69.95%	100%

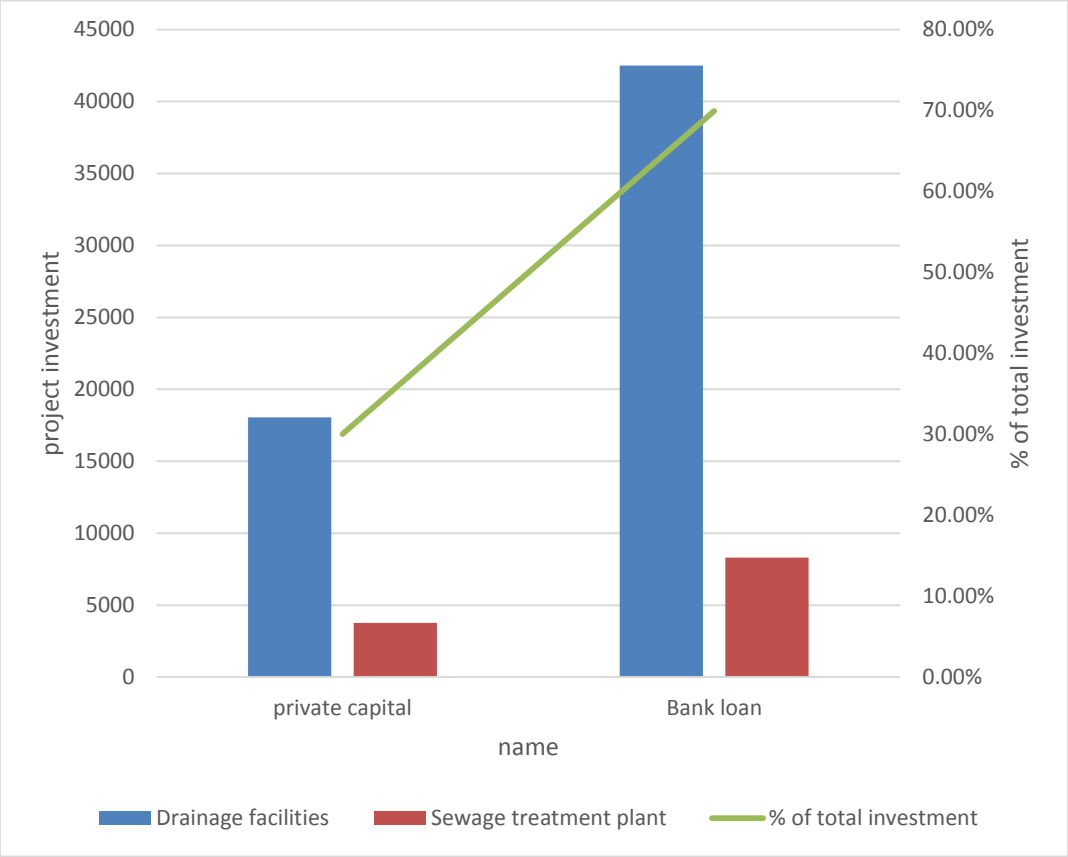

Figure 2. Detailed comparison of project investment amount

As shown in Figure 1, the self-owned funds were used for 180.5068 million yuan for drainage facilities and 37.6847 million yuan for sewage treatment plants, totaling 218.1915 million yuan. The bank loan was used for 425,001,000 yuan for drainage facilities and 83,002,000 yuan for sewage treatment plants, totaling 508,000,300 yuan. Self-owned funds accounted for 30.05% of the total investment, and bank loans accounted for 69.95% of the total investment.

4.2. Project Income

As shown in Table 2, the winning bidder, City A Water (Group) Co., Ltd., calculated the internal rate of return (IRR) of all funds at 7%, and the final price of sewage treatment fee and sewage treatment fee were 0.79 yuan/cubic meter and 99,560 yuan/km respectively.

Table 2. Project income estimate table

Years	1	2	3	4-25
Unit price of sewage treatment service fee (yuan/cubic meter)	0.79	0.79	0.79	0.79
Sewage treatment fee income (ten thousand yuan)	1864	2086	2461	2987
Unit price of drainage facilities service fee (yuan/km)	99560	99560	99560	99560
Total revenue	9265	9575	9874	10530

4.3. Item Sensitivity Analysis

As shown in Figure 3, if the operating income drops by 5%, the total investment return rate (IRR) will drop to 6.72%; if the operating cost increases by 5%, the total investment return rate will drop to 7.52%. The yield level in both cases is still slightly higher than the benchmark interest rate for 3-year long-term loans. The project company can maintain a good level of income during the long-term operation of the project.

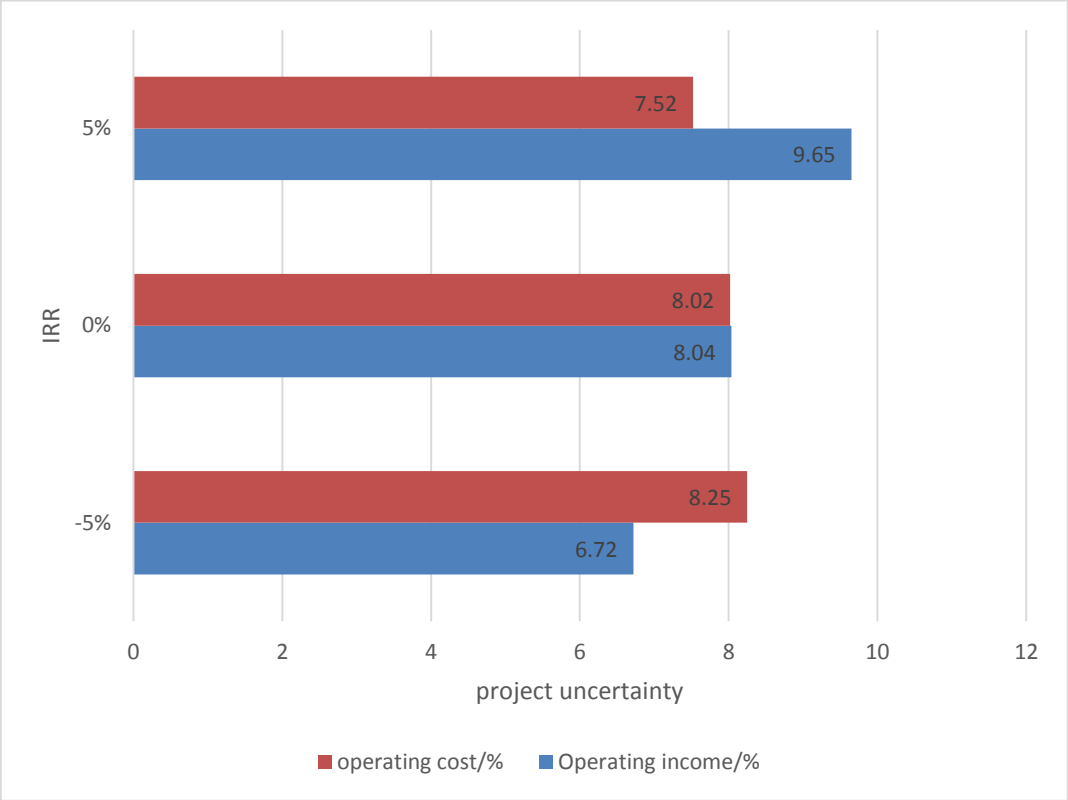

Figure 3. Project uncertainty analysis table

In addition, during the negotiation process of the project, both parties reached an agreement that when the project company receives tax incentives and the actual loan interest rate is lower than the interest rate adopted in the bidding, the project company will return the difference between the actual tax and financial expenses and the calculation. Although this clause is relatively important, it urges both the government and the enterprise to actively cooperate with the interest rate bidding method to obtain a preferential loan with a 5% decrease in the benchmark interest rate, which greatly reduces the financial pressure of both the government and the enterprise. However, since the terms have little effect on the project income level, we will not analyze it here.

5. Conclusion

This paper uses the PPP model as the main means of the government's comprehensive water environment governance construction, which can effectively solve the problems of the traditional model, such as single government investment, single source of funds and large gap, poor governance effect, weak operation and maintenance, and lack of professional ability. By analyzing the application of the PPP model in the project, combined with the previous research results, put forward corresponding countermeasures, improve the implementation of the PPP model in the management of government waters, and provide reference for the construction management of similar projects in the future. This paper studies the application of the PPP model in the upgrading and reconstruction project of the urban sewage pipe network in City A, and explores the highlights and shortcomings from five aspects: operation mode, transaction structure, payment mechanism, financial calculation, and government supervision. Through the research on the concept of water environment governance and the application of the PPP model, it provides theoretical support for the introduction of the PPP model into the public sector-led comprehensive water environment governance.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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