# Water Environment Management Model of the Reservoir and Case Study

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**Abstract.** Due to the rapid rise of the economy and population environment and resources are exposed to more and more pressures. The economy of the vicinities of the lakes and reservoirs all around of our nation is now going up quickly. And at the same time, the quality requirement of water grows while the supply of water is decreasing and exchanging. The pollution-acceptance capacity of water environment is reducing. What makes it worse is that the sewage discharge is up as that almost all of the lakes or reservoirs are not clean any more. Water conditions of the lakes and reservoirs is increasingly been deteriorated in our country. Prominent water pollution is urgent for scientific and effective water resource management, especially the security of drinking water for the people.

## 1. The theoretical basis of reservoir water environment management

### 1.2 Sustainable development theory

The sustainable development thought is aimed at the disadvantages of traditional development model. Sustainability mainly considers three aspects from time dimension: space, the human and the nature harmonious coexistence. Human activities and natural should be harmony so as to be corresponding with the asking of sustainable development. It must be coordinated between the development of human society and economic and the protection of resources and environmental. [1]The above definition underlines the requirement of generations to come. It puts forward that the economic development of contemporary must follow the requirements of environmental ethics, more than improving and enhancing the modern people's survival and living conditions, also consider intergenerational justice. We have to ensure the sustainable development of human society through the sustainable development of ecology and economy.

### 1.3 Linear programming theory

Mathematics called planning theory as studying the optimal value problem for a given target functions in several variables under the constraint conditions. When the objective function and expressions of function involved in constraint conditions are found to be in a type of unknown decision variables, the planning problem is linear programming problem. [2] Linear programming is a branch of operational research, which is a new study developed in the 1940 s. Its center is to study how to overall arrange, to use the least amount of resources to achieve the best effect. It has a wide range of applications in production management, transportation, national defense industry and national economy and many other fields.

General form of linear programming mathematical model is:

To get a set of variables $x_j\,(j=1,2,...,n)$, to meet the constraint conditions

$$a_{11}x_1+a_{12}x_2+...+a_{1n}x_n \le b_1(or \ge b_1, or = b_1)$$

$$a_{21}x_1+a_{22}x_2+...+a_{2n}x_n \le b_1(or \ge b_2, or = b_2)$$

.....

$$a_{m1}x_1+a_{m2}x_2+...+a_{mn}x_n \le b_m(or \ge b_m, or = b_m)$$

$$x_1, x_2, ..., x_n \ge 0$$

And make the objective function $F(X)=C_1X_1+C_2X_2+...+C_nX_n$ （1）

reach the biggest or smallest value.

A system of linear equations can work as linear programming mathematical model’s constraint

 

condition; the linear inequality is also one way. [3]Can be the maximum linear objective function, also can be in linear objective function minimum. These issues are inconsistent in the form, which is not convenient for solving linear programming problem, so the linear program problem always use "standard form" to solve. Linear programming standard form is as follows:

Figure out a set of variables $x_1, x_2, ..., x_n$ to meet the constraint conditions

$$a_{11}x_1 + a_{12}x_2 + ... + a_{1n}x_n = b_1$$
$$a_{21}x_1 + a_{22}x_2 + ... + a_{2n}x_n = b_2$$
.....
$$a_{m1}x_1 + a_{m2}x_2 + ... + a_{mn}x_n = b_m$$

Among which,

$b_1, b_2, ..., b_n \geq 0$ , and make the objective function $F(X) = C_1X_1 + C_2X_2 + ... + C_nX_n$ （2）
get the minimum.

## 2. Water environment quality evaluation model

**(1) The principle of water quality evaluation**

The existing water quality survey data should be used as far as possible; if data is insufficient then it should be measured.

**(2) Evaluation standard**

Evaluate Lake Reservoir water environment quality evaluation standard according to the surface water environment quality standards GB3838-2002 to.

**(3) Evaluation model**

Adopt the single index method for surface water environmental quality assessment according to the environmental elements minimum limit law principle. [4] Minimum limit law of environmental elements is: it is not the environmental factors of the average condition that can determine the quality of the whole environment; instead, it is by the largest gap of the optimal state and worst in all key elements of the environment. That is to say, the environmental quality depends on the "minimum condition" in environment in all key elements while can't use other environmental elements to make up or to replace.

**2.2 sources estimate model**

**22.1 Point source estimate model**

(1) Industrial waste water volume forecast model is:

$$Q(t_i) = W(t_i) \times G(t_i) \times (1 + \eta t) \quad (3)$$

(2) Urban sewage volume prediction model is:

$$W(t) = pk\gamma(t)N(t)(1 + \eta t)S\zeta 10 \quad (4)$$

**2.2.2 Nonpoint source estimation model**

(1) Rainfall runoff model

Typical methods are the soil and water conservation bureau of SCS method put forward in the 1950s. The soil and water conservation bureau put forward a method of rainfall runoff (SCS) and it has been used in the study in Shanghai suburb farmland nonpoint source pollution. In fact it can also be applied to the similar climate, soil and land use under the conditions of farmland; it is very practical in the research of non-point source pollution. [5]At present it has already been widespread used in the United States, other countries and regions are also taking it for references.

After a rainstorm, basin water balance equation can be expressed as:

$$S(t) = P(t) - Q(t) \quad (5)$$

Basic equations a rainstorm runoff process is as follows:

$$Q = \frac{(P - 0.2S^{'})^2}{P + 0.8S^{'}}, S^{'} = \frac{25400}{CN} - 254 \quad (6)$$

(2) Diction of soil erosion loss model

At present, soil erosion equation is adopted to improve the soil loss calculation. This kind of

calculation is with the modified USLE equation, soil erosion prediction model is:

$$A = R \cdot K \cdot L \cdot S \cdot C \cdot P$$

**2.3 pollution evaluation model**

Point source and nonpoint source evaluation model adopts standard pollution load method. That is:

$$P_{i,j} = \frac{C_{i,j}}{C_{si}} \times Q_j \times 10^{-6} \quad (7)$$

Load of pollutants i is as follows:

$$P_i = \sum_{j=1}^{n} P_{i,j} \quad (8)$$

Load of pollutants j is as follows:

$$P_j = \sum_{i=1}^{m} P_{i,j} \quad (9)$$

Ratio of pollutants i in total pollution load:

$$K_i = \frac{P_i}{\sum_i \sum_j P_{i,j}} \times 100\% \quad (10)$$

Ratio of pollutants j in total pollution load:

$$K_j = \frac{P_j}{\sum_i \sum_j P_{i,j}} \times 100\% \quad (11)$$

## 3. Analysis of Xin Licheng reservoir

According to the status quo of the monitoring results, total phosphorus and ammonia nitrogen are chosen as factor analysis in snowmelt period, total phosphorus and CODcr as factor analysis in the plentiful.

(1) Upstream water storage load calculation

According to the water flow and the Xin Licheng reservoir tail contaminant concentration, the water pollution load of the upstream can be calculated. Computation formula is as follows:

$$W_i = C_i \times Q \quad (12)$$

(2) Surroundings' pollution load calculation

According to the lakes push flow attenuation model, calculate the reservoir storage pollution load calculation formula :

$$C_i = C_p \times \exp\left(-\frac{k_1 \times \phi \times H \times r^2}{172800 \times Q_p}\right) + C_h \quad (13)$$

## 4. Summary

With the industrialization and urbanization, the water pollution problem emerged and has been plaguing the developed countries and developing countries. Started in the middle of the 20th century, theory and practice for the exploration of the water environment management has been born for more than half a century. In the process, researchers both at home and abroad have made quite quantities of research results in the aspect of theory and practice. After serious pollution of water environment, through the various efforts of treatment and management, a great recovery has been got and water quality improved.

## References

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