Long Term Compensation Analysis about Reservoir Resettlement Based on Grey Prediction

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***Abstract* — The most distinguished characteristic of long-term resettlement compensation pattern is to turn the one-time compensation or emplacement into yearly compensation which is based on the immigrants' scientific measurement of the farmland loss in the process of construction. Because of the high risk of long-term compensation scheme, the reckoning of future possible income should be accurate as much as possible. Due to the data of long-term compensation is not enough in this paper, the author applies grey system to predict the income of immigrants.**

Keywords - Hydropower project construction, Patterns of immigrant resettlement, Long-term compensation resettlement, Project benefit sharing, grey prediction

I. INTRODUCTION

The rapid development of hydropower construction will inevitably causes the loss of submerged reservoir and project-occupied area, which gives rise to a certain amount of immigrant resettlement. This will bring some sorts of contradictions, such as ecological environment deterioration of the region, lack of resources, the nervous relationship between people and land. One of the important constrains is the immigrant resettlement of hydropower project, which involves in politics, economy, society, population, resource, environment and engineering, and it's a complex engineering system. Whether the immigrant resettlement scheme is reasonable will directly affect the development of hydropower construction as well as the social stability. The immigrant resettlement should be solved properly is the prerequisite of vigorous expansion of the hydropower construction [1].

Long term compensation on hydropower construction immigrants resettlement mainly focuses on farmland suffered from flood and dry land, thus to change the static one-time compensation into long-term yearly compensation. According to the approved compensation standard to offer compensation based on their loss in submerging land, compensation standard normally based on the immigrants' average product of the crops in the first 3 years, and according to the food price published by the local food department to determine the annual production value of the plough. [2] This long-term compensation will be carried out by project owner in currency or material annually. The power station runs, the compensation should be implemented till the power station expires. After the expiration, the project owners should level off the land and return it to the residents. Theoretically, the compensation should be adjusted according to the price index published by the government offices until the power plants expires. With the development of practice and research on long-term compensation pattern, the realization forms has been diversified [3].

The most distinguished characteristic of long-term resettlement compensation pattern is to turn the one-time compensation or emplacement into yearly compensation which is based on the immigrants' scientific measurement of the farmland loss in the process of construction, thus to ensure the immigrant's long-term income and stable life. In this way, immigrants can get equal or more income than the one before flood, and the quantity of immigrant relocation can be decreased, then the problem of residual farmland comes from the move out of immigrant which cannot be managed and cultivated will be solved. Meantime, the surplus labor force can be spared, which is beneficial for the recovery and promotion of the original production and living standard. The implementation of long-term resettlement compensation in favors of motivating immigrant in selecting the scheme of immigrant resettlement and arouse the enthusiasm of removal. At the same time, the government's pressure in the process of immigrant resettlement and project owner's tension in raising capital can be alleviated [4].

Because of the high risk of long-term compensation scheme, the reckoning of future possible income should be accurate as much as possible. There are most method to predict the income of immigrants' long-term compensation. Due to practice long-term compensation is for a relatively short time, the data is not enough. Apply grey system to predict the income of immigrants is a reasonable method. This paper based on resettlement of Longtan Hydropower Station, and used 2004-2007 immigrants living income, by using the grey system to predict the resettlement's living standard for a long time.

II.BASIC THEORY OF GREY SYSTEM

The grey system is a transitional system between white and black box system. Grey prediction use data which contain known information and unknown or uncertain information. Byanalyzing strong regularity of the dissimilarity between the differential system factors, then establishing a differential equation model, it predicted the future development trend. This paperpredicted the living standard of the Longtan Hydropower Station, because the forecast variables is only one, so we can use GM(1,1) model to predict.

III. ESTABLISH GM (1,1) MODEL

Put $X^{(0)}$ as GM(1,1) model sequence

$X^{(0)} = (x^{(0)}(1), x^{(0)}(2), ..., x^{(0)}(n))$,

$X^{(1)}$ is 1-AGO sequence of $X^{(0)}$,

$X^{(1)} = (x^{(1)}(1), x^{(1)}(2), ..., x^{(1)}(n))$,

$x^{(1)}(k) = \sum_{i=1}^{k} x^{(0)}(i)$, $k = 1, 2, ..., n$

Put $Z^{(1)}$ as Next mean generating sequence of $X^{(1)}$

$Z^{(1)} = (z^{(1)}(2), z^{(1)}(3), ..., z^{(1)}(n))$

$z^{(1)}(k) = 0.5\, x^{(1)}(k) + 0.5\, x^{(1)}(k-1)$

Grey differential equation model of GM(1,1) is as follow.

$x^{(0)}(k) + az^{(1)}(k) = b$

In the formula, a is called the development coefficient, b is the grey action quantity. We suppose that $\hat{\alpha}$ is parameter vector to be estimated. So we can kwon:

$\hat{\alpha} = (a, b)^T$

$\hat{\alpha} = (B^T B)^{-1} B^T Y_n$

$$B = \begin{bmatrix} -z^{(1)}(2) & 1 \\ -z^{(1)}(3) & 1 \\ \cdots & \cdots \\ -z^{(1)}(n) & 1 \end{bmatrix}, \quad Y_n = \begin{bmatrix} x^{(0)}(2) \\ x^{(0)}(3) \\ \cdots \\ x^{(0)}(n) \end{bmatrix}$$

$\frac{dx^{(1)}}{dt} + ax^{(1)} = b$

The above formula we called the whitening equation. The Solution of equation is as follow.

$\hat{x}^{(1)}(t) = (x^{(1)}(0) - \frac{b}{a})e^{-at} + \frac{b}{a}$

The Grey differential equation of GM (1,1) is as follow:

$x^{(0)}(k) + az^{(1)}(k) = b$

The Solution of equation is as follow.

$\hat{x}^{(1)}(k+1) = [x^{(1)}(0) - \frac{b}{a}]e^{-ak} + \frac{b}{a}$, $k = 1, 2, ..., n$

$x^{(1)}(0) = x^{(0)}(1)$,

$\hat{x}^{(1)}(k+1) = [x^{(0)}(1) - \frac{b}{a}]e^{-ak} + \frac{b}{a}$, $k = 1, 2, ..., n$

The formula of reducing value is as follow.

$\hat{x}^{(0)}(k+1) = \hat{x}^{(1)}(k+1) - \hat{x}^{(1)}(k)$

It is formula of Grey prediction

GM (1,1)model is needed to predict the residual test data. If the relative error is in the allowable range, you can use the model.Otherwise,it should be modified.

IV.PREDICT THE IMMIGRATION NET INCOME OF LONGTAN HYDROPOWER BY USING GREY SYSTEM

A. Set up the input sequence

This paper representative analysis the resettlement living standard between different periods in Luodian County, which Located in Longtan Hydropower Station submerged area. Because land is main source of immigrant net income, to simplify the problem, we just compare cultivated land compensation gap between different periods of Longtan Hydropower Station. We establish GM (1,1) model that immigrant got per-capita net income from 2004 to 2007,and usethe actual income of 2008 to predict the result of test, then predict annual per capita income from 2009 to 2031.

By investigation and study, we got immigrant agricultural income which commonly depend on wage income, family operating cash income, property income and transfer income. The family operating cash income and wage income is the most important source. The income proportion is 41.06% among total income that immigrant Engaged in agricultural production. According analysis, the agricultural net income of Luodian County should be in table 1.

TABLE I INCOME OF LUODIAN COUNTY

Time(year)	2004	2005	2006	2007	2008
per-capita net income (Yuan)	1386.0	1496.0	1648.0	1776.5	1918.7
Agricultural income (Yuan)	554.4	598.4	659.2	710.6	767.5

Table 1: 2004-2008 annual per capita net income and estimate of agricultural income in Luodian County

So, the input data of gray system is y= [554.4 659.2 598.4 710.6].

B. using MATLAB programming to achieve the results of gray prediction

1) Raw data Accumulation
2) Structure accumulation matrix B and constant vector
3)Solving grey parameters
4)Put the parameters into mathematical model to predict.
5)Programming code (skip).

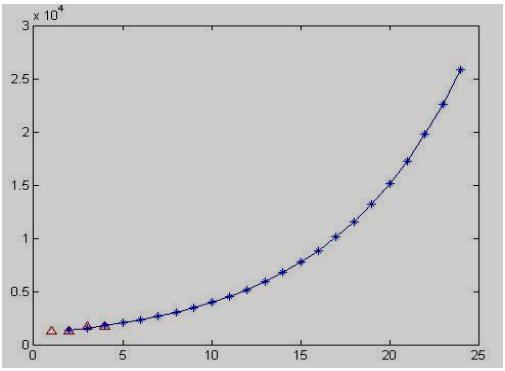

Figure 1 The grey forecast result of immigrant agriculture income

C. *data forecast*

We enter the forecast time parameter, which we assume it is 25 years, then we get the immigrants agriculture income is 6001.6 Yuan in 2032. The result is shown as Figure 1.

We test the predicted value of the agriculture income of cultivating land in 2008. The predicted value is 775.63491 Yuan, and the actual survey value was 767.468 Yuan. So the relative error is:

| (767.468-775.63491) /767.468| * 100%=1.06%

Because the error is relatively small, the forecast data is close to the actual data, so the prediction data is credible.

V. GARY FORECAST OF LONG TERM COMPENSATION INCOME

A. *Establish gray input sequence of long term compensation*

When the normal reservoir level of Longtan hydropower station is 375 meters, 56.55 million mu land is submerged. There is 8.05 million people that need to resettlement. This paper still only research land long term compensation income of cultivatable land.

According to the results of the consultation, the standard ofdry paddy Compensation is 625kg per acres in 2007, Reference the market price of dry paddy, the placement standard of money is about 1049 yuan per mu in 2007. According to the national grain and oil price monitoring system data, we found annual dry paddy price from 2009 to 2012 in Guizhou. So we can get per capita income of long-term compensation. It is shown or the in table.

TABLE II LONG TERM COMPENSATION INCOME PER CAPITA

Time(year)	2009	2010	2011	2012
the market price of drypaddy(Yuan/ton)	1930	2020	2620	2700
Compensation income (Yuan/ mu)	1206.25	1262.5	1637.5	1687.5
Per capita compensation income(Yuan)	1230.375	1287.75	1670.25	1721.25

We use the annual immigration income as input data from 2009 to 2012. It is y= [1230.375 1287.75 1670.25 1721.25].

B. *Gray forecast of long term compensation income*

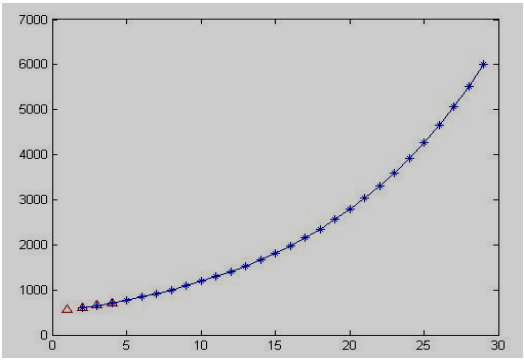

Figure 2 Grey forecast of long term compensation income

The grey system model is used to predict the compensation income 2013-2032. The forecast result is shown as Figure 2.

C. *Forecast result analysis*

Comparing the Forecast result of resettlement income between the per capita agricultural planting income and long-term compensation income in Luo Dian county from 2013-2032, we can see clearly that Long term compensation income is much higher income than agricultural production, The longer the time, the greater the gap.it is shown as Figure 3. The most important reason lies in the long-term compensation is not to consider the cost of production inputs. Immigrant compensation income completely determined by the output of the crop. In addition, the liberation of the rural labour force, immigrant can engage in other work, immigrant living standards will further improve.

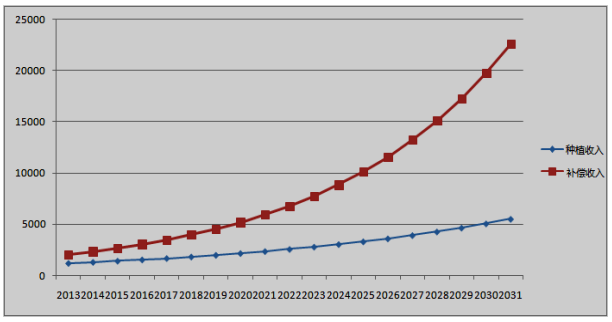

Figure 3 Compare between the per capita agricultural planting income and long-term compensation income

VI. CONCLUSION

Taking long-term compensation mechanism, it will reduce initial construction capital for power plant owner, andthe owners can save interest to compensate immigrant every year.at the same time, the immigrants can improve their living standards by resettlement compensation

income .so, Long term compensation resettlement mode has obvious advantages, it is worth learning and promotion.

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