A Model for Ecological Services Valuation Which Should be Considered in Analysis of Land Use Project

Jingyuan Zhu[1], Jiaming Zhu[2]

1. College of Finance, Anhui University of Finance and Economics, Bengbu, 233030, China
2. College of Statistics and Applied Mathematics, Anhui University of Finance and Economics, Bengbu, 233030, China

Abstract: This paper aims to create a comprehensive evaluation model that incorporates the cost of environmental degradation into the cost-benefit assessment of land development. Firstly, we use Logistic regression analysis to confirm that it is very likely to assess the environmental cost of land development projects. Secondly, we select polluted river, poor air quality, poorly treated wastewater and climate changes to build the Nonlinear Fitting Model Based on Fourier Transform. By giving different weights to these four factors, the cost of environmental degradation can be calculated, and then the real economic cost can be obtained by linear addition to the economic cost. Finally, we use the model to analyze the cost-benefit of small community projects and large-scale national projects, and then takes time into consideration, the long-term cost-benefit of land development projects is forecasted by using the neural network algorithm.

Keywords: Nonlinear fitting; Logistic regression analysis; Neural network algorithms; Pearson coefficient; Environmental degradation; Cost effectivenes

1. Introduction

Ecosystem services are the conditions and processes through which natural ecosystems and the species that make them up, sustain and fulfil human life[1]. The origins of the modern history of ecosystem services are to be found in the late 1970s[2]. There are four kinds of capital that be recognized by Economic theory – human, financial, manufacturing and natural. Ecosystem services are the equivalent of 'natural capital[3]'. Obviously, developed economies have paid more attention to the first three factors[4], while the factor of nature have always been considered negligible. Nevertheless, no matter small projects or large-scale projects will have an impact on it and a cumulating of these activities may limit ecosystem services, even cause environmental degradation. The cost of environmental degradation treatment may be much higher than the profits of the project itself. The more serious problem is that the destruction of biodiversity is irreparable. As early as the 20th century, some scholars have noticed the environmental and economic costs, and put forward some specific solutions, such as Arthur Pigou, a British economist in the 1920s, who theoretically discussed the externalities and proposed that polluters should be taxed according to the harm caused by pollution. In the period of industrial revolution, the need to calculate environmental costs promoted the assessment and calculation of air, water and soil pollution losses. At the same time, the economic theory of environmental quality and public goods emerged[5]. Nowadays, experts of the United Nations Environment Programme (UNEP) have put forward the idea that economic development must be limited by ecological laws, and emphasized the sustainable development of the environment.

This paper is structured in two parts. Part one assesses the environmental cost of land use. We build two models to evaluate the environmental cost, including with and without environmental degradation factor, and we focus on four typical economic costs for environmental issues: river pollution control cost, air quality protection cost, waste water treatment cost, climate change cost. We conclude that it is very likely and necessary to consider the factor of environmental degradation when evaluating a land use project Otherwise the huge costs of mitigating environmental degradation may make the loss overweight the gain. Part two proceeds by using our models to specifically analysis the cost-benefit-ratio of land use projects of both small community projects (we use community housing affairs as a research sample) and large-scale national projects(we use national transportation projects as a research sample), and then we also take time into account. What's more We finally test the validity of our model, prove their stability and feasibility, and put forward relevant suggestions.

And our contributions may be as follows:

Bring ecosystem services into the cost-benefit ratio of projects to facilitate a more comprehensive estimation of the projects.

H K .N C C P

International Journal of Intelligent Information and Management Science
ISSN: 2307-0692, Volume 8, Issue 2, April, 2019

Provide reasonable suggestions to land use project planners and managers.

Reminds people to avoid destroying the environment first and then governing it, and advocates people to cherish nature and live in harmony with nature.

2. Environmental Cost Evaluation Model

2.1. Determination of the possibility of environmental cost evaluation

Traditional economic theories often neglect the impact of their decisions on the biosphere. In order to meet their needs, natural resources and environment are usually assumed to be infinite. This view obviously has some defects. In fact, Li Fengshan (2015) analyzed the marginal cost and benefits the use of land resources and draws a conclusion that the land resource development cost often is not fully considered in land use projects, the cost is narrow. The relative lack of protection of land resources result in serious damaged to ecological environment [6]. Therefore, it is necessary to build a new model of land use evaluation which including environmental cost, in order to gain a comprehensive valuation of the cost-benefit ratio of the project.

For the sub-problem of whether it is possible to evaluate the environmental cost of land use development projects, we considered using linear logistic regression model to analyze the correlation between the total cost of environmental protection and the total revenue of land development in the United States from 2000 to 2011, by using SPSS software, we confirmed there IS a possibility of assessing the environmental cost of land development projects.

2.1.1. Logistic regression analysis

According to the analysis, the environmental cost assessment of land development projects can be regarded as a prediction problem. It is stipulated that if the visible data trend of total land benefit is closely related to the trend of environmental cost, the environmental cost (non-random number), is considered to have the value and possibility of evaluation. Because the existing similar problems often use Logistic regression analysis model to get accurate results of correlation degree. Therefore, we consider using the linear logistic regression model to analyze the correlation between the total cost of envi-

ronmental protection and the total benefit of land development in the United States from 2000 to 2011.

Logistic regression analysis is a generalized linear regression analysis model, which is suitable for data mining, prediction and other fields, especially for describing the correlation of data[7]. The P value in the result is also called saliency[8] It is an important index to measure the effect of independent variables on dependent variables. When P < 0.005, we think that independent variables are very significant relative to dependent variables. When taking Y as dependent variable and X1 and X2 as independent variables, we find that the model has obvious defects. Therefore, we need to modify the model to take Y as dependent variable and X1 as independent variable.

2.1.2. Assumptions

Because land development projects are affected by many uncertainties, such as federal policies, natural disasters, etc., we neglect some of the small probability factors. We focus on river pollution, air pollution, wastewater treatment and climate change. Considering the stability of the model, we assume that some factors will not change too much. The following assumptions are made:

Land development projects are mutually independent.

There are other extreme factors that cause abnormal environmental degradation and affect the normal production and life of human beings.

The government's land development policy has not changed much during this period.

Assuming that the period of study is 2000-2011, a total of 12 years

2.1.3. Notations

X_1: Total environmental protection cost in the United States 2000-2011.

X_2: Total cost of land development projects in the United States from 2000 to 2011.

Y_1: Total benefit of land development in the United States from 2000 to 2011.

b_2: Non-standardization coefficient

P_2: Significant index .

2.1.4. High correlation

When Y is the dependent variable and X_1 is the independent variable, the following results are obtained:

Table 1. Relative coefficient

	Non-Standardization Coefficient		Standardization Coefficient
	B	Standard Error	β
X1(constant)	0.994	0.002	0.435
	0.00002772	0.000	

Dependent variable is $\ln(1/Y)$

H K . N C C P

International Journal of Intelligent Information and Management Science
ISSN: 2307-0692, Volume 8, Issue 2, April, 2019

Through the coefficient table, we can get P of the model including environmental degradation factors is 0.000 , less than 0.005, indicating that the total cost of environmental protection X1 is significant for the total income of land development Y. It shows that the cost of environmental protection has a great weight in the total benefit of land development, and decision makers should pay more attention to it in land development projects. To some extent, it proves that it is not proper to neglect environmental costs when valuing a land use project. Therefore, it is very likely and necessary to take environmental costs into account in the evaluation of land use development projects.

2.2. Project cost evaluation including environmental degradation

Through the environmental cost assessment model of 2.1, we concluded that it is necessary to consider the role of environmental degradation in land development projects, which can be seen as a combination of classification and prediction problems. In order to solve this problem and obtain the concrete quantitative relationship between the total economic cost and the total land development cost and the cost of environmental degradation, we consider using the non-linear curve fitting model.

2.2.1. Nonlinear fitting model based on fourier transform

Nonlinear curve fitting is known input vector xdata and output vector ydata .

The function relationship between input and output is known as:

$$ydata = F(x, \ xdata) \tag{1}$$

But the coefficient vector x is unknown. By curve fitting, x is obtained and the following least squares expression of output is established:

$$\min \sum (F(xc, xdata) - ydata)^2 \tag{2}$$

Nonlinear fitting has the advantages of high precision, high reliability, and diversified fitting forms. Through fitting various forms, we find that the fitting accuracy of the non-linear fitting model based on Fourier transform is the highest. Therefore, we carried out the non-linear fitting based on Fourier transform for the total cost of land development and the cost of environmental degradation respectively, so as to get the reasonable solution of the model. Among them, without considering other small probability events, we focused on air pollution, river water pollution, wastewater discharge and climate change as four indicators to reflect the overall level of environmental degradation.

Nonlinear fitting has the advantages of high precision, high reliability, and diversified fitting forms. Through fitting various forms, we find that the fitting accuracy of the non-linear fitting model based on Fourier transform is

the highest. Therefore, we carried out the non-linear fitting based on Fourier transform for the total cost of land development and the cost of environmental degradation respectively, so as to get the reasonable solution of the model. Among them, without considering other small probability events, we focused on air pollution, river water pollution, wastewater discharge and climate change as four indicators to reflect the overall level of environmental degradation.

2.2.2. Notations

A: Economic cost of air pollution control
B: The economic benefits in term t
C: Total economic cost in term t
D: Economic costs of climate change prevention
F: Economic cost of wastewater treatment
R: Economic cost of river pollution control
RBC: Cost-benefit ratio
Wt: Total cost of land development
is: Social discount rate

2.2.3. Analysis of four typical economic cost of environmental degradation

Total cost of land development: We searched land price data from 2000 to 2011 in various states of the United States. We made visualization analysis of these scattered large amounts of data (see Figure 3). From the result chart, we can see that it is not conducive to a clear and targeted analysis when considering the land benefit difference of each state comprehensively, so we choose the median house price as the representative in this study model analysis.

The discrete point data of total land cost in the United States from 2000 to 2011 are fitted by Fourier cubic fitting with MATLAB, and the image and specific function expressions of total land cost varying with time are obtained.

Total cost of land development:

$$\begin{aligned} Wt = &80470 - 290.7 \times \cos(0.3876 \times t) \\ &- 12210\cos(2 \times t \times 0.3876) + 6335 \times \\ &\sin(2 \times t \times 0.3876) - 3874 \times \cos(3 \times t \times 0.3876) \\ &+ 1470 \times \sin(3 \times t \times 0.3876) \end{aligned} \tag{3}$$

The Economic Costs of Four Typical Environmental Degradations:

Under the same conditions, the cost of river water pollution control, air pollution control, wastewater discharge control and climate change prevention are respectively fitted by Fourier quadratic fitting, and the curves and functional expressions of the four indicators' cost varying with time are obtained.Cost of river water pollution control (R-square=0.9776).

$$\begin{aligned} R_t = &73.62 - 6.204 \times \cos(t \times 0.3118) - 11.54 \times \sin(0.3118 \times t) \\ &- 2.179 \times \cos(2 \times 0.3118 \times t) - 5.022 \times \sin(2 \times t \times 0.3118) \end{aligned} \tag{5}$$

H K . N C C P

International Journal of Intelligent Information and Management Science
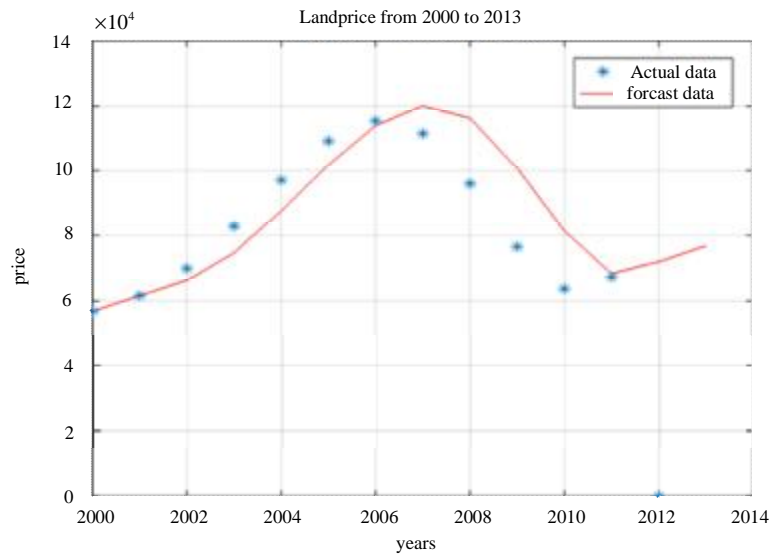*ISSN: 2307-0692, Volume 8, Issue 2, April, 2019*

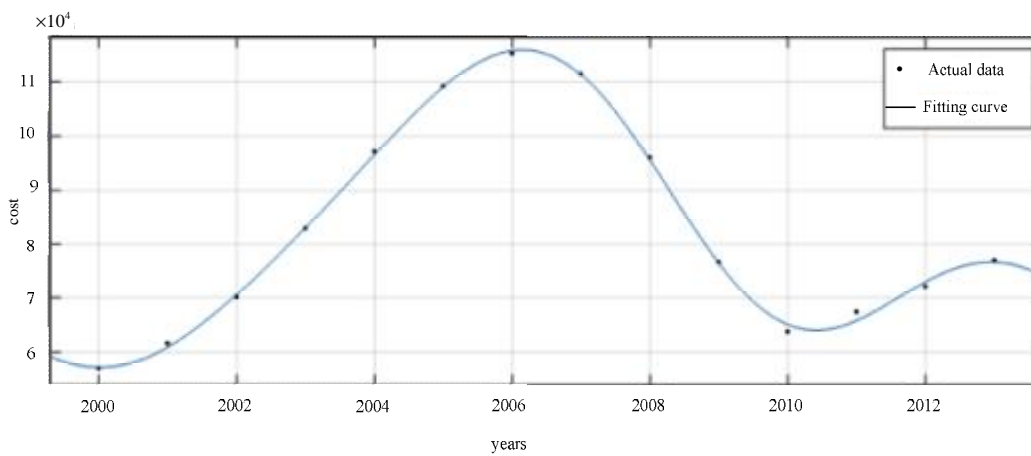**Figure 1. Change of land cost**

Figure 2. Change of river water pollution control cost

Cost of air pollution prevention and control (R-square=0.984)

$$A_t = 70.49 - 7.129 \times \cos(t \times 0.2886) + 10.3 \times \sin t \times 0.2886 \\ + 6.444 \times \cos(2 \times t \times 0.2886) - 2.205 \times \sin(2 \times t \times 0.2885) \quad (5)$$
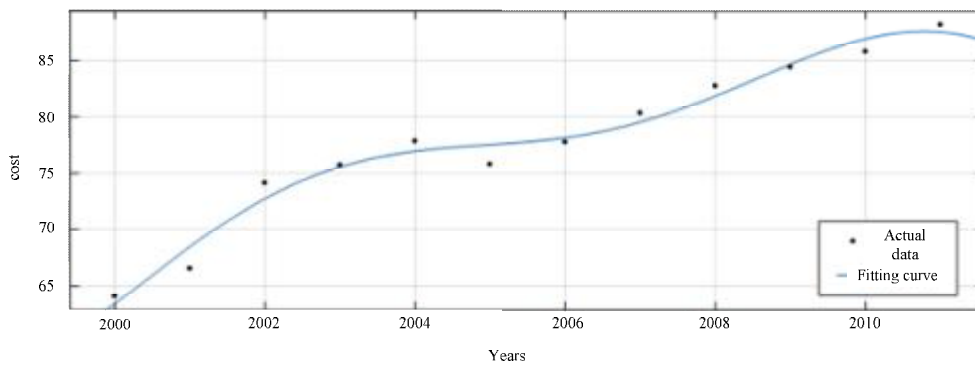

Figure 3.Change of air prevention and control cost

H K .N C C P

International Journal of Intelligent Information and Management Science
ISSN: 2307-0692, Volume 8, Issue 2, April, 2019

Cost of wastewater discharge control (R-square=0.9297)

$$F_t = 43.66 - 6.418 \times \cos(t \times 0.2831) - 1.278 \times \sin(t \times 0.2831) \\ - 2.643 \times \cos(2 \times t \times 0.2831) + 4.723 \times \sin(2 \times t \times 0.2831) \quad (6)$$
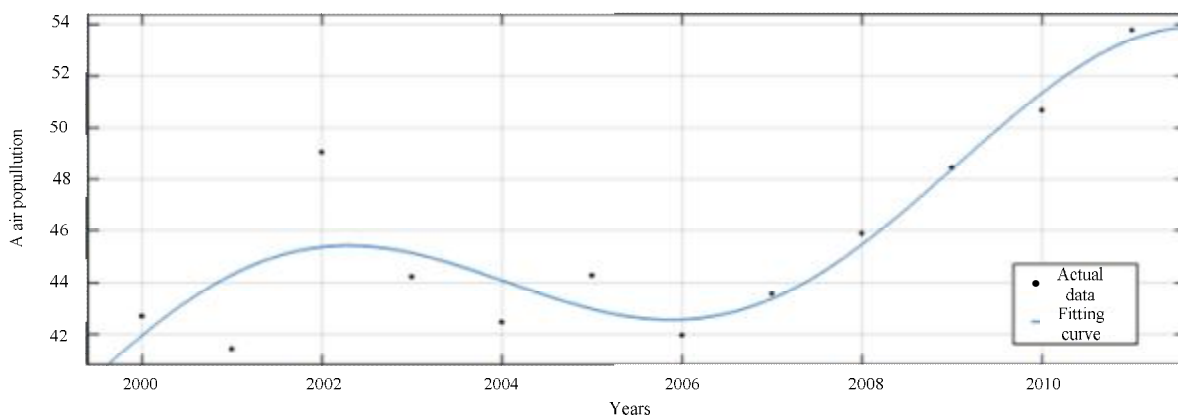

Figure 4.Change of wastewater discharge control cost

Cost of climate change prevention (R-square=0.9648)

$$D_t = 163.6 + 1357.1 \times \cos(t \times 0.2831) - 1.278 \times \sin(t \times 0.2831) \\ - 2.643 \times \cos(2 \times t \times 0.2831) + 4.723 \times \sin(2 \times t \times 0.2831) \quad (7)$$
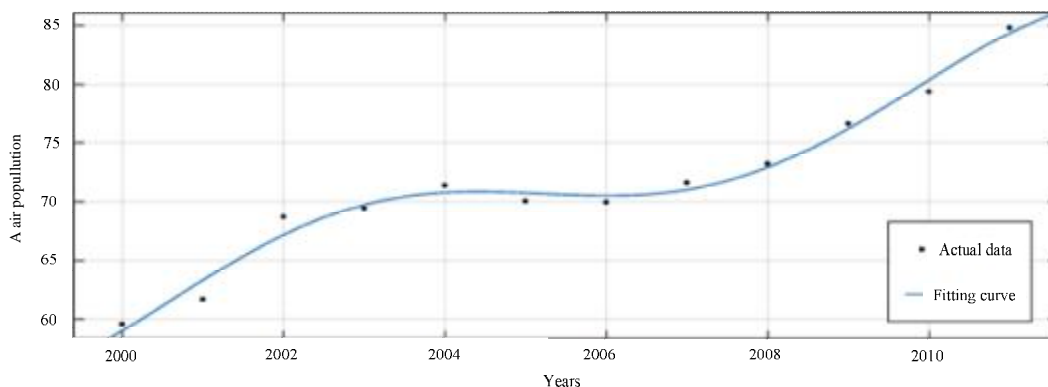

Figure 5. Change of climate change prevention cost

Comprehensive Consideration of Land Cost and Environmental Degradation Cost

According to the hypothesis, we can confirm that there is a certain linear relationship between Ct and Wt, Rt, Ft, At and Dt. It can be described as: total economic cost:

$$C_t = W_t + \alpha_1 R_t + \alpha_2 A_t + \alpha_3 F_t + \alpha_4 D_t \quad (8)$$

Among them, $\alpha_1 - \alpha_4$ represents the cost of river water pollution control, the cost of air pollution control, the cost of controlling wastewater discharge and the cost of preventing climate change, respectively, as a percentage of the total environmental protection cost of the federal government. By consulting relevant literature, we can determine the values of $\alpha_1 - \alpha_4$ are :

$$\alpha_1 = 25\% \quad \alpha_2 = 30\% \\ \alpha_3 = 18\% \quad \alpha_3 = 30\% \quad (9)$$

Then we can get the total economic cost:

$$C_t = W_t + 0.25R_t + 0.3A_t + 0.18F_t + 0.3D_t \quad (10)$$

On the other hand, we introduce the concept of cost-benefit ratio as an evaluation index.

The formula for calculating the benefit ratio is as follows[9].

$$RBC = \frac{\sum_{t=1}^{n} B_t (1 + i_s)^{-t}}{\sum_{t=1}^{n} C_t (1 + i_s)^{-t}} \quad (11)$$

The basic principle of its application is that for a development project, there are several implementation schemes, using the model results, the cost and benefit of each scheme can be calculated, and the evaluation index value can be calculated by the benefit ratio formula. According to the index value, the optimal design scheme can be designed.

2.2.4. Evaluation of the model

H K .N C C P

International Journal of Intelligent Information and Management Science
ISSN: 2307-0692, Volume 8, Issue 2, April, 2019

Strength: Enormous Flexibility: When the influence factors change with the different areas, the weight of each factor can be determined by different assignment methods, and then the expression of the model can be modified appropriately to make it effective; Advantages of fuzzy reasoning: Because some environmental data can change at any time and cannot be measured accurately, the data set we get may not be comprehensive. But our model can be all quite feasible by varying parameters, allocation rules, even without extensive data sets. But we can make it possible to change parameters and assign rules, even if there is no extensive data set, our model can still be feasible. So our model has good fuzzy reasoning; Decision optimization: This model introduces the concept of cost-benefit ratio as the evaluation index, which clearly and explicitly describes the degree of excellence of the evaluation results. Therefore, the decision maker can design the optimal scheme according to this index to reduce the environmental cost and the impact on the environment ecology; Weakness: The limitation of data: There are 12 discrete data points in this model during the period 2000-2011. Compared with other better models, the amount of data we choose is too small, which will inevitably lead to some errors in the process of fitting; The limitation of data: Relevance of influencing factors - In the hypothesis of the model, we believe that land development projects are independent of each other and will not affect each other. But in real life, there are very few. There are some influences among various land development projects, which may restrict or promote each other. At the same time, all kinds of environmental pollution are not completely independent. These factors are not proper taken into account in this model, so there are certain uncertainties.

2.2.5. Modified model considering relevance

Nonlinear fitting model based on Fourier transform does not take into account the correlation between various independent variables very well. It is necessary to find a better model to eliminate the evaluation error caused by the correlation between independent variables. For example, improper treatment of wastewater may affect the pollution of rivers. When the intensity of pollution exceeds the capacity of rivers, water quality deteriorates, bacteria breed and then destroy the river ecosystem, produce odor and, to a certain extent, make the air quality worse. Therefore, they cannot be simply regarded as independent. We are considering improving the total cost of the economy by adding a correlative item to build a more comprehensive model:

$$C_t = W_t + \alpha_1 R_t + \alpha_2 A_t + \alpha_3 F_t + \alpha_4 D_t + \beta N_t \qquad (12)$$

$$N_t = \beta \times R_t \times A_t \times F_t \times D_t \qquad (13)$$

3. Long-term and Short-term Analysis of Different Scales

3.1. Cost and benefit analysis of small community projects in the short term

3.1.1. Assumptions

Because the cost and benefit of land use development projects are influenced by many factors, the cost of land development by the government changes dynamically every year, and the benefit of the developed land is uncertain every year. Considering the accuracy and reliability of the model, we have the following assumptions:

At that time, the whole national economic market was in a benign competition, without vicious competition and monopoly.

In order to maintain sustained and stable economic growth, the government has sound economic policies.

No special natural disasters occur and the ecological environment is relatively stable.

During this period, there was no large-scale immigration in the United States and there was no social stability.

Suppose the period of study is 2000-2011, totaling 12 years.

3.1.2. Notations

Ct1: Construction Cost of Small Community Projects; Ct2: Construction Cost of Large National Projects; Bt1: Benefits of Small Community Projects; Bt2: Benefits of Large National Projects; R: Fitting Coefficient

3.1.3. Short-term cost-benefit analysis model for small community projects

Cost-benefit analysis of land use development of small community projects can be summarized as a prediction model. Considering the accuracy and reliability of 2.2.2 Fourier transform-based non-linear fitting model in estimating the non-linear curve, the function model is relatively simple. Therefore, in the analysis of land development cost and benefit of small community projects, we still use the non-linear fitting model based on Fourier transform to fit and analyze the cost and benefit of small community projects in the United States from 2000 to 2011, and find out the specific functional expressions. From the formula of economic benefit ratio:

$$RBC = \frac{\sum_{t=1}^{n} B_t (1+i_s)^{-t}}{\sum_{t=1}^{n} C_t (1+i_s)^{-t}} \qquad (13)$$

We can know, when $t=1$ the above formula can be simplified to:

$$RBC = B_t / C_t \qquad (14)$$

So ,we can get:

$$B_t = RBC \times C_t \qquad (15)$$

Through a large number of predictions and taking the mean, we got:

$$RBC = 2.1511 \qquad (16)$$

3.1.4. Cost and benefit analysis

H K . N C C P

International Journal of Intelligent Information and Management Science
ISSN: 2307-0692, Volume 8, Issue 2, April, 2019

By Using MATLAB to fit the cost of small-scale community projects in the United States from 2000 to 2011 based on Fourier transform, we got the curve and function expression of the cost changing with time:
Construction Cost of Small Community Projects:

$$Ct = 3834 + 62.6 \times \cos(t \times 0.3088) - 967.9 \times \sin(t \times 0.3088) \\ + 213.4 \times \cos(2 \times t \times 0.3088) - 132.5 \times \sin(2 \times t \times 0.3088) \quad (17)$$
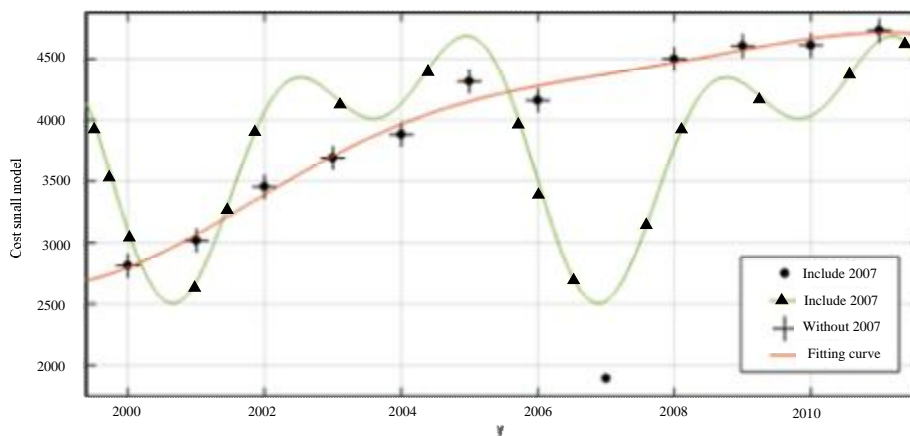
Construction cost change map of small community projects:

Figure 6. Change of small projects' construction cost

Through the analysis of the "change chart of construction cost of small community projects", we can see that the data of 2007 is the outlier. When the data of 2007 is included in the fitting, the result has poor correlation. After calculating the R-square is 0.6654, the fitting effect is not good. After removing the data points of 2007, the fitting effect is obviously improved; R-square is 0.9866, the whole curve shows an upward trend, indicating that the cost of small community projects in the United States increased year by year from 2000 to 2011, and the rate of increase slowed down after 2011.To explain reason of the sharp decline in the construction cost of small community projects in 2007, we searched the internet and found that the real estate bubble in the US was affected by the subprime crisis in 2007, and a significant propor-

tion of real estate in small community projects. Therefore, we can infer that the cost of small community projects will also be greatly affected in 2007, so the emergence of 2007 difference is extreme. Circumstances should be deleted.

By using MATLAB to fit the benefits of small community projects in the United States from 2000 to 2011 based on Fourier transform nonlinearity, the curve and function expressions of the benefits changing with time were obtained:
Construction benefit of small community projects:

$$B_{t1} = 8400 - 2101 \times \cos(t \times 0.3081) - 290 \times \sin(t \times 0.3081) \\ - 500.8 \times \cos(2 \times t \times 0.3081) - 375.5 \times \sin(2 \times t \times 0.3081) \quad (18)$$
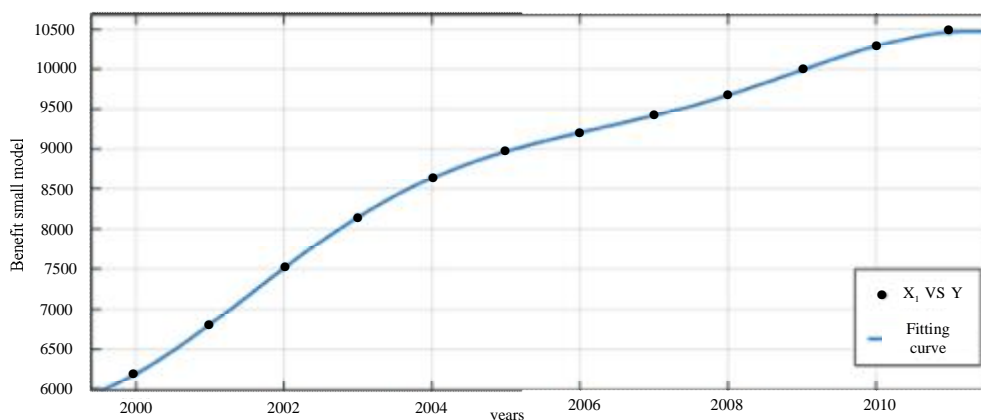
Benefit change map of small community projects:

Figure 7. Change of small projects' construction benefit

H K . N C C P

International Journal of Intelligent Information and Management Science
ISSN: 2307-0692, Volume 8, Issue 2, April, 2019

When fitting the income of small community projects, we can see that the trend of benefit curve is basically the same as that of cost curve according to the change chart. The overall trend is upward, and the speed slows down after 2011. Compared with the "cost change map of small community projects" in 2007, the benefits of small community projects were not greatly affected in 2007. The analysis shows that the proportion of real estate in the benefits of small community projects is small, the main sources of benefits are community service centers and urban business circles, etc., and the benefits of small community projects increased steadily and continuously from 2000 to 2011.

3.2. Cost and benefit analysis of large national projects in the short term

3.2.1. Short-term cost-benefit analysis model for large community projects

The cost-benefit analysis of large-scale national projects is the same as the cost-benefit analysis of 3.1.3 small-scale community projects. The non-linear fitting method

based on Fourier transform can be used to model and solve them. The difference between the two methods is that their cost and benefit are affected by different factors. The most notable is that large-scale national projects are greatly influenced by the relevant policies of the federal government. The cost and benefit of small community projects are largely determined by the business model of the community.

3.2.2. Cost and benefit analysis

By using MATLAB to fit the cost of large-scale national projects in the United States from 2000 to 2011 based on Fourier transform, the time-varying curve and functional expression of the cost are obtained.
Construction cost of large-scale national projects:

$$
\begin{aligned}
C_{t2} = {}& 1693 + 320.7 \times \cos(t \times 0.2897) - 410.7 \times \sin(t \times 0.2897) \\
& + 156.9 \times \cos(2 \times t \times 0.2897) + 54.18 \times \sin(2 \times t \times 0.2897)
\end{aligned} \tag{19}
$$

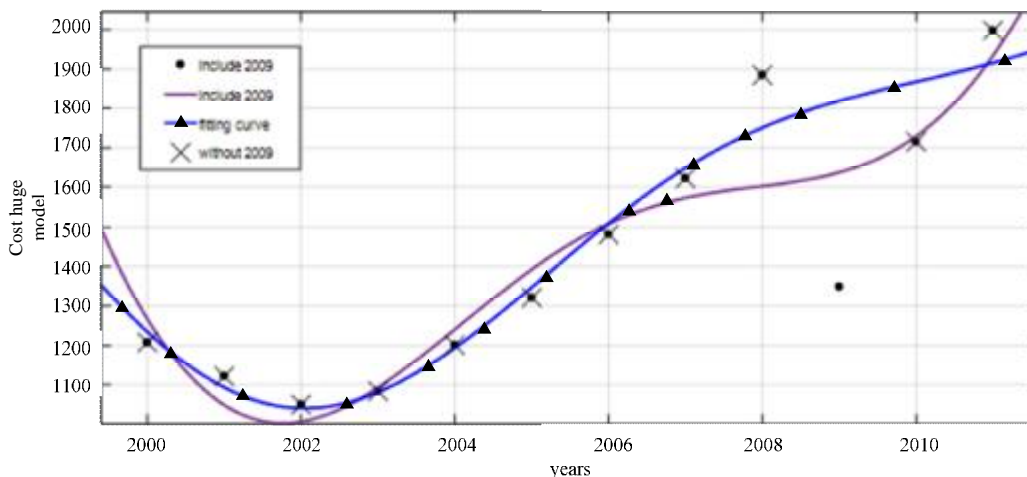Construction cost change map of large-scale national projects:

Figure 8. Change of large national projects' construction cost

By observing the "cost change chart of large-scale national projects", we can find that the cost of large-scale national projects declined in 2000-2002, reached its minimum in 2002, and then increased gradually in 2002-2011, with an outlier in 2009. After eliminating the year of 2009, the R^2 of the fitting line increased from 0.8343 to 0.9339, and the fitting effect improved significantly. Therefore, it is reasonable to think that the data points in 2009 is an outlier, and the fitting curve after eliminating is more representative.

By using MATLAB to fit the benefits of large-scale national projects in the United States from 2000 to 2011 based on Fourier transform nonlinearity, the curve and function expressions of the benefits changing with time were obtained.
Construction benefit of small community projects :

$$
\begin{aligned}
B_{t2} = {}& 3766 + 494.7 \times \cos(t \times 0.2939) + 989.5 \times \sin(t \times 0.2939) \\
& - 80.18 \times \cos(2 \times t \times 0.2939) - 313.8 \times \sin(2 \times t \times 0.2939)
\end{aligned} \tag{20}
$$

Benefit change map of large-scale national projects:

H K . N C C P

International Journal of Intelligent Information and Management Science
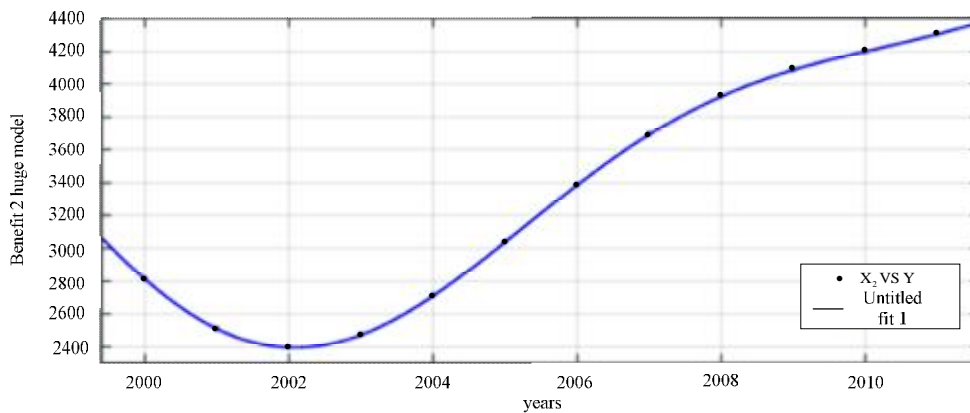*ISSN: 2307-0692, Volume 8, Issue 2, April, 2019*

Figure 9.Change of large national projects' construction benefit

By observing the income change chart of large-scale national projects, we find that its change law is roughly the same as that of the cost change chart of large-scale national projects. The income of large-scale national projects affected by cost reached its minimum in 2002, and then increased steadily year by year. The difference is that the income of large-scale national projects did not appear abnormal in 2009. This is the result of market regulation.

3.3. Cost and benefit analysis of different scale projects in the long term

3.3.1. Assumptions

Component hypothesis: raining 65%, validation 25% testing 15%; Number of hidden neurons: 1; A training algorithm: Levenberg-Marquadt; Plot interval: 31 epochs; We take small community projects as representative to analyze.

3.3.2. Analysis of long-term cost-benefit of projects by neural network algorithms

In the foregoing, we have established effective prediction and evaluation models for projects of different sizes for short-term cost-benefit analysis. When considering the time variation, we build another long-term prediction model[10].
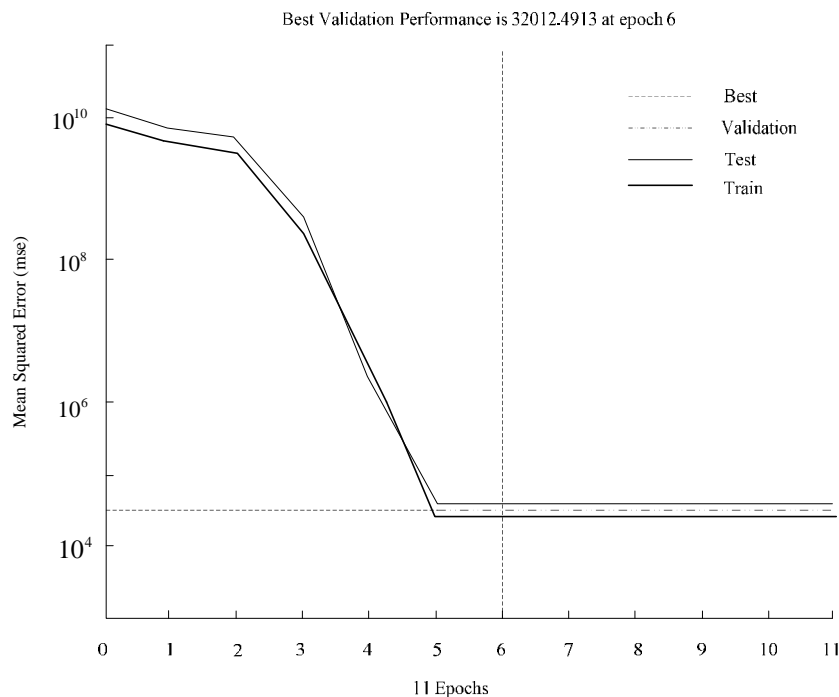

Figure 10. Best performance verification chart

H K . N C C P

International Journal of Intelligent Information and Management Science
ISSN: 2307-0692, Volume 8, Issue 2, April, 2019

Because the grey prediction GM(1,1) and time series method are mainly used to deal with the data with certain linear relationship or periodic change, and cannot predict the data with normal distribution. Whilst, the neural network algorithm can deal with complex data properly and get reliable information. So in this paper, we will use the neural network algorithm to build the model and make a long-term forecast of the cost-benefit of small community projects.

3.3.3. Results and analysis

Best validation performance: According to the "Best Validation Performance" chart, training, validation and test-

ing are synchronously declining in the initial stage, reaching the minimum value at the fifth time and growing steadily almost unchanged. It is noteworthy that the variance between the three is the smallest at the sixth time, achieving the desired results.

The gradient curve: The gradient curve reflects the change of output with the change of input, and the gradient is always greater than zero in the whole stage, which shows that output increases with the increase of input; Validation checks are almost zero at 0-6 times, and grow rapidly after 6 times.
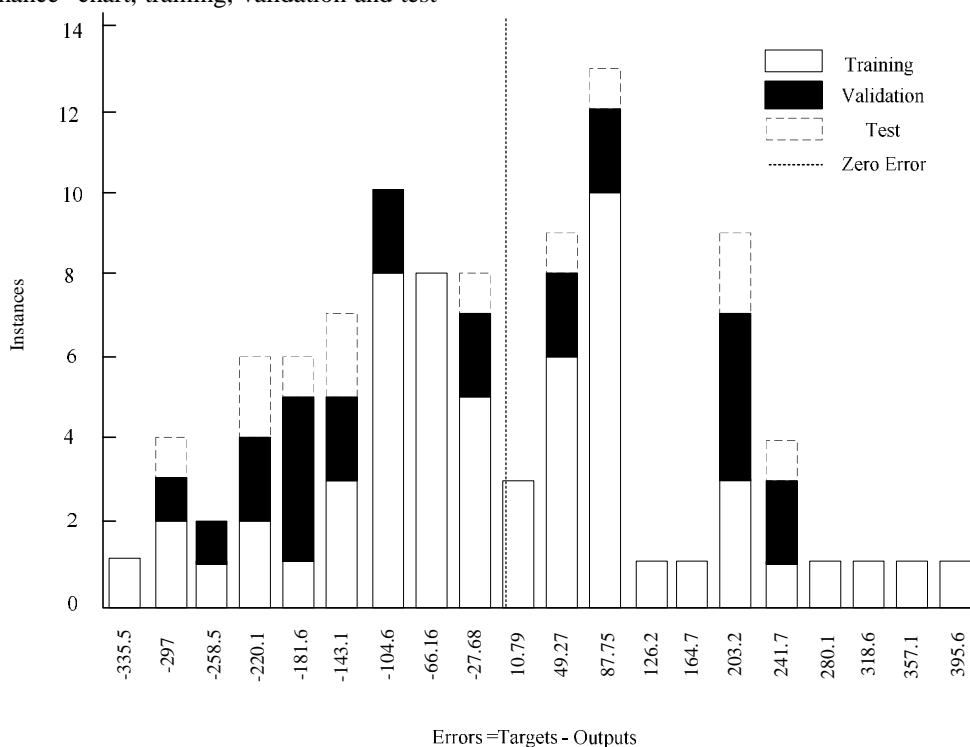
Number of hidden neurons: 1:

Figure 11. Error curve

In the error curve, the zero error position appears in the middle position. If the number of training is too small, there will be no validation data, and the number of test data is not related to the number of training data to a certain extent.

Correlation coefficient:

Considering the correlation of training data, validation data and test data, we can see that the correlation coefficient of neural network is R=1 for training data and all data, but not very friendly for validation data and test

data. The correlation coefficient is 0.51073 and 0.039344, respectively.

In conclusion we use the neural network algorithm to make a long-term prediction of the cost-benefit of small social projects. We find that the evaluation parameters of the results are close to the standard reference value, which shows that the long-term cost-benefit prediction using the neural network algorithm is feasible, and the model we built has good stability and reliability with the change of time.
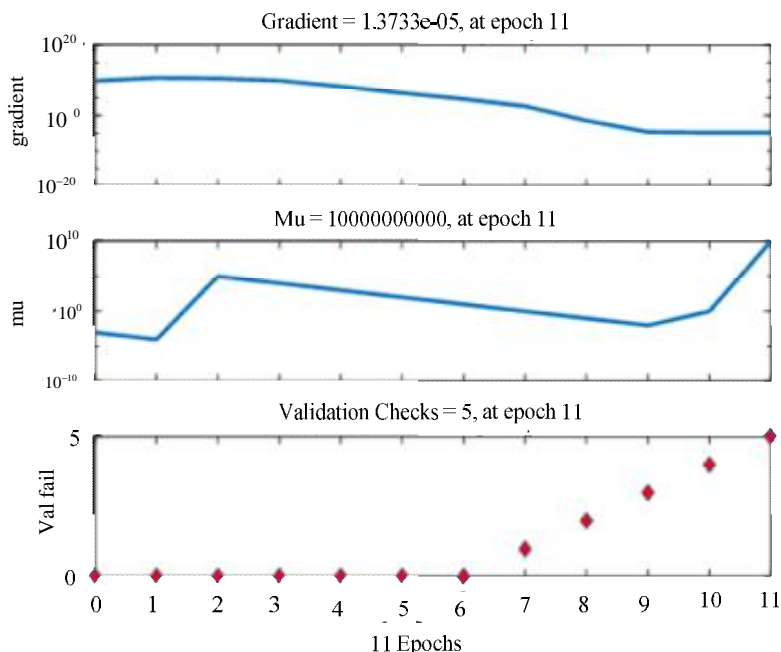
H K .N C C P

International Journal of Intelligent Information and Management Science
ISSN: 2307-0692, Volume 8, Issue 2, April, 2019

Figure 12.Long-term cost-benefit prediction of small social projects

4. Model Test Using Pearson Coefficient

Through 3.1 based on the short-term cost and benefit analysis model of small community projects and 3.2 based on the short-term cost and benefit analysis model of large national projects. We can know that both of them belong to the same model in essence, and the evaluation of their effectiveness belongs to the problem of evaluation. Since the function expressions of the above models are in the form of time as a single variable, the effectiveness of the cost-benefit model can be evaluated by the linear relationship between the result data and the theoretical standard data. The stronger the linear relationship, the better the effectiveness is. Pearson coefficient is an index describing the trend of the same movement of two sets of linear data, so we consider using Pearson coefficient to evaluate the above model.

Pearson coefficient: When the linear relationship between the two variables increases, the absolute value of the correlation coefficient tends to 1; if the correlation coefficient equals 0, it shows that there is no linear correlation between them.

Its mathematical formula is as follows:

$$\rho_{X,Y} = \frac{cov(X,Y)}{\sigma_X \sigma_Y} = \frac{E((X - \mu_X)(Y - \mu_Y))}{\sigma_X \sigma_Y}$$

$$= \frac{E(XY) - E(X)E(Y)}{\sqrt{E(X^2) - E^2(X)}\sqrt{E(Y^2) - E^2(Y)}} \quad (21)$$

$$\rho_{X,Y} = \frac{N\sum XY - \sum X \sum Y}{\sqrt{N\sum X^2 - (\sum X)^2}\sqrt{N\sum Y^2 - (\sum Y)^2}} \quad (22)$$

$$\rho_{X,Y} = \frac{\sum XY - \frac{\sum X \sum Y}{N}}{\sqrt{\left(\sum X^2 - \frac{(\sum X)^2}{N}\right)\left(\sum Y^2 - \frac{(\sum Y)^2}{N}\right)}} \quad (23)$$

The theoretical standard benefits of small-scale community projects and large-scale national projects can be obtained by formula (*1). The actual standard benefits of small-scale community projects and large-scale national projects can be calculated by formula (*2) and formula (*3), respectively. As shown in the table below:

Table 2. Benefits of small community projects and large scale national projects

Table 2.1. Small community projects

Theoretical Standard Benefits	Actual Standard Benefit
6193.914437	6360.749349
6808.806165	7017.683432
7506.465399	7710.288133
8142.991013	8308.152642
8633.009771	8748.53064

H K .N C C P

International Journal of Intelligent Information and Management Science
ISSN: 2307-0692, Volume 8, Issue 2, April, 2019

8967.533244	9044.61888
9201.40558	9264.204503
9416.467345	9488.0892
9675.599841	9765.150647
9986.106457	10082.00442
10287.2227	10359.58987
10467.29779	10478.72091

Table 2.2. Large community projects

Theoretical Standard Benefits	Actual Standard Benefit
2810.444704	2730.852305
2509.397171	2467.866556
2395.058756	2396.832111
2473.58894	2514.275156
2709.341833	2776.705044
3037.709957	3115.561865
3385.470212	3458.555337
3692.054026	3750.375719
3925.022307	3966.129513
4085.056042	4113.429877
4199.301457	4222.977393
4305.775971	4331.381599

By calculating, the Pearson coefficients between theoretical standard benefits and actual standard benefits of small and large-scale projects can be obtained:

$$Pearson(Small) = 1.000$$

$$Pearson(Large) = 0.998$$

It shows that there is a strong linear relationship between the theoretical standard benefit and the actual standard benefit, and the actual standard benefit is calculated by the model we established. It further shows that the 3.1 cost and benefit analysis model based on short-term for small community projects and 3.2 cost and benefit analysis model based on short-term for large-scale national projects are effective.

5. Conclusions

We began by searching the data of environment, land cost and land income from 2000 to 2011, and used them to obtain the function curves and expressions by nonlinear fitting way. The results obtained the degree of correlation of variables through logistic regression, and solved the question whether it was possible to evaluate the environmental cost. We then added the factor of environmental degradation, and determine the four degradation factors and their weights which constitute the environmental cost, so as to achieve the goal of truly and comprehensively forecasting a project's cost-benefit ratio in short terms. Our conclusion illustrates that it is very likely and necessary to take environmental costs into account when evaluating the development projects. Finally, we use two different algorithms to create cost-benefit evaluation models for both small projects and large-scale projects from respectively long-term and short-term perspective. By correlation analyzing we concluded that the models we built and the results we got are not only robust but also have high validity and strong adaptability. In other words our models have a strong feasibility which can be used as an accurate theoretical guidance for project planners and managers to evaluate benefits and environmental costs.

6. Acknowledgments

References

[1] Yao S., Liu J., Han S., et al. The ecosystem service value as a new eco-efficiency indicator for industrial parks. Journal of Cleaner Production. 2017, 164, 597-605.

[2] Dong L., Liu C., Qiang F., et al. ELM evaluation model of regional groundwater quality based on the crow search algorithm. Ecological Indicators. 2017, 81, 302-314.

[3] Ndamani F., Watanabe T. Developing indicators for adaptation decision-making under climate change in agriculture: A proposed evaluation model. Ecological Indicators. 2017, 76, 366-375.

[4] Zhou J., Qin X., Liu L., et al. A potential evaluation model for land consolidation in fragmental regions. Ecological Indicators. 2017, 74, 230-240.

[5] Zhang J., Feng T., Zhou D., et al. Land eco-security evaluation in the Shule River Basin during 2005–2014 in Gansu Province, China. Human & Ecological Risk Assessment. 2017, 23, 1731-1744.

[6] Pauw J.B., Petegem P.V. Eco-school evaluation beyond labels: the impact of environmental policy, didactics and nature at

H K . N C C P

International Journal of Intelligent Information and Management Science
ISSN: 2307-0692, Volume 8, Issue 2, April, 2019

school on student outcomes. Environmental Education Research. 2017, 24, 1-18.

[7] Fazel N., Torabi H.A., Kløve B.. Analysis of land use and climate change impacts by comparing river flow records for headwaters and lowland reaches. Global & Planetary Change. 2017, 158, S0921818117300772.

[8] Sieber S., Amjath-Babu T.S., Reidsma P., et al. Sustainability impact assessment tools for land use policy advice: A comparative analysis of five research approaches. Land Use Policy. 2018, 71, 75-85.

[9] Levine J., Merlin L., Grengs J. Project-level accessibility analysis for land-use planning. Transport Policy. 2017, 53, 107-119.

[10] Dan L., Ning T. Analysis of characteristics of land use in Zhalong Wetland. Journal of Interdisciplinary Mathematics. 2017, 20, 1411-1414.

[11] M. Young, The Technical Writer's Handbook. Mill Valley, CA: University Science. 1989.