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Ecological cost assessment about different scales project

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Abstract. *Many project decision makers do not consider the value of ecosystem services in the decision-making process. This article addresses this issue which is to use the life cycle method to select relevant indicators. And use the Analytic Hierarchy Process (AHP) to establish an ecological cost assessment model by MATLAB, EXCEL and other software to calculate ecological costs of project. Finally, based on the results of the model, provide advice to project decision makers.*

The characteristics of this paper is monetizing the impact on the ecological environment and using the life cycle method to establish a complete and coordinated indicator system to make the model more accurate and easier to calculate.

First, we conduct a full life cycle analysis of the project construction to obtain environmental impact indicators in each stage. Then use the AHP method to analyze the indicators, calculate indicator weights by MATLAB, and verify the validity of the AHP model; finally, we adopt different cost analysis methods according to the categories of indicators, including the energy analysis method, the virtual governance method, the market value method and so on. Finally, we calculate the ecological cost of the project.

After the model is built, we collect data by understanding the land planning bureau report, the engineering design department plan, and then evaluate the ecological costs of large projects and small projects. According to the results of the model calculation, the land planner decision makers are proposed to rationally plan land resources and reduce the waste of ecological resources.

Keywords: *Ecological cost; AHP; MATLAB*

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1. Introduction

1.1. Background

In recent years, due to excessive exploitation and utilization of resources, a series of problems such as soil erosion and land desertification have been caused. According to the Millennium Ecosystem Assessment Report released by the United Nations in 2005, more than two-thirds of the services provided by global natural resources are declining, and this trend may not be effectively reversed in the next 50 years. Most land-use projects do not take into account the economic costs of ecosystem services, which has caused excessive consumption of natural resources and destruction of ecosystems.

1.2. Significance

This paper uses certain ecological and economic research methods to study the economic cost of ecosystem services through qualitative and quantitative means, so that land use projects can not casually use ecological resources, which is of great significance to effectively protect existing natural ecosystems and improve the status of ecological environment. Besides it, the research report provides a basis for sustainable use of land resources and ecological environment protection. Not only can the government rationally plan land resources, reduce the waste of ecological resources, but also provide decisions for social and regional economic development, urban construction and environmental planning.

2. Problem Analysis

Under the premise that ecological environment is used wantonly by land use project, this paper aims to take ecosystem service as the economic cost of the project, and establish a model to qualitatively and quantitatively analyze the cost.

To deal with the problem, we will divide into three steps: First, analyze the influence factors of the ecological environment, select reasonable index, establish the evaluation index system, and establish the model for the index. And use the model to analyze the cost and benefit of different scale cities; Second, to evaluate the validity of the model according to the analysis and the establishment of the model; Thirdly, the economic cost of land use projects is quantified, and how to influence the planners and managers of land use projects is judged, and how the model changes with time by studying the relationship between index and events.

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3. Ecological Service Assessment Model

3.1. Analysis of the problem

The first problem requires us to establish an ecosystem service assessment model and analyze the cost and benefit of different scale land use and development projects under the premise of considering ecosystem services. In order to solve this problem effectively we monetize the value of ecosystem services and monetize the degree of damage to the environment in order to evaluate the value of ecological cost. In order to achieve this goal, we have three steps.

- Make a comprehensive and systematic analysis of the environmental impact caused by the engineering construction by using the life cycle method, determine the scope of the impact on the ecological environment, and obtain the environmental impact data.
- Establish the Evaluation Index system of Ecological cost of Engineering Construction, and use Analytic Hierarchy Process to Determine the Weight of Different Ecological Cost Index
- Calculate the ecological cost value.

3.2. Data source

In this paper, different types of land use projects use consulting theoretical literature and related projects environmental impact reports, engineering feasibility studies and government planning reports, and also from the field research, design departments, The data obtained from the construction department survey can be used as evidence to reflect the real economic cost of land use projects when ecosystem services are considered.

3.3. Model preparation

We know that the whole life cycle analysis of a project shows that different types of environmental impacts are the basis for assessing environmental costs, so we need to first work out a matrix of resource depletion, environmental pollution, and ecosystem damage. Then AHP is used to evaluate the resource consumption, environmental pollution and ecosystem weight. Finally, different unit ecological cost assessment methods are used for different evaluation objects, and the final total ecological cost is obtained.

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3.4. Model establishment

- Discriminant function

A discriminant function for the actual occurrence of environmental impact and the severity of the corresponding impact

$$D_{ij} = f(I_{ij}, T_j)$$

The matrix of resource depletion, environmental pollution and ecosystem damage is obtained.

Tab.1 D_{ij} Value table

D_{ij} Value	Implication
0	Make no difference
2	Small degree of influence
4	Moderate degree of influence
6	Significant degree of influence
1, 3, 5	The degree of influence is between the above two

- Establish AHP Model

The weight matrix (*Wr,Wp,We*) of resource depletion, environmental pollution and ecosystem damage is obtained.

- Ecological cost assessment methods

The final ecological cost is obtained by using different ecological cost assessment methods for different types of evaluation objects.

$$P = P_r + P_p + P_e$$

- Different types of projects

The above formula is for large engineering projects, but for minor projects, we do not consider the impact on ecosystems, so the ultimate ecological cost of small scale works projects is

$$\begin{cases} P = P_e \\ P_e = \sum_{j=1}^{5} W_j P_j \end{cases}$$

3.5 The cost-benefit analysis of large-scale construction projects

First of all, the environmental cost of large-scale construction projects is evaluated, and we take highway construction as an example. Highway construction is the only way to urban construction, however, this does not mean that the environment can be vandalized. At present, highway construction affects the ecological environment of the areas along the route in many ways. To become one of the main factors causing the deterioration of the ecological environment. Only by

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finding a good balance between the two and adopting effective strategies can the harm caused by highway construction be minimized.

- Analysis on the degree of Environmental impact on the whole Life cycle of Expressway Construction.

Tab.2 i with j specific value

j value	Corresponding environmental impact	*i* value	Construction link
1	Steel loss effect	1	1.1
2	Cement loss effect	2	1.2
3	Wood depletion effect	3	1.3
4	Asphalt loss effect	4	1.4
5	Lime depletion effect	5	1.5
6	Influence of sand and stone material consumption	6	1.6
7	Water consumption effect	7	1.7
8	Power consumption reduction effect	8	2.1
9	Oil consumption effect	9	2.2
10	Air pollution	10	2.3
11	Acoustic environmental pollution	11	2.4
12	Water environment pollution	12	2.5
13	soil pollution	13	2.6
14	Soil erosion effect	14	2.7
15	Land occupation impact	15	2.8
16	Water environmental impact	16	3.1
17	Animal and plant effects	-	-

This paper analyzes the degree of environmental pollution in the life cycle of expressway. The expressway construction is a project of natural resources exploitation, and its construction process will inevitably result in the impact of the related ecological environment along the highway. The main factors that cause the ecological environment influence are soil pollution, water pollution, noise pollution, air pollution and so on.

Tab.3 Environmental pollution degree matrix

Environmental pollution impact degree matrix					
Process tree number	Air pollution	Acoustic environmental pollution	Water pollution environment	Soil pollution	Total
1.1	1	1	0	0	2
1.2	0	0	2	0	2
1.3	3	3	1	1	8

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1.4	0	0	0	0	0
1.5	0	0	0	0	0
1.6	0	0	0	0	0
1.7	0	0	0	0	0
2.1	0	0	1	0	1
2.2	2	1	2	0	5
2.3	3	3	1	2	9
2.4	1	1	0	2	4
2.5	0	0	0	0	0
2.6	0	0	0	0	0
2.7	1	1	0	0	2
2.8	0	0	0	0	0
Total	11	10	7	5	33

The ecological environment is inevitably negatively affected in the expressway construction project, but the analysis of the ecological damage degree can help to judge the ecological service cost in the land use project.

Tab.4. Ecosystem damage degree matrix

Ecosystem damage degree matrix					
Process tree number	Soil and water loss	Land occupancy	Water environmental analysis	Animal and plant effects	Total
1.1	2	6	0	1	9
1.2	1	0	2	1	4
1.3	5	5	2	1	13
1.4	0	0	0	0	0
1.5	1	0	0	0	1
1.6	0	0	0	0	0
1.7	2	3	0	1	6
2.1	1	4	0	1	6
2.2	0	0	2	1	3
2.3	5	0	2	2	9
2.4	1	0	0	0	1
2.5	0	0	0	0	0
2.6	0	0	0	0	0
2.7	1	2	0	1	4
2.8	1	0	0	0	1
Total	20	20	8	9	57

The materials used in different engineering materials are different, and the materials used for various types are different, but the loss of the material is the relative concept of the consumption quantity and the scarcity degree.

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Tab.5. Resource loss matrix

Resource depletion quantization matrix										
Process tree number	commonly	commonly	slight	serious	slight	slight	commonly	commonly	serious	Total
	Wood	Steels	cement	asphalt	Lime	Sand and stone	Water	Electric	Oil	
1.1	0	0	0	0	0	0	1	1	1	3
1.2	2	4	2	5	2	2	2	2	5	26
1.3	0	0	1	0	4	4	3	3	5	20
1.4	0	0	2	4	0	2	2	2	2	14
1.5	0	2	1	0	0	1	1	1	1	7
1.6	0	0	0	0	0	0	0	0	1	1
1.7	1	1	1	1	1	1	1	1	1	9
2.1	0	0	0	0	0	0	0	0	0	0
2.2	1	1	1	1	0	1	0	0	1	6
2.3	0	0	0	0	1	1	0	0	1	3
2.4	0	0	1	1	0	1	0	0	1	4
2.5	0	0	0	0	0	0	0	0	0	0
2.6	0	0	0	0	0	0	0	0	0	0
2.7	0	0	0	0	0	0	0	0	1	1
2.8	0	0	0	0	0	0	0	0	0	0
Total	4	8	9	12	8	13	10	10	20	94

Because there are 9 indicators of resource depletion, the total consumption is 94*4/ 9= 42, which is consistent with the quantity of environmental damage and ecosystem damage. Finally, the total degree matrix of environmental damage in the whole life cycle of expressway construction is obtained.

$$(r, p, e) = (42, 33, 57)$$

- Evaluate the weight of Resource consumption

Using Analytic hierarchy process to evaluate the weight of Resource consumption, Environmental pollution and Ecological destruction cost.

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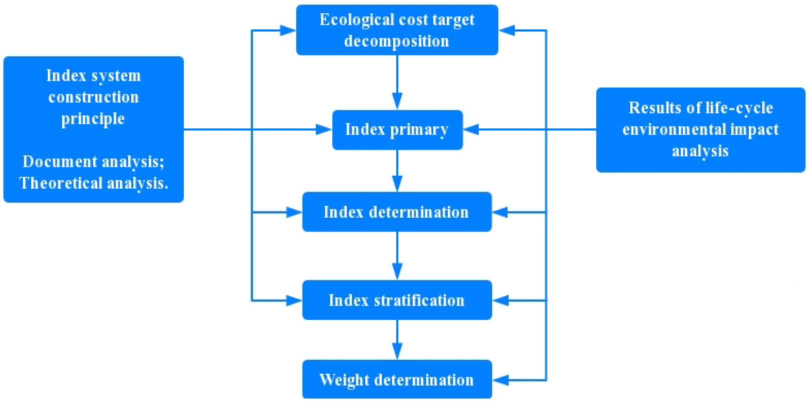

Fig.1 Evaluation process

Taking Ningluo Expressway as an example, we refer to the theoretical literature and environmental impact reports of related projects and establish the following index system through various departments' visits and investigations.

Tab.6. Evaluation Index system of Ecological cost of Ningluo Expressway

Target layer	Subgoal I	Subgoal II	Index layer
Ecological cost of Expressway construction	Resource consumption cost(r)	Natural resource consumption cost(r_1)	(r_{11})Log and wood cost reduction
			(r_{12})Steel consumption cost
			(r_{13})Cement consumption cost
			(r_{14})Asphalt consumption cost
			(r_{15})Quicklime consumption cost
			(r_{16})Sand consumption cost
			(r_{17})Water consumption cost
			(r_{18})Electric consumption cost
			(r_{19})Oil consumption cost
	Environmental pollution loss cost(p)	Ecological cost of air pollution(p_1)	(p_{11})TSP pollution loss cost
		Acoustic environmental pollution cost(p_2)	(p_{21})Loss cost of noise pollution
		Water environmental pollution cost(p_3)	(p_{31})COD pollution ecological cost
			(p_{32})Ammonia nitrogen pollution ecological cost
			(p_{33})Oil pollution ecological cost
		Soil environmental pollution cost(p_4)	(p_{41})Ecological cost of construction waste pollution
			(p_{42})Ecological cost of domestic waste pollution
	Ecosystem damage cost(e)	Soil erosion ecological cost(e_1)	(e_{11})Soil and water loss cost of nutrient loss
			(e_{12})Loss cost of Soil and water loss
		Land occupation ecological cost(e_2)	(e_{21})Cost of ecological loss of occupied forest land
			(e_{22})Cost of ecological loss of farmland
			(e_{23})Cost of ecological loss of occupied grassland

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Index layer: r_1- r_{1j}
Weight calculation of natural resource consumption index layer

$$\begin{pmatrix} 1 & 1/2 & 1/2 & 1/3 & 1/2 & 1/4 & 2/5 & 2/5 & 1/5 \\ 2 & 1 & 1 & 2/3 & 1 & 1/2 & 4/5 & 4/5 & 2/5 \\ 2 & 1 & 1 & 3/4 & 1 & 2/3 & 1 & 1 & 1/2 \\ 3 & 3/2 & 3/4 & 1 & 2/3 & 1 & 6/5 & 6/5 & 3/5 \\ 2 & 1 & 1 & 2/3 & 1 & 1/2 & 4/5 & 4/5 & 2/5 \\ 4 & 2 & 3/2 & 1 & 2 & 1 & 1 & 1 & 1/2 \\ 5/2 & 5/4 & 1 & 5/6 & 5/4 & 1 & 1 & 1 & 1/2 \\ 5/2 & 5/4 & 1 & 5/6 & 5/4 & 1 & 1 & 1 & 1/2 \\ 5 & 5/2 & 2 & 5/3 & 5/2 & 2 & 2 & 2 & 1 \end{pmatrix}$$

Index layer:p_3- p_{3j}
Weight calculation for water environmental pollution indicator layer

$$\begin{pmatrix} 1 & 5 & 2 \\ 1/5 & 1 & 1/3 \\ 1/2 & 3 & 1 \end{pmatrix}$$

Index layer:*p4*- *p4j*
Weight calculation of soil pollution Index layer

$$\begin{pmatrix} 1 & 1/3 \\ 3 & 1 \end{pmatrix}$$

Index layer:e_1- e_{1j}
Weight calculation of soil and water loss Index layer

$$\begin{pmatrix} 1 & 9 \\ 1/9 & 1 \end{pmatrix}$$

Index layer:e_2- e_{2j}
Weight calculation for ecosystem indicator layer

$$\begin{pmatrix} 1 & 6 & 5 \\ 1/6 & 1 & 6/5 \\ 1/5 & 5/6 & 1 \end{pmatrix}$$

Target layerII.
Environmental pollution weight index

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$$\begin{pmatrix} 1 & 1 & 2 & 2 \\ 1 & 1 & 2 & 2 \\ 1/2 & 1/2 & 1 & 1 \\ 1/2 & 1/2 & 1 & 1 \end{pmatrix}$$

Ecosystem damage weight index

$$\begin{pmatrix} 1 & 1/2 \\ 2 & 1 \end{pmatrix}$$

Target layer I.
Weight calculation

$$\begin{pmatrix} 1 & 3 & 1/3 \\ 1/3 & 1 & 1/9 \\ 3 & 9 & 1 \end{pmatrix}$$

Use MATLAB to get the weight matrix vector and CR test as shown in the following table.

Tab.7. Weight matrix vector value table

Matrix	Weight vector	λ_{max}	*CI*	*RI*	*CR*
r_1- r_{1j}	W=(0.0419,0.0839,0.0947,0.1278,0.0839,0.1363,0.1079,0.1079,0.2157)^T	9.0449	0.0056	1.45	0.0039
p_3- p_{3j}	W=(0.5816,0.1095,0.3090)^T	3.0037	0.0018	0.58	0.0032
p_4- p_{4j}	W=(0.25,0.75)^T	------	------	0	------
e_1- e_{1j}	W=(0.9,0.1)^T	------	------	0	------
e_2- e_{2j}	W=(0.7324,0.1378,0.1297)^T	3.0418	0.0074	0.58	0.0128
p- p_j	W=(0.3333,0.3333,0.1667,0.1667)^T	4	0	0.9	0
e- e_j	W=(0.3333,0.6667)^T	------	------	0.58	------
rpq	W=(0.2308,0.0769,0.6923)^T	3	0	0.58	0

From the result of calculation, we can know CR<0.1.Which shows that our model is reasonable.

- Calculating ecological cost value

There are many ecological resources in the ecosystem, such as land, water resources, atmospheric resources, etc. Different types of land use development projects use them to different extent and in different ways, so different methods of assessment are needed for different ecological cost.

Tab.8. Ecological cost evaluation method table

Evaluation object	Appraisal procedure
Resource consumption and	Energy analysis

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ecological cost reduction	
The cost of acoustic environmental pollution and atmospheric environmental pollution	Will investigation method
Ecological cost of water pollution	Virtual governance method
Soil pollution ecological cost	Virtual governance method
Soil erosion ecological cost	Market value method
Land occupation ecological cost	Comprehensive evaluation method of ecological function
Ecological cost of water environment damage	Market value method and Shadow engineering method
Wildlife effect	Market value method

The result of weight is analyzed, and the ecological cost is evaluated by using three layers of indexes without adjusting the weight, and the numerical value is obtained.

- Conclusion

In the large project of the Project of the Ningluo Expressway, the model is set up and the ecological cost evaluation is carried out on the different pollution effects by using different assessment methods. The cost of the resource consumption is about 1.7 billion yuan, and the environmental pollution cost is 53.5 million yuan. The cost of damage to the ecosystem should be nearly 18 billion yuan. The utilization of these ecological resources is data, so that the land management can be used as a basis to manage the land development projects and to adhere to the sustainable development of the land.

3.6 The cost-benefit analysis of small-scale construction projects

We take residential building construction as an example. Residential buildings are everywhere in our lives, but with the development of the economy, we often hear developers overdeveloping land and building buildings, but this practice has brought about soil erosion and noise pollution. Therefore, the ecological resources should be used reasonably on the premise of improving the living comfort of the residents.

- Analysis of the whole Life cycle of Environmental pollution

By searching for information, we understand the four steps of building engineering planning, design, construction and operation. The types of environmental pollution caused by building engineering are garbage discharge, land pollution, air pollution, water pollution and sound pollution.

Tab.9 i with j In the small-scale construction projects

j value	Type of environmental pollution	*i* value	Life cycle
1	Garbage discharge	1	Planning

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2	Land pollution	2	Design
3	Air pollution	3	Construction
4	Water pollution	4	Operation
5	Sound pollution		

By consulting theoretical literature and environmental impact reports of related projects and visiting various departments, the corresponding environmental impact degree matrix(D_{ij}) of each link is obtained.

Tab.10. Environmental impact degree matrix

Stage	Garbage discharge	Land pollution degree	Air pollution level	Water pollution degree	Noise pollution level
Planning stage	2	1	2	1	1
Schematic design phase	2	1	2	1	1
construction stage	6.9	7.8	7.6	5.4	8.0
Operation phase	4	3	4	2	1
Total	14.9	12.8	15.6	9.4	11

- Using Analytic Hierarchy Process to determine the weight of each Environmental impact Type.

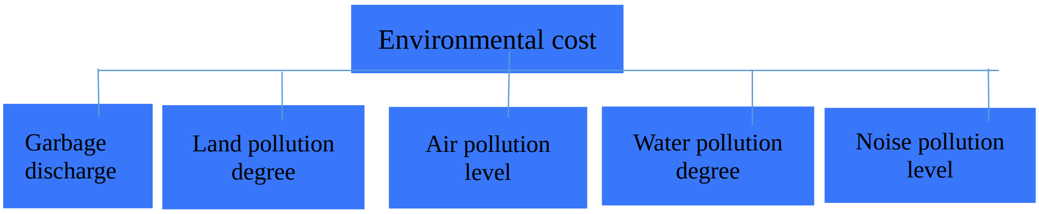

Fig.2. small-scale construction projects ecological cost

The following matrices are constructed through data analysis, survey visits, data inquiries, etc.

$$\begin{pmatrix} 1 & 1 & 1 & 2 & 2 \\ 1 & 1 & 1 & 2 & 2 \\ 1 & 1 & 1 & 2 & 2 \\ 1/2 & 1/2 & 1/2 & 1 & 1 \\ 1/2 & 1/2 & 1/2 & 1 & 1 \end{pmatrix}$$

Using MATLAB to calculated the weight Vector Matrix

Tab.11. Weight matrix vector value table

Weight vector	λ_{max}	*CI*	*RI*	*CR*
$W=(0.25,0.25,0.25,0.125,0.125)^T$	5	0	1.12	0

- Assessment methods

According to Tab.10, different assessment methods are used for different pollution types, however, the impact of small projects on resources and ecosystems is not obvious, so it is not considered here.

According to the formula.

$$\begin{cases} P = P_e \\ P_e = \sum_{j=1}^{5} W_j P_j \end{cases}$$

The weight result is analyzed, and the ecological cost is evaluated by using the three-layer index weight, and the numerical value is obtained.

Tab.12. The weights in the layer of indicator ecological cost

Index	Weights D_a	Unadjusted ecological sample value
Garbage discharge	0.25	4320000
Land pollution degree	0.25	3560000
Air pollution level	0.25	240000
Water pollution degree	0.125	650000
Noise pollution level	0.125	130000
Total		8900000

4. Conclusion

Taking the residential building construction of small-scale projects as an example, through the investigation and analysis of the pollution and damage degree caused by garbage discharge, land pollution, air pollution, water pollution, sound pollution and so on during the construction and operation stages of the building items. The ecological cost assessment model is constructed to study the economic cost of ecological service in the development and construction of residential buildings so as to provide a scientific theoretical basis and practical guidance for the environmental management problems encountered in the construction process. Although the economic cost to the ecological environment is far less than that of the large-scale projects, most of the small projects are distributed around us, which are closely related to our lives and add up to a great deal. Any improper use of environmental resources should be stopped in time.

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References

[1] Weng Naiyi. Assessment of impacts of Human activities on ecosystem stress: a case study of Guanzhong region [D]. Northwestern University, 2014.
[2] Jin Yuwan; Yang Wei; Sun Tao; Li Ming. Assessment of the impacts of reclamation activities on coastal wetland ecosystem in the Yellow River Delta [J]. Wetland Science, 2015.
[3] Liu Jingyan; Chen Lei; Song Ning; Duan Xiaochen. Study on CS,BPNN estimation method of Environmental cost of Green High Speed Railway Construction [J]. Journal of Railway Engineering, 2015.
[4] Wang Xiaoli; Gao Zhenbin; Su Jing; Chen Zhifan; Zheng Mingxia. Comparison of Regional ecosystem Services valuation methods and case study [J]. Journal of Environmental Engineering and Technology, 2018.
[5] Xue Minggao; Xing Lu; Wang Xiaoyan. Spatial Correction and valuation of Land ecosystem Service equivalent Factor in China [J]. Chinese Land Science, 2018.
[6] Xie Gaodi; Lu Chunxia; Cheng Shengkui. Progress in Global ecosystem Services valuation [J]. Resource Science, 2001.
[7] Yang Qiaomu; Zhao Shiqiang. Analysis and control of environmental cost of construction project in life cycle [J]. Price Theory and practice, 2009.
[8] Feng Yingbin; He Chunyan; Yang Qingyuan; He Jian. Using ecosystem Service value to evaluate the Ecological effect of Land use Planning [J]. Journal of Agricultural Engineering, 2014.
[9] Zhang Kun; Lin Naifeng; Xu Delin; Yu Dandan; Zou Changxin. Progress in Ecological Security Research in China: assessment models and Management measures [J]. Journal of Ecology and Rural Environment, 2019.
[10] Ni Weiqiu. Advances in methods of ecosystem Services Assessment [J]. Rural economy and Science and Technology, 2017.
[11] Pan Hesi; Li Ying; Chen Zhenhuan. Review and Prospect of valuation methods for Forest ecosystem Services [J]. Resources and Environment in Arid region, 2018.
[12] Sun Yue Fan; Xu Canyu. Study on the Evaluation method of ecosystem Services value of Natural Resources assets [J]. Economic Research reference, 2016.
[13] Han Yiwen; Dai Fei. Advances in ecosystem Services in Urban Green Space: indicators, methods and Assessment Framework [J]. Chinese Garden, 2018.
[14] Dai ErFu; Wang Xiaoli; Zhu Jianjia; Zhao Dongsheng. Ecosystem Services tradeoff: methods, models and Research Framework [J]. Geography Research, 2016.
[15] Ma keMing; Kong Hongmei; Guan Wenbin; Fu Bojie. Ecosystem Health Assessment: methods and directions [J]. Journal of Ecology, 2001.
[16] Zou Yang; Zou Xinqing; Yang Wen. Evaluation of ecosystem Service value based on Land use change in Sanya City [J]. Journal of Jiangxi Agriculture, 2015.
[17] Xiang Guopeng; Ning Peng; Luo Xingwu. Review on the study of Entrepreneurial ecosystem and Construction of dynamic Model [J]. Science and

ISSN 2616-5667 Vol.3, Issue 3: 51-67, DOI: 10.25236/AJETS.2020.030307

Technology Management, 2016.
[18] Wang Jieqiong; Ge Junwen; Cheng Shuiping. Study on Ecological Restoration of Urban Rivers based on the improvement of Integrated efficiency of Water ecosystem Service [J]. Journal of Western Habitat Environment, 2019.
[19] Huang Zhaoyi; Yang Dongyuan. A Review of theoretical Studies on Ecological cities at Home and abroad [J]. Urban Planning, 2001.
[20] Huang Conghong; Yang Jun; Zhang Wenjuan. Advances in ecosystem Services function Assessment Model [J]. Journal of Ecology, 2013.
[21] Cao Zhi; Min Qingwen; Liu Moucheng; Bai Yanying. Ecological carrying capacity based on ecosystem Services: concepts, connotations and Assessment models and applications [J]. Journal of Natural Resources, 2015.
[22] Wu Yuanxiang; Wang Hanyu; Jin Hua; Pan Xiaoyu. Study on Ecological Service Assessment Model of Urban Green Infrastructure [J]. Urban Architecture, 2018.
[23] Zhao Qianxia. Study and implementation of Land Ecological Assessment system [D]. China University of Mining and Technology, 2016.
[24] Ma Lin; Liu Hao; Peng Jian; Wu Jiansheng. Advances in supply and demand of ecosystem Services [J]. Journal of Geography, 2017.
[25] Fan Mingming; Li Wenjun. Advances and controversies in the study of Ecological compensation Theory: thinking based on Ecological and Social Relations [J]. China's population, resources and environment, 2017.
[26] Fan Yulong; Hu Nan; Ding Shengyan; Liang Guofeng; Lu Xhunling. Advances in terrestrial ecosystem services and biodiversity [J]. Journal of Ecology, 2015.
[27] Cao Qiwen; Wei Xiaomei; Wu Jiansheng. Advances in ecosystem Services tradeoff and Cooperation [J]. Journal of Ecology, 2016.
[28] Zou Yang; Zou Xinqing; Yang Wen. Evaluation of ecosystem Service value based on Land use change in Sanya City [J]. Journal of Jiangxi Agriculture, 2015.
[29] Wu Houjian; Wang Xuelai; Ning Longmei; Lu Yufeng. The impact of Land use change on ecosystem Service value: a case study of Wuhan City [J]. Resources and Environment in the Yangtze River Basin, 2006.
[30] Zhang Yu; Wang Deyu. Dynamic change Analysis of Land use types in Xianlin area of Nanjing based on remote Sensing data [J]. Journal of Nanjing normal University (Engineering Technology Edition), 2017.
[31] Ma Bingying; Huang Jiao; Li Shuangcheng. Optimal allocation of Land use in Beijing-Tianjin-Hebei Urban agglomeration based on Eco-economic tradeoff [J]. Advances in Geography, 2019.
[32] Chen Zhu; Fu Weicong; Huang Yabing; Que Chenxi; Zheng Qiquan. Land use Evolution and Simulation in Fuzhou based on Logistic-CA-Markov Model [J]. Journal of Anhui Agricultural University, 2019.
[33] Niu Qian; Zhou Xu; Xu Youxia; Yang Jiangzhou; Zhang Ji.Analysis of ecosystem Service value Evolution based on Land use in Wujiang Watershed of Guizhou Province[J].Ecological Science,2019.
[34] Xie Liwei; Lei Xue.Analysis on the impact of Expressway Construction on the surrounding Ecological Environment and its Protection measures [J]. Hunan traffic technology, 2018

ISSN 2616-5667 Vol.3, Issue 3: 51-67, DOI: 10.25236/AJETS.2020.030307

[35] Huang Honggang.Impact of Highway Construction Project on Ecological Environment and Protection Strategy [J]. Sichuan cement,2018.
[36] Yang Jin; Liu Zhiqiang; Shen Weibo.Countermeasures of Ecological Environment Protection in Highway Cotruction--Taking the Highway around the South as an example [J]. Ecological economy, 2015.