

# Research on the Evaluation of Ecological Assets Loss in Railway Construction Project Route Selection

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**Abstract:** At present, the route selection of railway construction projects from the perspective of environmental protection fails to objectively and comprehensively reflecting environmental protection requirements. Therefore, incorporating ecological asset assessment into the route selection of railway construction projects is conducive to promoting environmental protection to participate in railway route selection and improve railway route selection. This article summarizes the current status of railway route selection, identifies the existing problems in railway environmental route selection, and combines the research progress of ecological asset assessment, and proposes the assessment content and evaluation index system of ecological asset assessment in railway environmental route selection, and points out the future research prospects.

## 1 Introduction

With the gradual promotion of concepts such as green transportation and ecological railways in the field of transportation, the environmental protection work of railway construction projects has received more and more attention. At present, the route selection of railway construction projects from the perspective of environmental protection is only carried out from the perspective of identifying and avoiding ecologically sensitive areas. Ecosystem service functions and natural resource values have not attracted attention. The railway construction project route selection has not been objective and comprehensive to reflect environmental protection requirements. Therefore, the ecological loss which can be caused by the railway construction project can be reasonably evaluated. It is conducive to reducing the impact of railway construction projects on the ecosystem from the source and reducing the loss of ecological assets. The invention is favorable for providing reasonable suggestions for the line selection of the railway construction project from the environmental protection angle.

## 2 Present Situation and Problems of Railway Environmental Protection Route Selection

At present, the environmental protection route selection of railway construction projects is mainly divided into two steps, one is to identify ecologically sensitive areas, and the other is to put forward line bypass requirements. The identification of ecologically sensitive areas is

mainly to collect information on important environmentally sensitive areas in administrative areas along the route, and draw the boundaries and subareas of important environmentally sensitive areas, and label the names, grades, functional area names, and environmental protection line selection key feature points. Route bypass requirements are mainly based on the requirements of laws and regulations, and related policies and planning. The requirements for route avoidance are put forward in the areas of important environmentally sensitive areas where development is explicitly prohibited.

The current railway environmental protection route selection is essentially an environmental policy selection route. It only pays attention to the compliance of relevant environmental laws and regulations, and puts forward circumvention requirements for areas prohibited by laws. Although it can meet basic ecological environmental protection requirements, it does not from the perspective of the value of ecological assets and the protection of ecosystems. It not only lack the consideration of the natural resources loss, but also pays no attention to the ecosystem's service functions and service values. Moreover, no attention has been paid to the service function and service value of ecosystem, and there is also a lack of research on spatial heterogeneity of ecological assets, temporal dynamics and spatial transfer of ecological assets.

## 3 Ecological Asset Assessment Methods and Analysis of Their Advantages and Disadvantages

Ecological assets are developed on the basis of the concepts of natural capital and ecosystem service

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function, and they are the combination and unity of the two. Vogt, who introduced the concept of natural capital in 1948 when discussing national debt, pointed out that our depletion of natural resource capital reduced the ability to repay debt, a budding international understanding of the importance of ecological assets<sup>[1]</sup>. In the 1970s, ecosystem services<sup>[2]</sup> began to become a branch of scientific terminology on ecological and economic research. After the development of recent decades, the researches of foreign scholars on ecological assets mainly focus on the ecological service function value assessment and the natural resources accounting of ecosystem assets.

Since the late 1990s, the concept of ecosystem services, the value theory of ecological benefits and the evaluation methods of ecosystem services have only begun to be introduced in China. Therefore, the domestic evaluation of the value of ecosystem services in China is still in the initial stage of introducing relevant concepts,

establishing evaluation theory and methods, and accumulating research cases. In general, the researches on ecological assets by domestic scholars mainly focus on the value of individual ecosystem services, the value of regional ecosystem services, the study of ecological assets assessment methods and the study of ecological footprint assessment based on changes in ecological assets<sup>[3]-[7]</sup>.

In the field of ecosystem service value theory and evaluation method, Chinese scholars have made a useful discussion on various assessment methods when carrying out the evaluation of ecological assets. In the application of specific evaluation methods, the main choices include shadow project in the market assessment method and the alternative market evaluation technology, opportunity cost method, payment intention method, expenditure method, etc<sup>[8]-[13]</sup>. The advantages and disadvantages of various assessment methods are shown in Table 1.

**Table 1.** Ecological Asset Assessment Methods and Advantages and Disadvantages Analysis.

Category	Method	Advantage	Disadvantage		
The physical assessment method of ecological assets	The physical stock assessment method	The evaluation method and process are simple and easy to understand and master by the general public.	Different types of ecological assets are difficult to compare and summarize horizontally		
	Resource measurement	Data are mostly obtained in the regional statistical yearbook, different types, regions of ecological assets can be compared horizontally, can also be summarized analysis	It is difficult to fully reflect the exchange of ecological assets between regions, and it is not possible to analyze the quality differences of the same type of ecological assets within the region		
	Emergy Analysis	Emergy Dollars Analysis Expenditure Method	Can compare physical or non-material energy at different categories and levels Can better quantify the value of ecological environment	Due to the complexity of eco-economic systems, duplicate and missing data may exist Failure to fully and truly reflect the value of ecological assets	
The assessment method of the value of ecological assets	Direct market Approach	Market Value Method	The evaluation is more objective Comprehensive and sufficient data is required, and due to market fluctuations, disputes are large when measuring non-material assets		
	Opportunity cost approach	Opportunity cost approach	It fully reflects the ecological value of the resource system and has high credibility Eco-environment value can be quantified by ecological restoration costs or protection costs	Unable to measure resource scarcity value The assessment value is low, and the value of environmental and ecological services cannot be measured	
		Cost Recovery Method	Cost Recovery Method	Eco-values that are difficult to estimate directly can be represented by alternative projects	Non-uniqueness of replacement project, large difference in time and space of replacement project
	Surrogate Market Approach	Shadow project	Human capital approach	Can quantify the value of life that is difficult to quantify	There are still flaws in the attribution of benefits and theoretical issues
	Travel Cost Method	Travel Cost Method	Can calculate the use value of ecosystem rest, can evaluate the value of ecological environment without market	The non-edible value of the ecosystem cannot be calculated and its credibility is lower than the direct market approach	

Category	Method	Advantage	Disadvantage
	Hedonic price method	price Value can be found through side comparison analysis	Subjective, highly influenced by other factors, credibility is lower than direct market approach
Simulate Market Method	Contingent Valuation Method	The value evaluation applicable to commodities that lack the actual market and the alternative market can evaluate the economic value of various ecological service functions, and is suitable for the evaluation of unique landscapes and cultural relics	The actual evaluation results often have significant deviations, the accuracy of the survey results depends on the actual survey program and the survey respondents and many other factors, the credibility is lower than the direct market law

## 4 Study on the Evaluation of Ecological Assets in the Selection Line of Railway Construction Projects

### 4.1 Evaluation content

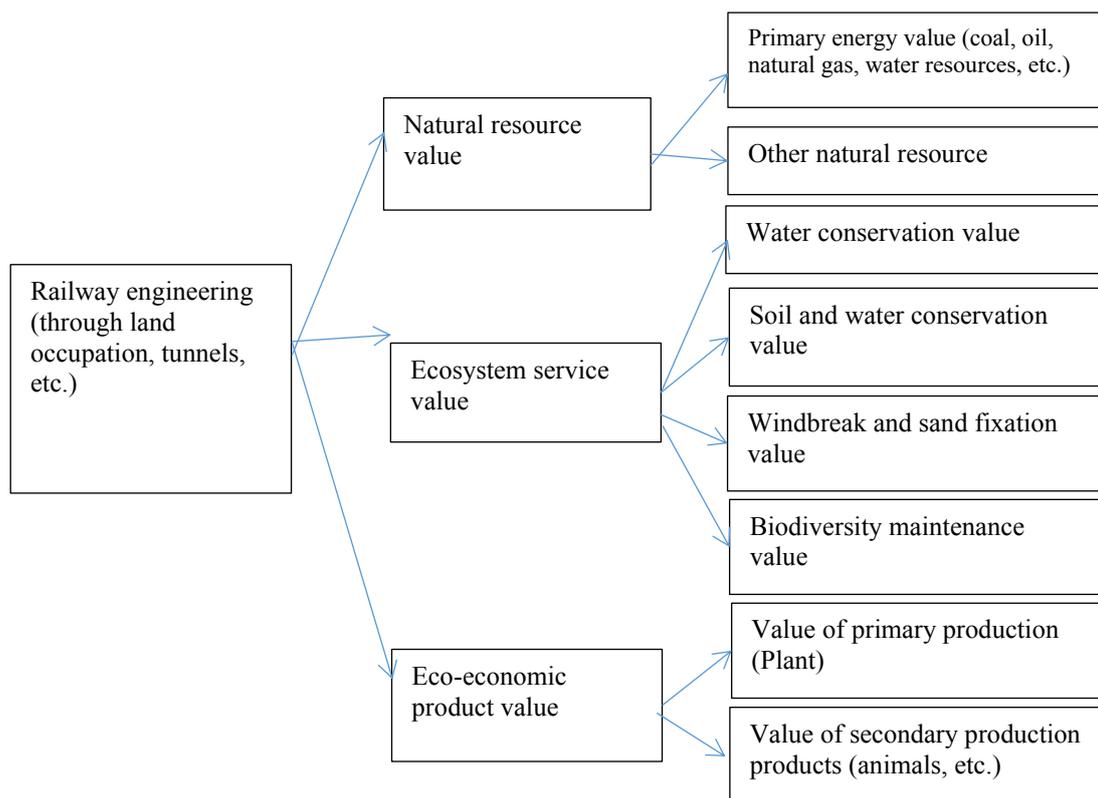
Ecological assets are the value of various service benefits that human beings obtain from the natural environment<sup>[14]</sup>, including the value of natural resources, the functional value of ecosystem services and the value of eco-economic products. The value of natural resources does not only includes coal, oil, natural gas and other primary energy which are provided by the natural environment, but also the natural environment of water resources, ecosystem area and other natural resources. In addition, the ecosystem components of ecological assets mainly include forest ecosystems, grassland ecosystems, wetland ecosystems and farmland ecosystems, which have dual properties of resources and environment, and can be regarded as producing biological resources for human use, such as wood, medicinal materials, building materials, food, etc. From the environmental attributes, the ecosystem can be regarded as the function of supporting and maintaining the sustainable development of the ecological environment on which human beings depend. The ecosystem has a variety of ecosystem service functions such as water conservation, soil and water conservation, wind and sand protection, and biodiversity maintenance.

As a major transportation infrastructure, the railway will cause irreversible ecological impact once completed, so it is especially necessary to give full consideration to the ecological environment impact in the railway construction project during the line selection stage. On

the one hand, the railway covers a large area and is a line-type project, often occupies natural resources, causes certain energy waste and other natural resource losses, reflects in the ecological assets as the impact on the value of natural resources; It will bring double damage to the resource and environmental attributes of ecosystem, and it will have an impact on the functional value of ecosystem service and the value of eco-economic products in ecological assets. Therefore, in the evaluation of ecological assets selected for railway construction projects, we should not only consider the impact of railway construction on the value of ecological assets resources. The impact of the service value of the ecosystem and the value of eco-economic products should also be taken into account, as shown in Figure 1.

### 4.2 Evaluation indicator system

According to the characteristics of railway construction projects, combined with the progress of ecological assets assessment and research at home and abroad, comprehensive consideration of ecological assets assessment content, the establishment of railway construction projects in the selection line of ecological assets assessment index system. The ecological asset evaluation index takes the value of ecosystem service, the value of natural resources and the value of economic products as the evaluation object, and the evaluation index system mainly starts from the scientific and practical, considers the possibility and reliability of data acquisition, and constructs a set of scientific and practical index system. The system of ecological assets assessment index in the selection line of railway construction projects can be seen in Table 2.



**Figure 1.** Eco-asset Assessment Framework in the Selection Line of Railway Construction Projects.

**Table 2.** Ecological Assets Evaluation Index System in Railway Construction Project Route Selection.

Category	Criterion	Target	Index		
Evaluation of Ecological Assets in Railway Construction Project Route Selection	Natural resource value	The number of natural resources	Natural resource consumption	Ecological footprint of fossil energy consumption Loss of water consumption Ecosystem area loss	
		Quality of natural resources	Loss of fossil energy waste	Loss of economic value caused by waste of fossil energy	
	Ecosystem service value	Ecosystem service function value	Changes in ecosystem quality	Water conservation	Loss of economic value caused by ecosystem (field, forest, grassland) occupation and destruction
			Water conservation	Windbreak and sand fixation	Water conservation value
			Windbreak and sand fixation	Soil and water conservation	Wind and sand fixation value
			Soil and water conservation	Biodiversity conservation	Soil and water conservation value
	Eco-economic product value	Number of eco-economic products	Other service functions	Consumption of eco-economic products	Maintenance of biodiversity value
			Eco-economic product output	Consumption of eco-economic products	Values such as air purification, carbon sequestration, and recreation, as well as providing feasibility, cultural and social value
			Consumption of eco-economic products	Consumption of eco-economic products	Output value of agricultural products Forest product output value Output value of livestock and poultry products
			Consumption of eco-economic products	Consumption of eco-economic products	Value of agricultural product consumption Forest Products Consumption Value Livestock products consumption value

## 5 Research Prospect

The value of ecological assets involves different time scales and different spatial scales. At the same time, it is also affected and restricted by many factors. Different time periods, different locations, and different research objects will affect the valuation method. Therefore, how to choose the appropriate method for railway construction projects is a problem that needs to be studied.

The evaluation of ecological assets is mainly aimed at the evaluation of the value of ecological service functions of ecosystem assets and natural resource accounting. If the evaluation of ecological assets is a single system, it can only provide a reference for railway route selection and cannot be used as future ecological compensation. In addition, there is no fixed fee collection standard and quota for ecological asset assessment. Unlike the railway budget, how to link the ecological asset assessment with ecological compensation and railway budget needs further study.

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