



Research Article

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A new method for environmental degradation valuating

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ABSTRACT

This paper analysis about the treatment cost coefficient method of environmental degradation valuation, found that this method is flawed, if calculation according to this method, the unit treatment costs and pollutant emission standards with full correlation, which is not realistic. This paper proposes an improved method - the treatment of coefficient method revised by the treatment difficulty.

Key words: Environmental Pollution, Imputed Treatment Cost, Environmental Degradation Valuating, Residue

INTRODUCTION

Environmental and Economic Accounting System (SEEA) focuses on three aspects of environmental issues, natural resources depletion, environmental degradation, besides defensive expenditure[1]. Natural resources depletion is to calculate how much value of the materiality environmental resources human has consumed; defensive expenditure means environment protecting expenditure, in order to prevent environmental destruction and repair those which have been damaged; environmental degradation discusses how to calculate the environmental worth which has been destroyed but not repaired yet. If the resource depletion value measures reduce of environmental assets in the number, then the value of environmental degradation are used to judge the quality decline of environment.

There are two main estimation methods of environmental degradation value, one based on the cost approach, which assumes that govern emissions of pollutants and the elimination of the degradation of the environment back to the state prior to the beginning, to the cost of the process of governance needs as environment degradation estimate value [2]. Second, the harm-based approach to economic activity so that the discharge of pollutants environment degradation, environmental degradation, in turn, will generate economic activity damage that pollution caused economic losses, assuming that there is no degradation of the environment, these losses do not occur, and therefore pollution to replace the loss of value of environmental degradation.

Wang Yan used this method to estimate the loss of environmental pollution in Shandong Province [3]; the environmental organization Greenpeace and the School of Public Health of Peking University also adopted it to estimate the damage to human health caused by PM2.5 [4]. The former State Environmental Protection Administration and the National Bureau of Statistics jointly issued, has Accounted the value of environmental degradation in 2004 by these two methods respectively [5]. Obviously, both methods are indirect calculation ways for environmental degradation value. Although environmental management costs and environmental pollution loss can be used to reflect the value of environmental degradation, but the former represented the efforts trying to correct the environmental problems from the cost, the latter is on behalf of the seriousness of environmental problems, as the different starting point of the two valuation methods, the estimated results exist divergences above the nature, the numerical value will be significantly different as well.

From the available literatures, more scholars used the method based on damages to calculate the value of environmental degradation, however, from the angle of cost are sparse. This article attempts to estimate that from the cost.

ESTIMATION METHODS OF ENVIRONMENTAL MANAGEMENT COST

During the production and human life, may produce a variety of residues, these contain many kinds of environmentally harmful pollutants. We divide these pollutants into two parts: one is the contaminants have been removed, the corresponding material volume index is "contaminant removal," the expense which has removed the spent will be recorded by "operating costs this year" in environmental statistics, it is the actual cost has been paid, can be called "actual treatment cost", The other is those contaminants have not been removed and discharged, the corresponding physical volume index is "pollutant emissions," What we need to evaluate is how much cost if we remove all this kind of contaminants, we called "virtual control costs." Since the first part of the pollutant has not been released to the environment, will not lead to environmental degradation, so the "actual treatment costs" can not be included in the value of environmental degradation, it belongs to a part of the defensive expenditures. Environmental degradation is mainly caused by the second part pollutants, therefore, we can utilize "virtual treatment cost." to delegate the value of environmental degradation. Environmental management costs classification as shown in Table 1:

Table 1. Environmental management costs classification

Types of pollutants	Physical volume index	Management costs	Accounting methods
Have been removed	Pollutants removal	Actual management cost	Direct statistics
Not removed	Pollutants emissions	Virtual management cost	Indirect estimation

The same kind of residue, such as waste water contains a variety of pollutants, we need to do virtual management cost estimation for each pollutant, and the basic idea seems simple: multiply the emission of pollutants by the corresponding unit management cost of pollutants, that's the virtual management costs of the pollutants. The data of emissions can be gained from environmental statistics, and the unit of management costs is to divide actual management cost by the pollutants eliminated.

This idea is based on two assumptions: one is the pollutants can be eliminate; Assuming that ideal unit management cost and the actual unit management cost are same, namely the spare costs of pollutants is changeless.

In fact, meeting the two assumptions is impossible, it is difficult to eliminate the pollutants 100%, and difficult to make improvement when the removal rate reaches a certain level, because the spare costs of management is after that pollution is increasing. But as no more information obtained now, this assumption is just for reference.

The question is how to calculate the unit pollutant cost of treatment, the difficulty lies in: the data of existing practical management cost are often the data of total costs in comprehensive treatment of various pollutants, it is hard to get the actual cost of management pollutants alone, in fact, the same residue contains contaminants are often more than one. When in environment management, several pollutants are removed together, it is difficult to distinguish between the management cost of contaminants. For the data of pollutant emission is calculated according to different pollutants, so you need to break down the unit management cost of pollutants first and make estimation of the virtual management.

At present, the unit cost of pollutants management can be calculated in two ways to: one is achieved by survey or experiment. When making survey of the quantity and costs in pollutants elimination by companies, or by experiment to get the cost of different process imposed to the unit pollutant, "China green national economic accounting research report 2004" adopted this method. Second, estimate the unit management cost according to the environmental statistics of the actual amount of pollutant removal and the cost, with a model way to estimate the unit management costs of various kinds of pollutants. This paper adopts the second way to estimate the virtual management costs.

The determination of environmental pollutants unit treatment cost methods mainly include: [6]

1. The function method of pollutants combines cutting cost.[7]

From the theory of environmental economics, the marginal processing costs of pollutants is under a certain level of pollution reduction, increase the cost of unit pollutant reduction. For the discharge of pollutants in the production and consumption, mainly refers to the expenses needed. The marginal processing costs can be regarded as the price of the "pollution", is the cost needed in a unit of emissions of pollutants, can be used as a unit treatment cost of pollutants. This kind of method which involves many variables, it is necessary to have sufficient statistics. When the

amounts of data are insufficient, the parameters are of less significance. Through the trial, sometime it can be found that the unit treatment cost of pollutants is less than zero, and unable to meet the needs of the application.

2. The treatment cost coefficient method. [8]

This method introduces the concept of treatment facilities benefits, to calculate the coefficient of each pollutant's treatment cost, apportions the overall expenses between the various pollutants, which can estimate the unit treatment costs of various kinds of pollutants. A certain treatment facilities of i th pollutant treatment efficiency can be represented as:

$$\eta_i = \frac{I_i - E_i}{S_i} \quad (1)$$

η_i is the processing efficiency when dealing facilities i th pollutants, E_i is i th pollutants concentration of export, I_i is i th pollutants concentration of import, $(I_i - E_i)$ is the i th pollutants elimination concentration, S_i is the pollutant emission standards of i th, i is the category of the contaminants.

According to the calculation the each pollutant treatment efficiency of total treatment efficiency, the proportion of treatment cost coefficient is expressed as:

$$\gamma_i = \frac{\eta_i}{\sum_{i=1}^n \eta_i} \quad (2)$$

γ_i is the treatment cost coefficient of pollutants, η_i is i th pollutant treatment efficiency.

$$C_i = C \cdot \gamma_i \quad (3)$$

C_i is i th pollutants treatment cost, C is total actual cost for waste water or exhaust gas, can be obtained according to the "the year's operation costs".

In this way, the residue of the total actual treatment cost is decomposed into different pollutants of treatment cost, finally, divide the pollutants treatment cost by the respective elimination amount, and can get all kinds of pollutants unit treatment cost. That is:

$$\bar{C}_i = \frac{C_i}{(I_i - E_i) \times M} \quad (4)$$

Among them, \bar{C}_i is i th pollutants treatment cost, M is waste water or exhaust emissions in total, $(I_i - E_i) \times M$ is the amount of the pollutant removal.

Treatment cost coefficient method is clear, do not need to estimate the parameters. The idea is to eliminate pollutant concentration relative to the proportion of emission standards on behalf of the processing efficiency, and to determine the proportion of total costs. That means the more pollutants eliminated on a standard, the more the cost should be spent.

From formula (2) (3) (4), the combination can be obtained:

$$\bar{C}_i = \frac{C \cdot \eta_i / \sum \eta_i}{(I_i - E_i) \times M} \quad (5)$$

Then put formula (1) into the formula (5), get:

$$\bar{C}_i = \frac{C \cdot \frac{I_i - E_i}{S_i} / \sum \frac{I_i - E_i}{S_i}}{(I_i - E_i) \times M} = \frac{C}{S_i \cdot M \cdot \sum \frac{I_i - E_i}{S_i}} \quad (6)$$

For different pollutants, S_i is not identical, because of different pollutants emission standards different. But C 、

M 、 $\sum \frac{I_i - E_i}{S_i}$ are all fixed numbers, then above equals can be more explicit written as:

$$\text{let: } a = \frac{C}{M \cdot \sum \frac{I_i - E_i}{S_i}} \quad \text{then: } \bar{C}_i = \frac{a}{S_i} \quad (7)$$

It can be seen clearly that, in Formula (7), a is a constant to different pollutants. the difference between the unit treatment cost of different pollutants depends entirely on emission standards S_i , and with an inverse relationship, the higher the standard of the pollutants, the unit treatment cost is relatively lower, on the other hand, the higher, which means different pollutants in proportion to the unit cost of treatment relationship is determined completely by the emission standards. Standard once decided, the proportion of unit treatment cost relationship is settled, no matter what types of pollutants, if their emissions standards are same, then their unit cost treatment must be equal. It's clearly not meet with the facts, even if different pollutants emission standards are the same, but its treatment process, treatment difficulty, unit treatment cost is difficult to in full accord. Thus, this approach is flawed.

THE IMPROVEMENT IN THE UNIT TREATMENT COST ESTIMATION METHODS

Because the above method is flawed, this paper gets an improved method, the treatment of coefficient method revised by the treatment difficulty. The improvement ideas of this article is, on the basis of original treatment efficiency formula, difficulty coefficient multiplied, then get the improved treatment efficiency, formula is expressed as:

$$\eta_i = \frac{I_i - E_i}{S_i} \cdot \frac{E_i}{I_i} \quad (8)$$

In formulas (8), E_i is i th exports of pollutants concentration, I_i is i th the import of pollutants concentration, S_i is pollutants emission standards, i is category of the contaminants. E_i/I_i is treatment difficulty coefficient, its size is equal to 1 - pollutants elimination rate, that's the proportion of the relative concentration of import to export concentration is higher, the elimination rate is lower, the more difficult to control the pollutant elimination, the more difficult treatment.

Put formula (8) into the formula (5), can get the improved unit treatment cost formula:

$$\bar{C}_i = \frac{C \cdot \frac{I_i - E_i}{S_i} \cdot \frac{E_i}{I_i} / \sum (\frac{I_i - E_i}{S_i} \cdot \frac{E_i}{I_i})}{(I_i - E_i) \times M} = \frac{C \cdot \frac{E_i}{I_i}}{S_i \cdot M \cdot \sum (\frac{I_i - E_i}{S_i} \cdot \frac{E_i}{I_i})} \quad (9)$$

Simplified form written is as follows:

$$\text{let: } b = \frac{C}{M \cdot \sum (\frac{I_i - E_i}{S_i} \cdot \frac{E_i}{I_i})} \quad \bar{C}_i = \frac{b}{S_i} \cdot \frac{E_i}{I_i} \quad (10)$$

In formula (10), E_i is i th pollutants export concentration, I_i is the pollutants import concentration, E_i/I_i is treatment difficulty coefficient, S_i is the standards of pollutants emission, M is the amount of residue, i is the category of the pollutants, b is a constant to different pollutants.

From the formula (10), the improved unit treatment cost is not only related to the emission standard, but also related to the treatment difficulty, even if the emission standards are same, the pollutant of unit treatment cost is higher.

CONCLUSION

This paper analysis about the treatment cost coefficient method of environmental degradation valuation, found that this method is flawed, if calculation according to this method, the unit treatment costs and pollutant emission standards with full correlation, which is not realistic. This paper proposes an improved method - the treatment of coefficient method revised by the treatment difficulty. As the new method, the improved unit treatment cost is not

only related to the emission standard, but also related to the treatment difficulty, even if the emission standards are same, the pollutant of unit treatment cost is higher. The new method retains the advantages of the former method, and make up for its shortcomings.

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