

A Framework of Pollution-Based Environmental and Economic Accounting for China

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Abstract: This paper firstly introduced the background and integral framework of the study on the Chinese System of Integrated Environmental and Economic Accounting. Then it set forth the accounting contents of physical and monetary accounting of environmental pollution, and environmentally adjusted GDP accounting within the framework of the Chinese Environmental and Economic Accounting System. It also introduced briefly accounting approaches for physical quantification of water pollution, air pollution and solid waste in different sectors and regions, and related environmental protection expenditure, maintenance cost and environmental degradation cost. Finally the paper concluded the preliminary achievements of integrated environmental and economic accounting in China in 2004 and discussed the research prospect of CEEA.

Key words: Green national accounting, Environmental and economic accounting, Physical accounts, Monetary accounts, Environmentally adjusted GDP

1 Background

In the past twenty years since the inception of reform and opening-up program, China has made remarkable achievements on economic development. China' GDP increases with an average annual growth rate of 9.5%, but negative effect herewith is also remarkable due to merely pursuance of short-term positive economic growth and measurement of economic growth speed and scale only by means of GDP index. Chinese economic growth is all along accompanied by the traditional industrialization extensive growth pattern and also characterized by "high consumption, high pollutants discharge and low efficiency". Meanwhile, Chinese society has also stepped into the period with various conflicts protruding in which GDP per capita is about 1000-3000 US dollars since 2003. In order to confront new issues and challenges, Chinese government duly proposed to fully implement scientific concept of development and build a harmonious society. Especially the establishment of strategy of "building a resource-conservative and environment-friendly society" provides clear direction for the sustainable development of society and economy in China.

To build a socialistic harmonious society is a new cosmopolitan task, in which solutions for many issues should be gradually sought in practice such as issues of harmony among social relations, harmony between human beings and nature and etc. How to make scientific assessment and estimation on the history, current situation and future trend of economic development of the human society in the viewpoint of "scientific concept of development" and "building a harmonious society" is a key and fundamental issue urgently to be solved, just for which the proposal of green national economic accounting system is put forward to provide a feasible and effective measure.

Therefore, on the basis of an extensive and further investigation and analysis on its feasibility, the Research Project of “Integrated Environmental and Economic Accounting (Green GDP Accounting) of China” was launched in due form jointly by the State Environmental Protection Administration (SEPA) and the National Bureau of Statistics (NBS) in 2004, which marked that the State Act began to play a leading role in the implementation of green GDP accounting around China and the green GDP accounting began to step out from the tower of ivory, step towards the common people and into the actual government policy-making with the guidance of concept of green GDP^[1].

2 China Environmental and Economic Accounting Framework (CEEA)

2.1 China Green National Accounting Framework

According to SEEA^[2], environment performs three functions to the system of national economy: supplying material resources, accommodating waste and providing ecological service. Then System of Green National Accounting may be broken down according to these different functions, and systems of Green National Accounting with different themes may be constructed to control the scope and difficulty of the comprehensive accounting system. This is possible in *The Framework of System of Natural Resource, Environmental and Economic Accounting in China*, which takes Chinese management practice into consideration, seeing resource and environment (narrowly-defined) as parallel concepts, and breaks down the whole system into two independent parts, i.e. Green National Accounts based on natural resource and Green National Accounts based on environment (narrowly-defined). The paper mainly focuses on green accounting based on environment, i.e. the framework and methodologies for environmental and economic accounting.

According to the classification by SEEA, and the existing form and customs in the economy, natural resources include: 1) land/soil resources; 2) forest resources; 3) mineral resources; 4) water resources; and 5) animal resources. Resource accounting needs to measure the resource stock that an economic system processes first, and then calculate the changes in a certain period. To make adjustments to aggregators by resource depletion value, we deduct resource value consumed in economic production from GDP to obtain *domestic product adjusted by resource depletion value*, or green dpGDP, as are also the objective and idea of the accounting adjusted by resource depletion.

2.2 Chinese Environmental and Economic Accounting Framework

2.2.1 Recent Framework for Environment and Economic Accounting

Integrated Environmental and Economic Accounting include four aspects: physical pollution accounting, monetary pollution accounting, input and output accounting of environmental protection, and accounting of environmentally adjusted GDP. Recent framework for Chinese environment and economic accounting (CEEA) would only include three relatively simple parts, i.e. physical and monetary accounting of environmental pollution and accounting of EDP¹, while physical and monetary

¹ In China, GDP is used more often than NDP. To acquire the recognition of common people, EDP

accounting of eco-damage and input-output accounting of environmental protection will not be taken into account. Fig.1 is the recent accounting framework of CEEA.

2.2.2 Technical line of environmental and economic accounting

Technical approaches adopted in accounting are as shown in Figure 2. Its calculation can be divided into three steps: 1) Physical accounting of pollution consisting of generation amount, treatment amount and discharge amount of pollutants; 2) Monetary accounting of pollution which refers to making calculation on actual cost and imputed cost for pollution control by using pollution control cost method and making calculation on environmental degradation cost caused by pollutants discharge by using environmental cost method; 3) Accounting of environmentally adjusted (by maintenance cost) GDP (EDP) and proportions of maintenance cost and environmental degradation cost in GDP. Within the framework, the proportion of maintenance cost in the GDP is called IEDPa .

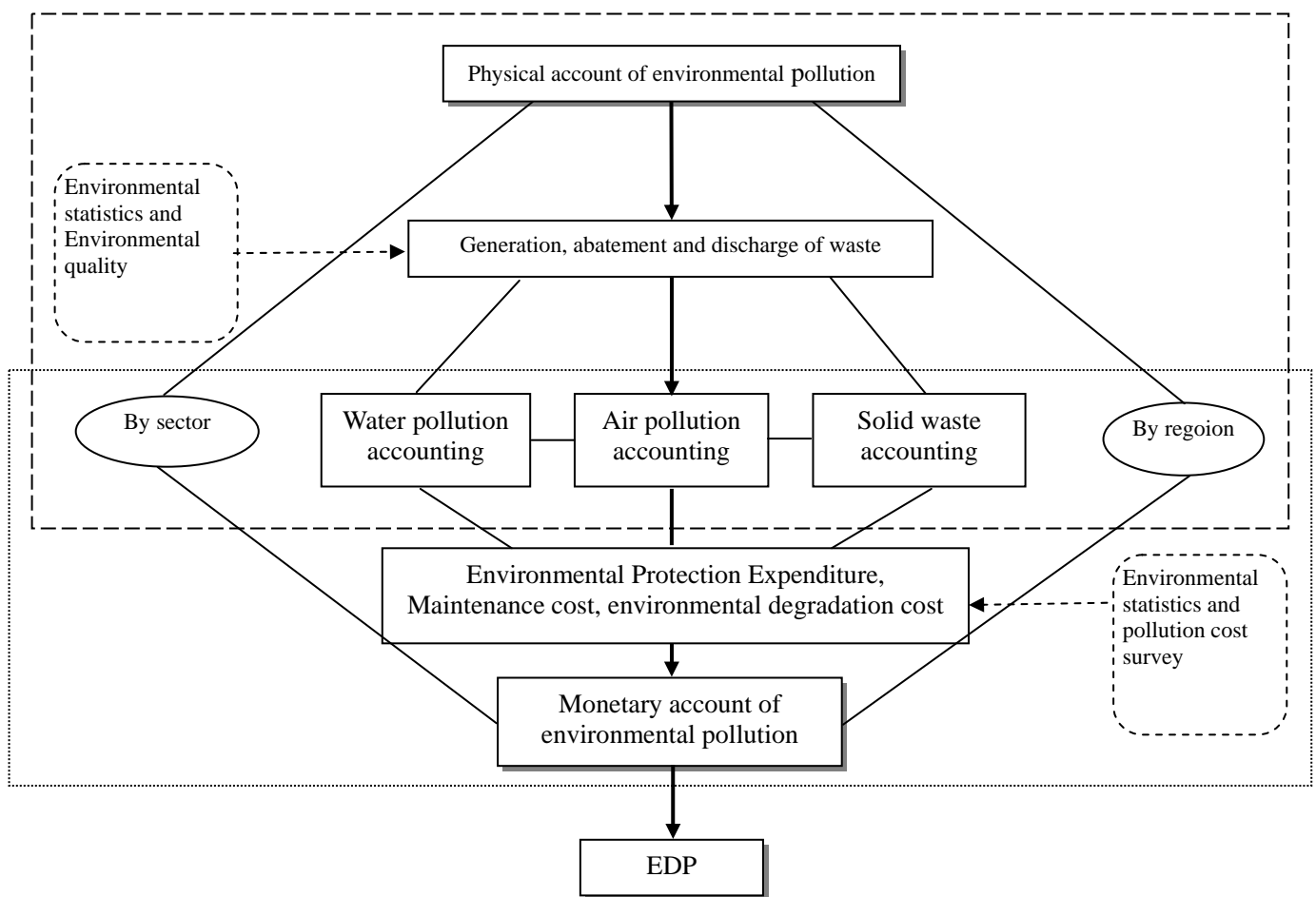


Fig.1 Recent accounting framework of CEEA

There are two approaches to value environmental pollution cost: The first is to calculate the necessary cost to abate pollutant discharge in the process of production

in CEEA is defined as the difference between maintenance cost and GDP rather than NDP in SEEA.

and consumption with the current treatment technologies (best abatement technologies, BAT), the result of which is called maintenance cost in CEEA. The second is to calculate pollution costs caused by the pollutant discharge that will lead to the environmental deterioration, the result of which is called environmental degradation cost in CEEA, or damage value in SEEA. Environmental degradation cost is generally valued by region, and makes adjustment on GDP only at aggregate level. It will be somewhat difficult to make breakdowns by sector.

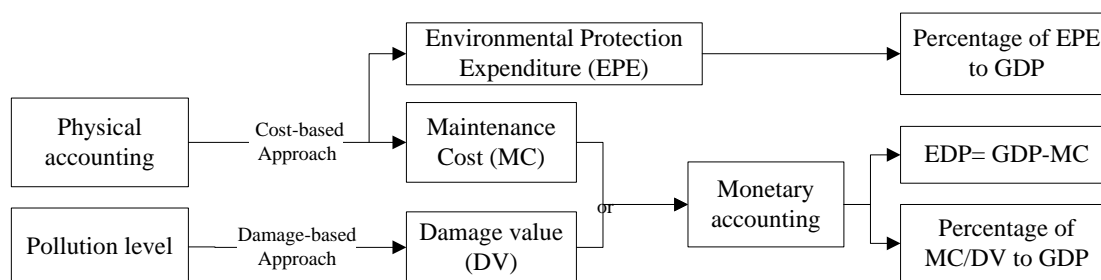


Fig.2 Technical line of CEEA

2.2.3 Framework of physical accounting for environmental pollution

Physical accounting of environmental pollution includes physical accounting of pollution discharge, treatment and generation by industry and by region. It include seven specific components – four physical accounts by region, i.e. of water pollution, of air pollution, of industrial wastes and of urban households wastes; and three physical accounts by industries/sectors, i.e. of water pollution, of air pollution, and of industrial wastes, which are presented in seven matrixes. Territorial accounting scopes include 31 provinces, municipalities and autonomous regions and three regions of different economic level of Eastern, Middle and Western. Industrial accounting scopes include three industries of Primary, Secondary and Tertiary, there in the Primary industry are focused on farming, large-scale living stocks and rural households, while in tertiary industry consist of public service sectors and urban households.

2.2.4 Framework of monetary accounting for environmental pollution

The monetary accounting of environmental pollution includes two parts. One part is to measure monetary flow of environmental pollution in current economic accounting, mainly accounting environmental protection expenditure. The other part is to evaluate environmental degradation cost based on physical accounts and economic cost of pollution accidents. According to accounting methods, environmental degradation cost can be divided into maintenance cost and pollution cost, and the latter is named as environmental degradation cost in the report.

The framework of monetary accounting is presented in Fig.3. Seven tables for monetary valuation of water pollution, air pollution and solid wastes pollution in Figure 3 could be converted into that for physical quantification which constitutes framework for physical accounting.

2.2.5 Accounting for environmentally adjusted GDP

Subtracting the sum of maintenance cost of air, water and solid wastes pollution by

industry and by region from the traditional GDP is the green GDP adjusted by environmental pollution (EDP) by industry and by region.

There are three calculation approaches: 1) production approach: $EDP = \text{gross output} - \text{intermediate input} - \text{maintenance cost}$; 2) income approach: $EDP = \text{compensation for laborer} + \text{taxes less subsidies on production} + \text{Depreciation of fixed capital} + \text{operation surplus with deduction of maintenance cost}$; 3) expenditure approach: $EDP = \text{Final consumption} + \text{capital with deduction of maintenance cost} + \text{net export}$.

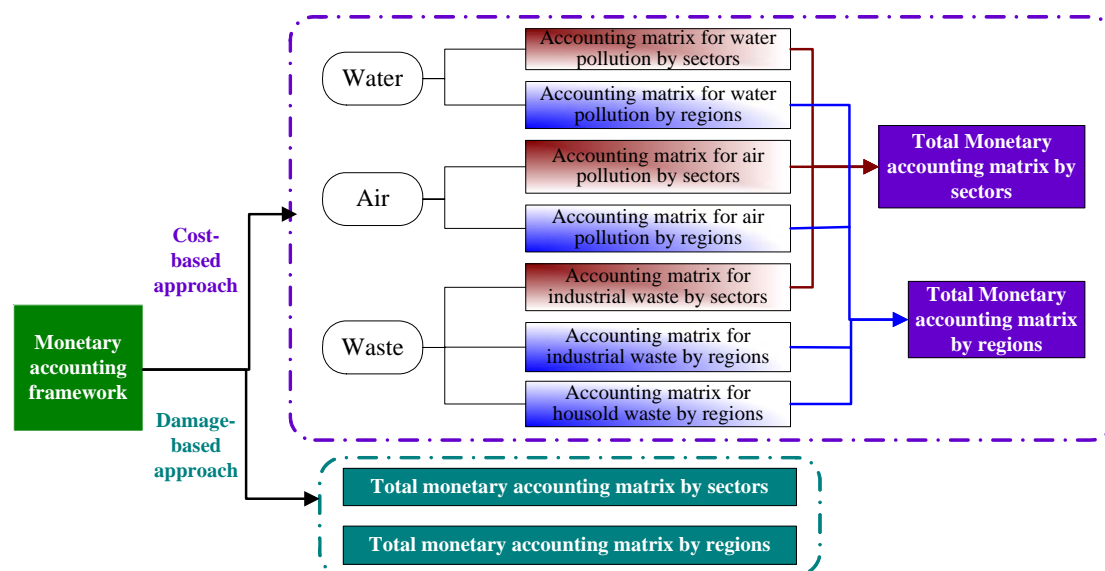


Fig.3 Framework of monetary accounting

3 Scopes and methodologies of Chinese Environmental and economic accounting

3.1 Physical accounting of environmental pollution

Water pollution: 1) Accounting indicators: discharge, discharge of meeting standards, and discharge of violating standards of waste water, generation, abatement and discharge of pollutants in waste water. Regards industrial waste water, generation, abatement and discharge of COD, $\text{NH}_3\text{-N}$, cyanide and oil and discharge of heavy metals will be accounted; regards waste water of farming, stock raising, public sectors and households, only generation, abatement and discharge of two pollutants of COD and $\text{NH}_3\text{-N}$ will be accounted. 2) Accounting methodologies: most of accounting items directly use environmental statistics and all primary items and part of industrial items are estimated with surveying data and the discharge/generation coefficient.

Air pollution: 1) Accounting indicators: Regards industrial sectors, generation, abatement and emission quantity of SO_2 , soot, industrial dust and NO_x will be accounted; regards public sectors and households², generation, abatement and emission quantity of SO_2 , soot and NO_x will be accounted; regards farming industry and rural households, only generation/discharge quantity of SO_2 , soot and NO_x will be accounted. 2) Accounting methodologies: most of accounting items directly use environmental and energy statistics, while abatement quantities of public sectors and urban households, as well as emission of primary industry and rural households are

² Exclusive of transportation sector.

estimated with energy consumption and emission coefficient.

Wastes pollution: 1) Accounting indicators: regards industries, generation, utilization, store, disposal and deposit quantity of common solid wastes and hazardous wastes will be accounted; regards urban households wastes, production, quantity of sanitary landfilling, compost, incineration and simple treatment, as well as deposit quantity. 2) Accounting methodologies: the physical items of industrial and hazardous wastes use environmental statistics, while those of household wastes use statistics of construction departments, except that the generation quantity is roughly estimated with per capita wastes generation and population.

3.2 Monetary accounting of environmental pollution

As stated above, environmental pollution cost composes of two parts, i.e. environmental protection expenditure and environmental degradation cost. The estimations of environmental degradation cost caused by pollutants emission is the most crucial and difficult step in monetary accounts of environmental pollution.

Environmental protection expenditure: Most of environmental protection expenditures have statistics, but environmental protection expenditure of households waste gas, industrial solid wastes, urban households wastes and waste water of stocks living and farming should be accounted. In theory, it is simple to calculate the real pollution treatment cost, i.e. to multiply treatment quantity by per unit treatment cost. Basic formula is: Environmental protection expenditure = treatment(abatement) quantity of pollutants \times per unit EPE. Treatment (abatement) quantities of pollutants are available in statistics or by calculation and the per unit environmental protection expenditure is worked out with surveying data.

Maintenance cost: The accounting method of maintenance cost is the same as the method of environmental protection expenditure, i.e.: Maintenance cost = pollutants discharge \times per unit maintenance cost.

Environmental degradation cost: In this framework, we call the cost calculated by pollution cost method as environmental degradation cost. The method entails the specific surveys of pollution losses. The physical impacts of pollution emissions upon local environment, such as the impacts upon crops output, health and ecological environment, should be valued with certain methods and converted to monetary cost with the certain monetization method. Theoretically speaking, however, only pollution loss represents the genuine environmental degradation cost, and estimation of pollution loss embodies the benefit of treatment^[3].

Given the reliability of the related researches and data availability, the valued items of pollution cost include: 1) Health cost caused by air pollution; 2) Crops loss of air pollution; 3) Material losses caused by air pollution; 4) Economic losses of water scarcity due to pollution; 5) Health losses of water pollution; 6) Crops losses of water pollution; 7) Avoidance expenses of industrial sectors for water pollution; 8) Urban households economic losses for water pollution; 9) Losses of land taken up by solid wastes deposit; 10) Losses of pollution accidents.

4 Accounting for environmentally adjusted GDP

Maintenance cost from monetary accounting of environmental pollution is used to

adjust the traditional GDP to get the green GDP adjusted by environmental pollution (EDP), i.e. $EDP = \text{total output} - \text{intermediate input} - \text{maintenance cost}$. At the same time, calculate the percentage of environmental degradation cost to traditional GDP. The relationship of various indicators is shown in Table 1³.

Table 1 Accounting for environmentally adjusted GDP year/currency unit

| Items | Codes | Items | Codes |
|-----------------------|-----------------|------------------------------------|-------------------|
| Total outputs | (1) | Environmental pollution cost (-) | (6) |
| Intermediate input(-) | (2) | PEP ₁ | (7) = (6) / (3) |
| GDP | (3) = (1) - (2) | Ecologic damage cost (-) | (8) |
| Maintenance cost (-) | (4) | PEP ₂ | (9) = (8) / (3) |
| EDP | (5) = (3) - (4) | Environmental degradation cost (-) | (10) = (6) + (8) |
| | | PEP | (11) = (3) - (10) |

Note: EDP (Environ - Domestic Product) refers to the GDP adjusted by maintenance cost;; PEP (Percent - Environ - Product) refers to the percentage of environmental degradation cost to GDP.

5 Imputed abatement cost and degradation cost of pollution in China in 2004

- 1) The accounting result of maintenance cost revealed that the input for environmental pollution control was insufficient seriously in China.** The maintenance cost for environmental pollution amounted to 287.44 billion yuan in 2004 in China, among which maintenance costs for water pollution, air pollution and solid wastes were 180.87 billion yuan, 92.23 billion yuan, 14.35 billion yuan respectively, accounting for 62.9%, 32.1% and 5.0% of the total maintenance cost. In 2004, the gross domestic product of all the industries (by production approach) amounted to 15987.8 billion yuan in China while the environmentally adjusted GDP was 15700.4 billion yuan, which means that proportion of maintenance cost in the total GDP, namely as I_{EDP}^a , was only 1.8%. Therefore, the input for environmental pollution control was insufficient seriously in China.
- 2) Environmental degradation cost just reveals environmental expenses in the process of economic development.** The total environmental degradation cost⁴ in 2004 calculated by pollution cost approach was 511.82 billion yuan, among which the environmental degradation costs caused by water pollution, air pollution, and solid waste and pollution accidents were 286.28 billion yuan, 219.8 billion yuan, 5.74 billion yuan, accounting for 55.9%, 42.9% and 1.2% of the total degradation cost respectively. Even it is an incomplete accounting result, the environmental pollution cost has accounted for 3.05% of the GDP (in total 16759.95 billion yuan). This striking figure just tells us that environmental pollution is quite severe at present.
- 3) The accounting approach based on the environmentally adjusted GDP is quite feasible.** Even though there are underestimated and missing items in statistical data and ecological damage loss, it is still practical and feasible to make initial accounting for maintenance cost of environmental pollution by adopting

³ Since there is only statistics of GDP with production approach, the calculation methodologies for expenditure approach and income approach are not presented in the table.

⁴ Accounting for environmental degradation cost does not cover ecological damage, groundwater pollution, soil contamination and etc.

treatment cost method and then conduct environmentally adjusted GDP accounting in the light of preliminary accounting results, which could be extended and applied in local statistical and environmental protection departments. It also accords with actual conditions of China to make accounting for environmental degradation cost by using damage cost approach, which is of significant reference for the integrated decision-making on economy and environment and could be applied at the national level.

- 4) **It is still an arduous task and has a long way to go to set up a perfect green national economic accounting system.** The green national economic accounting system is an enormous system, so it would be a long-term goal and need a very long process to establish green national economic accounting system ultimately. Whether or not the green GDP accounting system could be set up and real growth quality of national economy could be reflected by means of green GDP index depend on the concerted efforts of statistical, environmental, resources departments and the social public.

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