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WORLD MARITIME UNIVERSITY

Shanghai, China

**Application of green GDP Concept to the
Calculating Method of Economic Benefits of the
Yangshan Deep-water Port**

By

WANG RUIZHI

China

A research paper submitted to the World Maritime University in partial
Fulfillment of the requirements for the award of the degree of

MASTER OF SCIENCE

(INTERNATIONAL TRANSPORT AND LOGISTICS)

2006

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DECLARATION

I certify that all the material in this research paper that is not my own work has been identified and that no material is included for which a degree has previously been conferred on me.

The contents of this research paper reflect my own personal views, and are not necessarily by the University.

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After great effort of over than six months, my dissertation, which is the study on the application of green GDP concept to the calculating method of economic benefits of the Yangshan Deep-water Port, has finally come to the end. This dissertation is completed under the instructions of my supervisor, Professor Hou Ronghua. Here, please allow me to express my thanks to my supervisor Professor Mr. Hou, who generously gave his kind help and introduction during the whole progress of my paper writing .Every time he had to spend a lot of time in correcting my paper. Without his support and help, I can not accomplish my project very well. As Professor Hou's strict requirements of study, great passion for working and respectable high efficiency at the process of this work, I can complete my research with required quality and quantity. Hence, these influential personalities will continuously affect my attitudes towards study and work tremendously in my life. I have also benefited quite a lot from the instructions and ability trained by Professor Hou during the daily communication in the progression of this dissertation.

Meanwhile, the finish of this dissertation can't leave the contribution of all professors from WMU and SMU, who help me building a completed knowledge network. During the progression of this dissertation, I have also got enormous help from many classmates and friends. They often give me some effective advice and discuss problems with me about my project, so my project implementation can come out as soon as possible. Hereby, I give my sincere thanks to them. Finally, I am going to thank my parents and all the people caring for me, who give me strong support both in life and study during these years.

ABSTRACT

**Title: APPLICATION OF GREEN GDP CONCEPT TO THE
CALCULATING METHOD OF ECONOMIC BENEFITS
OF THE YANGSHAN DEEP-WATER PORT**

Degree: Master of Science (International transport and logistics)

With the construction of the first phase of the Yangshan Deep-water Port, it has successfully brought Shanghai and its surrounding areas billions of dollars benefit income. It is quite obvious that every transportation project is aimed to get the most economic benefit income, but it is also can not denied that certainly negative influences to humans' health, natural resources and ecologic environment is being brought when the transport project is being built and putting into operating. So it is obvious that any economic benefits making by the Yangshan Deep-water Port should not at the sacrifice of environment and ecology.

But refer to the present method of calculating the economic benefits of the Yangshan Deep-water Port, it has mostly focus on the economic evaluation aspects, so we put forward the question of how to apply green gross domestic product (GDP) index which bases on ecologic and environmental aspects into the method of calculating the benefits of the Yangshan Deep-water Port to meet the requirement of sustainable development.

In the dissertation, it has divided into following parts. The first chapter is the introduction. This chapter has included the problem formulation, the methodology and purposes of the study and the overall structure of the dissertation. In chapter two, it is the literature review, which has

introduced the present methods to calculate economic benefits of a certain transport project. And in chapter three, it will present the background of Yangshan Deep-water Port and “with and without test” which is the present method to calculate the economic benefits of the Yangshan Deep-water Port. The fourth chapter is referring to application of green GDP concept into the calculating method of economic benefits of Yangshan Port. There would be three aspects will be influenced from the construction and operating stages of the Yangshan deep-water Port, such as the human being health, natural resources and ecologic environment. And in the last chapter, it discusses the difficulties to apply green GDP concepts into the whole evaluation method.

So after a period of time’s researching the relating theories and backgrounds of this problem, and with the help and guidance of Professor Hou Ronghua, I have tried my best to make analysis of the present method of calculating economic benefits of Yangshan Deep-water Port, and provided solutions and recommendations of how to modify the method under the concepts of green GDP.

KEY WORDS: Green GDP, Human health, Natural resources, Environmental protection, Economic benefits calculating, With and without test

LIST OF ABBREVIATIONS

GDP	Gross Domestic Product
TEU	twenty-foot equivalent unit

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- Table 3.2.2.1** Economic benefits of the Yangshan Deep-water Port
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LIST OF FUNCTIONS

1. Green GDP's calculating function:

$$\begin{aligned}\text{Green GDP} &= A - B - C \\ &= E - C\end{aligned}\quad (1)$$

Where

A----- GDP

B----- Fixed assets

C----- Usage value of natural resources in production

E----- Net domestic product

F----- Usage value of natural resources in production

2. Project national economy appraisal criterion under green GDP accounting

$$= A - E1 - E2 - E3\quad (2)$$

Where

A----- Project national economy appraisal criterion

E1----- Value of project effect on human health

E2----- Value of project effect on resource

E3----- Value of project effect on environment

3. The Yangshan Deep-water Port's national economy appraisal criterion under green GDP accounting

$$= A - E1 - E2 - E3\quad (3)$$

Where

A ----- The Yangshan Port national economy appraisal criterion

E1----- Value of the Yangshan Port effect on human health

E2----- Value of the Yangshan Port effect on resource

E3----- The value of the Yangshan Port effect on environment.

4. The effect on human health by transport project generated particle can be evaluated by the following equation:

$$PC = PD \times PA \times \frac{E_1}{E_1 + E_2 + E_3 + E_4} \quad (4)$$

Where

PC-----value of effect on human health by transport project generated particle

PD-----particle led disease number

PA-----medical cost per disease

E1----- transport project generated particle

E2-----chimney generated smoke

E3-----fire generated smoke particle

E4-----other generated particle

5. The effect on human health by transport project noise pollution can be evaluated by the following equation:

$$NC = ND \times NF \times NA + NR + NP \quad (5)$$

Where

NC----- value of effect on human health by Yangshan Deep-water Port project noise pollution

ND----- the Yangshan Port project noise pollution related disease number

NF----- factor of the Yangshan Port noise pollution in final disease

NA----- medical cost per disease

NR----- cost for elimination of the Yangshan Port noise

NP----- compensation for affected residents nearby project

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CHAPTER ONE INTRODUCTION

1.1 Problem Formulation

China boasts fast economic growth over the past two decades, but behind the "growth" were enormous environmental costs. That is to say, the process of economic growth, however, is also a process involving the increased consumption of natural resources, environmental pollution and ecological degradation. China's ocean environment, especially the shallow waters just off the coast, has been severely polluted by an increasing run-off of contaminants into the sea. The oceans have a limited capacity to absorb pollution. Now we have less and less fish and the ocean environment is deteriorating. We cannot endlessly exploit the oceans any more. We should protect them. Furthermore, it is difficult for oceans to recover from pollution, and so the pressing task is to reduce pollution in the future. At present, China cannot recycle all the pollutants it produces due to lagging recycling facilities and poor environmental awareness in some areas. But the authorities have pledged to make more efforts to improve this situation.

So it is obvious that China has experienced a severe situation of environmental pollution, not only including ocean, but also human health and natural resources have been damaged a lot resulted from the increasing number of economic development and projects construction. So to take into account the scarcity of natural resources in economic development, a new requirement of sustainable development and

environmental preference should be introduced while calculating the economic benefits of transport projects.

As we all know that the Yangshan Deep-water Port is one of the most important transport projects not only to Shanghai but also to China. It has a profound influence on transportation, trade and economy of Shanghai and its nearby areas, even the whole country. Then what is rather significant to make it clear is that how much economic benefit the Yangshan Deep-water Port can contribute to Chinese economic growth? So it is very worthy to make a detailed and deep studying for the accounting method of economic benefits for the Yangshan Deep-water Port. After the research and analysis, we find that the present method is not so perfect and complete, because it is not including the cost of the loss of natural resources and the cost of environmental pollution. As it known to all that both in the processes of construction and operation, the Yangshan Deep-water Port really costs a lot of natural resources and environment to produce the economic value, for example, it destroys millions arcs of plow lands, impairing the valuable usage of tide energy, reducing even using up many mineral resources, and it will contaminate the environment of air, water and vegetation, breaking the balance of nature and also do harm to the wild animals and human beings living around.

In a word, it is amazingly clear that the economic outcomes produced by the Yangshan Deep-water Port are at the expense of the losing of natural resources and the pollution of environment. These two expenses are too important not to be ignored and excluded from the accounting of economic benefits of the Yangshan Deep-water Port in order to meet the requirement of sustainable development which is populated in the world scale.

Therefore, in this paper, the author raised a kind of method to revise and improve the present method of accounting the economic benefit for the Yangshan Deep-water Port, which includes the consideration of the costs of natural resources and environmental pollution. It is called “Green Method”, which is under the concept of green GDP.

Green GDP is derived from Gross Domestic Product (GDP), which is a core indication of domestic economy accounting system to measure the economic level, analyzing the economic benefit and making forecasts of economic situations in a country or an area. However, as the idea and of sustainable development strategy come out and more and more attention is given to environmental protections, the indication of the GDP is obviously not that complete to meet the requirement, since it is lacking the calculation of summing up all the cost of natural resources and environmental pollution. So it is an opportunity for green GDP to come out of water, green GDP is made out to modify the GDP, making more focus on environment problems, especially adding the cost of natural resources and environmental pollution to the total economic cost. Green GDP successfully solves the problem of deficiency and inaccurate of GDP. And at the same time, it is also very practical and reasonable to apply the green GDP concept and its indications into the accounting method of economic benefit for the Yangshan Deep-water Port.

Therefore, in this paper, after a period time of arguing, reasoning, and further analyzing, we finally tried hard to make this ‘Green Method’ work out well. The “Green Method” is application of the concept of green GDP to the method of accounting of economic benefit for the Yangshan Deep-water Port. This new green method is according to the present conditions in China and making the use of some green GDP

indications in order to get the real economic benefits of the Yangshan Deep-water Port.

In the paper, it has also raised the issue of how to set up a system to evaluate the economic benefits which based on the principle of green GDP. And with the further investigation and research, it comes three categories of the impacts of the Yangshan Deep-water Port, such as human being health, natural resources and ecologic environment. So with these three aspects of modifications, the result of economic benefits is surely been more reasonable and accurate which can meet the requirement of sustainable development and environmental preservation.

1.2 Purposes and Methodology of Study

In the dissertation, it presents the “with and without test” to calculate the economic benefits of the Yangshan Deep-water Port. The “with and without test” means “Contrast between Have and not Have” on Economic Evaluation of Transport Project. This test is one of the most popular tests to evaluate the economic benefits of a certain project in quantity, and others are like Evaluation of Increase Test, Forth and Back Contract Test, Comprehensive Test and Horizontal contract Test, these kinds of tests are so as to find out effects through making contracts between the two aspects:

(a) Forth and Back Contrast Test is the direct way to evaluate the relative benefits between the indications before and after the construction of the project.

(b) With and without Test refers to the forecasting evaluation of having or having not the construction of the project, in order to measure the real effects and impacts of the project.

(c) Horizontal Contrast Test means the contracts between the relevant indications which are in the same industry category, so as to evaluate the economic benefits and competitive ability of the project.

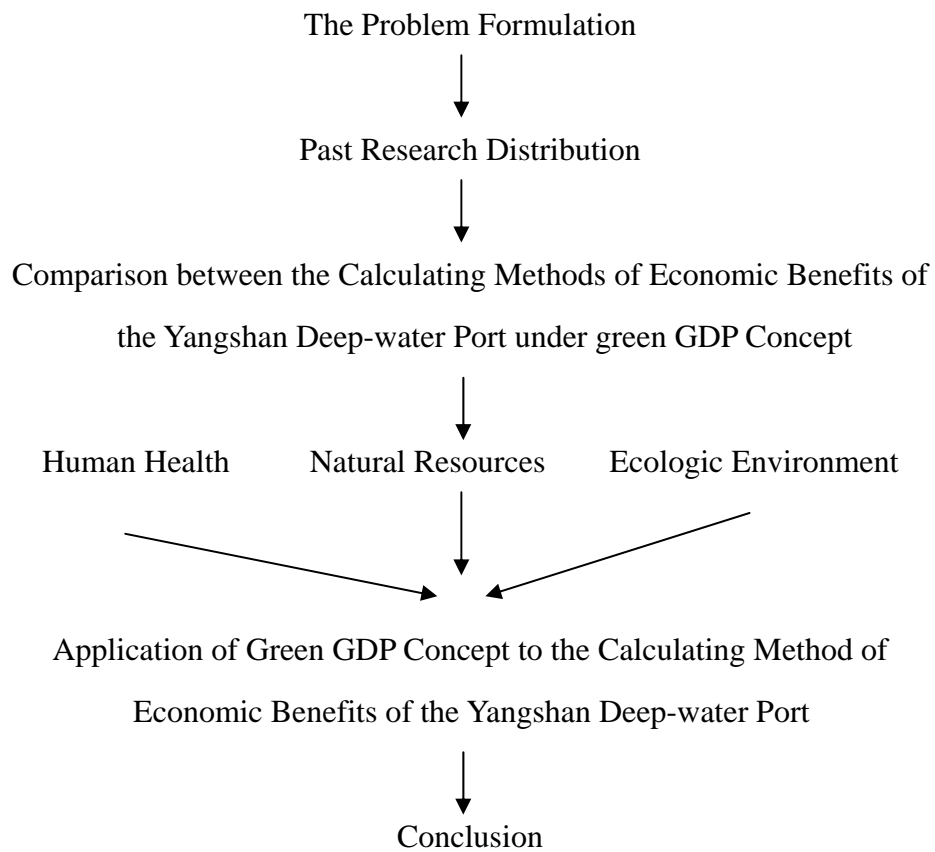
Refer to the “With and without test”, which means the contract of actual impacts and economic benefits before and after the construction of a certain project. Here “With” means the economic benefits brought by the construction of this project, and “Without” means the project has not built any more. This test can reflect the actual economic benefits after the built up of the project.

Therefore, in the dissertation, “with and without test” is applied in the method to calculate economic benefits of the Yangshan Deep-water Port. Under several reasonable assumptions and referring to many statistics from some information sources and the investigations and researches made by experts both in domestic and aboard, with the help of this test, it can get the total estimating economic benefits of the Yangshan Deep-water Port. This test will be divided into two aspects, one is from the short term and the other is from the long term. From these two time periods, it will get a more accurate and practical result of the economic benefits.

1.3 Overall structure of the dissertation

In the dissertation, it has divided into the following parts. The first chapter is the introduction. This chapter has included the problem formulation, the methodology and purposes of the study and the overall structure of the dissertation. In chapter two, it is the literature review, which has introduced the present methods to calculate economic benefits of a certain transport project and many traditional research contributions in the relating fields. And in chapter three, it will present

“with and without test” which is the present method to calculate the economic benefits of the Yangshan Deep-water Port. The forth chapter is referring to application of green GDP concept into the calculating method of economic benefits of Yangshan Deep-water Port. And in the last chapter, it discusses the difficulties to apply green GDP concept to the modified whole evaluation method. In order to further analysis and make the explanation, the overall structure of the dissertation is as follows:



CHAPTER TWO LITERATURES REVIEW

2.1 Traditional research contribution to the calculating method of economic benefits of transport projects

Regarding the economic appraisal of transport projects, European countries have begun to evaluate their effect on environment on a quantitative basis (Grant-Muller, 2001). In the USA, their promotion on economy has been emphasized (Adler, 1987). The environment protection requirements are lower than those in the EU. In international context, the most recent development is to use AEANDP (AFTER ENVIRONMENTAL ADJUSTMENT NET DOMESTIC PRODUCT), which deduces artificial capital depreciation, environmental resources depreciation and loss from the environment pollution, to study the projects effect on national economy. That is, environment loss has been regarded as a cost.

In domestic literature, the former State Planning Commission and the Ministry of Construction published Economic Appraisal Method and Parameters for Capital Construction in 90s last century (State Planning Commission,1994). Other ministries, including the Ministry of Communications, have issued their methods of their features. In September 2003, the Law of the People's Republic of China regarding Environmental Effect Assessment of Capital Projects was published and put into enforcement. Its Article 17 Item 5 stipulates that capital project environment effect assessment should include economic gain and loss

of environmental effect.

The framework of green GDP accounting was established. Experiment of it has begun in one province or city for every big region. Although China's green GDP theory was leading in the world and has gained support and recognition in practice, no breakthroughs have been made on techniques and methods till now. This can be shown that construction project incidence on the environment has the problem of market insensitivity which means there is no market price for the effect. This leads to difficulty in accounting. The pricing of environmental effect is also a world wide difficult problem.

As for the definition of green GDP there are several sayings. We define it as a data obtained after the deduction of the cost of resources, environment and human health from the traditional GDP. Therefore, the judgment of specific projects will be altered by these three items under the green GDP accounting framework. Generally speaking, the economic indications will become worse after the adjustment. For example, the green GDP accounts for 74.94 % and 75.75 % by way of production and payment calculations respectively, according to the results of green GDP accounting for Beijing 1997 by the Beijing Ninth Five Year Key Research Project National Economy Accounting System Study in EPD as a Core Criterion. Green GDP has 2 levels of region and business (project). This paper chooses to study the national economy appraisal of transport project under the green GDP in order that human health, environment and resource effect can be effectively reflected and scientific development concept can be established on one hand, on the other hand, macro adjustment and control sector needs to analyze and judge the true situations of social and economic development by these new measurements. Thus, economic growth

gained internal energy.

In fact, if the project can be resource-saving and environmentally friendly, it means the cost of resources and environment protection is reduced. Hence, ultimately and from a long-term development view, green GDP brings more benefit to business and project than harm.

2.2 The background of Green GDP theory

In order to get the new economic pattern and changes and developments of the green GDP and sustainable development, experts and scholars from home and abroad have conducted a series of researches of green GDP development and its indication systems in many respects. The brief introduction of this topic's studying development process as follows.

2.2.1 Green GDP theory in foreign countries

GDP (gross domestic product), the market value of all final goods and services produced by all resident units within a country(or a region) in a given period of time. GDP is not just reflecting the development of product but reflecting the tendency of increase of all services, reflecting the scale and level in the national economy and social development, GDP is also one of the most essential core indications of national income accounting system, it gathering up the product outcomes of all activities into an extreme statistic figure, and this figure can completely measure the economic level of a country or a region, analysis the economic benefits and forecast the economic tendency.

The GDP data obtained with production approach is the sum of the value-added of all departments of national economy; the GDP data obtained with distribution approach is the sum of the labors reward, net

taxes on production, operating surplus, depreciation of fixed assets, and the GDP data obtained with use approach is the total expenditure on final consumption, total capital formation and net export of goods and services. These three approaches in theory can get the same result; but in fact, it will be different from different statistics. GDP has been the well recognized and united measurement, because it has followed several functions:

- (a) GDP can reflect the economical and poverty level of a country or a region
- (b) GDP can reflect the scale of economic development and the tendency of economic growth
- (c) GDP can analysis the economic policy and modify the industrial structure

2.2.1.1 The formation of sustainable development theory

The sustainable development theory is coming to meet the requirement of environment preservation. After the late of 80s, sustainable development theory is popularly accepted and spread by international societies and governmental organizations as a complete definition of “the sustainable development is not only satisfying the need of present generation, but also do no harm to the ability of gaining satisfaction for the next generation.”

The thought of green GDP is developed from the further study of environment problems, in the early 1950's, K. Willam had realized that whatever in theory or in the indications of designing the economic development, but his idea did not raise the attention of other people. Until the latter 1960s and the early 1970s, some western countries faced the problems of job-losing, inflation and environmental pollution and

natural imbalance, so in 1977, the experts of United Nations environment arrangement department put out a report, which concerning about the concept of environmental development. In the report, environmental development refers to the development which meets the requirement of environmental development, that is the economic development should be in the limitation of the rules of environment, once it beyond the limit, the function of reproduction of natural resources and self-cleaning of environment will be destroyed, then will cause serious environment problems to effect the sustainable development of productivity.

In 1980s, some experts and international institutes has worked on the relationship between environment and economy and made such a big breakthrough, that is economy and social development are the basis of smoothing the important environment problems, and at the same time, the goals of economy and social development should be avoided the environmental pollution, or minimize the degree of pollution.

In 1987s, in the report of “our common future” delivered by the international environment and development committee, it explains the concept of ‘sustainable development’. After this report, sustainable development is accepted and spread by international societies, governments and organizations.

The definition of sustainable development is to not only fulfill the requirement of present generation, but also do no harm to meet the need of following generations. And the economic development, social progressing and environmental preservation are the three supports of sustainable development.

2.2.1.2 The development from GDP to green GDP

In 1980s, there are three kinds of methods to add natural resources and environmental pollution cost into GDP accounting system. The first is setting up a totally brand new system which includes environmental considerations, this is the most effective way to show results in the indications of GDP, but the new system is too difficult to build. The second method is to maintain the existing GDP system at one hand, and make a few modifications and adjustments of environmental cost to GDP at the other hand, and this method is now adopted by the United Nations as the principle of Green GDP. The third one is to build the other system which includes the environmental expenses parallel to the existing GDP system; however, this way is not accepted by United Nations nowadays.

As mentioned in above, the way to calculate GDP has not included the natural resources, so it can not reflect the economic loss of natural resources. That means take air, water and forests as an example, everyone can get as much as these natural resources at free, these natural resources loss are not included in the field of calculating GDP. So GDP can not reflect the economic loss of natural resources, and also can not restrict the uses of natural resources by people efficiently and effectively. Furthermore, it can lead to the severe environmental pollution and the losing of valuable natural resources. As a solution to meet the requirement of sustainable development, it comes out the point of adding environmental factors into the accounting method of GDP and the concept of “environmental cost”, which then developed into green GDP theory.

However, the items of GDP accounting has not included the costs of natural recourses and environment pollution, only calculate the market

value of direct products served to human beings by ecology system, but not calculate the indirect value produced by ecology system as the living supportive system, so the concept of GDP is not so complete and perfect in some aspects. It results these main negative impacts, the first is aggrandize the economic growth rate based on the rising of GDP figure, the second is not predict the loss of devaluation of natural resource and degradation of environment, the third is to ruin the natural resource and environmental which are the basis and conditions to economic development due to the over-pursuing of material fortune, so these three deficiencies obstacle the sustainable healthy development of an economic society and can not satisfy the requirement of sustainable development.

So in the late 1990s, more and more scholars suggested to modify the accounting items of GDP by some environmental indications. In a word, there are three kinds of methods to modify GDP, the first is to set up a totally new GDP accounting system, it is the most efficient way to reflect the indications of economic development ability, but it is very hard to calculate this system by present accounting level, the second is still to maintain the system of national income accounting system, but only modify the environmental cost of the net national product value, the concept of green GDP is just derived from this method, and now adopted by United Nations, the third one is to set up another system which is parallel to the present national income accounting system and includes a complete environmental indications item, but this way is not accepted by United Nations. Then we will focus on the one of green GDP as follows:

Green GDP is derived from GDP, and adding resources and environment indications to the calculation of GDP index, it is also

called “ecology GDP”. It removes out the environmental cost from the total national income value, implying the sustainable development principles and realizing the optimal union of economic benefit, social benefit and ecology benefit.

2.2.1.3 Definition of green GDP

As for the definition of green GDP there are several sayings. We define it as a data obtained after the deduction of the cost of resources, environment and human health from the traditional GDP. Therefore, the judgment of specific projects will be altered by these three items under the green GDP accounting framework. Generally speaking, the economic indications will become worse after the adjustment.

The switch of concepts from GDP to green GDP can not only make out the significance of sustainable development, but also provide a more accurate and more reasonable method to calculate the total value of domestic product. Furthermore, this concept also can be applied into the accounting method of economic benefit in any valuable product. It is also the practical value and objective, so we make Yangshan Port be an example to calculate its economic benefit in the new method which based on the concept of green GDP.

2.2.1.4 Indications of green GDP

From the production view, green GDP is total national income value deduct natural resource and environmental costs, here the natural resources are divided into two categories, one is the loss of natural resources, it means the consumption of natural resource which is directly used in production process, the other is the degradation of environment, it means the environment grade has greatly reduced due to the over use of environment.

Green GDP's calculating function:

$$\begin{aligned}\text{Green GDP} &= A - B - C \\ &= E - C\end{aligned}\quad (1)$$

Where

A----- GDP

B----- Fixed assets

C----- Usage value of natural resources in production

E----- Net domestic product

F----- Usage value of natural resources in production

2.2.2 Green GDP theory in China

2.2.2.1 The situation of environmental studying

Since 2003, China has begun to develop the research of accounting the cost of natural resources and environmental pollution. It has a deep implication of the change for the development strategy and environmental preservation strategy of China and after that, there is an increasing number of people pay more attention to the environmental issues. There are four stages of Chinese environmental improvement, the first stage is from 1950s to 1980s, and our GDP system is based on MPS, only calculates the values produced by the first and second man factorial industry, and even not includes the third service industry, so it is not accurate to reflect the real domestic income of a country. The second stage is that from 1982s to 1991s, in this period of time, China has introduced SNA system which is accepted and used widely by developed countries. The third stage is from 1992s to 1995s, during this period of time, MPS is not allowed to use any more, China has developed and enforced its own system to account GDP. The fourth stage is started at 2003, when China has first calculate the detailed substances of environment and natural resources.

2.2.2.2 Green GDP theory study

In China, green GDP is considered as an adjusted GDP, it is also an indication of sustainable development. Green GDP is modified by a series of environmental indications on the basis of the present method of GDP. And these environmental indications have four parts:

- A. environmental capital depreciation
- B. expenses of the preventing for environmental destroy
- C. expenses of the recovery for resources and environment
- D. the extra expenses caused by using resources not optimize

2.2.2.3 Current situation in China

With regard to China, green GDP is the most efficient indication to reflect sustainable development. From now on, there is not one country can calculate green GDP to meet the requirement of statistics, neither can China.

China now is to establish "green GDP" index system. The State Statistical Bureau (SSB) and the State Environmental Protection Administration (SEPA) are jointly working on the criteria for the so-called green GDP, which deducts the cost of environmental damage and resources consumption from the traditional gross domestic product.

According to an international seminar on "green GDP" calculation held in Beijing Friday by the SSB and SEPA, related departments will soon establish theoretical systems and basic frameworks to evaluate the overall environment and economy, set up indexes to calculate pollutant materials and environmental costs and spread the new index systems from experimental sites to other areas. The growth of the Chinese economy is still of low efficiency and consumes huge resources, noting

the introduction of a "green GDP" index system has become an urgent and crucial task for sustainable development.

In the past 25 years, China has achieved an economic miracle with average GDP growth at above 8 percent every year. However, as GDP has become the main standard, or the only standard in some regions, to evaluate the government's performance, many local officials have turned a blind eye to development in other fields, including medical care, education, culture and environmental protection. The traditional GDP index could not fully reflect the relationship between economic growth and the environment, the environment and people.

If the current high-cost growth and serious pollution continues, China will face a heavily-polluted environment and a serious shortage of natural resources in the near future, which would not support its future development. We must adopt a scientific approach to the current accounting system of GDP, a comprehensive indicator of the economy.

Southwest China's Chongqing Municipality, the only trial city designated by the SSB in 2001 for developing the "green GDP" system, has studied data collected from 1,415 local enterprises and non-profit institutions. Based on the study, an initial feasible "green" GDP accounting approach has come into being.

Beijing now has started trial calculation of green GDP. Beijing is attempting to calculate the city's "green" gross domestic product (GDP). The experiment is scheduled to figure out the "green" GDP of 2004 by the end of next year based on the formula of "conventional GDP minus environmental loss". The "green" GDP was defined as the GDP resultant from deducting resource consumption and environmental loss

from the conventional GDP. The pilot calculation will not include the cost of resource consumption. The investigation will cover the cost on pollution management and sewage disposal, the effect of air and water pollution on human health, the effect of water pollution on crops, the condition of construction materials and the economic loss caused by pollution.

Beijing, along with nine other provinces and municipalities, was chosen by the central government in March to conduct experiments on calculating the green GDP. The full test results are expected to be released next year and will lay the foundation for a nationwide system of green GDP.

With the further social improvement and economic development, there is an increasing number of economic experts have realized the importance of GDP, the indication of a country's economic level, but at the same time, they also aware of the significance and the huge impact of environment protection and natural resources preservation.

2.3 Chapter summary

In this chapter, it discusses the concepts of GDP, green GDP and the development from GDP to green GDP, and the indications of green GDP, from above statements, it is quite obvious that in order to meet the requirement of sustainable development, there is an increasing number of attention is given to the environmental protection and natural resources preservation issues, we could say that green GDP is one of the trends of new economic evaluation indications. Furthermore, the developing of thinking from GDP to green GDP can also inspire the concept of how to apply the environmental measures and indexes to the general evaluation of a certain project, here we may focus on some

transportation projects, because with the development science and technology, more and more large transport projects have been taken account into the blueprints of a modern international city like Shanghai. These kinds of large scale transport projects can bring a lot of economic benefits to Shanghai's total economic income, and can lead to a great improvement of Shanghai's international reputation and it's political and economic position in the world.

CHAPTER THREE PRESENT METHOD OF CALCULATING ECONOMIC BENEFITS OF THE YANGSHAN DEEP-WATER PORT

3.1 Background of the Yangshan Deep-water Port

3.1.1 Geographic background

The Yangshan Deep-water Port is a mega-port project under construction on the Eastern China Sea. It will turn Shanghai into the shipping hub of northeast Asia, with complete logistic facilities and surging foreign trade as support. It is being built on two islands 27 kilometers from Luchao port in the southern Nanhui District. So far, RMB YUAN 3.5 billion (US\$421 million) has been spent after a year of construction, about 24.5 percent of the anticipated total investment in the first-phase construction, which includes a 31.8-kilometer-long cross-sea bridge and five berths. According to the plan, the Yangshan Deep-water Port has about 18 square meters continental areas and about 20km deep water coastal line, it has more than 50 container berths and container throughput will be 2.2 million TEUs in 2005, 5.5 million TEUs in 2010 and 13.4 million TEUs in 2020.

The Yangshan Deep-water Port will become the deepwater container hub port of Shanghai International Shipping Center with good deepwater conditions. The Yangshan Deep-water Port will mainly undertake the businesses concerning the supply of the oceangoing containers in the hinterland and the transfer of international containers.

3.1.2 Advantages Analyses

There are four main advantages of the Yangshan Deep-water Port, the first is to accept large size ships based on its deep water container berths and infrastructure facilities; the second is its better geographical position to gain large cargo throughput and to become the hub port to attractive national and international containers; the third is its highly handling speed; the forth is to offer integrative service of transshipment, processing, warehousing and multimodal transportation. However, the Yangshan Deep-water Port's most important task is focused on the first function, which means to solve the two problems of lacking of deep water port and deficiency of container throughput for the long term development of Shanghai Port, so as to reach improvement of port function and set the firm basis of sustainable development.

3.1.2.1 Infrastructure structure

The berth depth of the Yangshan Deep-water Port is more than 15 meters and can service Postpanamax ships, which is the biggest container ship in the world. However, before it is constructed, it is not easy for large ships to call at Shanghai Port. There are two reasons, one is the shortage of container capacity in Shanghai and the limited water depth in local waters have been a bottle-neck for the city from becoming an international shipping center; the other reason is the quantity limitation of deep water berths, so in this circumstances, many large ships have to increase the time expenditure by waiting outside the port areas. But these two situations will be never happened since the Yangshan Deep-water Port phrase one's completion. It has provided somewhat best conditions for large ships to call at, and it can also shorten the time expenditure economic loss in order to lower the costs of loading and discharging.

3.1.2.2 Geographical position

Geographically, the Yangshan Deep-water Port is seated in Shanghai, which is the largest economic center and the big coastal port city of China and also near the trunk line of international sea-routes, therefore, with this perfect and advantageous position, the Yangshan Deep-water Port can attract multi-liner ships to call at and to be the deep-water container hub port of Shanghai International Shipping Center and make Shanghai be the most important port of northwest Asia. Shanghai's geographic advantage of abutting on the sea and the Yangtze River endows it with an advantageous position as a big port in the world. With China's smooth entry into WTO, the imports and exports in foreign trade will continually increase. The economic hinterland of Shanghai Port will also continuously stretch towards the middle and western regions with the improvement of national traffic network system, and with convenient distribution and transport conditions and prompt and considerate port service environment, more ship owners and cargo owners will deem Shanghai Port as the cargo distribution center. It is predicted that until 2005, the container throughput of Shanghai Port will surpass 15 million TEUs.

3.1.2.3 Handling speed

The Yangshan Deep-water Port has 18 cranes to serve container ships, and it is equipped one crane in every 88 meters which can totally meet the requirement of the world first class ports. In 26th January 2006, in the discharging process for a 4300TEU container ship of CMA CGM, the Yangshan Deep-water Port has exercised its efforts to accomplish the task in less than 20 hours and also create a brand new history record of dealing 218TEUs per hour. So as known to all, the Yangshan Deep-water Port is famous for its fast loading and discharging speed and its best container handling service providing.

3.1.2.4 Modern logistics parks

On April 8th of this year, Shanghai International Transportation Center started the Yangshan Logistics Park project as the matching project of the Yangshan Deep-water Port Construction Project. By the end of 2005, the logistics park project has been accomplished and put into use with the first phase of the Yangshan Deep-water Port construction simultaneously.

The Logistics Park, covering 13.8 square meters, is to be built into the biggest modern logistics park in Asia. It includes three functional sections, logistics as storage, logistics electrical machinery, electrical appliances as storage, logistics and IT information. Three are three advantages of the Logistics Park are:

(a) Opposite the Yangshan Deep-water Port with "water" in between, the park is the most important hinterland of the deepwater port and meets the strong radiation from it, becoming the "battlefront" of Shanghai's new round economic booming.

(b) Convenient traffic.

The park has convenient traffic network, it takes no more than 50 minutes driving from the Zone to Pudong Airport, the Yangshan Deepwater Port, Shanghai Chemical Industrial Park and downtown.

(c) Advantageous investing environment.

The park authority will provide excellent enterprises from all over the world with first-class investing environment covering all aspects such as policies, resources, manpower and services, and offer the companies settled in the park a most spacious stage!

3.1.2.5 Developing hinterlands to western and inland areas

The Yangshan Deep-water Port should continually expand its hinterland both in the country and overseas. In detail, it means the Yangshan Deep-water Port should not only take the account of covering the areas along the Yangtze River, but also should consider western and inland areas these old and conventional manufacturing areas as its expanding hinterlands to increase domestic sea trade transportation competition. For example, if a container transship base can be built in Xian, it will be a container resource center in northwest areas for the Yangshan Deep-water Port. Furthermore, based on the previous example of taking Taicang Port as the feeder port for Jiangsu Province, Shanghai can let Congming and Changxing or Wusong areas be its transshipment feeder ports to efficiently and effectively handle the containers in and out the Yangtze River. According to some statistics, and with the contrast of some free ports like Singapore and Hong Kong, which has the transshipment throughput ratio of 50%, there is only 2% of international transshipment throughput in the whole throughput quantity in Shanghai, so it is very obvious that it is very important for the Yangshan Deep-water Port is to become the international transshipment port, then it can realize to be the international transport port.

As for the connection of Shanghai and westerns and hinterland areas, the first railway train has already depart from Luchao port railway station, it marks the official opening of railway services in Shanghai's Pudong area. The rail-line, costing a total RMB YUAN 2 billion (US\$248 million) and extending for 42.87 kilometers, is the first element of the new transport links to the Yangshan Deep-water Port. Currently with four stations, at Ruanxiang, Caojing, Haiwan and Pingan, the Pudong railway is designed to pass through several districts across the city, including Jinshan, Fengxian and Nanhui, and transport

containers to and from the Yangshan Deep-water Port on the East China Sea and the mainland.

3.1.2.6 New city emerges in Shanghai

The Lingang New City, a city close to the Yangshan Deep-water Port, was unveiled recently after two years of construction.

The city, which made its debut in late March, has already signed investment contracts of US\$1.25 billion with domestic and foreign companies, an official of the Lingang New City told reporters on Tuesday. The development of the new city so close to the Yangshan Deepwater Port was a strategic step towards the Shanghai's goal of building an international shipping center by 2020. Lingang, covering nearly 300 square kilometers with a population of 800000, has the most potential among the country's developing areas. At the southeastern tip of Shanghai, Lingang faces Pudong International Airport to the north and the Yangshan Deep-water Port to the south, boasting easy access to five modes of transportation: ocean, air, river, highway and railway. Lingang is designed to be an equipment manufacturing base that will house automotive, ship, logistic, electronic and aerospace equipment, and will be a supporting stronghold for the emerging the Yangshan Deep-water Port.

3.2 The present method of calculating economic benefits of the Yangshan Deep-water Port

In April 1st 2002, the Yangshan Deep-water Port project has officially broken through. Shanghai Tongsheng Investment (group) limited corporation has invested huge amount of money into the Phase One including port areas, bridge and all equipments with five container quays of 2000000TEU throughput annually and has finished in 2005.

So since then, Shanghai has enough deep-water port to handle the biggest container ships. The whole the Yangshan Deep-water Port project has divided into four constructive periods using single channels, and will be completely done in 2020 with the total budget of RMB YUAN 500 billion and can reach 15000000 TEU annually. As a part of Shanghai Port, the Yangshan Deep-water Port can solve the problem of lacking deep-water port in Shanghai before, and it has a batch of 15 meters deep berths to satisfy the requirement of the enlargement of international container ships, and also has better competitive advantages to other ports. So in this part, the “with and without test” is used to calculate the main economic benefits of the Yangshan Deep-water Port in the following several aspects.

The “With and without test”

3.2.1 Short-term economic benefit loss of Shanghai without a deep-water port

Generally speaking, in terms of a shipping company, of course it will choose low cost ships as much as possible, but the basic rules for a shipping company to decide the size of ships is according to its cargo volume. So on the basis of cargo volume, the shipping company will choose large ships as much as possible, in order to get the low cost resulted from economic scale. At present, the depth of Yangtze River route near Shanghai is only 8.5 meters, the sixth generation container ships with 14.5 meters designed draft can only get 25% of cargoes volume now in Shanghai Port, this cargo loading level is much lower than the general request of shipping company of about 40% to 60% of the total container slots of the container ships. Under this circumstance of 8.5 meters water depth, shipping companies will use the forth generation container ships instead of the sixth generation, even if the local cargoes can fulfill the larger container ships.

The fourth generation container ships has a designed draft of 12.5 meters, it can reach 60% of container slots coverage with 8.5 meters water depth in Shanghai Port. After the second dredging project, it will deepen the water depth to 10 meters, and the sixth generation ship can cover 55% of total slots, so it should be taken into consideration of if there are enough cargoes to fulfill the ship transport capability of once or twice a week of 3300TEU. In the short term of about five years, the choice of which kind of ship scales for shipping companies is according to the water depth, the local cargoes amount and the frequency of liner schedule.

Conditions used in the following calculating are in the Table 3.2.1:

Table 3.2.1 Cargo loading level

	The 6th generation container ship	The 4th generation container ship
Designed sea gauge	14.5m	12.5m
Present water depth 8.5m	25%	60%
Future water depth 10m	55%	

In the next step, it will choose two possible water depths to analysis the problem in the short term:

The first hypothesis: when water depth is increased into 10 meters, the shipping company will use the sixth generation container ships.

The second hypothesis: when water depth maintains 8.5 meters, the shipping company will use the fourth generation container ships.

Under these two hypotheses, not fully loading container ships still should take the advantage of tides in order to increase draft by one to

two meters, but this usage of tides can cause expensive time consuming loss.

(a) The economic loss of waiting tides

The hourly cost of the sixth generation container ships is 1900 dollars, and the fourth generation is 1500 dollars. How much time for waiting tides is decided by the draft when ship starts to sail, which means it depends on the ship's stowage rate. If we suppose that the average waiting time is six hours, which is the half of tides' lasting time.

So in the first hypothesis, every time the sixth generation container ships call at the port, it will make the loss of 11400 dollars (1900 dollar per hour * 6 hours). Since the sixth generation container ships are designed to get 60% of the container slots loading rate, the total number of containers in Shanghai Port is 100% of stowage rate (suppose that the same amount of import and export cargo quantity). Therefore, the average waiting time loss is 1.9 dollars per TEU (11400 dollars / 60% of container loading rate). In the second hypothesis, the waiting time loss is 2.2 dollars per TEU of the fourth generation container ships using the same kind of calculating method as mentioned above. In a word, these two timing loss per TEU is all opportunity cost, which means the cost margin between with and without deep water port in Shanghai.

(b) The increased voyage cost caused by using smaller ships

In general, shipping companies often use large ships to get lower costs as much as possible. If there will be enough cargoes in the near future in Shanghai, shipping companies will definitely use the sixth generation container ships. If these big ships can not be used due to draft limitation, shipping companies should have to use the fourth generation container ships, then it will cause the increased cost in every voyage. On

grounding of the calculation, total containers of every round voyage including containers from other areas except Shanghai will increased by 33 dollars per TEU. Therefore, in the second hypothesis, the opportunity cost of without deep water port will divided into two parts, the lose of time waiting loss and the lose of using smaller ships loss, then adding them up to 35 dollars per TEU.

(c) The meaning of short term loss

The loss caused by water draft limitation, especially in the second hypothesis is rather huge, but this large loss is still not big enough to lead shipping companies to change its service mode in Shanghai fundamentally, which means shipping companies will not change to call at other regional hub ports instead of Shanghai port directly. In conclusion, in the short term, the amount of cost increasing is not very large and can not influence the service mode for shipping companies. So does not impact a lot without deep water port in Shanghai.

3.2.2 Long term economic loss if Shanghai has no deep water port

The situation is quite different between short term and long term. With the trend of enlargement of ship scale, more shipping companies would use larger ships, such as 10000TEU container ships and even 15000 TEU container ships. These super large ships have a deeper designed draft, and cost much more every hour on the voyage than the sixth generation container ships. Furthermore, the service mode of full loading ships will cause the development of shuttle service mode or pendulum service mode. In North Asia, the hub port will play a more important role in the whole port system. The water depth of hub port should be able to handle the large fully loaded container ships.

So in a word, the long term economic loss is much more than short term economic loss in Shanghai and eastern areas. From the long term view, shipping companies may give up calling at Shanghai port directly and at the same time to provide cargoes to other regional hub ports. So from the long term view, it will impact a lot on economic loss if Shanghai has no deep water port, and it will increase a lot of costs and also influence the shipping companies to change its service mode and the possibility of providing cargoes to other regional hub ports. Here we use “with and without test” to estimate the economic benefits loss of transshipment.

(a) The economic benefits loss of voyage cost

First we supposed that if the Yangshan Deep-water Port has not been constructed, so trunk lines ships can not call at Shanghai Port, the transshipment should have to be done in other countries. However, after the Yangshan Deep-water Port has built to serve the fifth and the sixth generation container ships, the cost of per TEU of these big ships is much cheaper than those small ships since the economic scale. As statistics show that in 2005, the economic benefits loss of voyage cost in transshipment overseas can be RMB YUAN 7.2 billion without Yangshan Port, and till 2010 this figure can be gone up to RMB YUAN 6.6 billion.

(b) The economic loss of using towing boats

Based on the same principles as mentioned above, if the Yangshan Deep-water Port is not be built, Shanghai Port can only serve the ships in siding lines and the transshipment have to be happened in foreign countries. So if we supposed to accomplish the same amount of cargoes, there should be more ships to call at Shanghai port without deep water berths, which will cause relatively much more times to use pilots and towing boats. Statistics show that in 2005, the economic cost of using

piloting and towing boats can be summed up to about RMB YUAN 7 million due to the transshipment happened in foreign countries not in Shanghai. And till to the year 2010, the final economic benefit cost can be increased to RMB YUAN 6 million.

(c) The economic loss of ships on the voyage

If there is no the Yangshan Deep-water Port, super large container ships will still wait for tides to enter the port, so the shipping companies may not to use these big ships. There can be two ways, the first is to arrange 2700 TEU ships for the overseas transportation lines, but this kind of ship has a low speed which can increase the time consuming cost of the voyage. The other way is to use siding line ships to do the transshipment in Hong Kong or other foreign transshipment ports, which will result the time increased by siding line ships to wait for trunk ships and transshipment handling. We suppose that the cargo value is 20000 dollars per TEU, and the cargo cash flow loaning rate is 7%, and the increasing time of transshipment is 42 hours, so according to the annually planned container throughput quantity of the Yangshan Deep-water Port, the economic loss of the transshipment in foreign countries will be RMB YUAN 87 million in 2005, and will increase to RMB YUAN 1.61 billion in 2010.

(d) The economic loss of lump-sum freight of transshipment in Hong Kong or other foreign ports

The port cargo handling charges in Japan, Korea and Hong Kong are very high, the different lump-sum freight rate of transshipment (dollar per TEU) are as follows, Japan 150, Hong Kong 200, Singapore 110 and Shanghai 64. So if Yang Shan Port is not to be built, the containers should be transshipped through Hong Kong or other foreign ports. Furthermore, we supposed that if the average transship lump-sum

freight is RMB YAUN 1600 per TEU, the economic loss of lump-sum freight of transshipment in Hong Kong and foreign ports will be RMB YUAN 20.8 billion in the year 2005 and then increase to RMB YUAN 38.4 billion in the year 2010.

Table 3.2.2.1

Economic benefits of the Yangshan Port

In RMB million

	2005's	2010's
Voyage benefit economic loss	720	660
Towing benefit economic loss	7	6
Time loss of ships	87	161
Lump-sum freight of transshipment in Hong Kong and foreign ports economic loss	208	384
Total	1022	1211

Table 3.2.2.2

The evaluation of direct influence of the first period of the Yangshan Port

In RMB billion

		2002	2003	2004	2005	2006	After 2007
Transportation				2.05	5.11	7.67	10.23
Construction		34.47	28.73	28.73	22.98		
Direct influence	Produce	34.47	28.73	30.78	280.9	7.67	10.23
	employment	16107	13425	14625	11938	1200	1200

Table 3.2.2.3

Total economic benefits of Yang Shan Port

In RMB billion

Year	2002	2003	2004	2005	2006	2007
Agriculture	3.31	2.76	2.81	2.33	0.18	0.24
Food processing	3.96	3.30	3.36	2.79	0.22	0.29
Textile	2.82	2.35	2.39	1.99	0.16	0.21
Public utility	0.29	0.24	0.27	0.26	0.20	0.13
Fuel	0.16	0.13	0.17	0.20	0.13	0.18
Chemical industry	0.43	0.36	0.37	0.31	0.02	0.03
Architecture material	2.22	1.85	1.85	1.48	0.01	0.01
Steel	5.03	4.20	4.20	3.36	0	0
Metal product	0.19	0.16	0.16	0.13	0.01	0.01
Machine	17.70	14.75	14.86	12.06	1.56	1.69
Electronics	1.46	1.22	1.24	1.03	0.08	0.11
Others	0.03	0.02	0.04	0.07	0.07	0.10
Retail	2.26	1.89	1.92	1.59	0.13	0.17
Service	1.28	1.07	1.08	0.90	0.07	0.09
Education	2.05	1.71	1.74	1.44	0.11	0.15
Bank	0.09	0.07	0.07	1.95	1.65	1.31
Indirect/derived output	43.30	36.09	36.54	31.89	4.51	4.73
Indirect/derived output	482.45	402.08	407.91	338.44	33.89	40.78
Initial product change	34.47	28.73	30.78	28.09	7.67	10.23
Initial employment change	161.07	134.25	146.25	119.38	12.00	12.00
Total output influence	77.77	64.82	67.32	59.98	12.18	14.96
Total employment number	64352	53633	55416	45782	4589	5278

3.3 Chapter summary

In this chapter, it presents the total background of the Yangshan Deep-water Port, its geographic position, important advantages in several aspects, and its economic benefits outcome. Here, it use the “with and without test”, this test is a current evaluation method to calculate the economic benefits of a certain port project. This estimating method is providing the short term and the long term economic benefits income with several definite hypothesizes. Because the Yangshan Deep-water Port phrase one has been put in operation for just a period of time, it is still lacking of enough statistics and figures to be used in this calculating method. However, this “with and without method” provides us with an estimating method to get the economic benefits income of the Yangshan Deep-water Port, and these figures in the above tables can help us to further analysis the green economic benefits income under the principles of green GDP in the next chapter.

**CHAPTER FOUR APPLICATION OF GREEN GDP
CONCEPT TO THE CALCULATING METHOD OF ECONOMIC
BENEFITS OF THE YANGSHAN DEEP-WATER PORT**

In the last chapter, it presents the economic benefits income of the Yangshan Deep-water Port with the “with and without test”. From the statistics in the tables above, till year 2010, this number will be amounted to about RMB YUAN 121100 million of total economic benefits of the Yangshan deep-water Port.

However, from the point view of the further requirement of sustainable development, and under the principle of green GDP, the thinking of applying the green GDP indications and standards into the method of calculating a transport project’s economic benefits is putting forward to us. And it is so crucial to get the relatively correct results of economic benefits of a certain transport project instead of the over-evaluating of economic benefits, which is ignoring its negative impacts on the environment. So it is regarded to be the most significant problem of our living conditions and future human development. If we neglect the environment and ecology whether on purpose or not, it is very serious indeed, because the way of only economic oriented is not reasonable and sustainable any more, it need to be a system of comprehensive evaluations to give the most scientific standard to evaluate a certain project. It should make the largest profit on the basis of environmental protection, natural resources preserving and natural balance keeping. The economic benefits are just in short-term, but on the contrast, the

influence on the overall environment and ecology can last for really a long time, and some pollutions and damages are not able to be recovered or renewable. So how to set up a complete system to evaluate a construction project on both environment and economic aspects is urgent ahead of all the issues.

That is quite obvious that every transportation project is aimed to get the most economic benefits, but it is also can not denied that certainly negative influences to humans' health, natural resources and ecologic environment is being brought when the transport project is being built and putting into operating. So any economic benefit making should not at the sacrifice of environment and ecology. Keeping the balance of nature and reduce environment pollution are the two requirements which should be reached simultaneously and definitely.

So refer to the transportation project of the Yangshan Deep-water Port, we should also give the evaluation form both the economic and environmental aspects. In the last chapter, it has presented the economic benefits calculating of the Yangshan deep-water Port with the “with and without test”. But this method has not make further economic evaluation of its negative influences on human being, natural resources and ecologic environment either in quantity or quality, so it is taken granted as the shortage of this method.

Therefore, in the following contents of this chapter, it will apply some principles, concepts and indications of green GDP to modify the method, which means apply the concept and indications of green GDP into the calculating method of economic benefits for the Yangshan Deep-water Port. And the new green economic benefits calculating method, it will pay more attention to the importance of human being

health, natural resources and ecologic environment issues. And some formulas and functions to calculate the economic evaluations of these negative impacts of the Yangshan Deep-water Port.

In the following, it will analysis this problem in several respects, the first is to present the important meaning to calculate the economic benefits of the Yangshan Deep-water Port under the concept of green GDP; the second is to give the overall ecologic environmental evaluation of the Yangshan Deep-water Port; the third is from three different aspects to illustrate the negative impacts on human health, natural resources and ecologic environment brought by the Yangshan Deep-water Port.

4.1 The significance of calculating economic benefits of the Yangshan Deep-water Port under the concept of green GDP

There are the four important reasons why green GDP concepts and principles should be taken into the consideration of the evaluation of the Yangshan Deep-water Port:

- (a) Improvement of efficient usage of the limited natural resources
- (b) Reach the economic benefits evaluation of the Yangshan Deep-water Port under the concept of green GDP, and then make the comparison between the two economic benefits results.
- (c) Providing evaluative standards for a nation to evaluate a project, on the basis of different influences on the ecologic environment made by different kinds of transportation modes.
- (d) It is an important part of analyzing the cost, income and profit of a transport project investment evaluation.

In the cost, income and profit analysis of a transport construction project, in terms of a traditional national economy appraisal of transport projects, resources costs are opportunity costs or shadow prices; their external costs include pollution prevention and treatment and accidents. But the loss of non marketable production, mental injury, death, pain and other costs related to human life values are excluded, while all these, that need researching in future, must be taken into account now. Therefore, under the concept of green GDP, there would be the overlap or losing calculating items between the old and new green economic benefits evaluations, for example, the loss of labor ability cause from mental pains, distress, mental damage, death and so on losses relating to the cost of human being life values can not to be included in the calculating items of this green calculating method of economic benefits, on the other hand, it always neglects to account the economic loss of damaging the natural environment, so in a word, it needs the further analysis and research on the economic evaluation of a transport project.

So project national economy appraisal criterion under green GDP accounting

$$= A - E1 - E2 - E3 \quad (2)$$

Where

A----- Project national economy appraisal criterion

E1----- Value of project effect on human health

E2----- Value of project effect on resource

E3----- Value of project effect on environment

This is also can be applied into the calculating method of economic benefits of the Yangshan Deep-water Port. It means the economic benefits which has been calculated in the last chapter with the “with and without” method, should be modified through following processes:

The Yangshan Deep-water Port's national economy appraisal criterion under green GDP accounting

$$= B - E1 - E2 - E3 \quad (3)$$

Where

B ----- The Yangshan Port national economy appraisal criterion

E1----- Value of the Yangshan Port's effect on human health

E2----- Value of the Yangshan Port's effect on resource

E3----- Value of the Yangshan Port's effect on environment.

As is known to all, all the port constructions will definitely impact a lot on the surrounding ecologic balance, so on the basis of green GDP concepts, when we calculating the economic benefits for the Yangshan Deep-water Port, the national economy appraisal of transport projects is studied in terms of several aspects accounted in the green GDP: the first is their effects on human health are analyzed on a quantitative basis; the second is the evaluation of transport project of the Yangshan Deep-water Port's effect on resources studied are water pollution of port construction and operation. Land use comparison is conducted among major transport infrastructure. Some measures are put forward to reduce the negative incidence. The third is how to maintain the ecological environment when the project is being constructed is suggested. Finally, national economy appraisals of transport projects are comparatively studied under the traditional and green GDPs accounting. The results obtained have a strong theoretical and practical implication for the realization of sustainable development of transport, especially the Yangshan Deep-water Port.

In addition, how much influence has the Yangshan Deep-water Port on the human being health, natural resources and ecologic environment is still need to be studied. That is to say, how much economic loss indeed

refer to the economic level, the monetary value, and the economic benefits income of the Yangshan Deep-water Port in the total national gross domestic product is very important to the environmental quality of evaluating a transport project, and is also significant to the further improvement to satisfy the requirement of sustainable development.

4.2 The overall environmental evaluation of the Yangshan Port

The Yangshan deep-water Port is located near Hangzhou Bay. It is the closest natural deep-water port of Shanghai, and it is famous for its beautiful views, multiple kinds of creature breeds and rich fish resources.

From the overall view, it has been given a high enough attention to the environmental protection problem. As it is planned, the protection of environment budget is up to RMB YUAN 1.4 billion. In the construction of this port, not only the regular environmental preservation and ecologic protection measures have been taken, for example, the protection actions like the procession of “sewage, exhausted gas, noises and solid exhausted stuff”, some latest relevant measures also have been adopted by the port authorities, such as making reasonable plans to explode rocks underwater, adopting the most up-dated technological way to drudge fairways, taking the most effective and efficient environmental preserving plans of building Donghai Bridge, and applying the integral usage management of land and water resources, taking environmental inspections during and after the construction of the port, and also depositing special and professional sewage dealing stations in the deep-water port, taking actions of preventing oil leaking, planting as much trees and green vegetations to maintain the nature balance, these protecting measures have been taking by port effectively and efficiently.

In the construction and operating processes, the Yangshan deep-water Port is also focusing on the ecological protection. Since two years ago, the right moment the port has broken through there are thousands ecologic professions both in domestic and foreign countries have inspected the ecologic indications of the Yangshan Deep-water Port. Recently, the latest investigation evaluation from Shanghai Environmental Inspection Centre, says that since the broke through of the Yangshan deep-water Port, it has basically not given obvious bad impacts on the quality of surrounding water and the nearby land environment, and has not impact sever on the whole ecologic environment balance of Hangzhou Bay waters. Therefore, this evaluation has a profound meaning that the Yang Shan deep-water Port can be the world ecologic port project.

However, though many measures have been taken in the construction and operation periods, every huge port areas project has more or less surely to influence the nearby ecologic environment, natural resources and human beings. The latest advanced scientific evaluation and the long-term ecologic trace investigation can decrease these bad influences to the lowest degree. So on the basis of this point of view, in the first period of the port construction, Shanghai Government has taken “ecology” as the key word in the whole project.

Except for the sea, environmental experts are also focus attention on extra thirteen themes, such as land, air, sound environment, solid exhausted stuff and the pollution accidents and so on. Lots of professors have raised a series of protective measures and put them into action. From the view of National Environmental Institute, says that the increasing awareness of the importance of environment has been applied into the construction and operation of a port project. And from

the residents' points of two provinces of Shanghai and Hangzhou, everyone is looking forward the Yangshan deep-water Port can not only be an international hub port, but also to be ecologic idealist place along the East Sea.

However, though many measures have been taken in the construction and operation periods, the every huge port areas project has more or less surely to influence the nearby ecologic environment, natural resources and human beings. The latest advanced scientific evaluation and the long-term ecologic trace investigation can decrease these bad influences to the lowest degree.

4.3 The environmental indications of the Yangshan Deep-water Port under green GDP concept

Though there are many different systems of indications of green GDP, in this dissertation, we divide these indications into three main parts, and they are human being health, natural resources and ecologic environment. In the next step, we will develop these three parts as much detailed as possible.

4.3.1 Evaluation of Effect on Human Health by the Yangshan Port Project

Generally speaking, referring to the Yangshan deep-water Port project, it has a negative bearing upon human health via environment. In the following, the sources of negative effects on the human being health will be divided into two aspects, air pollution emissions and noises.

4.3.1.1 Evaluation of effect on human health by the emissions

Hazardous gas and particle are the two emissions by the Yangshan Deep-water Port project which will damage to human being health via

air pollution.

4.3.1.1.1 The effect on human health by the Yangshan deep-water Port project generated hazardous gases

As is known to all, in the construction and operating periods of the Yangshan deep-water Port project, it will consume a large quantity of oil fuel. But when oil fuel burned, hazardous gas will be generated if the fuel cannot be fully burned mainly. These emissions are mainly CO, NO_x and CH, etc.

A. CO

CO is the middle product of burning of hydrocarbons fuel, produced as hydrocarbons cannot be fully burned mainly due to local lack of oxygen or low temperature, and is emitted with gas waste from internal combustion engine. When automotive is overloaded, at slow speed or at neutral gear, fuel cannot be completely burned and gas waste will contain considerably more CO. It will be combined with Hemoglobin in blood after entering human blood via breathe, forming Carboxy-hemoglobin, which causes low ability of carrying oxygen and body reaction. For example, hearing will be harmed due to lack of oxygen for ear nerve cell. Breathe of over CO will cause human choke, lip purple or even death. Long-time breathe of CO is a potential threat to people nearby transport projects.

B. NO_x and HC

NO_x are produced when organic compound containing N is burned or N₂ in the air is directly compounded with oxygen under high temperature. HC is emitted to air mainly due to hydrocarbons (such as gasoline, kerosene, diesel, etc.) which have not been burned fully in internal combustion engine gas waste and gas waste from oil crack in petrochemical industry. Hydrocarbons are considered as pollutants due

to their relation in the generation of light chemical oxidizer. HC and NO_x in the air can produce a new pollutant, light chemical smog, when exposed to strong ultraviolet ray of the sun. Then smog can lead to more bronchitis, coronary heart disease, TB and heart feeble.

These hazardous gases can do harm to our human health severely. So refer to the Yangshan Deep-water Port, in order to evaluate the impact on human health, we should make the analysis of the main sources of using oil fuel which will produce hazardous gas. The large amount of oil fuel would be used in two main different aspects, one is the total consumption in the port inside areas, and the other is from ships.

In the port areas, it is not so hard to evaluate how much oil fuel will be needed in the overall operating and maintenance of infrastructures and equipments, such as container handling machines, cargo movement trucks, power plants and the all equipments used in the rear area of the port. These complicated infrastructure equipments need a huge amount of oil fuel, which is a main resource of hazardous fuel emission gases.

And also there will be used many large trucks to move the constructive equipments and containers, so there will be a lots of trucks move in and out of the port forward and backward areas and in the highways surrounding the port, these trucks will release huge amount of hazardous gases such as CO, it will also lead to the increase of CO concentration in air beyond the normal limit by a lot, and maybe cause severe damages to human health and other lives. If the relevant environmental protection measures are not being taken effective to solve this problem, it will influence nearby residents' health when the certain hazardous gases concentration degree access the point of normal limitation.

The other source of fuel emission is from ships, according to results of a study conducted by Civic Exchange, emission from ships is one of the few sources of pollution that continues to increase by the year. And unlike other major pollution sources, such as power plants, ships also pollute the air in a severe degree. The emission from ships is associated with the quality of fuel used, which means the excessive emissions may be a result of engine problems.

So as mentioned above, the consumption from the port inside areas and from ships are the main sources of the emission of oil fuel. As the largest port construction, the Yangshan Deep-water Port with large number of infrastructures, equipments and trucks will consume a lot of fuel oil and generate hazardous gases as mentioned above. So when we calculate the economic benefits of the Yangshan Deep-water Port, we should deduct the cost of hazardous gas's damage to human health from the total economic benefit result of the Yangshan Deep-water Port. But if there are other activities that generate these harmful gases, say, heavy industries and chemical industries, their effect must be deducted. Otherwise, harm of the Yangshan Deep-water Port on human body would be assessed too high.

4.3.1.1.2. The effect on human health by the Yangshan deep-water Port project generated particle

In addition to the hazardous gases released from oil fuel burning, particle which is generated from the Yangshan Deep-water Port is another way to impact human being health.

Particle pollution in air can induce respiratory inflammation in human body. American scientist argues that active oxidizer yielded by particle is a root that causes inflammation (Nel, 2005). However, particle pollution in air is not completely caused by transport project. The effect

on human health by transport project generated particle can be evaluated by the following equation:

$$PC = PD \times PA \times \frac{E_1}{E_1 + E_2 + E_3 + E_4}$$

(4)

Where

PC-----value of effect on human health by transport project generated particle

PD-----particle led disease number

PA-----medical cost per disease

E1----- transport project generated particle

E2-----chimney generated smoke

E3-----fire generated smoke particle

E4-----other generated particle

According to this function, if port authority is going to calculate the total particle quantity, it should put the quantity figure into the above function, and then under this measurement, the port authority may get the economic benefits evaluation of particle emission from the effect of the Yangshan Deep-water Port on human health. In the construction and operating processes of the Yangshan deep-water Port project, the particle emission to the air is one of key sources of the damage to human health.

4.3.1.2 Evaluation of effect on human health by the Yangshan deep-water Port project noise

In the construction and operating processes of the Yangshan Deep-water Port, it will as other transportation projects generate a large sum of noise pollution. Noise pollution is considered to be unbearable because it is not natural. Noise harm is summarized as follows:

(a) Disturbance of sleep

Noise in environment can make people asleep or awaken, which will negatively affect work efficiency and health. Generally speaking, 40db continuous noise can affect 10% of people, 70db can affect about 50% of people, while 40db sudden noise can awake 10% of people, and 60db can awake 70% of people. The long term disturbance of sleep can lead to sleepless, fatigue, bad memory and also the serious neurasthenic problem. And in the high degree of noise environment, this kind of disease will happen to reach more than 50% or 60%.

(b) Impairing hearing

When people are in the situation of noisy environment in the short time, after they get back to the normal surroundings, hearing will also be damaged in the short term and can be recovered in the short time. But when people are exposed in the relatively high degree of noise without any protection actions, it will need more than several hours or long time to get recovery of hearing sensitive ability. And if this situation lasts for a long period, it may not be able to get to the original ability. Generally, noise below 85db will not harm hearing, but above that it can be dangerous. Statistics show that long term working under circumstances of noise above 85db can significantly increase hearing impairment.

(c) Causing disease

Besides hurting hearing, noise can cause other diseases like stress, high blood pressure, gastric ulcer, circulatory system disease and cardiac disease. Long term working under noisy environment hampers also cause heart attack and nerve problems.

So as the largest port construction, the long time noise produced by the vehicles and all kinds of port equipments of the Yangshan Deep-water

Port will affect a lot to the nearby residents' rest and even their health. So if port authority is going to calculate the value of impact of noise on human health, the effect on human health by the Yangshan Deep-water Port noise pollution can be evaluated by the following equation:

$$NC = ND \times NF \times NA + NR + NP$$

(5)

Where

NC----- value of effect on human health by the Yangshan deep-water Port project noise pollution

ND----- the Yangshan Port project noise pollution related disease number

NF----- factor of the Yangshan Port noise pollution in final disease

NA----- medical cost per disease

NR----- cost for elimination of the Yangshan deep-water Port noise

NP----- compensation for affected residents nearby project

If we put the figure into the above function, and then under this measurement, the port authority may get the economic benefits evaluation of noise pollution from the effect of the Yangshan Deep-water Port on human health.

However, there is still problem when we calculate the economic benefits evaluation of noise pollution, because the compensation cost for the residents suffered a lot from noise pollution according to the regulations of Shanghai Government are so hard to calculate. And the numbers of diseases caused by noise pollution resulted from the Yangshan Deep-water Port project are not that clear to measure, because these different diseases can cause by a multiple reasons, we can define a certain multiplier of the noise pollution, which will reach a economic cost of noise pollution leading to a certain disease.

4.3.2 Evaluation of Effect on Natural Resources by the Yangshan Port Project

As we all know, China has given more and more support to research and study its natural resources especially relating to a certain transportation project. In order to build large port constructions without harming the environment, China has expanded research on cultivation of port related resources, the utilization of sea water and energy, and the monitoring and surveying of ocean pollution. The core research work of a comprehensive survey will make better account of China's oceanic properties.

However, it says that the port authority and many experts have paid an increasing number of attentions to the protection of natural resources and the preservation of ecologic balance, there is still many kinds of severe pollution problems, especially in the large scale transport project, like the Yangshan Deep-water Port. In order to make a clear analysis of this problem of the effect from the Yangshan Deep-water Port on the natural resources, here natural resources can be categorized into three general parts, such as land, water and fishery.

4.3.2.1 Land

With the development of economy in China, in order to encourage the development of transport, a lot of preferential land prices have been offered for many projects investors. This kind of good price may increase the land usage ratio in the project and directly lead to the serious waste of land resources in some degree, which is not good for the sustainable development. Therefore, in order to meet the requirement of land resource preservation principles, in national economy evaluation of land use of transport project, the cost of additional use of land must be raised, in order to reduce abuse of the

resource.

In general, highway occupies more land than railway (Communications Science Research Institute, 2005). But in the construction of a port, only docks, warehouses and storage areas need land to build, and navigation channels does not need land. We can see the below table of comparison of land occupying among railway, highway and water:

Table 4.3.2.1

Major Transport Land Use Comparison in acre per ton km

	railway	highway	water
1996 (2002)	19.7 (24.47)	-	12
future	20-25	100-200	6

Source: www.iicc.ac.cn

In the above table, though compare to railway and highway, port construction project has relatively occupied less land resources, the large scale of port project like the Yangshan Deep-water Port still consume large amounts of land resource. In the year of June 2002, the first phrase of the Yangshan deep-water Port project has been put into construction, and total investment is about 143.1 billion dollars, and it is composed of three parts, the port, Donghai Bridge and the port of Lingang new areas. According to the blueprint, first phrase will build about 1600 meters coastal lines, five deep-water container berths which can handle the fifth and the sixth generation container ships with the throughput of more than 220 million TEUs. The total land areas are about 17000 square meters, and the port authorities has constructed lots of warehouses, producing assistants and some matching equipments. So the Yangshan Deep-water Port project must have taken a lot of lands, and the berths, warehouses, Logistics Park and some equipment will occupy much areas and also covering some high values.

4.3.2.2 Water

As for the Yangshan Deep-water Port, in its construction and operation periods, it is no doubt that the waters around the port will suffer great pollution. Here, the main sources of pollution is resulted from oil leaking, chemical substances leaking out of ship collision, and the sewage spill from both the off-shore equipments and the ships on sea.

In the first place, with millions of container ships would move in and out of the Yangshan Deep-water Port in the near future, ships can pollute the water on which they sail. Oil pollution, taking place when it is handled improperly or overflow at a wreck, has a severe negative effect on inland river and sea. In addition, oil pollution comes from engine fuel and lubricant, washing and ballast. When a port is being constructed, concrete waste in building foundation can also pollute water. During operation, pollutants are mainly dusts, including coal, ore, grain, etc., among which coal dust has the largest quantity. Moreover, pollution like oil spill and chemical accidents may occur in port water.

In the second place, some oil ship collisions can cause a subsequent crude oil spill to a very serious degree. The leaking oil will form a large scale oil belt on waters. Clean-up efforts with several cleansing ships may limit pollution to recover the leaking oil and prevent it from spreading further. But strong winds and waves at the spot of the collision are likely to hamper the clean-up. Without mention the possibility of deaths and injures have been occurred in the accidents, as for the oil leaking which could have a huge influence on the waters, and may not be recovered for a long time and also break the ecologic living conditions for sea animals like most kinds of fishes.

Referring to the Yangshan Deep-water Port, though we have already committed that it is overall a ecologic port construction, not damaging surrounding natural environment a lot and can well controlled the degree of deteriorating of natural resources, but it also has some negative impact on the ecologic nature balance, especially the diversity of fish and marine creatures. In addition, biological diversity has been damaged and some ocean resources are on the verge of exhaustion due to change of fairways and natural tides, these kind of behaviors conducted by people have damage the living conditions for most marine lives. It will also lead to the extinction of some fish species and the large some of reduction of fish export volume.

4.3.3 Evaluation of Effect on Environment by the Yangshan Port Project

Generally speaking, transport has a negative effect on environment. Its pollution ranks second after chemical industry. Transport projects have an effect on natural environment. Environmental degradation may not always be noticeable. When the air becomes foul, or water thickens and changes color, we see it. But when the soil is polluted, we do not realize the levels of lead and mercury have reached such high levels that our food chain is in danger. The best environmental protection is not to destroy the ecosystem when constructing a certain transport project. Land of worse vegetation should be used with priority.

And according to the estimating of Chinese Environment and Development Association, the natural vegetation in China has a huge value in maintaining waters and soil, modification of temperature, pollution protection, and utilization of creature diversification and so on. It can reach the economic benefits of RMB YUAN 110000 billion of the ecosystem every year, and the present economic value excesses

RMB YUAN 47000 billion and the potential economic value will be beyond RMB YUAN 65000 billion. So the evaluation of economic loss from transport projects on ecological value can be estimated referring to these figures. A tree of 50 years old has an ecological value shown in below:

Table 4.3.3

Ecological value of a 50 years old tree in dollar

Item	value
O2 producing	31200
Hazardous Gas absorbability& pollution prevention	62500
Soil fertilizer increasing	31200
Water Source foster	37500
Shelter bird and other animals	31250
Protein producing	2500

Source: Jiefang Daily 12 March 2005

So from the table above, it provides us with the importance of ecologic environment to our lives and the sustainable development. With regard to the Yangshan Deep-water Port project, in the construction and operation periods, it has do harm to the environment to some degree. So the Yangshan Deep-water Port has taken a lot of actions to improve the environmental protection in several aspects.

As for the actions that could be taken to reduce emissions from ships, we could suggest mandatory regulations and voluntary programmer followed in Europe and the United States. For example, ports and other authorities in California US, offer financial and administrative incentives to encourage shippers to adopt less polluting practices such

as using cleaner fuel and sailing at slower speeds. And the local air quality and public health would be improved if vessels used better quality fuel.

And also referring to the hazardous gas generated by lots of trucks, after a serious study by the port authority and environmental protection experts, on the basis of trucks are the sources of air pollution at present, it is said that these trucks may equip with some articles of decreasing the emission amount, and after these improvement, the particle emission amount will decrease by about 30%, and at the same time, the emission quantity of CO will be less than half amount of the old figures. Therefore, it can really reduce the air pollution degree efficiently and effectively and decrease the damage to human being health.

With regard to noise pollution, the port constructive departments have adopted the recommendations and suggestions put forward by the environmental experts, and take a lot of actions to relieve the noise pollution degree, and these costs can be calculated relatively easy to evaluate. For example, it will be equipped noise insulating screen on the both sides of the transport lines outside the port areas, and it is not very hard to calculate the cost of noise insulating screens.

To reduce pollution of water resource by shipping, port should not be located in water with stream along the indifferent depth which will lead to the accumulation of pollutant at sea near shore. Underwater structure should be so designed as to minimize effect on water (For example, lots of stakes below water can be harmful to the movement of water and thus its quality). Any wastes must be treated before disposal. Under green GDP accounting, cost of water pollution prevention and treatment caused by transport project must be deducted.

4.4 Chapter summary

In this chapter, at the first place, we discuss the overall impact of the construction and operation of the Yangshan Deep-water Port on human being health, natural resources and ecologic environment. It is obvious that the total negative effect is not too bad, though every transport object always has bad influences to the nearby residents and environment. Since the well-consideration plan of environmental analysis, investigation and research by thousands of relating experts and professions during the constriction and operation periods, it can be ensured that many actions of environmental protections have been taken by the port authorities, these measurements and preserving solutions are efficient and effective to keep natural balance.

In the second place, we discuss the impacts bringing from the Yangshan Deep-water Port on the people's health, natural resources and ecologic environment in a detailed way. As it is known to all that, the national economy appraisal of transport projects is studied in terms of three aspects accounted in the green GDP: their effects on human health are analyzed on a quantitative basis; Land use comparison is conducted among major transport infrastructure. Also in the evaluation of transport project effect on resources studied are water pollution of port construction and operation. Some measures are put forward to reduce the negative incidence. In the assessment of transport project effect on environment, the negative indexes are raised for emission on green GDP. Finally, national economy appraisals of transport projects are comparatively studied under the traditional and green GDPs accounting. The results obtained have a strong theoretical and practical implication for the realization of sustainable development of transport.

But the environment preserving and protection system is not one day work, it needs continuously and sustainable efforts made by the port authority, ship owners and relevant experts. So we should not misguide by GDP index which is not include the environmental costs and other kinds of economic costs of the impacts on the environment and ecology made by a certain project, because when counting China's gross domestic product (GDP), those natural and social costs should be included so as to ensure sustainable development.

Although China is attempting to count "green GDP," which may deduct the cost of environmental pollution and resource net wastage, the social cost and expense for economic development has not been considered. Sustainable development demands both natural and social harmony, the relations among different persons, regions, cities and rural areas should be properly handled. Increasing social conflicts may offset the economic progress made by the country, so the government should further improve the living conditions of low-income people and eradicate corruption. So it is necessary to extend the scope of green GDP, which should also include economic losses caused by all kinds of accidents in production, food safety, medical services, construction projects and transportation, as well as the expense for handling those accidents. This will help prevent accidents from occurring again, admitting that it is still difficult to count losses of human life, health and time caused by accidents in terms of currency.

CHAPTER FIVE THE DIFFICULTIES TO IMPLEMENT GREEN GDP CONCEPT TO THE CALCULATING METHOD

Agreeing that green GDP is a good idea, but the complex standard will be difficult to implement green GDP index to the calculating method of economic benefits of the Yangshan Deep-water Port. While many countries are also seeking to develop similar standards, there will be hard to find some feasible way of calculating a useful green GDP system in the calculating method of economic benefits of transport projects in the foreseeable future.

This is because it is too difficult to calculate the true value of environmental factors of the Yangshan Deep-water Port, which have too many uncertainties. Unifying environmental and economic data into one coherent calculation is also a daunting challenge. The economy and the environment are indeed two very different variables, and these two should be considered separately. Therefore, creating a multi-index development assessment system using green GDP indications and a system to assess the environment cost of the Yangshan Deep-water Port should be the objective. Furthermore, we will roughly analysis the difficulties from two aspects that are the technical difficulties and the ideological obstacles.

Though accompanied with the above difficulties, China still started to study how to include environmental evaluating indexes into the evaluation of economic benefits of most certain transport projects. Well

aware of the environmental protection need, some projects of regions in China have already started to take environmental protection seriously. Furthermore, we will roughly analysis the difficulties from two aspects that are the technical difficulties and the ideological obstacles.

5.1 The technical difficulties

The value of products and labor can be decided when they enter the market. Their value is reflected by market prices. But how would the value of environmental factors, which do not come into the market at all, is reflected? When a forest is damaged, for example, many animals living within it will become extinct. How does one place a value on such a loss? Here we put forward some modes of estimates.

While we cannot decide on the losses associated with a polluted river, we can calculate the investments needed to treat it. The environmental costs of a concrete project can also be estimated in market prices. In Yunnan Province, for example, chemical plants and exploitation of farmland have caused serious pollution in Dianchi Lake. If efforts are made to clean the lake, the costs would be 10 times the profits created by the farmers and chemical producers. Estimated in this way, it should be concluded that the economic activities around the lake have produced great losses, not counting the losses of extinct fish and plants in the lake and the climate change in the nearby area. These modes of estimates have their own merits and flaws. They are to be further improved in practice.

5.2 The ideological obstacles

Green GDP means a significant ideological breakthrough and brand new perspective in development, which is based upon the concept of coordinated and sustainable development. The criteria to assess a

region's development will be changed when the green GDP system is introduced. The system to assess the achievements and work performance of local officials will also be changed. Pure economic growth used to be the only criterion to value a region's economic performance. The green GDP, however, will give a comprehensive evaluation of economic growth, social progress and environmental protection. A region's GDP figures will surely be reduced when the environmental costs are deducted, which may be difficult for local officials to accept.

Despite technical and ideological obstacles, the new system of green GDP should still be introduced to the calculating method of economic benefits of the Yangshan Deep-water Port. Otherwise, the Yangshan Deep-water Port's real economic benefits income and Shanghai's real development level will not be reflected, and a sustainable and balanced development will not be achieved.

CHAPTER SIX CONCLUSION

In the dissertation, it is tried to solve the problem of how to modify the current method of calculating the economic benefits of the Yangshan Deep-water Port in order to meet the latest requirement of sustainable development and environmental preservation. So in order to further investigate and analysis, it divided into several main chapters to explain the issue.

In the first chapter, it presents the introduction to the dissertation, developing into problem formulation, purposes and methodology of study and the overall structure of the dissertation. In the second chapter is the literature review which says the theory and indications of green GDP and its influences on the calculating method of economic benefits of transport project.

In the third chapter, it discusses the current method to calculate the economic benefits of the Yangshan Deep-water Port, here it refer to the “with and without test”. This test is popular used in the evaluation of most kinds of the calculating economic benefits of a certain transportation project. With this test, it has divided into two aspects, one is the short-term economic loss if Shanghai has no deep-water port, and the other is from the long term view to calculate the economic benefits loss. After the careful and accurate calculating process through the equations and functions, the author can get the final estimation of economic benefits gained in the year of 2010 of the Yangshan

Deep-water Port in three tables.

In the fourth chapter, it has introduced the significance of calculating economic benefits of the Yangshan Deep-water Port under the principles of green GDP. It is divided into two aspects, and the one is the overall environmental evaluation of the Yangshan Deep-water Port, the other is the environmental indications of human health, natural resources and ecologic environment. Furthermore, in each aspect, with the help of lots of functions and equations, it can set up the mathematical relation between the economic benefits evaluation and the cost of environmental loss.

Then in the fifth chapter, it presents the difficulties of implementing the green GDP principles into the calculating method of economic benefits of the Yangshan Deep-water Port in the technologic aspect and the theory aspect. These difficulties deserve to be further explored and researched by all the experts in the world. And it is quite sure that if green GDP index system can be applied into the calculating method of the evaluation of economic benefits of most projects, it will both boast the economic development and the maintenance of ecologic balance.

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