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Value Assessing and Financial Reporting of Marine Resource Assets: Taking NB-ZS Maritime Space as a Case Study

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Abstract: As a key component of natural resources, marine resource assets have become increasingly important in the construction of today's ecological civilization. Firstly, the statements of the assets and liabilities for marine resources are constructed from the physical assets and estimate value based on a full discussion of the measurement approach applied to the exceptional features of marine resource assets and liabilities. Secondly, the statements of the assets and liabilities of the Ningbo-Zhoushan marine area (hereinafter to be referred as NB-ZS) are presented based on detailed data. Finally, based on empirical and case studies, this paper has constructed a three-level statement system of marine resource assets and liabilities: the statement of physical assets, the statement of estimated value, and the summarized statement. The conclusions and countermeasures include the following: (1) the measurement of the value is effective based on the measurement of the physical assets for the statement system of marine resource assets and liabilities; (2) the statement system of marine resource assets and liabilities is applied to a detailed marine area, taking NB-ZS as an example; and (3) the statement of marine resource assets and liabilities can promote the protection of marine resources and the sustainable development of the marine economy after delicate measurement of its value compared with its physical assets.

Keywords: marine resource; assets and liabilities; value volume; physical volume; balance sheet

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1. Introduction

With rapid economic development, the problems related to resource shortages, environmental pollution and ecological degradation have intensified, and people are aware of the importance of the sustainable development of resources and are attaching more and more importance to building an ecological civilization. According to international law and the United Nations Convention on the Law of the Sea, the maritime space under China's actual jurisdiction covers an area of about 3 million square kilometers, one third of the country's land area, and has enormous economic and ecological value. However, with the increasingly serious problems of environmental pollution and destruction of marine resources, people are increasingly aware of the importance of protecting the marine ecological environment, promoting the rational use of marine resources, and thus accelerating the sustainable development of China's marine economy. In recent years, the large-scale development and utilization of marine resources in China have strongly supported the development and growth of the marine economy. However, the traditional development model of high input, high consumption and high pollution has led to a series of problems such as marine environmental pollution, local ecosystem degradation and tightening of the constraints on marine resources, which has constrained the transformation of the marine economy into a quality- and benefit-oriented one. To realize the efficient management of marine resources, on 11 January 2022, the Ministry of Ecology and Environment and

another six departments jointly issued the "14th Five-Year Plan for Marine Ecological Environmental Protection", which provides a comprehensive plan including a specific deployment of marine ecological environmental protection during the 14th Five-Year Plan. Since the 18th National Congress of the Communist Party of China (CPC), the Central Committee of the CPC with Comrade Xi Jinping at its core has attached great importance to the development of the marine industry and integrated the construction of a strong marine country into the goal of "two hundred years". To coordinate the protection and development of marine resources during the 14th Five-Year Plan period, and to promote the construction of a strong marine country, the CPC Central Committee has put forward a five-pronged proposal, including improving the top-level design, adhering to the ecological priority, optimizing the industrial structure, and so on.

The maritime space is the blue national territory of the country and an important state-owned resource asset as well as a basic element for the development of the marine economy and the prosperity of the country. Exploring the compiling of a natural resources balance sheet is a major initiative made by the Third Plenary Session of the 18th CPC Central Committee, and researching the asset accounting of marine resources is an urgent need and important task in natural resources' asset management, which can lay the foundation for mapping out the assets of marine resources, compiling the balance sheet of natural resources for the whole nation and carrying out auditing of the departure of leading cadres. Scholars have conducted many studies on the asset-based management of marine resources, mainly focusing on the study of property rights of marine resources, value assessment and the compiling of balance sheets.

In the research on property rights, Luo et al. (2021) clarified the property rights of marine resources assets and determine the classification of marine resources assets, i.e., the right of ownership, right of use and right of profit [1]. Cao et al. (2014), based on the theory of property rights economics, proposed that property rights are prerequisites for the effective utilization, exchange, preservation, management of and investment in resources, and they are also preconditions for the effective allocation of marine resources [2]. Wang et al. (2012) researched the three-dimensional and multi-level property rights system of marine resources, which is composed of the rights system, initial allocation system, market transaction system and management guarantee system, and they provided theoretical support for the multi-level utilization of marine resources [3].

In terms of value assessment, Li et al. (2018) discussed the value composition from the perspectives of the labor theory of value, utility theory of value and functional theory of value based on exploring the basic connotation of marine resource assets [4]. Kong et al. (2021) used the hypothetical development method to measure the price of maritime spaces in detail and explore the application and limitations of the hypothetical development method in the field of maritime space price assessment by analyzing the process of measurement and the results of the measurement [5]. Zou et al. (2017) discussed the theoretical system of assessment and systematically analyze factors affecting the assessment of the value of maritime space resources from the perspective of the theory of land rent and the theory of distribution of contributions of production factors [6]. Shen et al. (2022) constructed the theory and method of accounting for the value of marine resources assets, used the market method and income method to measure the expected net income of marine resources assets without the right of use and comprehensively accounted for the value of marine resources assets [7]. Sang et al. (2024) combined the characteristics of marine resource assets and the current management mode of marine area use, put forward the relevant methods on how to determine the basic accounting unit, divided the homogeneous area and selected the price signals and other key issues and in this way constructed a set of technical methodology systems for the accounting of the value volume of marine resource assets [8].

In terms of balance sheet compilation, He et al. (2018) explored the accounting ideas and methods of physical and value-based accounting, and they constructed China's national marine resources balance sheet by defining the connotation of assets and liabilities

of marine resources and combining the existing relevant research results [9]. Cui et al. (2020) designed a three-tiered framework system for marine fishery resources asset accounting and constructed tables such as the stock and change table of marine fishery resources and the balance sheet based on use rights and interests [10]. Li et al. (2009) defined the key concepts in the process of marine resources balance sheet compilation and determined the accounting scope of marine resources assets with a higher degree of accuracy [11]. Based on the two major functions of evaluation and assessment of natural resource balance sheet, Wang et al. (2021) have designed a marine resource balance sheet by analyzing the connotations of assets and liabilities of marine resources, the setting of accounts and the accounting methods [12].

Through years of research and exploration, China has established a relatively perfect system for the management of marine resources. With the tasks of marine ecological environmental protection put forward in recent years, the asset-based management of marine resources has become an emerging research content. Regarding how to define the assets of marine resources, improve the property right system and carry out asset accounting assessment and evaluation, the academic exploration mainly focuses on the construction of the balance sheet framework based on the property right system of marine resources, the form of liabilities of marine resources, the connotation of defining the assets and liabilities of marine resources, etc. There is less research on accounting and statement preparation of the assets of marine resources based on the valuation, and there is a relative lack of empirical research. Because of this, this paper carries out research on the value accounting of marine resources assets, assesses the value of marine resources assets based on the income method, market method, cost method, and hypothetical development method, assesses the value of marine resources liabilities based on the residual method and market method, and establishes a technical route and method of classifying the value of marine resources assets based on the accounting of physical volume and value to provide theoretical and technical support for the compiling of a marine resources balance sheet.

2. Measurement of Marine Resource Assets: A Value-Based Analysis

2.1. Meaning and Methodology of Asset Valuation of Marine Resources

2.1.1. Meaning of Asset Valuation of Marine Resources

According to the definition of the Technical Guidelines for the Appraisal of Maritime Domain, the activities of maritime domain appraisal professionals who assess the value of specific maritime domains based on certain principles, procedures and methods are defined as maritime domain appraisal, which is characterized by marketability, realism, predictability and complexity. Borrowing from this definition, this paper argues that the assessment of the value of marine resource assets can be defined as based on a specific purpose, following established principles and processes, and selecting appropriate methods. All economic activities need to be converted into monetary value before they can be included in the scope of accounting, and the value assessment of marine resource assets involves expressing the value of marine resource assets in monetary form. In this paper, based on physical accounting, we select appropriate valuation methods to account for the monetary gains or losses brought about by economic activities. The assessment of the value of marine resource assets can help to determine the basic value of marine resource assets, provide basic information on this value to the relevant departments and units of the national economy, provide an authoritative basis for the value of marine resource assets for insurance, transfer and other business activities, and determine the standards for economic compensation and indemnification for damage to marine resources.

2.1.2. Methodologies for Assessing the Asset Value of Marine Resources

There are numerous methods for assessing the value of marine resources, each of which has its unique features but is related to each other. Based on the theory of resource asset valuation, He et al. (2015) proposed that there are three basic methods for assessing the value of marine resource assets: the income method, the market method and the cost

method [13]. There is also a recognized classification of appraisal techniques for resource asset value in academia, which classifies them into the direct market method, alternative market method and hypothetical market method based on the degree of market development. The Technical Guidelines for Maritime Area Appraisal issued by the State Oceanic Administration (SOA) in 2013 summarizes five methods of appraising the price of maritime areas: income method, cost method, hypothetical development method, market comparison method, and correction method of the benchmark price coefficient. The effectiveness of the value assessment methods has an essential impact on the credibility and comparability of the final accounting results, and different methods are suitable for evaluating different values of different resources. By comparing the links and differences between methods, the most suitable value assessment method for each marine resource asset is selected. Borrowing from the viewpoints of the scholars of He et al. [13], through their analysis and improvement, this paper summarizes four methods of value assessment of marine resource assets according to the research needs, which are the income approach, market approach, cost approach, and assumption development approach, as shown in Table 1.

Table 1. Comparison table of marine resource assets valuation approaches.

Assessment Methodology	Scope of Application
income approach	Fishery resource assets, port and shipping resource assets, tourism resource assets, ecological environment resource assets
market approach	Fishery resource assets
cost approach	Tourism resource assets, ecological and environmental resource assets
scenario development approach	Other marine resource assets

2.2. Methods for Assessing the Value of Marine Resource Assets and Conditions for Their Application

2.2.1. Income Approach

The income approach, which may also be referred to as the income-reduction approach, assumes that the development and utilization of marine resources assets will continue to yield income for numerous years in the future, and it discounts the income to the valuation reference date at a certain discount rate to arrive at the total monetary amount, which is the value of the marine resources assets. The basic formula is as follows:

$$P = \sum_{i=1}^{n} \frac{A_i}{(1+r_1)(1+r_2)\cdots(1+r_i)} \tag{1}$$

In the formula, P represents the value of marine resource assets, A_i is the return of marine resource assets in years i, r_1, r_2, r_i, which represent the discount rate of marine resource assets in years 1, 2 and i $(i = 1, 2, \cdots, n)$. Assuming that the discount rate is constant and the amount of return in each year is A_i, the formula is as follows:

$$P = \sum_{i=1}^{n} \frac{A_i}{(1+r)^i} \tag{2}$$

Assuming that the discount rate and the amount of return in each year are constant, the formula is as follows:

$$P = \frac{A}{r}\left[1 - \frac{1}{(1+r)^n}\right] \tag{3}$$

When applying the income approach, there are three key points to emphasize: the amount of return, the discount rate, and the period of return.

Firstly, based on the type, characteristics and purpose of the marine resources assets, one of the three items, net profit, net cash flow or total profit, which best reflects the amount

of return on the marine resources assets, can be selected as the expected return. Secondly, the determination of the discount rate depends on the level of interest rate, but in essence, the discount rate cannot be equated with the interest rate. According to the practical needs of the assessment of the value of marine resources assets, the discount rate is determined using the "composition method", namely the discount rate= risk-free interest rate+ risk-added rate. The risk-free interest rate is calculated by the 1-year deposit rate, which is a method recognized by academics; the calculation of the risk-added rate is based on the actual estimation of the marine resource assets, and the method of Liu (2010) is used to select the value added of the marine industry corresponding to various types of marine resource assets and calculate the average annual growth rate of the value added, which is used as the risk-added rate of various types of marine resource assets [14]. Finally, based on the concept of sustainable development, this paper assumes that marine resource assets can continue to gain income in the future; i.e., the income is infinite years.

The income approach, which can more accurately reflect the principal value of marine resource assets, is generally applicable to a class of marine resource assets with predictable future returns and requires two prerequisites to be met before this approach can be used: firstly, it is possible to measure in monetary terms the marine resource assets being assessed; and, secondly, it is possible to measure in monetary terms the risks assumed by the owners of the marine resource assets.

2.2.2. Market Approach

The market approach, also known as the market comparison approach, involves finding examples similar to the marine resource assets to be calculated, comparing the transaction time, resource conditions and individual factors of the marine resource assets to be valued with those of the examples, and then correcting them to arrive at the value of the marine resource assets to be valued. The calculation formula is show below (Formula source: Zhang Guoan et al. (2009) [15]):

$$P = P_B \times C \times D \times E \times F \tag{4}$$

In Formula (4), P denotes the value of the marine resource assets to be estimated and P_B denotes the value of the marine resource assets in the comparison example;

C denotes the sea state index to be estimated/comparative sea state index;

D indicates the valuation date price index for the maritime space to be valued/transaction date price index for the comparison maritime space;

E is the regional factor condition index for the maritime space to be estimated/regional factor condition index for the comparison maritime space;

F denotes the Individual Factor Condition Index (IFCI) for the maritime space to be assessed/Individual Factor Condition Index (IFCI) for the comparison of maritime space;

The market approach requires two conditions to be met: first, the market for marine resources assets is active; and second, the marine resources assets to be valued are comparable to the comparison, and information on relevant indicators and technical parameters can be obtained. The results of the market approach can objectively reflect the real value of marine resources assets in the market, but the application of this method is premised on active market conditions and requires a large number of examples of marine resources asset transactions and information for comparative analysis to arrive at the final value of marine resources assets.

2.2.3. Cost Method

The cost approach is to calculate the value of marine resource assets by deducting the loss value from the actual replacement cost of the assessed marine resource assets. The formula is as follows:

$$P = R - Q - V = R \times T \tag{5}$$

where P denotes the value of marine resource assets, R denotes replacement cost, Q denotes physical depreciation, V denotes economic depreciation, and T denotes the rate of salvage.

First, there are three methods for estimating replacement cost R. The first, the replacement accounting method, is derived by summing the direct and indirect costs of marine resource assets. The second price index method, which estimates the replacement cost by applying a price index to adjust the historical cost of the marine resource assets, is calculated by the following formula:

$$R = H \times \frac{\mathrm{P_c}}{\mathrm{P_d}} \tag{6}$$

where R denotes the replacement cost; H denotes the historical cost of marine resource assets; P_c denotes the price index at the time of valuation of marine resource assets; and P_d denotes the price index at the time of construction of marine resource assets.

The third is the functional value approach, which looks for a comparison similar to the marine resource asset to be valued and estimates the replacement cost using the comparison, which is calculated by the following formula:

$$R = \frac{\mathrm{P_e}}{\mathrm{P_o}} \times \mathrm{R_o} \tag{7}$$

where R is the replacement cost; P_e denotes the annual production of the resource asset in the assessed marine area; P_o denotes the annual production of the reference; and $\mathrm{R_o}$ denotes the replacement cost of the reference.

Secondly, physical depreciation Q refers to the decrease in value brought about by the decline in the physical properties of the resources as a result of the influence of natural external forces. There are two methods for its estimation. The first is the observation method, which comprehensively analyzes the relevant influencing factors through technical appraisal by professionals and expresses the degree of influence of natural external forces on the functioning of marine resources assets in terms of the rate of newness T. The calculation formula is as follows:

$$Q = R \times (1 - T) \tag{8}$$

where R is the replacement cost; and T is the rate of newness.

The second method is the chronological method, which is calculated by the following formula:

$$\mathrm{Q} = \frac{\text{replacement cost} - \text{estimated residual value}}{\text{Total useful life}} \times \text{practical serviced life} \tag{9}$$

Among them, Total useful life = practical serviced life + Service life. practical serviced life = nominal serviced life × asset utilization ratio. Marine resource asset utilization ratio = (The cumulative actual utilization time of Marine resources and assets up to the assessment date/The cumulative legal utilization time of Marine resources and assets as of the assessment date) × 100%

The rate of newness, T, can be calculated based on the useful life method using the following formula:

$$T = \frac{\text{Expected service life}}{\text{Total useful life}} \times 100\% \tag{10}$$

The cost of the restoration method can also be used to calculate the rate of newness, using the following formula:

$$T = 1 - \frac{\text{rehabilitation expense}}{\text{replacement cost}} \times 100\% \tag{11}$$

Finally, economic depreciation V refers to the decrease in value caused by factors other than the asset, such as political factors, and is determined by the appraiser on a case-by-case analysis; economic depreciation is not calculated under normal circumstances.

There are two prerequisites for the application of the cost method: first, there is the same or comparable historical information, and when applying the cost method, it needs to obtain necessary information such as related indicators from historical documents. The second is that the costs of forming the value of marine resource assets are effective costs, and they can show the average level of society or industry. The cost method takes into account the depletion of marine resources assets in a more comprehensive manner, and the results obtained are more scientific, but its calculation is complicated and technically demanding, and the selection of comparative references requires sufficient available information.

2.2.4. Hypothetical Development Method

The hypothetical development method is used to subtract the cost and profit of development from the value of the maritime space after development, and the result is the asset value of the maritime space resource. The formula is as follows:

$$P = V - Z - I \tag{12}$$

where P denotes the asset value of marine resources; V denotes the value of the developed maritime space; Z denotes the development cost; and I denotes the development profit.

This method is mainly used for the calculation of town sea-use type projects. V does endorse the selection of adjoining land prices, which are estimated by selecting adjoining land prices of the same use type based on the use of the maritime space after development.

Based on the previous analysis of the methods for assessing the value of marine resources assets, taking into account the conditions for the use of each method and the desirability of the method, and because of the limited availability of data and relevant information, this paper, in the case study, selects the income approach to measure the value of the types of marine resources assets suitable for the application of the income approach.

2.3. Valuation of Liabilities for Marine Resources

Excessive use of the sea by human economic activities will cause the marine ecological environment to deteriorate. In this paper, the liabilities formed by the excessive depletion of marine resources are measured by user costs, which can be calculated by the residual method, and the liabilities formed by damage to the marine ecological environment are measured by the costs of pollution control and ecological compensation, which can be calculated by the market method.

2.3.1. Residual Method

From the perspective of sustainable development, economic compensation is needed to solve the ecological and environmental problems caused by the exploitation of marine resources. The exploitation of marine resources for a certain economic activity will lose the opportunity for the natural development of the resource to create income; that is, the value of the ecological environment of the maritime space formed by itself will be lost. When irreversible ecological damage is caused, this opportunity cost loss is calculated and included in the liability for marine resources. The application of the residual method is the value of development activities in the maritime space belonging to the owner of the right to use the maritime space, with the cost of purchasing an equivalent amount of land in the adjacent areas of the maritime space instead of the cost of calculating the total benefits, which is then subtracted from the cost of the actual economic activities. The result is the value of the economic compensation, which is also included in this paper to consider the project of the marine resource liabilities. The calculation formula is as follows:

$$P = (D - C) \times \text{the correction coefficient of the life span of the maritime space} \tag{13}$$

where P is the value of economic compensation; D is the value after development; and C is the cost of development of the maritime space. The estimation of land price in adjoining areas is optional. The correction coefficient for the life span of the maritime space is calculated by the following formula (formula source: https://www.zjzwfw.gov.cn/zjservice/item/detail/lawtext.do?outLawId=32706e27-fdb6-40f4-b6ff-32e05f8eab95; accessed on 12 May 2024):

$$y = \frac{1 - \frac{1}{(1+r)^n}}{1 - \frac{1}{(1+r)^N}} \tag{14}$$

In the formula, y is the correction coefficient of the life span of the maritime space; n is the serviceable life of the post-development stretches of land; N is the remaining period of use of the original maritime space; and r is the discount rate.

2.3.2. Market Approach

Anthropogenic disasters caused by human economic activities may result in the loss of the value of the use of maritime spaces and the loss of the value of the living resources of maritime spaces. Loss of the use value of maritime spaces can be considered as a user cost, calculating the value of the loss of functional use of maritime spaces that have been and will be damaged. If the maritime space is damaged, in the case of the port and navigation maritime space, both the port side and the ship side are damaged; salt production and industrial water use, which utilize seawater resources, will be affected. These damages are assessed using the market approach with two possibilities (Liu et al. (2007) [14]).

If the change in output due to the loss of the value of the sea area is not significant in terms of the volume of sales in the market as a whole, i.e., it is assumed that the prices of products and factors of production remain unchanged after the change in output, these losses are assessed using the market approach, which is calculated as follows:

$$L_1 = P\Delta Q \tag{15}$$

If the change in output has a significant impact on prices and factors of production, it is necessary to calculate the corresponding loss in the value in use of the sea according to the change in the price of the product, which is calculated as follows:

$$L_2 = \Delta PQ \tag{16}$$

where L_1 and L_2 denote the loss of value if the output has insignificant and significant effects on the prices of products and factors of production, respectively; P and ΔP, respectively, denote the price and its change; and Q and ΔQ, respectively, denote the yield and the change in production.

The loss of value of living resources in the maritime space relates to aquaculture losses and fisheries capture losses. Estimates are based on the market approach and are calculated using the following formula:

$$L_3 = (p - c_v)\Delta Q \tag{17}$$

In the formula, ΔQ is the change in fishing volume or aquaculture volume; c_v is the cost per unit of product; p is the market price per unit of product, which is determined by several factors such as market supply and demand, fishing conditions and seasons, and the average value of the recent years is usually selected as the market price.

Concerning the calculation of the owner's interest in marine resources, as mentioned above, it is derived from the assets of marine resources less the liabilities, so the methodology for valuing them is not analyzed separately.

3. Balance Sheet of Marine Resources Based on Value Assessment

The compilation of a natural resources balance sheet can help to grasp the status of natural resources and the effectiveness of their management and ultimately achieve the

goal of rationally utilizing natural resources and protecting the natural environment. The balance sheet of marine resources can provide useful information for the promulgation of policies related to the management of maritime spaces or the trading system of marine resources and the compensation system for ecological damage in maritime spaces. Drawing on the principle of balance in accounting, the balance sheet of marine resources satisfies the equation of "assets of marine resources = liabilities of marine resources + owner's equity of marine resources", which reflects the physical information of assets of marine resources, liabilities of marine resources and owner's equity of marine resources at a certain point in time, and at the same time, it reflects the value information of related elements. The object is maritime space resources. The ownership of marine resources belongs to the state, so the balance sheet of marine resources should be prepared with the state as the main body.

The balance sheet is a well-established document that reflects the financial position of an enterprise at a particular date and is available in two forms: reporting and account-based. Accounts are divided into left and right columns, with the left column reflecting items of assets, and the right column reflecting items of liabilities and owner's equity. The existing techniques and forms of balance sheets provide a theoretical basis and practical guidance for the preparation of the balance sheet of marine resources. In this paper, the balance sheet of marine resources is designed according to the account structure to reflect the current status of marine resources assets, to enable the government departments and relevant functional departments to grasp the actual situation of marine resources assets and improve the efficiency of the use of marine resources.

3.1. Principles and Pathways for the Preparation of a Balance Sheet for Marine Resources

3.1.1. Principles for the Preparation of a Balance Sheet for Marine Resources

Firstly, there is the basic principle: the balance sheet of marine resources should be consistent with the balance sheet of natural resources. Marine resources are one kind of natural resource, and the preparation of the balance sheet of marine resources is subject to the coordination and control of the balance sheet of natural resources. Accounting research on marine resources can supplement and improve the existing natural resources accounting system, so the practical application of the preparation of the balance sheet of marine resources should be consistent with the requirements of the natural resources accounting system. Based on existing research and practical application, the preparation of the statement should be linked to other natural resource accounting systems as much as possible to improve the overall system of natural resource balance sheets.

Secondly, there is the principle of value measurement: since the balance sheet ultimately reflects the value of assets in monetary terms, the accounting of the value of marine resource assets is further analyzed based on the accounting of the physical quantity of marine resource assets. The "physical quantity" and "value" reflect the actual changes in the quantity of marine resources while at the same time taking into account the quality of the situation. Under the requirements of the accrual system, the balance sheet of marine resources should reflect the results of "physical accounting" and "value accounting" at the same time. The special mobility of the ocean determines that the marine resources have a strong variability. Combining changes in physical quantity and changes in value, the advantages and disadvantages of economic activities should be analyzed in an integrated manner. For example, the impact of pollution on the maritime space is persistent in time, and it is manifested in the current or later time frame, and diffusion in the scope of the impact, with the possibility of pollution spreading to neighboring areas, and these losses should be included in the scope of accounting for the value of the volume of the loss. Accounting should also be performed when there is a change in value but no change in physical responsibility.

Finally, there is the principle of practicality. The balance sheet of marine resources should be able to be generalized for use in the preparation of balance sheets of other types of marine resources, and at the same time, it should provide true and reliable information to the users of the statement. There is a rich material exchange between various types

of resources, which will produce new value. Thus, marine resources still have a broad space for exploration and research. The accounting and statement preparation of marine resources assets is the basic work for improving the research system of marine resources asset accounting, and the balance sheet of marine resources provides users with accurate and effective information, reflecting their value in use.

3.1.2. Pathway to a Balance Sheet for Marine Resources

In the study of natural resource assets, Xiao et al. (2015) designed a dynamic and static statement system [16]. Similarly, there are many types of marine resources, and the presentation of their quantity and value is more complicated in terms of structure and format, and one statement is not enough to reflect the substance. Therefore, the purpose of this paper is to design a set of report systems suitable for the management of marine resources assets, which can fully reflect the control of the status of marine resources. Based on the classification and property rights analysis of marine resources assets in the previous section, a balance sheet of marine resources assets and liabilities is prepared in three steps, which are based on the logic of "physical first, then value; classification first, then summary".

The first step is a statement of the physical volume and value of marine resources assets, liabilities and ownership interests. The design of the tables follows the balancing equation: closing stock = opening stock + additions during the period—reductions during the period, reflecting the opening and closing physical quantities, opening and closing values, and changes in the current period's physical quantities and values of the assets, liabilities and owners' equity of marine resources.

The second step is to prepare a statement of assets and liabilities of marine resources. Based on physical and value accounting, a statement of assets and a statement of liabilities for marine resources are constructed in a disaggregated structure.

The third step is to prepare a balance sheet for marine resources. Following the structure of an account-based statement and incorporating the balancing equation "Assets = Liabilities + Owners' Equity", the physical and value results are disaggregated to reflect the actual status of the assets and liabilities of the marine resources.

3.2. Preparation of a Balance Sheet for Marine Resources: Physical Volume Accounting

3.2.1. Physical Volume Accounting for the Resource Accounting Element for Maritime Spaces

Based on the physical accounting of natural resources set up by the state, this paper compiles a physical volume table of marine resource assets based on the accounting elements of marine resources and their categorization. As mentioned above, marine resource assets are divided into seven categories: fishery resource assets, harbor and navigation resource assets, tourism resource assets, mineral and energy resource assets, biological resource assets, ecological environment resource assets and other marine resource assets, and the total amount of marine resource assets is calculated based on these seven indicators. Therefore, the physical volume of marine resource assets is accounted for horizontally by the specific object of accounting, i.e., various types of marine resource assets, and vertically by its classification statistics and total subtotal, and it follows a balanced equation: the closing stock of marine resources = the opening stock of marine resources + the increase in marine resources in the current period—the decrease in marine resources in the current period. In addition to reflecting the opening and closing stocks of marine resource assets, increases and decreases in specific marine resource assets are shown according to the factors affecting them.

3.2.2. Physical Inventory of Marine Resource Assets

In the table of physical quantity of marine resource assets, the physical unit of measurement is used as the unit of physical quantity accounting. Referring to the practice of He Yixiong et al. (2015) [13], this paper selects the area unit of hectare to carry out the

physical quantity statistics of marine resource assets, to carry out a unified comparison between different types of maritime spaces and to clarify the use status and the changes in the increase or decrease in various types of marine resources [9]. Because the characteristics of different types of marine resources vary greatly, various types of marine resource assets can be divided into two levels according to their respective characteristics or attributes, and the statistical analysis of physical quantities can be carried out under the second level of division.

A statement of the physical volume of marine resources assets can reflect the amount of change and the reasons for the change, which can help to find the root cause and target in the process of decision making and improvement. However, the balance sheet of the physical volume of marine resources does not need to reflect the reasons for the increase or decrease in marine resources but rather only the total amount at the beginning of the period, the total amount at the end of the period and the change in the current period.

3.2.3. Physical Scale of Liabilities for Marine Resources

The table of the physical volume of marine resources liabilities is horizontally consistent with the table of the physical volume of marine resources assets, and it is a categorized indicator of the marine resources that have been accounted for, with no secondary segmentation due to the complexity of recognizing the liabilities. Vertically, it shows the specific physical volume accounting items of marine resources liabilities, i.e., the opening stock, the current change and the closing stock. Changes in the quantitative consumption of marine resources are reflected in the table of physical volume of marine resources liabilities. Increases are recorded as "+" if there is an increase, zero if there is no increase and "−" if there is a decrease.

Similarly, the physical volume of marine resources liabilities can clearly reflect the amount of change and the reasons for the depletion of resources, but the physical volume of the marine resources balance sheet does not need to reflect the reasons for the changes in marine resources but only the total amount at the beginning of the period, the total amount at the end of the period, and the change in the current period. To meet the requirements for the preparation of the balance sheet of the physical volume of marine resources, a summary table of the physical volume of marine resources liabilities is compiled for statistical purposes.

3.2.4. Physical Scale of Ownership Interests in Marine Resources

Owners' equity in marine resources is calculated by deducting liabilities from marine resources assets. At the same statistical time, the closing inventory data of marine resources assets are consistent with the physical volume table of assets, the closing inventory data of marine resources liabilities are consistent with the physical volume table of liabilities, and the results in the physical volume table of marine resources owners' equity are calculated by using the equation "Marine resources owner's equity = Marine resources assets—Marine resources liabilities". The results in the physical inventory of marine resources are calculated through the equation "Marine resources owner's equity = Marine resources assets—Marine resources liabilities".

3.3. Preparation of a Balance Sheet for Marine Resources: Accounting for Values

3.3.1. Accounting for the Volume of Value of the Resource Accounting Elements of Maritime Spaces

The measurement of the value of marine resources assets and liabilities is based on the calculation of value assessment methodologies, which vary from one marine resource to another depending on the attributes of the resource. In accounting for the value of marine resources, it is necessary to take into account not only the value of the resources themselves but also changes in value caused by dynamic elements. At the same time, in the process of accounting for the value of marine resources, it is also necessary to satisfy the balance equation: end of the period stock = beginning of the period stock + increase in the current

period—decrease in the current period. In terms of presentation structure, the value scale is designed on the basis of the tabular structure of the physical volume scale.

3.3.2. Scale of Values of Marine Resource Assets

The marine resource asset value table is based on the refinement of the table structure of the physical volume of marine resource assets, so the format of the two types of tables is consistent. The balance sheet of the value of marine resources only reflects the value of changes in value but not the reasons for the changes in the value of marine resources, and it contains the opening value of marine resources, the change in the value of marine resources and the closing value of marine resources. In order to meet the requirements for the preparation of the balance sheet of the value of marine resources, a summary table of the value of marine resources assets has been prepared to facilitate statistical analysis of the data.

3.3.3. Scale of Values of Liabilities for Marine Resources

The table on the value of marine resources liabilities is consistent with the structure of the table on the physical volume of marine resources liabilities. The change in the value of the liability for the current period is shown in terms of the cause of the liability, the current change in user costs, pollution control and ecological compensation costs, and the change in the value of the liability. Similarly, in order to meet the requirements for the preparation of a balance sheet of the value of marine resources, a summary table of the value of marine resources liabilities has been prepared for statistical purposes.

3.3.4. Scale of Values of Ownership Interests in Marine Resources

The value of the owner's interest in marine resources is obtained by deducting the value of liabilities from the value of marine resources assets.

3.4. Balance Sheet of Marine Resources

Based on the analysis of the physical and value accounting of the marine resources assets, a statement of marine resources assets is prepared by presenting the opening and closing values of the physical and value quantities, as well as the changes during the period, in a disaggregated manner. Similarly, a statement of liabilities for marine resources is formed by presenting physical and value quantities separately. Finally, based on the accounting of the physical and value of marine resources and the basis of the asset and liability statements, the balance sheet of marine resources is designed by following the following balanced equation: "Owners' equity in marine resources = Assets in marine resources—Liabilities in marine resources" and drawing on an account-based structure. The final balance sheet of marine resources, formed by the physical volume of the marine balance sheet and the value volume of the marine balance sheet, is shown in Table 2. Specifically, A1, A2, A3, A4, A5, A6 and A7 represent the opening physical stock of each of the seven types of marine resource assets classified according to the function of sea use, namely fishery resource assets, harbor and navigation resource assets, tourism resource assets, mineral and energy resource assets, biological resource assets, ecological and environmental resource assets, and the opening physical stock of other marine resource assets. C1–C7 represent the total physical volume of each of the seven categories of marine resource assets at the end of the period. D1–D7 represent the opening physical volume of each of the seven categories of sea area resource liabilities. T1–T7 represent the physical volume of each of the seven categories of sea area resource liabilities at the end of the period. A11–A71 represent the beginning-of-period value stock of each of the seven categories of marine resource assets. C11–C71 represent the stock of value at the end of the period for each of the seven categories of marine resource assets. D11–D71 represent the opening value of the liability for the seven categories of maritime resources. T11–T71 are the end-of-period values of the resource liabilities for the seven categories of marine waters.

Table 2. Balance sheet of marine resources (department: date).

Marine Resource Assets	Beginning of the Period Balances		End of Term Balances		Liabilities for Marine Resources and Owners' Equity	Opening Balance		Closing Balance	
	Physical Volume	Value Volume	Physical Volume	Value Volume		Physical Volume	Value Volume	Physical Volume	Value Volume
Marine resource assets:					Liabilities for marine resources:				
Fishery resource assets	A1	A11	C1	C11	User costs:				
Port and maritime resources assets	A2	A21	C2	C21	Liabilities for fishery resources	D1	D11	T1	T11
Tourism resource assets	A3	A31	C3	C31	Liabilities for port and shipping resources	D2	D21	T2	T21
Mineral and energy resource assets	A4	A41	C4	C41	Liabilities for tourism resources	D3	D31	T3	T31
bioresources assets	A5	A51	C5	C51	Liabilities for mineral and energy resources	D4	D41	T4	T41
Ecosystem resource assets	A6	A61	C6	C61	Biological resource liabilities	D5	D51	T5	T51
Other marine resource assets	A7	A71	C7	C71	Liabilities for ecological and environmental resources	D6	D61	T6	T61
					Other marine resources liabilities	D7	D71	T7	T71
					Pollution control and ecological compensation costs:				
					Fishery resource assets	D1	D11	T1	T11
					Port and maritime resources assets	D2	D21	T2	T21
					Tourism resource assets	D3	D31	T3	T31
					Mineral and energy resource assets	D4	D41	T4	T41
					bioresources assets	D5	D51	T5	T51
					Ecosystem resource assets	D6	D61	T6	T61
					Other marine resource assets	D7	D71	T7	T71
					Total liabilities	D8	D81	T7	T71
					Total owners' equity	F8	F81	o8	o81
Total assets	A8	A81	C8	C81	Total liabilities and owners' equity	A8	A81	C8	C81

The units of physical volume and value volume are, respectively, hectares and ten thousand dollars.

4. Case Applications for the Preparation of a Balance Sheet for Marine Resources

4.1. Status of Resources in the NB-ZS Maritime Space

4.1.1. Status of Natural Conditions

Zhejiang Province is a large coastal province, and the construction of the Zhejiang Ocean Economy Development Demonstration Zone is an important national strategy. In creating a large platform for the ocean economy, the NB-ZS maritime space is the core area. The 2020 Zhejiang Provincial Government Work Report puts forward the goal of moving toward the "Global Ocean Center City", and the two coastal cities of Ningbo and Zhoushan are working together to realize this goal. Wang et al. (2016) mentioned that the NB-ZS maritime space is one of the nine provincial key maritime spaces in Zhejiang province in their study on the development of the province's marine economy [17]. Based on this, this paper selects the NB-ZS maritime space to account for the asset value of maritime space resources and prepare a balance sheet of maritime space resources. The NB-ZS Maritime space is located in the middle of China's coastline, and the famous NB-ZS Port is an important hub of the national comprehensive transportation system, on which the development of Zhejiang's marine economy depends. According to statistics, the area of the NB-ZS maritime space is more than 800 square kilometers, and there are more than 2500 maritime space use projects. The NB-ZS maritime space has a large number of islands, which accounted for more than half of the province's total number of islands, totaling an island area of more than 1800 square kilometers. This maritime space is one of the richest areas in China in terms of coastline resources with a coastline length of over 4000 km and a beach area that ranks first in the province. The favorable location of the NB-ZS maritime space has become a booster for the development of the local marine economy.

4.1.2. Socio-Economic Status

The industrial and transportation use of the sea in NB-ZS waters is large in scale and number, serving port-related industries and agriculture and providing vast resources for urban development. The development of fishery farming and tourism is adapted to the local conditions. The long and winding coastline, rich in bait organisms, has a greater advantage in the development of fishery farming, and the natural landscape is peculiar and beautiful, attracting Chinese and foreign tourists. The NB-ZS maritime space involves the cities of Ningbo and Zhoushan, and in 2018, the region realized a total gross regional product of about 1206.3 billion yuan and a total tourism revenue of about 294.8 billion yuan.

4.2. Accounting for the Value of Resource Assets in the NB-ZS Maritime Area

Accounting for the physical volume of marine resource assets is the basis of accounting for the value volume. Therefore, the physical volume of marine resource assets in NB-ZS is counted first, and then the accounting for the value of marine resource assets in NB-ZS is further analyzed. Because the value assessment of certain marine resource assets requires more advanced technology, based on the data available at this stage, this paper selects 2018 as the research time to analyze the fishery resource assets, tourism resource assets, and harbor and navigation resource assets within the NB-ZS maritime space. Therefore, respectively, on the characteristic attributes of each of these three types of marine resource assets, their physical volume is counted, and the physical volume of resource assets in the NB-ZS maritime space is accounted for as shown in Table 3.

In Table 3, the closing stock is the physical quantity of NB-ZS marine resource assets in 2018, and the opening stock is the physical quantity of NB-ZS marine resource assets in 2017. For the unique attributes of different types of maritime space resource assets, different categories were created for physical quantity accounting. For the fishery resource assets in the NB-ZS maritime space, the area of seawater aquaculture in 2018 was 37,836 hectares, an increase of 6610 hectares compared with the previous year, but the output of seawater aquaculture products was 2,073,000 tons, which was a decrease of 93,000 tons compared with the previous year. As for the port and navigation resource assets in the NB-ZS maritime space, the cargo throughput in 2018 was 1084 million tons, an increase of 0.75 million tons

from the previous year, and the container throughput was 26,355,700 TEUs, which was an increase of 1,748,700 TEUs from the previous year. As for tourism resource assets in the NB-ZS maritime space, the area of the marine natural landscape in 2018 was 135,837 hectares, an increase of 49,018 hectares compared with the previous year, indicating that the area of natural landscape that can be developed into tourism resources within the controllable range of ecological environment has increased significantly. The passenger throughput in 2018 was 3,264,000, which was an increase of 184 million passengers.

Table 3. Physical statement of NB-ZS maritime space resource assets in 2018.

			Opening Stock	Increment	Reduction	Closing Stock
NB-ZS Marine Resource Assets	Fishery resource assets	Mariculture area (ha)	31,226.00	6610.00	-	37,836.00
		Production of mariculture products (tons)	216.60	-	9.30	207.30
	Port and Maritime Resources Assets	Cargo throughput (billion tons)	10.09	0.75	-	10.84
		Container throughput (10,000 TEUs)	2460.70	-	25.10	2635.57
	Tourism resource assets	Natural landscape resources (ha)	86,819.00	49,018.00	-	135,837.00
		Passenger throughput (10,000)	308.00	18.40	-	326.40

Data source: *Zhejiang Natural Resources and Environment Statistics Yearbook—2019, Zhejiang Natural Resources and Environment Statistics Yearbook—2018*.

The fishery resource assets, tourism resource assets, and harbor and navigation resource assets selected in this paper all belong to the type of assets with predictable future income; therefore, the income approach is applied to account for their value. Through the analysis in the previous article, the income approach is one of the common methods recognized by academics for assessing the value of marine resources, and it is well established in practical calculations. There are many types of marine resource assets, and considering the desirability of data and the applicable conditions of the value assessment methods, this paper chooses the income approach as the method of accounting for the value of marine resource assets. To make the research continuous, this paper analyzes the change in marine resource assets in NB-ZS from 2014 to 2018 and specifically prepares the balance sheet of marine resource assets and liabilities in NB-ZS in 2018.

4.2.1. Accounting for the Asset Value of Fishery Resources

There are many kinds of fishery resources in the maritime space, and it is extremely difficult to account for the amount of value of each species, so this paper chooses the income method to account for the overall fishery resource assets in the NB-ZS maritime space. Under the premise of sustainable development, this paper assumes that there is no limit to the number of years of income from marine resources. According to the previous section, the discount rate = risk-free interest rate + risk-added rate. The safe interest rate is the risk-free capital investment interest rate, and this paper takes the weighted average of the one-year time deposit rate of the Bank of China from 2014 to 2018 as the risk-free interest rate, which is calculated as 1.683% (Data Source: Bank of China RMB Deposit Rates: [EB/OL]. https://www.bankofchina.com/fimarkets/lilv/fd31/; accessed on 28 May 2024).

The determination of the risk-added rate is related to the value at risk of the industry, and its determination is difficult; as mentioned earlier, this paper adopts the methodology of Liu et al. (2010) [14]. Here, the results of the calculation of the average of the growth rate of the value added of the marine fisheries industry are used as the risk-added rate of the fishery resource assets. Available yearbook data as of 2016 are used to calculate the arithmetic average of the growth rate of marine fisheries value added in 2014–2016; the calculation results are shown in Table 4 as 4.92%. Then, the discount rate r = 1.68% + 4.92% = 6.6%. In addition, In order to more clearly and visually see the data and the magnitude of change in marine fisheries, we have introduced histograms and line graphs, as shown in Figure 1.

Based on the operation of the aquaculture industry in February and May 2018, calculated by the China Agricultural Information Network (CAIN), the average value of the market transaction price of aquatic products was 16,300 yuan/ton (Data Source: China Agricultural Information Network (CAIN). http://www.agri.cn/; accessed on 28 May 2024). It is noted that the direct production cost of aquatic products is about 0.5 million yuan/ton, and with other risk factors, it is estimated to be 0.8 million yuan/ton. Calculating the total fishery revenue of the NB-ZS maritime space in 2018 after deducting the total cost of gain is $27.04 \times (1.63 - 0.8) = 22.45$ billion yuan. Substituting the formula of the income approach, we calculated the asset value of fishery resources in NB-ZS maritime space in 2018 as $P = \frac{22.45}{(1+6.6\%)} = 21.06$ billion yuan.

Table 4. Added value of marine fishery from 2013 to 2016.

	Value Added of Marine Fisheries	Growth Rate (esp. in Economics)	Average Growth Rate
2013	399.76	-	4.92%
2014	412.66	3.23%	
2015	431.74	4.62%	
2016	461.54	6.90%	

Unit: Billion yuan. Data Source: *China Marine Economic Statistics Yearbook—2017*.

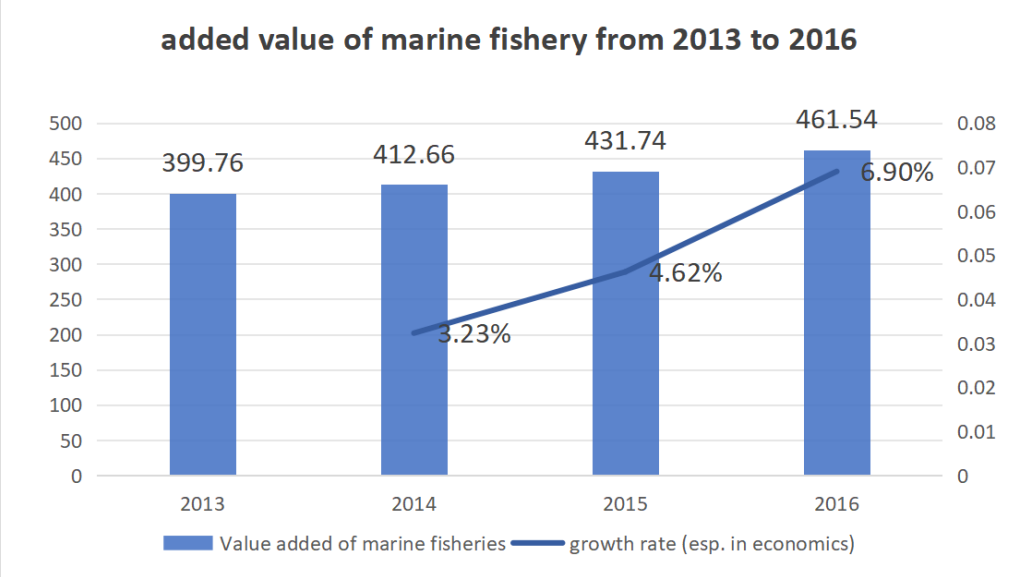

Figure 1. The added value of marine fishery from 2013 to 2016.

4.2.2. Accounting for the Asset Value of Port and Shipping Resources

Transportation use of the sea is one of the main functions of the NB-ZS maritime space, which is rich in coastline resources, of which the Zhoushan maritime space has 286.1 km of deep-water coastline, accounting for more than half of the province's total coastline. The unique geographical conditions determine that the NB-ZS maritime space has rich port resources and waterway resources. The NB-ZS Port Master Plan (2014–2030) shows that the NB-ZS maritime space has many excellent ports, among which the NB-ZS Port, which consists of Beilun, Yangshan and other major port areas, has outstanding economic benefits. Due to the lack of government statistics, the NB-ZS Port is the most representative, and at the same time, NB-ZS Port Co., Ltd. (Ningbo, China) is responsible for the management of navigation and freight transportation in the NB-ZS Port on behalf of the NB-ZS Port. Therefore, the study of this paper on the accounting of the value of the assets of the port and navigation resources in the NB-ZS maritime space is mainly based on the NB-ZS

Port, and the financial data of NB-ZS Port Co., Ltd. of the year 2018 are selected as the accounting basis.

We applied the income approach to account for the value of the developed and utilized port and navigation resource assets. In 2018, the NB-ZS Port realized a net profit of 3.207 billion yuan (Data Source: 2014–2018 Annual Reports of Ningbo Zhoushan Port Co., Ningbo, China), and in the same way, the risk-added rate of port and navigation resource assets, and the results of the calculation are shown in Table 5 as 5.39%, which means that the discount rate r = 1.68% + 5.39% = 7.07%. Furthermore, Figure 2 is cited to illustrate specific fluctuations in the added value of the marine transportation industry. Substituting into the formula of income method, the value of harbor and navigation resource assets in the NB-ZS maritime space in 2018 is obtained as $P = \frac{3.21}{(1+7.07\%)} = 2.99$ billion yuan.

Table 5. Added value of marine transportation industry from 2013 to 2016.

	Value Added of Marine Transportation	Growth Rate (esp. in Economics)	Average Growth Rate
2013	487.65	-	5.39%
2014	533.69	9.44%	
2015	564.11	5.70%	
2016	569.98	1.04%	

Unit: Billion yuan. Data Source: *China Marine Economic Statistics Yearbook—2017*.

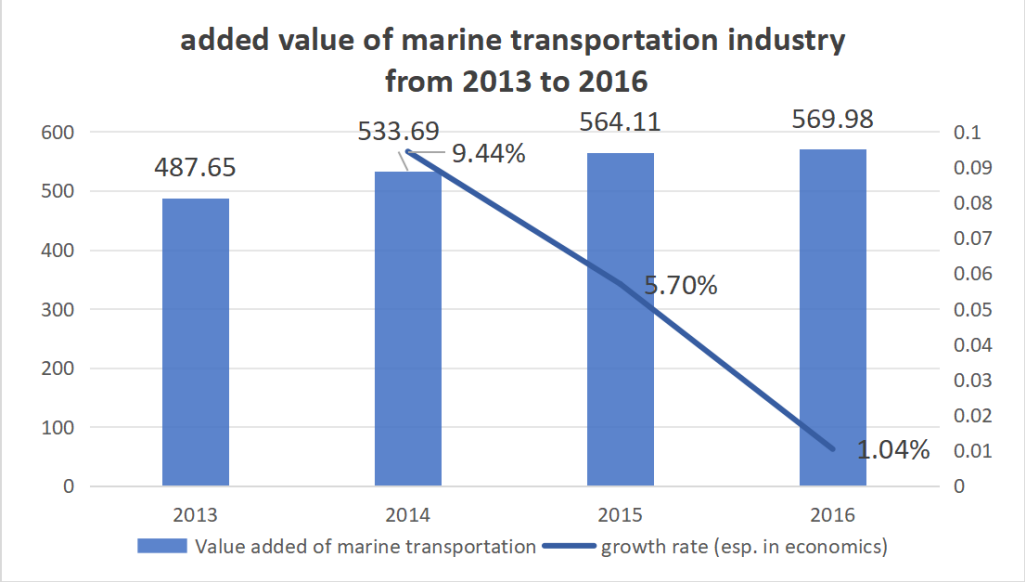

Figure 2. The added value of marine transportation industry from 2013 to 2016.

4.2.3. Accounting for the Asset Value of Tourism Resources

The NB-ZS maritime space received a total of 187 million domestic tourists in 2018, and the number of domestic tourists received rose year by year from 2014 to 2018 with a relatively stable growth rate.

The income approach is applied to account for the asset value of tourism resources in the NB-ZS maritime space in 2018. As shown in Table 6 and Figure 3, the value-added of the national coastal tourism industry in 2016 was about 1.24 trillion yuan. The national tourism revenue in the same year was 4.69 trillion yuan. The value-added rate of coastal tourism is calculated to be about 26.44% in 2018. Due to the difficulty of obtaining cost and other related data, Wu et al. (2008) used the value added of the marine transportation industry as the annual net income of the development of port site resources, and this paper draws on this method to calculate the annual net income of tourism resources in the absence of specific

statistical data on tourism costs, taxes and fees, etc. [18]. The rate of value added by the tourism industry in the NB-ZS maritime space in 2018 was 26.44%. Accordingly, the annual net profit of the tourism industry in the NB-ZS maritime space in 2018 was calculated as 294.79 × 26.44% = 77.94 billion yuan. We calculated the discount rate and risk-added rate in the same way. Based on the available yearbook data, we calculated the arithmetic average of the growth rate of value added of the coastal tourism industry from 2013 to 2016, and the result of the calculation is 16.74%, as shown in Table 6. Discount rate r = 1.68% + 16.74% = 18.42%; in this paper, we used the total tourism revenue instead of net income, substituting the formula to calculate the result as $P = \frac{77.94}{(1+18.42\%)} = 65.82$ billion yuan.

Table 6. Added value of coastal tourism from 2013 to 2016.

	Value Added of Coastal Tourism	Growth Rate (esp. in Economics)	Average Growth Rate
2013	783.97		16.74%
2014	975.28	24.40%	
2015	1088.06	11.56%	
2016	1243.28	14.27%	

Unit: Billion yuan. Data Source: *China Marine Economic Statistics Yearbook—2017*, National Tourism Revenue Data Source: 2016 China Tourism Statistical Bulletin [EB/OL]. http://travel.gog.cn/system/2017/11/10/016207023.shtml; accessed on 7 July 2020.

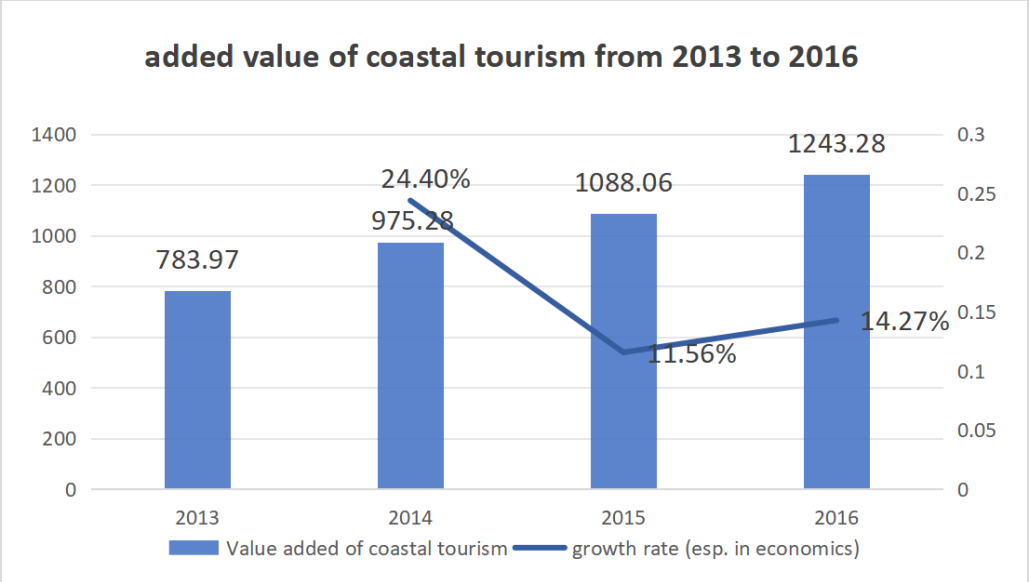

Figure 3. The added value of coastal tourism from 2013 to 2016.

4.3. Accounting for the Value of Liabilities for NB-ZS Marine Resources

The sources of pollutants in China's near-shore maritime space mainly include chemical oxygen demand, petroleum, cadmium, lead, etc. Combined with the values of fishery resource assets, tourism resource assets and harbor and navigation resource assets as previously accounted for, the value of liabilities is accounted for regarding the pollution that may be generated by these three types of economic activities. Similarly, the accounting of the value of liabilities for marine resources is also based on physical volume accounting.

The main pollutants in the sea outfalls of NB-ZS waters include nitrogen, phosphorus, chemical oxygen demand and other substances. Domestic sewage mainly contains nitrogen and phosphorus; according to the state council's "sewage charge levy management measures", the domestic sewage treatment of nitrogen costs 0.15 yuan/ton, the cost of treatment of phosphorus is 0.25 yuan/ton (Sewage Charge Collection Standards and Calculation

Methods [EB/OL]. https://wenku.baidu.com/view/8afc98caf505cc1755270722192e453610665b33.html; accessed on 14 July 2020), and the average of the two is 0.20 yuan/ton. The cost of treating chemical oxygen demand is 0.43 million yuan/ton. Based on the 2018 domestic sewage discharge of 685.08 million tons, the cost of domestic sewage treatment is calculated to be $137 million (*Data Source: China Ecological Environment Statistics Annual Report 2018*). A chemical oxygen demand (COD) discharge of 32,257 tons is calculated as a treatment cost of 139 million yuan. The total environmental protection investment capital in 2018 was 4.367 billion yuan, which was an increase of 17.82% compared with 2014, as shown in Table 7 and Figure 4.

Table 7. Investment in environmental protection in NB-ZS maritime space from 2014 to 2018.

	Ningbo Sub-Provincial City in Zhejiang	Zhoushan Prefecture-Level City in Zhejiang (Consisting Solely of Islands)	Add up the Total	Growth Rate (esp. in Economics)
2014	366,668	3990	370,658	
2015	444,073	2212	446,285	20.40%
2016	430,830	2019	432,849	−3.01%
2017	189,673	926	190,599	−55.97%
2018	433,758	2945	436,703	129.12%

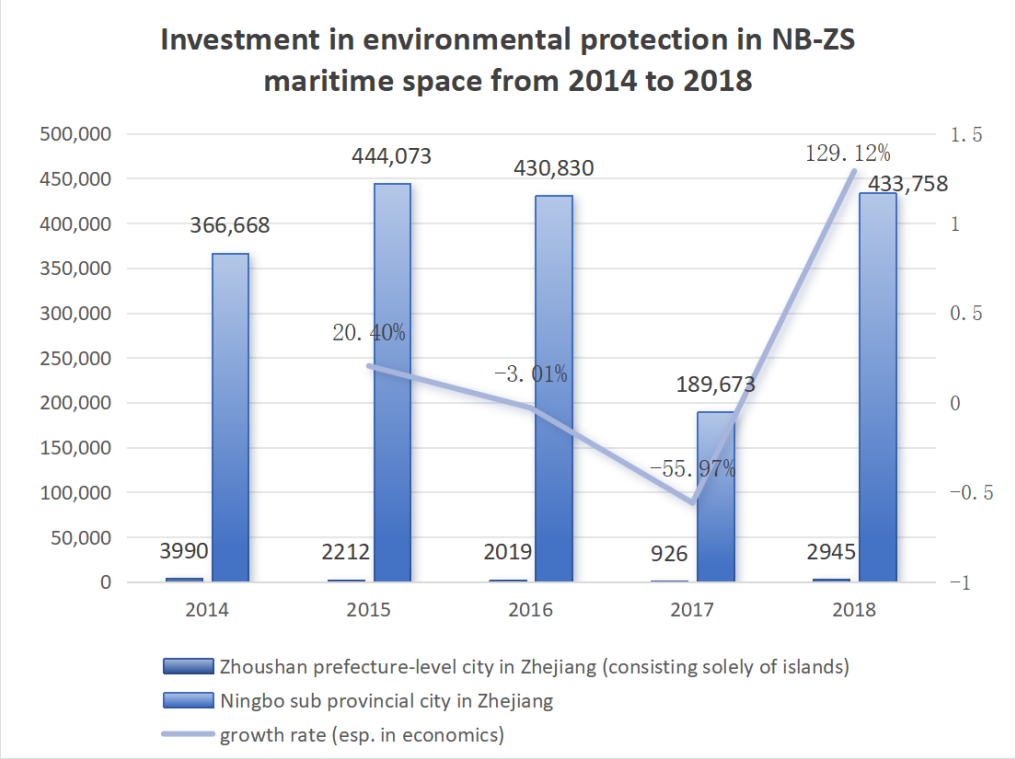

Figure 4. The investment in environmental protection in NB-ZS maritime space from 2014 to 2018.

According to this paper's definition of marine resource liabilities, its value includes user costs, pollution control and ecological compensation costs, which are limited by the availability of data. This paper shows the data of pollutants in agricultural and fishery zones, port and shipping zones and tourism zones, and it calculates that the pollution control cost is 4.367 billion yuan. Because 137 + 139 = 376 million yuan and the ecological compensation cost is 4.367 billion yuan according to the yearbook statistics, then the value of the liability of marine resources in 2018 is 137 + 139 + 4367 = 4643 million yuan.

4.4. Preparation of a Balance Sheet for the Resources of the NB-ZS Maritime Area

Based on the available data, this paper chooses 2018 as the research time and tries to compile a balance sheet of marine resources in NB-ZS. Due to technical limitations, the balance sheet of marine resources designed in this paper only involves the second-level classification of marine resource assets and liabilities, and the physical volume accounting is statistically derived after the third-level classification of marine resource assets and liabilities. Thus, this table only counts the value volume of marine resource assets and liabilities, and the calculation results are derived from the previous analysis of the value of fishery resource assets, harbor and navigation resource assets, and tourism resource assets of NB-ZS marine waters. Therefore, this table only counts the value of assets and liabilities of marine resources. The opening balance is the value volume of marine resources assets and liabilities in the previous year, i.e., 2017, which are calculated in the same way as in 2018. The results of the preparation of the balance sheet of marine resources in NB-ZS waters are shown in Table 8.

Table 8. Balance sheet of NB-ZS maritime space resources.

Marine Resource Assets	Opening Balance	Closing Balance	Liabilities and Ownership Interests in Marine Resources	Opening Balance	Closing Balance
Marine resource assets			Liabilities for marine resources		
Fishery resource assets	208.11	210.55	Pollution control and ecological compensation costs		
Port and Maritime Resources Assets	26.69	29.95	Pollution control costs	2.76	2.76
Tourism resource assets	563.21	658.17	Ecological compensation costs	19.06	43.67
			Total liabilities	21.82	46.43
			Total owners' equity	776.19	852.24
Total assets	798.01	898.67	Total liabilities and owners' equity	798.01	898.67

5. Conclusions and Recommendations

5.1. Conclusions

Marine resources are part of natural resources, but they are also important economic and strategic resources, and their value is increasingly emphasized in the process of social development. The accounting of marine resource assets can reflect their value, and the preparation of the balance sheet of marine resources can help to grasp the progress of the utilization of marine resources, and value changes. Therefore, this paper takes marine resource assets as the research object, builds a conceptual framework of accounting for marine resource assets, and designs a set of three-stage reporting systems of physical quantity and value, asset and liability, and balance sheet summary related to marine resources. This is intended to achieve the purpose of mastering marine resources and promoting the sustainable and healthy development of the marine economy.

First of all, this paper clarifies the concept of marine resource assets, defines the connotation of property rights of marine resource assets based on the accounting assumptions and accounting principles of marine resource assets and other basic content of the discussion, and clarifies the accounting elements of marine resource assets, category characteristics, and accounting equation content. Two points are summarized through the analysis: first, the accounting for marine resources assets follows the following equation: the closing stock of marine resources assets = the opening stock of marine resources assets + the increase in the current period—the decrease in the current period; second, the first-level accounting system of the balance sheet system of marine resources includes the physical volume accounting table and the value accounting table, and the accounting system of marine resources assets is used to grasp the current status of marine resources.

Secondly, the paper discusses the methods for assessing the value of marine resource assets, including four methods: the income method, the market method, the cost method and the hypothetical development method. It analyzes the value assessment methods applicable to different types of marine resource assets, and it measures the value of marine resource assets based on the value assessment methods. It can be found that different categories of marine resources assets are subject to different valuation methods, and for a category of marine resources assets with clear income, the income approach is a good choice for measurement.

Finally, based on the conceptual framework and value measurement for accounting for marine resource assets, we followed the balanced equation: Owners' equity of marine resources = Marine resource assets—Liability for marine resources. This paper constructs a three-level reporting system of the physical volume and value of marine resources, the asset and liability of marine resources, and the summary balance sheet of marine resources. It can be found that the balance sheet of marine resources is not only a table but also a comprehensive system reflecting the reserves and value changes in marine resources.

5.2. Policy Recommendations

Based on the summary and analysis of the content of the full text, this paper makes the following four recommendations:

Firstly, the property rights of marine resources assets should be clearly defined. The definition and clarification of property rights is the starting point for the preparation of a balance sheet for marine resources. In actual economic activities, it is important to clarify the relationship between ownership, use and management, coordinate the economic relations of all parties with an interest in the main body, improve the property rights system for marine resources assets, form a fair and reasonable market value, and promote the accurate accounting of marine resources assets. It has also promoted the system of paid use of marine resources and assets, established a mechanism for penalizing their use, improved the efficiency of the utilization of marine resources, and reduced the loss of marine resources and the destruction of the marine environment.

Secondly, marine resource assets should be categorized scientifically and reasonably. Classification is the way to assess the value of marine resources assets, and the setting of accounting accounts and the determination of the scope of accounting for marine resources assets are all based on the classification of marine resources assets. Comprehensive and scientific categorization can help the full coverage of the value assessment work so as not to miss any asset that needs to be accounted for and to ensure that the content of the balance sheet of marine resources is comprehensive and the information conveyed is effective. China is rich in marine resources and has a large population, and there is a strong regional nature, so given the differences between different regions, a thorough field investigation of marine resources, as well as a scientific and comprehensive subdivision of marine resources assets, formulation of a reasonable regulatory system, and prevention of waste of resources are all necessary.

Thirdly, a scientifically sound accounting system for marine resource assets should be designed. The accounting standards for marine resource assets should be standardized, and their use should be promoted throughout the country's maritime areas. Accounting for marine resource assets should include both physical and value accounting with value accounting based on physical accounting; accounting standards for marine resource assets should be formulated, and a matching and applicable system should be introduced.

Fourthly, a nationally unified information system on maritime resources should be established, and a balance sheet on maritime resources should be scientifically compiled. It should integrate information on maritime resources, improve the statistical survey system, update data promptly, and disclose unclassified information to prepare for the compilation of a balance sheet on maritime resources with data support and accounting. From the compilation of basic data statistics to the accounting of marine resources assets to the compilation of a balance sheet of marine resources, the work should be completed gradually

from the bottom up by departments at all levels with specific functional departments responsible for promoting the overall work and ensuring that the implementation of each link is in place, which is the only way to ensure that the balance sheet of marine resources can be announced regularly.

5.3. Reach Outlook

Due to the variety and complexity of marine resources and the high requirements of detection technology, the research content of this paper is still insufficient due to practical conditions, and the following two aspects need to be improved.

Firstly, concerning the measurement of marine resource assets, this paper utilizes the income method to conduct case studies of fishery resource assets, tourism resource assets, and port and navigation resource assets. Given the limited availability of data, other valuation methods have not been used for further comparative analysis, nor has accounting been carried out for all categories of marine resource assets. In general, the accounting methodology needs to be improved and the accounting content needs to be enriched. There is a need for more authoritative parameterization and price data to improve the accuracy of the accounting results. We will continue to explore more reasonable accounting methods, improve the accounting framework system, and enhance the reliability of the accounting results.

Secondly, the analysis of accounting and statement preparation for marine resource assets is based on the accounting principle of the accounting balance equation, thus constructing a three-level statement system for marine resource assets. However, as a kind of natural resource, the relevant research needs to be combined with environmental science to join the environmental quality of marine resources related research; for the measurement of resource assets, statistics need to be combined with more solid knowledge of statistics and economics and other disciplines to improve the physical volume of assets and liabilities of marine resources and the value of accounting. The content presented in the balance sheet of marine resources need to be more comprehensive and accurate as well. Therefore, the research on accounting and statement preparation of marine resources assets needs to include more disciplines, involve comprehensive and systematic analysis, show the results of multidisciplinary integration, and improve the system of the marine resources balance sheet.

Due to the long-term and stable nature of marine resources, this study mainly focuses on analyzing the relevant marine resources data in 2018, incorporating them into the research and analysis tables through precise measurement and scientific and reasonable accounting methods, revealing the development value of these marine resources and providing basic information for relevant departments. However, the relevant data on these resources will undergo certain dynamic changes over time, and more extensive and in-depth follow-up studies are still needed to more accurately assess the current status of these marine resources.

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