Journal of Environmental Management 248 (2019) 109232

Contents lists available at ScienceDirect

Journal of Environmental Management

journal homepage: www.elsevier.com/locate/jenvman

Research article

China's natural resources balance sheet from the perspective of government oversight: Based on the analysis of governance and accounting attributes

Malin Song[a], Shuai Zhu[a], Jing Wang[b], Shuhong Wang[c,d,*]

[a] School of Statistics and Applied Mathematics, Anhui University of Finance and Economics, Bengbu, Anhui 233030, PR China
[b] School of Management, Ocean University of China, Qingdao, 266100, PR China
[c] School of Economics, Ocean University of China, Qingdao, 266100, PR China
[d] Institute of Marine Development, Ocean University of China, Qingdao, 266100, PR China

ARTICLE INFO

Keywords:
Government oversight
Natural resources balance sheet
Environmental economic accounting
Property rights of natural resources

ABSTRACT

One of the top priorities of the Chinese government's oversight is to address the conflicts between economic growth and resource consumption and between economic development and ecological damage. In this regard, the advocacy and compilation of the natural resources balance sheet can boost the efficiency of the government's oversight and improve the quality of resource management. However, China's natural resources balance sheet is still at an exploratory stage, lacking the theoretical framework of balance sheet preparation, preparatory ideas, and a reporting system, which must be established urgently. First, the study states the purpose of compiling the natural resources balance sheet, and, subsequently, analyzes the theoretical basis, framework system, preparatory ideas, and sample sheet format, thereby offering theoretical and methodological support for its preparation. Moreover, the development, functions, deficits, and future development of the balance sheet are analyzed in the context of the Chinese system, which provides theoretical and methodological support for the preparation of the natural resources balance sheet and government oversight.

1. Introduction

The implementation of the reform and opening-up policy in 1978 has facilitated economic innovation, the introduction of foreign technologies, and an increase in capital and managerial experience, which, in turn, have accelerated the development of China's economy. After 40 years of rapid growth, China's GDP is ranked only second to the United States of America. With the rapid economic growth, the income level and consumption capacity of Chinese residents have grown progressively and the comprehensive national strength has increased, laying the economic foundation for the improvement of China's competence in the international market. Nevertheless, for a long time, China's economy has exhibited an extensive development pattern, featuring an economic developmental method that prioritizes “high investment, high consumption, and high pollution” and a political performance assessment that “considers GDP only,” which has boosted China's economic growth, despite its heavy price. Additionally, the rapid population growth has increased resource consumption, pollutant and household waste discharge, thereby leading to serious resource exhaustion and heavy environmental pollution. This has deepened the conflicts between human beings and nature, damaged the coordinated development between economic growth and environmental protection, and heavily restrained the sustainable development of China's economy. At present, China's natural resources imbalance between supply and demand is prominent and obvious, but the efficiency of the resource use is low. Let us consider the relationships between energy consumption and GDP growth as an example. According to the data calculation of *Statistical Communique on National Economy and Social Development in 2016*, China's GDP energy consumption comprised 0.68 ton of standard coal/CNY 10,000 (China's GDP energy consumption per unit comprised 3.7 ton of standard coal/USD 10,000, according to the price and exchange rate of dollars in 2015) in 2016, which is 1.4 times larger than the average world energy consumption levels in 2015 and 2.1 times larger than that of the average level of developed countries. Today, China's economic security and the lives of its citizens are severely threatened by resource consumption and environmental pollution. Besides, as resource imports are expanding, the foreign-trade dependence of our country's economic growth is increasing. Additionally, haze and water pollution caused by environmental pollution is not only reducing people's quality of life but is also causing considerable economic loss. This scenario clearly shows that the present resource consumption and ecological damage are significantly affecting China's

* Corresponding author. School of Economics, Ocean University of China, Qingdao, 266100, PR China.
E-mail address: shwang01@sina.com (S. Wang).

https://doi.org/10.1016/j.jenvman.2019.07.003
Received 17 December 2018; Received in revised form 3 May 2019; Accepted 3 July 2019

national interest and people's livelihood.

In this context, the Chinese government has started to guide and implement resource protection and environmental governance operation in many aspects. For instance, the Environment Protection Law, the most stringent law in history, has been published, special financial subsidies for environmental protection have been set up, enterprises are being encouraged to carry out technical innovation to increase the resource utilization efficiency, media supervision has been strengthened, and information disclosure has increased. These initiatives have facilitated legal, financial, public opinion, and technology support for increasing resource utilization efficiency and alleviating environmental pollution (Leiter et al., 2011; Chiu and Sharfman, 2011; Tang and Tang, 2013; Yusuf et al., 2017; Song et al., 2018; Wang et al., 2018). However, these specific governance measures are unable to "resolve existing problems and eliminate the root causes."

In fact, China's prominent conflicts among economic growth, resource consumption, and environmental pollution can be attributed to the political strategy of valuing only GDP and the development philosophy of pursuing economic growth based on political performance standards. In order to permanently resolve these conflicts, it would be essential to help the decision-making departments and the public form a positive economic development idea and raise their awareness regarding environmental protection. In this context, according to the judgment of the Third Plenary Session of the 18th Central Committee of the Communist Party of China on economic development, environmental protection, and achievement assessment of leaders, Chinese government has decided to prepare a natural resources balance sheet and set up a pilot scheme. As a part of its scheme, it has selected Huzhou in Zhejiang province, Yan' an in Shanxi province, Hulunbeier in inner Mongolia autonomous region, and other regions to guide and restrain the decision-making departments to ensure that the latter can transform their perspectives on economic development. This scheme also aims to raise the latter's awareness of resource management and environmental protection.

It must be pointed out that the natural resource balances sheet is prepared and designed for the off-office auditing of natural resources by the leaders. It not only serves as a critical means of governmental oversight but also provides information and system support for natural resources management and environmental protection in China. However, the preparation of the natural resources balance sheet is a complicated task. First, as a balance sheet, it needs to own accounting attributes; however, the identification of various natural resource assets and liabilities remains highly controversial. Second, from the perspective of accounting measurement and accounting, the factors put into the natural resources balance sheet should have economic value; however, owing to the current marketing and technological levels, the value of most natural resources is hard to determine. Finally, clear property right ownership forms the premise for accounting and preparation of the natural resource balance sheet. However, in the context of China's property rights system, the determination of the boundary of natural resource assets' property rights remains to be properly ascertained by the system. Given the situation, the preparation and application of China's natural resources balance sheet have been explored and studied from the perspective of governance and accounting attributes in the current study.

2. Literature review

The "natural resources balance sheet" serves as a novel concept developed by the Chinese government in 2013 with distinctive Chinese characteristics. Chinese scholars studied the balance sheet in 2014 for the first time, while few foreign scholars have studied the natural resources balance sheet. Studies focusing primarily on the "natural resources balance sheet" are sparse because the related domestic and foreign studies are merely at the exploratory stage. Based on the review of the main findings in the existing literature, literature arrangement and analysis are conducted for the following three aspects: relationships between the economy and environment, the system of national accounts (SNA), the system of environmental-economic accounting (SEEA) and natural resources accounting, and the natural resources balance sheet.

2.1. Relationships between the economy and environment

Studies on the relationships between economic growth and environmental and ecological damage significantly influence the direction of the economic development theory and economic decisions. It is generally acknowledged that the studies on the relationships between economic development and environmental pollution start with an analysis of the "inverted U-shaped" relationships between resident income level and environmental pollution. On this basis, several scholars utilize different mathematical models to demonstrate the "inverted U-shaped" relationships between the two (Andreoni and Levinson, 2001; Hartman and Kwon, 2005; Brock and Taylor, 2010), laying the theoretical foundation for follow-up research. Subsequent studies perform empirical tests on the theoretical result by using experience and evidence and find "inverted U-shaped" relationships between pollutant discharge and resident income (Selden and Song, 1994; Cole et al., 1997; Hilton and Levinson, 1998). However, the "inverted U-shaped" relationships are influenced by economic scale, industrial structure, and technical progress (Brock and Taylor, 2005; Song et al., 2018; Wang et al., 2018). Ficko and Bončina (2019) reveal that, as countries develop, environmental protection becomes less dependent on economic development. The environmental concern decreases even at high levels of economic development. For China, as environmental pollution increasingly threatening social and economic development, scholars are examining how to enhance environmental governance and ecological protection. These objectives are considered in the perspective of industrial restructuring, green technology progress, environmental regulation, and resource utilization efficiency to facilitate coordinated development of the environment and economy (He and Wang, 2012; Song et al., 2018; Wang and Song, 2017; Wang et al., 2018).

2.2. SNA, SEEA, and natural resources accounting

Some scholars in the environmental accounting field hold the view that natural resources accounting aims to revise the traditional SNA. Under the SNA, accounting focuses on GDP and its growth rate. Additionally, the accounting system, influenced by resource bias and environmental conditions, tends to generate "false economic prosperity" and "hollow" resources (Hartwick, 1990). To resolve the serious issues of resource consumption and environmental pollution, some scholars and organizations actively explored resource accounting problems and formed a series of representative index and accounting systems. In the 1970s, the American Massachusetts Institute of Technology introduced a point of view that suggested measuring the environmental changes as a consequence of economic growth by the ecological requisite index (ERI). Nordhaus and Tobin (1972) constructed the index of net economic welfare (NEW) to measure resources and environment; in the late 1980s, Repetoo and Magrath (1989) and Daly and Cobb (1989), respectively, put forward net domestic product (NDP) and the index of sustainable economic welfare (ISEW) for measuring the actual economic growth rate. Barbier (2013) proposes that if ecosystems are also considered capital assets, then it will be necessary to modify NDP to include natural and human capital as well. On this basis, through the efforts made by the environmental and economic organizations across the globe, the World Conference on Environment and Development and the United Nations finally proposed a comprehensive economic and environmental accounting system in the 1990s, which brings environmental accounting into the national economic calculation accounts. Finally, the SEEA-1993 was formed, bringing the natural resources accounts and adjusted national economic calculation accounts into the

same framework and creatively offering the calculation method (Holub et al., 1999) for ecological domestic product (EDP), which allows natural resource accounting with the method. With the development of the times and technological progress, the SEEA has been continuously improved upon to meet current resource and environmental accounting demands. In the 21st century, the SEEA 2012 (UN and UN, 2014) was eventually formed after being constantly improved upon and revised. As per Baskaran et al. (2012), some organizations are establishing performance measurement systems to benchmark their sustainability performance; Kumar et al. (2015) propose to construct the sustainability reporting system, that is, public reports that can be used by companies to provide certain information about economic, environmental and social dimensions. Dubey et al. (2017) develop and test sustainability benchmarking by using external pressures, organizational culture, and sustainable performance measurement systems. Accordingly, under the guidance of the sustainable development philosophy, some countries have accounted for the natural resources successively. For example, the statistics bureau in Norway prepared the natural resources calculation accounts on the basis of the physical measure method, while Finland set up the framework system of forest resources accounting. Additionally, Zimbabwe used the natural resources accounts to account for its natural resources; India measured and calculated its forest resources reserve in the national economic accounting process. Pulselli et al. (2008) evaluate the ecology and economy of integrated systems using energy synthesis in order to complement economic accounting. Uganda measured and calculated its forest resources in the national economic accounting process (Masiga et al., 2013); accounting and management of its domestic natural resources was conducted on the basis of the SEEA in Namibia (Morton et al., 2016; Zhang et al., 2017). These studies have exerted positive impacts on the changing economic development idea and environmental and ecological conservation.

Compared to the major developed countries, China's natural resources accounting theory and practice studies appeared late. However, recently, under the Chinese government, China's natural resources accounting has developed rapidly. This can be attributed to the country's knowledge on the related foreign theoretical systems and practice experience. Zhang et al. (2010) argue that the presence of the natural resources accounts helps to effectively recognize the natural resources value and improves the effectiveness of resources management and protection policies. Dong et al. (2016) study the promoting effect on the economic development of the ecological system and the like. In general, China's studies on natural resource classification, account opening and calculation, and economic results also concentrate on the frameworks of the SNA and SEEA, which practically align with the studies on natural resources accounting in European countries and the United States of America, at present.

2.3. The natural resources balance sheet

Most Chinese scholars emphasize the development and preparation of the natural resources balance sheet. As aforementioned, the natural resources balance sheet is a study theme with prominent Chinese characteristics. Since the introduction of the “natural resources balance sheet” concept, scholars have conducted a series of studies on natural resources balance sheet's meaning and functions, components, preparation principles, calculation attributes, and relationships between the form paradigm and articulation of the natural resources balance sheet. Regarding the meaning and functions, some scholars indicate that the “natural resources balance sheet” belongs to “financial statements” or “management statements” (Hu et al., 2015). The components, presence, and accounting method of the “natural resources balance sheet” are the key points and challenges of the study (Hu et al., 2015). When it comes to preparatory principles and accounting attributes, taking the property rights and valuation of the natural resources into consideration, the scholars emphasized addressing the problems of determining the sheet introduction range and measurement units of the resources (Jordan et al., 2010). As for the relationships between form paradigm and articulation, as it is a “balance sheet,” there are mixed findings on whether the “accounting balance principle” should be followed and double accounts adopted.

2.4. Shortcoming and contribution

There still exist shortcomings in the literature. The academic studies represented by the United States of America are limited to empirical research, mostly studying the economic consequences of environmental matters and related information disclosure from the economic or financial perspective. These studies rarely discuss the value measurement of environmental assets in the national accounting system from the accounting perspective (Al-Tuwaijri et al., 2004; Jose and Lee, 2007). In China, discussion on the theme of relevant studies frequently focuses on a specific aspect, and overall studies on the basic structure and logical framework of the “natural resources balance sheet” are not conducted because China's studies on the “natural resources balance sheet” are still at an exploratory stage, which also intensifies the differences in studies to a certain degree. Additionally, the current research on environmental accounting mainly focuses on the micro-level of enterprises and less on the macro-level of government.

This study aims to investigate the key points such as its compilation premise, measurement principle, accounting scope, constituting elements, and statement format based on the theoretical aspects of the natural balance sheet. We concentrate on this issue because natural resources accounting is an important part of the national balance sheet and a prerequisite for the preparation of the national balance sheet. It can fully reflect the government's performance regarding the possession, use, maintenance, and management of various natural resources, which is beneficial for the construction of ecological civilization. Moreover, it can contribute toward upgrading the national governance system and governance capacity.

3. Theoretical foundation of natural resources balance sheet

The compilation of the natural resources balance sheet was initiated and promoted by the Chinese government, and the aim to explore and compile the balance sheet is explicit. On the one hand, through the compilation of the natural resources balance sheet, the Chinese government would possess relatively precise and reliable information about the changes in resources and environment. In this way, the government will be able to provide a reference for evaluating and auditing leaders' performance. Thus, for the Chinese government, the natural resources balance sheet can be used for management and supervision. On the other hand, this balance sheet would enable the government to conduct a comprehensive and systematic accounting of the size (stock) and changes (flow and quality) of resources to get a clear picture of the environmental condition and understand the bottom line in order to facilitate the formulation of realistic policies and strategies. It can be seen that the natural resources balance sheet is the embodiment of the Chinese government's idea of economic development and governance; the process of compiling and applying this sheet depicts the process of integrating the national account system with the environmental—economic system.

According to the motivation and objective of this compilation, the natural resources balance sheet covers a wide range and field with an interdisciplinary character. The theoretical framework of the research includes the related theoretical basis of economics, environmental science, and accounting (See Fig. 1).

3.1. Sustainable development theory

The sustainable development theory has been gaining acceptance at a rapid pace in academia and practice circles due to an increasing

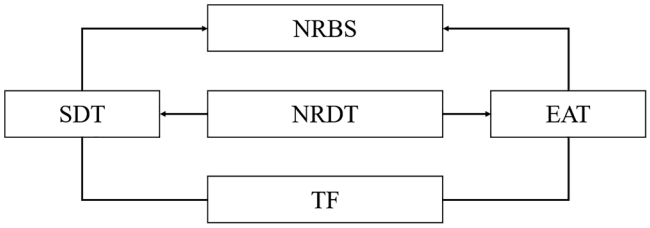

Fig. 1. Theoretical foundation of natural resource balance sheet. *Notes.* NRBS: Natural Resources Balance Sheet; SDT: Sustainable Development Theory; NRDT: Natural Resources Property Theory; EAT: Environmental Accounting Theory; TF: Theoretical Foundation.

awareness of population issues and the economic and environmental system. To maintain the productive and renewable capability of resources and the environmental system, the scholars in the field conducted in-depth research without damaging the basis of resources and ecological balance. Hartwick (1990) analyzes the issues pertaining to the calculation of environmental assets in national accounts and stated that economic growth can be measured accurately only when natural resources consumption is deducted from GDP. Hung (1993) rectifies Hartwick (1990) view, building the net national product model (net national product, NNP) under an uncertain condition. However, Harris and Fraser (2002) formulate the view on the disclosure of government policies and welfare information and provide suggestions for improving the calculation of natural resources. This view suggests that wealth is the correct basis for ascertaining the sustainability of development paths (Dasgupta, 2009). Following the approach developed by Dasgupta (2009), which was further elaborated by Arrow et al. (2012), Barbier (2013) explores the methodology to include ecosystem services in a wealth accounting framework. The approach requires recognizing ecosystems as a special component of natural or ecological capital. With the announcement of SNA2008 and SEEA 2012, some scholars started estimating the value of natural resources from the perspective of sustainable development. Obst and Vardon (2017) discussed the problem with estimating the value of the damage of natural resources and the degeneration of the ecological system and indicated that value estimation could provide data support and practical reference for governmental strategy-making and sustainability evaluation. This will provide the requisite environmental information for the national account and contribute toward making the strategy more scientific and the evaluation more accurate. Banerjee et al. (2018) find that constructing an economic and environmental calculation system by integrating the economy with the environment is effective for evaluating and predicting the potential business and environmental influence generated through the implementation of the economic strategy. The development of the sustainable theory promotes studies on the estimation of natural resources, technical standards, and evaluation rules; it also lays a basis for the compilation of the sheet and provides direction.

3.2. Environmental accounting theory

Regarding the study on environmental resources, environmental accounting theory is another important branch. On the basis of the economic character of resources, environmental accounting theory stresses the scarcity, finiteness, and value of the resources. Additionally, it confirms, measures, and manages the price and value of resources from the perspective of accounting, providing useful information for decision-making (Galos et al., 2015). Drawing on accounting elements and basic principles, environmental accounting regards the compensation and recovery costs of resources consumption and ecological destruction as environmental liabilities and costs (Tutore, 2010), providing a new perspective for natural resources accounting and management. For example, Gray and Bebbington (2001) introduce accounting elements, account systems, accounting principles, and measurement attributes into environmental asset accounting; Schreyer and Obst (2015) introduce a net present value method when measuring the value of environmental assets. The introduction of relevant accounting principles provides a basis for the accounting of environmental assets, as per which “relevant loan or borrowing must be balanced” and double-entry bookkeeping must be promptly generated. This provides direct support for the identification and measurement of the rights of the natural resource assets, liabilities, and owners' equity. The current development trend of the environmental accounting theory shows that the main body of its theoretical research is gradually shifting from the micro-subject represented by enterprises to the macro-subjects represented by the government. The theoretical research has begun to focus on the natural resources and economic environment. The study measured the consumption of the country's natural resources, based on its physical and value levels, and is therefore also referred to as “natural resources accounting” (Li, 2001; Mia, 2005).

3.3. Theory of natural resources property rights

From the perspective of accounting, the clear attribution of property rights is based on the premise of accounting entity determination, factor accounting, and financial statement preparation. In China, a country dominated by public ownership, the property rights of natural resources have distinct institutional and legal characteristics. According to the constitution of the People's Republic of China (2018), China's natural resources are owned by the state (owned collectively by all individuals). Demsetz (1974) points out that the property rights of natural resources are rooted in their scarcity, and the key feature of natural resources property rights is their exclusivity. However, in China's institutional context, natural resources are usually managed by the government, given that the state is usually a virtual subject of rights. This to problems such as unclear boundaries of natural resources property rights, unclear rights and responsibilities, ineffective supervision, and serious damage and loss (Thwaites et al., 1998; Borissov and Pakhnin, 2018). Therefore, *The Decision of the Central Committee of the Communist Party of China on Some Major Issues of Comprehensively Deepening Reform* puts forward the assertions of “improving the property rights and use management systems of natural resources assets” and “improving the national natural resources assets management system and uniformly exercising the responsibility as owners of natural resources assets.” This conclusion provides institutional and policy support for perfecting the natural resources property rights system and the formulating the natural resources balance sheet in China.

It is important to clarify that China's concept of compiling the natural resources balance sheet has been adapted from SNA and SEEA. The natural resources balance sheet particularly adopts or refers to the following elements and subject classification of the SNA and SEEA account systems: classification basis, statistics account, and calculation target. Based on this adaptation, it can be stated that the natural resources balance sheet is also capable of calculating the stock and utilization of different types of natural resources as the SEEA. Besides, consistent with the objective of the SEEA, the natural resources balance sheet is designed and prepared to reflect the impacts of economic development on environmental and resource factors, with a view to harmonizing the relationship between the economy and the environment. However, in the context of the Chinese government's emphasis on its governance and regulatory attributes, there are still some special points that must be focused in the design and compilation philosophy of the natural resources balance sheet. First, in addition to the calculation of resource stock and flow to estimate the “economic foundation,” the Chinese government puts forward and advocates that the natural resources balance sheet should have a special purpose, namely, to enable leaders to conduct off-office auditing. Under the current objective orientation, by depending entirely on the supply and utilization conditions of natural resources, the balance sheet may fail to monitor the leaders' fulfillment of responsibilities and duties. Therefore, the original

SEEA account system and its articulation must be adjusted to a certain extent to reflect the equivalence of "rights" and "responsibilities" in an effective manner. Second, unlike the SEEA system, which includes SEEA CF and SEEA EEA, the compilation of China's natural resources balance sheet has not yet broken through the category of resource and environment. Thus, it is still quite different from the EEA, an experimental account system that considers ecosystem as an accounting concept as well as a category (La Notte et al., 2019). Accordingly, its estimation of the ecological environment loss may be closer to the estimation on resource consumption and utilization efficiency, and would not include the degradation of the ecological system. Third, although the United Nations and other international organizations published the handbook Experimental Ecosystem Accounting (EEA) based on the SEEA framework in 2014, as far as China is concerned, the ecological system accounting, which is standardized and can be integrated with SNA and SEEA, is still under experimentation, that is, it is not operable in practice. Finally, from the perspective of off-office auditing, equal responsibilities must be allotted to check the wastage and degradation of natural resources. This requires accounting for the supply and utilization of natural resources as well as clarifying the responsibility subject. In other words, the compilation of the natural resource balance sheet should have clear responsibility orientation and function of governance, which would distinguish the natural resources balance sheet advocated by the Chinese government from that of the SEEA.

To sum up, the design and compilation of the natural resource balance sheet advocated by the Chinese government is not only adapted from SNA and SEEA, but it also has following characteristics. On the one hand, the compilation of natural resources balance sheet no longer fully follows the SEEA measurement method but uses accounting identities for reference. On the other hand, the special function of off-office auditing requires clearly defining the subject of responsibility in the compilation, the purpose of which is to achieve the coordinated development of economy and environment (Ogilvy et al., 2018). Therefore, the design and compilation of the natural resources balance sheet are not only reflected in the statistics and calculation of resource consumption, but also in the governance function, which can promote the rational consumption of resources and achieve sustainable economic development (Ogilvy et al., 2018). Based on this conclusion, this study draws on the theories of sustainable development and environmental accounting.

4. Analysis of the compilation of natural resources balance sheet

The balance sheet of natural resources should have accounting and management attributes, meet the principle for compiling the accounting statement, and have management and supervisory functions. Just as the SNA and SEEA are linked, the natural resources balance sheet is not independent; it is linked to the natural resource accounts. Since the balance sheet of natural resources reflects the situation of natural resources at a certain point in a specific region, it is expected to support resources management and economic decision-making. Therefore, the preparation of the balance sheet of natural resources should not only consider the accounting properties of the "balance sheet" itself but also ensure that the preparation of statements is rooted in the economic environment and institutional background of the main body and users involved in the preparation.

It should be pointed out that, unlike the traditional enterprise balance sheet, the responsibility subject of the natural resources balance sheet is not a microscopic enterprise but a macro subject. In terms of taking responsibility, Ogilvy et al. (2018) pointed out that accounting could play a role in reversing ecological degradation, which otherwise would incur expenses and become an economic burden for the subject of responsibility. Under the accounting principle of equilibrium, the liabilities of ecosystem degradation would lead to the reduction of net assets. Therefore, the application of accounting standards and framework can enable the responsibility subjects, such as governments and the state, to visualize the cost. It also fits with the off-office auditing function of the natural resources balance sheet. La Notte et al. (2019) further clarify the calculation account of the ecosystem and that of the natural resource assets; this implies that the natural resources balance sheet is not only different from the calculation account of the ecosystem but also different from the traditional balance sheets of enterprises. The responsibility subject of the natural resources balance sheet is more macroscopic, and the balance sheet differs from the ecosystem accounts.

4.1. Connotation and conception

4.1.1. Analysis of the relationship between the natural resources account and the natural resources balance sheet

The natural resources account was established in the late 1980s. After the introduction of SEEA-1993, the account was linked with the traditional national economic accounting system and gradually integrated with environmental and economic information. The natural resources accounting system's account considers natural resources as an accounting object and comprehensively uses physical and value accounting to reflect the natural resources stock and its changes, checking the condition of the utilization of natural resources during the process of economic development. The balance sheet of natural resources is calculated on the basis of the accounting identity, measuring the stock quantity at a certain point. Moreover, the natural resources account forms the basis for formulating and measuring the balance sheet (UN and UN, 2014). However, different from the accounting purpose of the natural resources account, the balance sheet of natural resources reflects the environmental quality and ecological changes after considering the relationship between the balance of assets and liabilities. The relationship between the two parts is shown in Fig. 2.

4.1.2. Analysis of connotation

Chinese scholars mainly discussed the connotation of the natural resources balance sheet based on the following two basic concepts: "natural resources" and "balance sheet." From the perspective of accounting, some scholars believed that the compilation of the sheet should emphasize the "asset = debt + owner's equity" accounting balance thought to reflect the stock condition of natural resources of the subject of liability. Some scholars understand it from the perspective of SNA and SEEA and believe that the emphasis of the compilation and measurement should be on the stock and flow of natural resources (UN and UN, 2014). Scholars also believe that the balance sheet compilation of natural resources should focus on the confirmation of the subject of responsibility because it is the premise of asset measurement (Collis et al., 2010; Schreyer and Obst, 2015). However, although the understanding of the connotation of the natural resources balance sheet is different, it is generally accepted that it is a static report reflecting the stock, which is conducive to strengthening resources and environmental management.

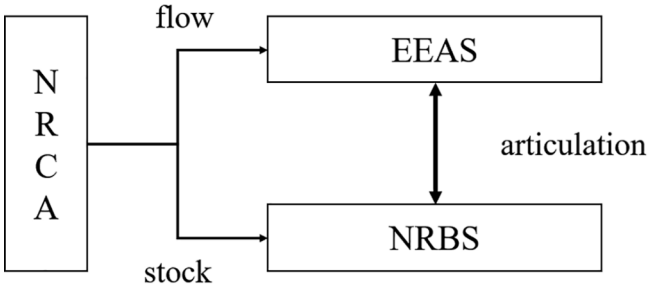

Fig. 2. Relationship between natural resources balance sheet and natural resources calculation account. *Notes.* NRCA: Natural Resource Calculating Account; EEAS: Environmental and Economic Accounting System; NRBS: Natural Resource Balance Sheet.

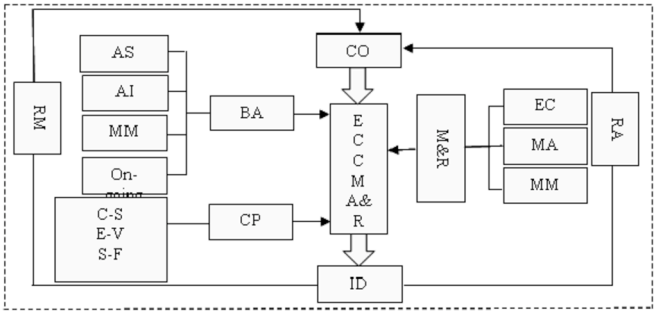

Fig. 3. Main frame of the natural resources balance sheet. *Notes.* RM: Resources management; AS: Accounting Subject; AI: Accounting Installment; MM: Monetary Measurement; C-S: Classify and Synthesize; E-V: Entity and Value; S-F: Stock and flow; BA: Basic Assumption; CP: Compilation Principle; CO: Compilation Objective; E: Element; C: Classification; C: Confirmation; M: Measurement; A&R: Arrange and Report; ID: Information Disclosure; M&R: Measurement and Report; EC: Element Confirmation; MA: Measurement Attribute; MM: Measurement Means; RA: Resignation Audit.

4.2. Main frame

As accounting theories and methods are the foundation of its existence (Mia, 2005; Jordan et al., 2010), the preparation process of a natural resources balance sheet also needs to comply with basic accounting assumptions. The recognition and measurement of accounting elements involve accounting recognition principles and measurement methods, and the construction of the logical relationships of statements cannot be separated from the guidelines of the accounting theory. Considering the purpose of users of the natural resources balance sheet, this study, which starts with the goal of statement preparation and, subsequently, combines it with basic accounting theory, establishes the main framework for the balance sheet natural resources development (see Fig. 3).

4.2.1. Compilation Objective and analysis of the premise

The objective and motivation of the compilation of the sheet mainly include the following two parts. The first part focuses on improving the auditing of retired leaders to maintain a balance between economic development and ecology. The second part focuses on supporting the resources management and economic decision-making with data. The compilation aims to ensure that, at all levels, the Chinese government's employees compile and use natural resources assets and liabilities. Moreover, the complexity of the elements and objects contained in the balance sheet of natural resources requires government workers at all levels and departments (bureau of statistics, national audit office, and the ministry of finance, among others) to cooperate with one another to gather the corresponding statement data.

At the same time, the development of the state should not deviate from the four basic assumptions of accounting entity, accounting stage, monetary measurement, and sustainable operation. The assumption of accounting subject is put forward, in essence, to determine the subject of responsibility, while the assumptions of accounting stage and continuous operation provide more preconditions for accounting and information disclosure. Additionally, the assumption of monetary measurement provides a unified scale for accounting and improves the comparability of accounting information (Collis et al., 2010). However, the liability subject of natural resources of the balance sheet has overcome the limitation of enterprises and economic organizations, thereby making the balance sheet a part of the government domain. From the aspect of property rights, the microscopic main body of the accounting elements of recognition and measurement standards posed a challenge to the existing accounting basic assumption, accounting theory innovation, and reconstruction. This factor negatively impacted the balance sheet preparation. Correspondingly, the estimation of the traditional natural balance sheet is completely based on value; however, in case of the sheet, considering the current condition of natural resources (classified management, multi-leaders management, and hierarchy management) and the evaluation technique in China, it is unrealistic to measure the natural resources by the value (Mia, 2005; Schreyer and Obst, 2015). Therefore, drawing on the suggestions of relevant scholars, it is believed that the balance sheet of natural resources should follow the compilation principle of "classification before synthesis, the physical value before value, and stock before the flow." Additionally, the purpose of the compilation of natural resources sheet shows that the underlying assumption of accounting calculation and information disclosure matches with the assumption of installment accounting and continuous operation.

In the traditional balance sheet, explicit ownership is the premise for accounting elements' confirmation and measurement. Under the condition of China's current property system, natural resources are owned by all people or the community. All the governmental levels serve as acting managers and supervisors. Therefore, data collection and resource management can be facilitated by all the governmental levels (Bramlett, 2010). Additionally, the classification of natural resources varies; different kinds of natural resources are managed or joint-managed by different departments. For example, land resources, water resources, and forest resources are, respectively, managed by the Ministry of Land and Resources, Water Department, forest department, and marine department. Meanwhile, the water resources can be managed jointly by the water department, the environmental protection department, and the agriculture department. Dispersed liability subjects are not good for the classified management of natural resources; this is because multi-leader management may lead to a loss of responsibility and management unavailability. According to the delegation agency theory, agents have self-interested motives. In the absence of effective client supervision, the agent may be induced to indulge in "moral risk" behaviors based on individual private interests (Jensen and Meckling, 1976). In China, the collective ownership of natural resources led to the phenomenon of "owner absence." The state is the virtual subject of rights; this leads to a lack of motivation and supervision ability for the acting agencies at all governmental levels. Subsequently, it cannot guarantee the efficient management of the government. Hence, the key as well as difficult areas for the compilation of the sheet are the confirmation of the liability subject and the ownership of the natural resource. Hence, under the presupposition that would actively improve the property system, the confirmation of the liability subject and its rights and responsibilities can facilitate the advancement of the exploration and application of the natural resources balance sheet.

Form the above-analysis, it can be seen that the compilation of natural resources balance sheet must focus on innovating the accounting and property theories. As stated above, the compilation conforms to two basic accounting assumptions—accounting installment and continuous operation. These assumptions are the reflection of the accounting attribute and feature. Based on the theory behind China's basic economic system, the property-ownership of natural resources and entity attribute challenge two basic assumptions, which are accounting subject and the measurement of value. However, it not only requires the micro-perspective of the subject of accounting theory and entity to adopt the macro-perspective, but it also requires the coordination of accounting theory and property theory to disregard the principle of "people only care about their staff." This approach aims to strengthen the interdisciplinary study of economy, laws, and accountancy. It also aims to provide a creative solution for confirming the lability subject of natural resources balance sheet and for demarcating ownership, usufruct, and the distribution right.

4.2.2. The analysis of compilation principle

It can be seen from Fig. 3 that "putting classification of natural resources before the summary," "calculating the entity before calculating

the value," and "calculating the stock of the resource before calculating its flow" are the three principles required to draft a natural resources balance sheet. These principles are obviously different from those required for drafting a traditional balance sheet featuring unified subjects, which calculate value and stock reporting. A mature financial statement includes the balance sheet, cash flow statement, and profit statement; each of these three basic statements plays a due and complementary part. This financial statement also analyzes the financial status, operating status, and achievements from the natural resources flow and stock, constituting a multidimensional accountant information system (Collis et al., 2010). Since the drafting of the natural resources balance sheet is still at an exploratory stage, its subject setting, calculating methods, and information reporting are relatively uncertain and divergent. In contrast, the content and form of the accountant balance sheet are quite consistent. As a result, it is hard to form an integral statement system to reflect both the stock and flow of the natural resources. Owing to its macroscopic characteristic in geographical distribution, diversity, and management hierarchy, it is unpractical and infeasible to aggregate the stock of the natural resources in general (Mia, 2005; Schreyer and Obst, 2015). Therefore, it is correct to follow the principle of "putting the classification of natural resources before the summary." For example, the focus must be to use the account setting system of the balance sheet and, subsequently, classify the natural resources species into a general account and a detailed account to calculate and aggregate different types of natural resources.

For the record, this study believes that a clear classification of natural resources' species and their subclasses and the clarification of the management party form the bases of the compilation principle. Taking the woodland resource as an example, it is hard to define whether it belongs to the land resource or forest resource. The Chinese Woodland Development Report issued by the Bureau of National Forestry and Grassland in 2017 considers the woodland resource as a forest resource, but The Communique of the Statistics of National Land, Mineral and Marine Resources issued in 2017 by the Ministry of Land and Resources views it as a part of the land resource. The statistics of the woodland resource can be interpreted erroneously and incompletely and calculated repetitively. This is because the natural resources are unevenly divided and managed by many authorities. In order to overcome this problem, it would be essential for the Chinese government to formulate a unified system for dividing natural resources and clarifying the species of natural resources, the subclass of each resource, and the authority in charge. In other words, the government must explore how to establish an integrated system, clear classification, and specific responsible entities. Besides, under China's current management system, characterized by centralization and the unification of the state power, the classification standard of natural resources' species and the management system formulated and issued by the central government will contribute toward creating a relatively unified regulatory accountant system, subject establishment and statement format, and improving the readability of natural resources balance sheet as well as the comparability of information.

Likewise, the diversity of the natural resources' species, the macrography of its distribution, and the uncertainty of environmental impacts complicate the balance sheet calculation. As a result, it becomes difficult to calculate the flow of natural resources, especially the water resources, biotic resources, and mineral resources, because they are influenced largely by the natural environment or technology development. In other words, it can be costly to calculate the flow of these resources and the calculation can be influenced by natural conditions. Therefore, this study holds that the stock of the natural resources should be calculated first. Indeed, the flow of the natural resources during a certain period can be deduced backward by comparing the stock of the natural resources in different periods. Additionally, calculating the natural resources' stock before calculating its flow is more practical and feasible when a statement system, which can comprehensively reflect its operating status and quality, cannot be established. Consequently, this can avoid impractical and far-fetched objectives. In other words, the focus must be to ensure how the statement can play an optimal role in information disclosure, management, and supervision. Additionally, the above characteristics of natural resources make it difficult to calculate their values. In addition, without the exploration and trade of mineral resource, some errors might appear even by using the fair value for calculation. Furthermore, considering the current environmental and technological condition, some natural resources might (or partly) achieve their values, but they might have option values, such as biodiversity, habit, and landscape. Therefore, the principle of "putting entity before value" sheet should be followed when drafting the natural resources balance.

Of course, this study states that it is not enough to just follow the principle of "putting entity before value." As we aim to draft the natural resources balance sheet, irrespective of whether we choose to find the "real circumstance" or to audit the outgoing officials, we must appraise the utilization efficiency and the stock quality of the natural resources. However, the calculation of entity or value when matched with the principle of "putting stock before flow" can only reflect the stock status—the scale of natural resources—but cannot reflect the change of the resources' utilization efficiency and quality. This outcome would emerge even if we consider the wastage and enhancement of resources. This defect might lead to inaccurate information disclosure in the natural resources balance sheet. Let us consider the forest resources, for instance. We assume that m units of the forest will be consumed for economic development, and its value is M. However, at the same time, n units of forest will be reforested, with N representing its value. Additionally, $m < n$, $M < N$, but $M/m > (N-M)/(n-m)$. In this case, whether we calculate the entity or the value, the end-of-period stock will always increase (the initial balance is assumed to be 0 to facilitate better understanding), according to the natural resources balance sheet. Additionally, if we audit officials regarding the departure, according to this method, their achievement of a coordinated development between economy and ecology would be apparent. However, after comparing the unit value of consumption with the unit value of reforestation, we can find that, as the forest asset increases, the unit value decreases. This implies that the quality of this area's forest resource is declining. Due to the principle of "calculating the stock of the resource before calculating its flow," it is obvious that following the principle of "putting entity before value" alone when drafting the natural resources balance sheet might lead to inaccurate information disclosure and a failure in achieving the goal. Hence, this study showcases that we should adhere to the calculation principle of "focusing on both entity and value" instead of "putting entity before value." The relevant factors' entity and value in the natural resources balance sheet must be compared and estimated simultaneously to discern the change in the resource quality.

4.2.3. Analysis of the measurement attribution and method

The fundamental condition throughout the financial accounting process is the confirmation and measurement of key factors. Taking the balance sheet as an example, we cannot ensure the validity of the object and the content of the statement without confirming its key factors. Accordingly, if we cannot measure the factors in the statement, then their role in information disclosure and managerial support will be meaningless. Since the choice of statement factors is restricted by economic and technological development, social cognition, measurement, and evaluation methods, the study chooses to first analyze the measurement attribution and methods. According to the principle of "focusing on both entity and value" for natural resources balance sheet calculation, first, we should simultaneously estimate the entity and value while studying the measurement methods. The measurement of natural resources entity generally relies on its physical units, such as a ton, hectare, or cubic meter. The development of remote sensing and exploring technology affects the measurement of resource entity rather than the choice of measurement attribution, according to the measurement characteristics of the natural resources' entity. Accounting

measurement, unlike the entity measurement, is based on the monetary unit of the value measured. Hence, the choice of its measurement attribution can be complicated. Several scholars believe that accounting itself is a measurement process; many basic accountant theories and methodological problems represent accounting measurement problems (Collis et al., 2010). The measurement attribution of accounting includes historical cost, current cost, net realizable value, future cash flow, and fair value, according to the International Accounting Standards Board (IASB) (Benston et al., 2007; Collis et al., 2010). Different measurements will lead to different calculated results in the process of financial accounting. However, IASB indicates that every factor in the financial statement can be measured through multiple attributions. Therefore, it is necessary to determine and elucidate the measurement attributions used for drafting the financial statement. Natural resources have numerous value measurements dimensions, such as species, forms, and functions. These dimensions determine different use values, economic values, option values, and heritage values. Additionally, the calculation of these values cannot be done by only one accounting measurement attribution. Therefore, when we calculate the value of the factors in the statement, we should choose suitable accounting measurement attribution according to its characteristics and elucidate the attribution.

4.3. Analysis of key factors

Starting with whether it has accounting attribution, current studies still hold the following two different opinions about the key factors constituting the natural resources balance sheet: the discussion on the condition for asset confirmation, which focuses on property ownership and revenue recognition; and the discussions about liabilities, which mainly include the existence and the content of the liabilities. In fact, the cognition of whether a natural resources balance sheet has accounting attribution will not only influence the confirmation of its calculating scope and the key factors, but also influence its articulation, drafting format, and functional effect.

4.3.1. Definition, confirming condition, and classification of natural resource assets

According to the definition of “asset” by IASB, the following three characteristics are needed for a factor to become an asset in the balance sheet: revenue generation from the enterprise's past transaction, having clear property ownership, and expectant profits. These three characteristics are the conditions that confirm the identity of assets in the process of accounting calculation (Collis et al., 2010). According to the calculating principle of SEEA 2018, a natural resource can be viewed as an asset. However, for natural resources, these assets' confirming conditions with accountant attribution might not be completely suitable. The natural resources managed by the Chinese government, an agent, are neither formed by past transactions nor have clear property ownership. Hence, they do not conform to the definition of “asset” in accountancy. Clearly, it is infeasible to consider only the accounting attribution when we define the asset factors of the natural resources balance sheet. According to the SNA2008 and SEEA 2012, the confirmation of the natural resources' assets should follow two basic conditions: “the ownership belonging to the authority” and “the inflow of the economic interests” (UN and UN, 2014). In fact, these two basic conditions expanded and innovated the definition of “asset” in accountancy. “The ownership belonging to the authority” breaks the limitation of an individual's enjoyment of the ownership or right of use, which makes it possible for the government to possess the ownership on behalf of the whole society. “The inflow of the economic interests” requires resources to have rarity and value. Based on the economic attribution, this condition aims to estimate whether a natural resource can become an asset. According to this condition, natural resources that cannot bring expectant economic benefits or fail to contribute toward current technology will not be included in the calculation.

In conclusion, when defining natural resources assets, we should consider the definitions by both IASB and SNA. First, we should clarify the ownership of the natural resources. In other words, we must ensure that these resources are owned by the government and have a clear boundary of property rights. Second, they must conform to the economic attribution of resources and must be rare and able to create value. Finally, the value created by these resources must bring some economic benefits for their owner or actual controlling party. By combining these defining conditions, we can find that the natural resources, once included in assets calculation, will have two indispensable attributions—governing attribution and accounting attribution.

To make the information disclosed in the natural resources balance sheet comparable and useful, we should classify relevant assets. Most scholars have used the designing and classification methods of SNA and SEEA when drafting the statements (UN and UN, 2014). This study holds that, by considering the calculating principle of “focusing on both entity and value,” the relationship between the natural resources balance sheet and the natural resources calculating account, and China's current value measurement technology, the classification system of SNA2008 and SEEA2012 can be applied feasibly to divide the natural resources asset accounts into land, water, forest, mineral, marine, and climate resources. Accordingly, considering the property rights and economic and accountant attributions, this study did not consider all subclasses of the above natural resources in the calculation.

4.3.2. The existence of natural resources liabilities

The existence of natural resources liabilities has always been a hot debate among scholars. As implied by the accounting attributions, many scholars believe that “asset” and “liabilities” are a pair of corresponding concepts (Collis et al., 2010). There must be a corresponding liability account since the natural resources can become the asset account in the natural resources balance sheet. Besides, it should be according to the accounting equation of “asset = liability + owner's equity.” According to this, some scholars believe that natural resources liabilities should depict the losses caused by past exploitation of natural resources and the compensation to be paid, which include environmental cost, resource tax, and compensation cost that need to be paid in the process of resource procurement and consumption (Tutore, 2010; Chen et al., 2014). However, some scholars pointed out that it is not correct to confirm the liability status of natural resources according to the stipulations of SNA2008 and SEEA 2012. The account system of SEEA2012 meets the equilibrium relationship of “the source of the asset = the possession of the asset,” and no separate natural resources liability account has been set up. Moreover, the definition of liability by IASB shows that the property-ownership may not be clear and that the debtor-creditor relationship may not exist. Therefore, functional account setting advocated by the SEEA2012 is superior to the liability account setting suggested by the natural resources balance sheet.

It cannot be agreed that the theory and thought of functional account setting show that the use of the natural resources' asset originates from its supply, reflecting the consumption status of natural resources. However, it might be contrary to the original intention of drafting the natural resources balance sheet as we use the thought and theory of the SEEA's account- and calculation-system setting to explain and define the drafting thoughts and key factors of the natural resources balance sheet. As mentioned before, through the drafting, the Chinese government aims to find the “real circumstance” and audit the outgoing officials; this objective cannot be achieved by only inspecting the consumption status of the natural resources' asset. The supply and consumption volume of resources was calculated and reported by using the equilibrium relationship of “the source of the asset = the possession of the asset.” Unfortunately, it cannot fully explain the goal of finding the “real circumstance.” Additionally, just reporting the supply and consumption status of the natural resources cannot illustrate whether the exploitation and consumption of natural resources are reasonable.

Moreover, it will not contribute toward providing useful and reliable information for departure auditing and resource management.

With regards to liabilities, this study states that the liability of natural resources should be included in the natural resources balance sheet, that is, how the calculation system can become complete and the information can reflect the responsibility to be shouldered and the cost to be paid by the government at all levels during the exploitation and utilization of natural resources asset. In other words, the liabilities must show how we can provide an appraising base for officials' departure auditing and performance assessment and provide decision support for governmental resource management. This study, by embracing relevant scholar's definition of the constituting components of natural resources' liability (Tutore, 2010; Chen et al., 2014), shows that a liability depicts the loss of natural resources that is caused by or is expected to appear due to the improper behaviors of the entity subject, including over-exploitation and consumption. The liability also includes the cost and compensation that have been paid to make up the loss. According to this definition, we can identify the liability subject and obtain authentic data on the relevant cost and price from the statement. This feature combines governing attribution and accounting attribution. Additionally, this account provides a direct support for achieving the drafting goal. Besides, this study holds the view that to reflect the destructiveness caused by the liability entity accurately and to provide information support for governance and ecological protection, the design and calculation of the natural resources liability account should also follow the principle of "focusing on both entity and value." This will enable us to reflect on the liability scale, stock, and the unit cost in a fairly reliable way. Currently, some scholars analyze the price and compensation of environmental destruction from the perspective of the enterprise environmental cost and find that the environmental cost of liability entity has two parts—voluntary compensation and passive acceptance (Tutore, 2010). This approach reveals the attitude of the liability subject toward environmental protection. This study argues that it is acceptable to subdivide the subjects in a proper way when establishing the natural resources liability account. We can classify, measure, and calculate the total liability amount in the voluntary compensation account; the liability amount in this account would include afforestation expenditure, the cost of environmental equipment upgrading, and the total liability amount in passive acceptance account, such as resource tax and pollutant charge. By comparing the total amount of these two accounts, we can provide referential information for appraising a liability entity's economic development philosophy and the level of ecological protection awareness.

This study argues that, in the process of setting up a natural resources liability account, segmentation can be appropriate to its subjects. In this context, the classification of measurement, accounting responsibility of the main body, afforestation fees, environmental protection equipment's modification cost account debt, resource tax (such as active and passive compensation), and discharge costs comprise the total liabilities, based on the two types of accounts, on the total amount of debt. It is necessary to provide information on these components to evaluate the economic development and ecological protection consciousness levels.

4.3.3. Net assets in natural resources balance sheet

The natural resources balance sheet must meet the accounting equation of "asset = liability + owner's equity" (Collis et al., 2010). However, it is more proper to name this balance as natural resources net asset in the designing process of the statement factors. Since the amount of "capital" invested by the entity subject and the remnant earnings cannot be directly calculated, the net asset can only be measured through the balance between natural resources' asset and natural resources' liability.

Hence, we cannot directly consider it as the owner's entity. It should be pointed out that the indirect calculating method of "natural resources net asset = natural resources asset - natural resources liability" is based on the condition that the natural resources' assets belong to the authorities. Therefore, in the natural resources balance sheet, natural resources net assets directly reflect the possession and control of the nation and the agent. At the same time, natural resources assets included in the calculation have the following two statuses: developed resource or undeveloped resource. If the technology condition and the price of the resource remain unchanged, then the undeveloped natural resource will automatically become a part of natural resources net asset at the end of the period. Hence, it is necessary to set detailed subjects, such as "already developed" and "to be developed" in the establishment of "natural resources net asset" to calculate the real consuming amount.

4.4. The exploitation of natural resources balance sheet

4.4.1. The setting of natural resources balance sheet

Based on the analysis of the drafting subject and premise, basic assumption and drafting principle, measurement attribution, and key factors of the natural resources balance sheet, this study has tentatively developed this statement. Considering that the drafting theory and drafting procedure of the natural resources balance sheet and the financial statement balance sheet have some proximity, this study tries to draft the natural resources balance sheet from the aspects of account setting, data summarizing, articulation, and statement design.

Embracing the drafting thought of "accounting attribution - classified account and general account - financial statement," this study prioritizes the account-system setting. According to the classification system of natural resources account of SEEA 2012, this study also classified the natural resources in the process of setting the account system. To take natural resources assets account as an example, its top subject should correspond to the classification of natural resources. Accordingly, based on the classification of different natural resources' subclasses, the secondary subject should be set up. For instance, farmland and woodland should be included in the land resources to meet the requirements of the classifying calculation. On the basis of subject classification and setting, we can calculate different types of natural resources assets through those classified accounts. This can facilitate the formation of the itemized accounts in a manner that they can summed up through the general account, that is, this approach can contribute toward the formation of the general ledger. Owing to the detailed differences between the setting of liability and net account and the setting of the natural resources' asset account, this study will not discuss the itemized accounts again.

4.4.2. Principle of data summarization and design of aggregated statement

From the drafting thought of "accounting attribution—classified account and general account—the financial statement," we can learn that the process of drafting, from the accounting attribution confirmation and measurement to the forming of the financial statement, is based on classification and aggregation (Collis et al., 2010). Since the drafting of the natural resources' balance sheet primarily borrows the thought of financial statement drafting, the calculation and aggregation of its data should also follow the principle of "classified calculation, aggregated statistics." In other words, we should calculate the classified accounts first, and, subsequently, aggregate the general accounts. However, it must be understood that the drafting of natural resources balance sheet follows the principle of "focusing on both the entity and the value." Hence, we should calculate the entity and value should be calculated simultaneously when calculating the natural resources' asset, liability, and net asset. According to the above conclusions, this study has designed the aggregated calculating statements of natural resources asset and liability. By drafting and calculating the aggregated statements, the stock and status of natural resources asset and liability can be clearly reflected. Additionally, by balancing the two, we can get the stock of natural resources' net asset to help the government manage natural resources (Tables 1 and 2).

Table 1
Natural resources' asset summary sheet (sample). Date: Unit: Entity Quantity/Value.

Project	Beginning Balance		Increase in the Current Period		Decrease in the Current Period		Ending Balance	
	Entity Quantity	Value	Entity Quantity	Value	Entity Quantity	Value	Entity Quantity	Value
Land Resources' Asset								
Cultivated Land Resource								
… …								
Total Land Resources' Asset								
Forest Resources' Asset								
Wood Resources								
… …								
Total Forest Resources' Asset								
Mineral Resources								
Petroleum Resources								
… …								
Total Mineral Resources' Asset								
Water Resources								
Industrial Water								
… …								
Total Water Resources' Asset								

4.4.3. Articulation and statement report in natural resources balance sheet

The unitary analysis of the aggregated statement cannot fully reflect the management quality of the resource and cannot provide reliable, comparable, and effective information for officials' departure auditing. Additionally, it will easily generate the defect of "showing only parts of the story," and it can even be "overshadowed by our perspectives." According to the accounting principle of "borrowing calls for loaning, and the two must maintain a balanced relationship" and the accounting equation of "asset = liability + owner's equity," we must transform the natural resources' asset and the summary of balance sheet to natural resources' balance sheet based on the inherent articulation of each account. In other words, we can avoid this defect. From the perspective of account structure, the relationship between the account of the natural resources' balance sheet and each aggregated statement can be seen in Fig. 4.

Based on Fig. 4, in the account-styled structure of the natural resources balance sheet, the datum recorded and reported by asset accounts is the aggregated datum of natural resources' assets, which come

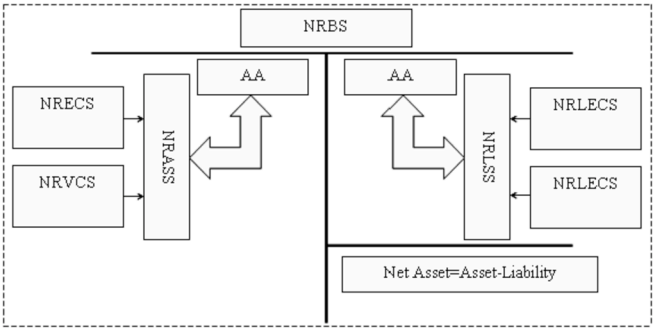

Fig. 4. Articulation of natural resources balance sheet based on the account structure. *Notes.* NRBS: Natural Resource Balance Sheet; NRECS: Natural Resource Entity Calculation Sheet; NRVCS: Natural Resource Value Calculation Sheet; NRASS: Natural Resource Asset Summary Sheet; AA: Asset Account; NRLSS: Natural Resource Liability Summary Sheet; NRLECS: Natural Resource Liability Entity Calculation Sheet.

Table 2
Natural resources' liability summary sheet (sample). Date: Unit: Entity Quantity/Value.

Project	Beginning Balance		Increase in the Current Period		Decrease in the Current Period		Ending Balance	
	Entity Quantity	Value	Entity Quantity	Value	Entity Quantity	Value	Entity Quantity	Value
Due: Environmental Governance Cost								
Land Resources								
… …								
Total Due: Governance Cost								
Due: Ecological Restoration Cost								
Land Resources								
… …								
Total Due: Governance Cost								
Due: Compensation/Subsidy cost								
Land Resources								
… …								
Total Due: Governance Cost								
Environment Protection Investment								
Environment Protection Facility								
… …								
Total Environment Protection Investment								
Environment Management Expense								
Afforestation Expense								
… …								
Total Environment Protection Expense								

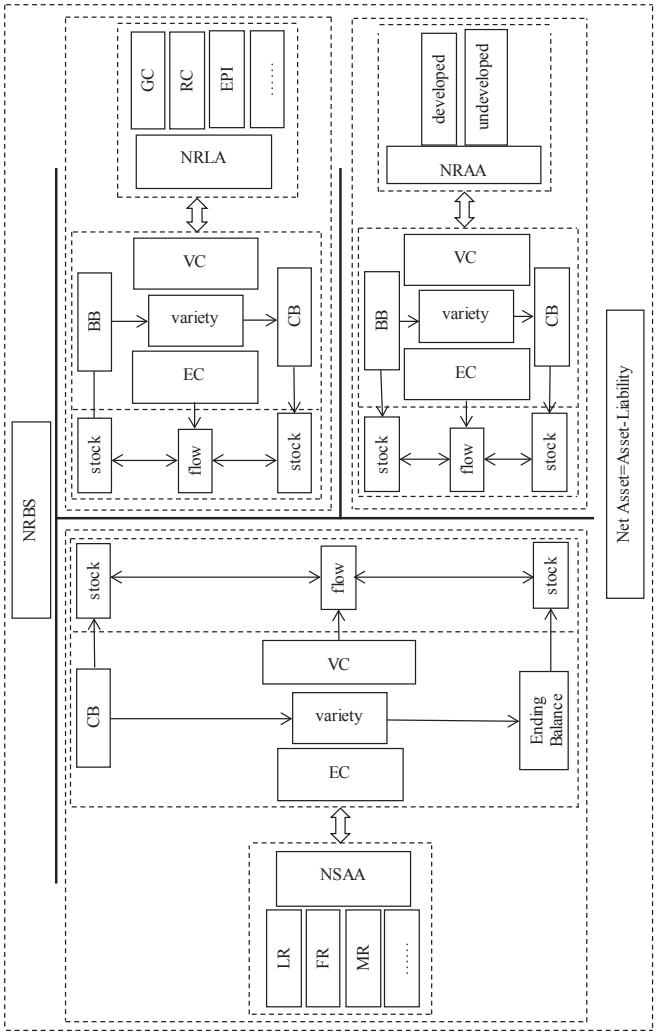

Fig. 5. Idea of compiling natural resources balance sheet based on the account structure. *Notes.* NRBS: Natural Resource Balance Sheet; LR: Land Resources; FR: Forest Resources; MR: Mineral Resources; NRAA: Natural Resources Asset Account; BB: Beginning Balance; EC: Entity Calculation; VC: Value Calculation; CB: Closing Balance; NRLA: Natural Resources Liability Account; GC: Governance Cost; RC: Restoration Cost; EPI: Environmental Protection Investment.

from the classified calculation and the summarization of natural resources asset entity and value. Accordingly, the datum recorded and reported by liability accounts is the aggregated datum of the natural resources' liability. Likewise, this datum also comes from the classified calculation and summarization of natural resources' asset entity and value. Finally, the datum in net asset account comes from the datum balance between the asset account and the liability account.

According to the account relationship in Figs. 4 and 5 gave us the strategy of how to draft the natural resources balance sheet. From this figure, we can learn that the data are taken from the classified aggregated accounts of natural resources assets and liabilities. In the process of statement drafting, we should follow the principle of "focusing on both entity and value" to calculate the initial balance, end-of-period balance, and variable amount (the balance derived by subtracting the decreased amounts from the increased amounts) and to measure and report the stock and the flow status. Subsequently, according to the equilibrium principle of "asset = liability + net asset," we can get the natural resources' net asset. According to this account structure, the left part of the statement shows the supply scale of the natural resources asset, and the right part reflects the scale of the remnant resources and relevant liabilities, which accords with the equilibrium principle of "the source of the assets = the possession of the assets" of the SEEA2012's account system. This study has developed and drafted the sample statement of the natural resources balance sheet, as shown in Table 3.

5. Tentative application of the natural resources balance sheet

The purpose of discussing the connotation and compilation of the balance sheet of natural resources from the perspective of government governance is not only to answer the questions of "why" and "what," but also to discuss the questions of "how to compile" and "how to use." This study combines the theoretical discussion about the prerequisite, compilation principles, and composition of the balance sheet of natural resources and selects some examples to make tentative compilation and development. In view of the diversity of natural resources, this study first selects the mineral resources to prepare a balance sheet for a single natural resource category, and, subsequently, selects a specific region for an attempt. Considering the characteristics of the resources, the complexity of measurement, and the availability of data, this study selects Huangshi City in Hubei Province and Jingdong County in Yunnan Province as samples for data collection. Subsequently, and the study compiles the balance sheet for metal resources in Huangshi City and the natural resources' capital in Jingdong County from the perspectives of a single-type natural resource and various natural resources.

5.1. Compilation of the metal resources balance sheet of Huangshi City

Huangshi City is located in Hubei Province, China, and is rich in metal mineral resources. The reserves of various metal ores deposits rank first in Hubei Province. Its metal resources, such as iron, copper, and gold, are dominant minerals and have the characteristics of concentrated distribution and good quality. Mineral resources are critical natural resources, and these resources are highly consumed in China. The investigation on mineral resources should focus on mining, reserves detection, utilization efficiency, environmental restoration, and governance. In this context, it must be noted that there are a wide range of mineral resources and a range of distribution areas, and hence data acquisition, collation, and report compilation are relatively complicated.

5.1.1. Data source and description

There are many statistical sources of mineral resources in Huangshi City, including Huangshi City Mineral Resources Statistical Yearbook (2014), Hubei Province Mineral Resources Master Plan (2008–2015), Hubei Province Statistical Yearbook (2011–2016), the Land and Resources Bulletin of Huangshi City for 2014 and 2015, and the Final Statement of Income and Expenditure of Mineral Resources (2015).

According to the statistical data, this study considers the major metal mineral resources (iron ore, copper ore, tungsten ore, and gold ore), which have been discovered and proved reserves in Huangshi City, as examples and compiles the balance sheet of natural resources. Drawing on the previous development ideas and sample format, first, this study compiles a summary table of metal resources in Huangshi City, based on the reserves and value of the city's main mineral resources. Second, according to the monetary expenditure of the government for the management and restoration of the ecological environment, as disclosed in the government's statistical yearbook and resource bulletin, a summary table of the metal resources balance sheet in Huangshi City is compiled. Finally, the two summary tables are to formulate the Huangshi[1] metal resources balance sheet.

[1] The main reason other mineral resources are not included is that the trading market for these resources has not matured in, and their value is difficult to be

Table 3
Natural resources balance sheet. (sample) Date: Unit: Entity Quantity/Value.

Project	Beginning Balance		Closing Balance		Project	Beginning Balance		Closing Balance	
	Entity Quantity	Value	Entity Quantity	Value		Entity Quantity	Value	Entity Quantity	Value
Natural Resources' Asset					Natural Resources' Liability				
Land Resources' Asset					Due: Environment Governance Cost				
Cultivated Land Resources					Land Resources				
… …					… …				
Total Land Resources' Asset					Due: Ecological Restoration Cost				
Forest Resources' Asset					Land Resources				
Wood Resources					… …				
… …					Environment Protection Investment				
Total Forest Resources' Asset					Environment Protection Facility				
Mineral Resources' Asset					… …				
Petroleum Resources					Environment Governance Cost				
… …					Afforestation Cost				
Total Mineral Resources' Asset					… …				
Water Resources' Asset					Total Natural Resources' Liability				
Industrial Water									
… …					Natural Resources' Net Asset				
Total Water Resources' Asset					Developed Natural Resources' Net Asset				
Total Other Natural Resources' Asset					Undeveloped Natural Resources' Net Resources				
Total Natural Resources' Asset					Total Natural Resources' Liability and Net Asset				

Table 4
Summary of Huangshi's Metal Resources' Assets in 2015. Date: December 31, 2015 Unit: 1000 tons/100 million yuan.

Project	Beginning Balance		Increase in the Current Period		Decrease in the Current Period		Ending Balance	
	Entity Quantity	Value	Entity Quantity	Value	Entity Quantity	Value	Value	Entity Quantity
Mineral Resources								
Iron Ore	146,180.660	850.770	1331.250	7.740	16,547.930	96.300	130,963.980	762.210
Copper Mine	1489.280	500.760	11.050	3.710	111.400	37.450	1388.930	467.020
Tungsten	15.570	11.100	0.000	0.000	0.610	0.430	15.140	10.670
Gold Mine	0.083	220.450	0.002	6.340	0.009	24.600	0.076	202.190
Total Metal Mineral Resource Assets		1583.080		17.790		158.780		1442.090

5.1.2. Analysis of Huangshi City's metal resources balance sheet

The related forms of Huangshi's metal resources' balance sheet are listed in Tables 4–6.

Tables 4–6 show that the volume and value of the major metal minerals in the end-of-term balance in Huangshi City in 2015 are less than that of the initial balance, indicating that their resources are in a state of net consumption. However, along with a decrease in the value of tungsten mineral resources and the ratio of the materials at the end of the period, the other three types of metal resources remain stable. Accordingly, along with a decrease of 10.5 million, yuan in payable compensation costs, the costs of environmental management in Huangshi City, in 2015, were 344.8 billion yuan and 353.5 million at the beginning and the end of the period, respectively. Additionally, the ecological cost was 304.5 million yuan and 351.0 million yuan at the beginning and the end of the period, respectively, increasing by 8.7 million yuan and 46.5 million yuan, respectively. In addition, according to the accounting equation of "Natural Resources Net Assets = Natural Resources Assets - Natural Resource Liabilities, " the final value of metal resources net assets in Huangshi City in 2015 was 144.209 billion yuan, which shows a decrease of 14.499 billion yuan from the beginning of the period.

5.2. Jingdong County's natural resources balance sheet

Jingdong County is located in the Yunnan Province, China. The natural resources are abundant and widely distributed in this county. The main dominant resources are grassland, arable land, and water resources. The report on these resources as samples includes most of the natural resources' accounts defined by SEEA 2012. It has a representative reference value.

5.2.1. Data source and description

Unlike the natural resources balance sheet of a single resource category, it is more difficult to collect and summarize information on various natural resources in a region. Due to the different physical measurement units and management departments of various natural resources, the statistical caliber of relevant data is prone to differences, and, owing to the low degree of market development of some natural resources, it is quite difficult to measure their value. Additionally, the data statistics and publication of different management departments in

(*footnote continued*)
confirmed relatively fairly.

Table 5
Summary of Yellowstone Metal Resources and Liabilities in 2015. Date: December 31, 2015 Unit: /100 million.

Project	Beginning Balance		Increase in the Current Period		Decrease in the Current Period		Ending Balance	
	Entity Quantity	Value	Entity Quantity	Value	Entity Quantity	Value	Entity Quantity	Value
Due: Environment Governance Cost								
Land Resources	–	–	–	–	–	–	–	
… …	–	–	–	–	–	–	–	
Total Due: Governance Cost	–	3.448	–	–	–	–	–	3.535
Due: Ecological Restoration Cost								
Land Resources	–	–	–	–	–	–	–	
… …	–	–	–	–	–	–	–	
Total Due: Governance Cost	–	3.045	–	–	–	–	–	3.510
Due: Compensation/Subsidy cost								
Land Resources	–	–	–	–	–	–	–	–
… …	–	–	–	–	–	–	–	–
Total Due: Compensation/Subsidy Costs	–	0.358	–	–	–	–	–	0.253

China aim to meet the needs of these departments, and hence these data have their own characteristics. For example, some management departments mainly consider the flow as the benchmark model of natural resources statistics, while some management departments take the stock as the basis. For some special natural resources, considering the cost of accounting or the importance of national security, there may be problems pertaining to the absence of statistical data or data confidentiality. Therefore, the preparation of the balance sheet of natural resources may not only need the collation of data of various statistical yearbooks but may also need drawing on and collecting exhaustive relevant data. The statistical data in the balance sheet of natural resources in Jingdong County are primarily collected from the Statistical Yearbook of Jingdong County and the Land and Resources Bulletin of Jingdong County for the period 2011 to 2015; additionally, the balance sheet draws on relevant existing data. Similarly, this study first compiles Jingdong's natural resources' assets summary table and, subsequently, compiles Jingdong's natural resources' liabilities summary table. Finally, the study collates the two summary tables to compile Jingdong's natural resources balance sheet.

5.2.2. Analysis of Jingdong County's natural resources balance sheet

The related forms of the natural resources balance sheet of Jingdong County are shown in Tables 7–9.

Tables 7–9 show that the physical quantity and value of the main natural resources in Jingdong County in 2011–2015 at the end of the sample period is greater than that in the opening, indicating that its resources are in a state of net growth. Accordingly, the cost of environmental management in Jingdong County in 2015 is 2.191 billion yuan, and the ecological cost is 2.448 billion yuan. In addition, according to the accounting equation of "Natural resources net assets = Natural resources assets - Natural resources liabilities," Jingdong County's natural resources net assets value is 3.329 billion yuan.

6. Conclusion and suggestions

6.1. Main conclusions

With the deepening of understanding of the relationship between economy and environment, all countries in the world are attaching importance to the coordinated development of economic growth and ecological protection. The balance sheet of natural resources proposed and advocated by the Chinese government has an important influence on the government oversight and resource management. This context is rooted in the transformation of economic development and political performance evaluation concepts. Based on the motivation of "leading audit of leaders" and "finding out the family background," this study discusses the connotation, main framework, components, preparation ideas, and sample presentation of the natural resources balance sheet. To fill the gaps in the literature, this study follows the principle of accounting balance and adopts double accounts. Subsequently, the study conducts the balance sheet accounting of China's natural resources from the perspective of government governance. The main conclusions are as follows. First, the natural resources balance sheet is an important part of the government oversight system. It not only has an information disclosure function of accounting statements but also has functions of management and supervision. Its accounting attributes and intellectual attributes cannot be neglected. Second, according to the theoretical basis of the preparation of the natural balance sheet, the theoretical key

Table 6
Summary of Huangshi's Metal Resources' Balance Sheet in 2015. Date: December 31, 2015 Unit: thousand tons/100 million yuan.

Project	Beginning Balance		Closing Balance		Project	Beginning Balance		Closing Balance	
	Entity Quantity	Value	Entity Quantity	Value		Entity Quantity	Value	Entity Quantity	Value
Nature Resources' Assets					Natural Resources' Liability				
Mineral Resources					Due: Environment Governance Costs	3.448	3.535	3.448	3.535
Iron Ore	146,180.660	850.770	130,963.980	146,180.660	Due: Ecological Restoration Costs	3.045	3.510	3.045	3.510
Copper Mine	1489.280	500.760	1388.930	1489.280	Due: Compensation/Subsidy Costs	0.358	0.253	0.358	0.253
Tungsten	15.570	11.100	15.140	15.570	Total Natural Resources' liabilities	6.581	7.298	6.581	7.298
Gold Mine	0.083	220.450	0.076	0.083	Natural Resources' Net Asset	1576.499	1434.792	1576.499	1434.792
Total Metal Mineral Resources' Assets		1583.080			Total Natural Resources' Liability and Net Asset	1583.080	1442.090	1583.080	1442.090

Table 7
Summary of Jingdong County's Natural Resources' Assets for 2011–2015. Date: December 31, 2015 Unit: hectare (10,000 cubic meters)/10,000 yuan.

Project	Beginning Balance		Increase in The Current Period		Ending Balance	
	Entity Quantity	Value	Entity Quantity	Value	Entity Quantity	Value
Land Resources						
Cultivated Land Resources						
Frequently-Used Cultivated Land Resources	30,513	1,912,820.64	1122	465,821.70	31,635	2,378,642.34
Interim Cultivated Land Resources	1884	148,573.15	−186	9302.07	1698	157,875.22
Total Cultivated Land Resources	32,397	2,061,393.78		475,123.78	33,333	2,536,517.56
Grassland Resources						
Warm Typical Grassland	115,500	554,400.00	642.60	306,360.00	116,142.60	860,760.00
Edible Forage Grassland	138,6000	27,720.00	48,600	15,318.00	1,434,600	43,038.00
Total Grassland Resources	1,501,500	582,120.00		321,678.00	1,550,742.60	903,798.00
Total Land Resources	1,533,897	2,643,513.78		796,801.78	1,584,075.60	3,440,315.56
Water Resources						
Lancang River Drainage	111,600	385,020.00			111,600	385,020.00
Red River Drainage	203,700	702,765.00			203,700	702,765.00
Total Water Resources	315,300	1,087,785.00			315,300	1,087,785.00

Table 8
Summary of Natural Resources and Liabilities of Jingdong County in 2011–2015. Date: December 31, 2015 Unit: /10,000 yuan.

Project	Beginning Balance		Increase in the Current Period		Ending Balance	
	Entity Quantity	Value	Entity Quantity	Value	Entity Quantity	Value
Due: Environmental Governance Costs						
Land Resources						
Cultivated Land Resources	–		–	107,807.00	–	
Grassland Resources	–		–	72.60	–	
Water Resources	–		–	111,198.40	–	
Total Due Governance Costs				219,078.00		
Due: Ecological Restoration Costs						
Land Resources						
Cultivated Land Resources	–		–		–	
Grassland Resources	–		–	244,794.00	–	
Water Resources	–		–		–	
Total Due: Recovery costs				244,794.00		
Due: Compensation/Subsidy Costs						
Land Resources						
Cultivated Land Resources	–		–		–	
Grassland Resources	–		–		–	
Water Resources	–		–		–	
Total Due: Compensation/Subsidy Costs						

and difficult problems, such as the balance sheet's compilation premise, measurement principle, accounting scope, constituent elements, and statement format should be studied. Additionally, the compilation framework and system of the natural resources balance sheet should be optimized and perfected to provide theory for the realization of its objectives and practical application. Third, the balance sheet of natural resources is not an isolated table, but a reporting system.[2] We should optimize the natural resources account and reporting system, improve its checking relationship and balancing principle, and promote the practice of drafting the natural resources balance sheet.

6.2. Suggestions

First, we should build a unified theoretical framework and make active efforts to promote compiling as a practice. As far as the balance sheet of natural resources is concerned, the biggest problem at present is that it belongs to a “concept” category and lacks a relatively complete and unified theoretical framework. This aspect has limited the study of its accounting scope, measurement attributes, responsibility subjects, and constituent elements to a “do-it-yourself” state, and hence the study lacks theoretical guidance and specification of natural resources’ assets. Another problem is that the current theoretical research on the balance sheet of natural resources has not yet effectively interacted with its preparation process. The actual problem encountered in the process of preparing the statement is a lack of targeted theoretical guidance. Therefore, Chinese scholars should actively combine theoretical research and practical operations and promote the formation and practice of the theoretical framework of natural resources balance sheets.

Second, based on the background of China's system, we should learn useful experience from other countries. China's natural resources balance sheet should be based on China's institutional background. However, considering that China's research and practice on natural resources accounting is relatively new, we should draw lessons from foreign concepts and experiences, such as SNA and SEEA's concept of “departmental shareholding” of property rights, which has reference value for resolving the issue of reporting elements under the Chinese natural resources property rights system characterized by public

[2] Considering that it is impossible to obtain the final value of natural resource liabilities, this study attempts to use the change value in this period to obtain the net assets of natural resources. Since the closing year of the eighth forest resources inventory in Jingdong County is 2013, the balance sheet of natural resources in this study does not include forest resources.

Table 9
Summary of Jingdong County's Natural Resources Balance Sheet for 2011–2015. Date: December 31, 2015 Unit: hectare (10,000 cubic meters)/10,000 yuan.

Project	Beginning Balance		Ending Balance		Increase in the Current Period		Project	Increase in the Current Period
	Entity Quantity	Value	Entity Quantity	Value	Entity Quantity	Value		Value
Nature Resources' Assets							Natural Resources' Liability	
Land Resources							Due: Environment Governance Cost	219,078.00
Cultivated Land Resources	32,397	2,061,393.78	33,333	253,6517.56	936	475,123.78	Due: Ecological Restoration Costs	244,794.00
Grassland Resources	15,01500	582,120.00	155,0742.60	903,798.00	49,242.60	321,678.00	Due: Compensation/Subsidy Costs	
Total Land Resources	1,533,897	2,643,513.78	1,584,075.60	3,440,315.56	50,178.60	796,801.78	Total Natural Resources' liabilities	463,872.00
Water Resources	315,300	1087,785.00	315,300	1,087,785.00	0	0.00	Natural Resources' Net Asset	
Total Water Resources	315,300	1,087,785.00	315,300	1,087,785.00	0	0.00	Natural Resources' Liability	332,929.78
Total Nature Resources		3,731,298.78		4,528,100.56	0	796,801.78	Total Natural Resources' Liability and Net Asset	796,801.78

property rights. Similarly, the natural resources of Norway and Australia accounting and reporting practices can also provide a reference for the preparation of China's natural balance sheet.

Third, management subjects must be clarified to avoid multi-management. Due to the wide variety of natural resources and geographical distribution, the jurisdictional subjects usually include multiple government departments; this can easily lead to multi-head management or management neglect. In the process of preparing the natural resources balance sheet, irrespective of whether it is multi-head management or management neglect, multi-management may lead to differences or even errors in resource classification, data statistics, and measurement attributes. Therefore, the compilation of natural resources balance sheet should clearly define the unified management subject; it should also contribute toward managing, guiding, and coordinating related functional departments to ensure the unity of resource classification, account setting, measurement attribute selection, and reporting format, and guarantee the efficiency and effect of information report and transmission.

Finally, adherence to the integrity and openness of the report must be emphasized. The compilation of the balance sheet of natural resources should follow the principle of accounting balance; it must also specify the elements, accounting scope, measurement attributes, and checking relationships to ensure the completeness of the contents and logic of the statements. However, the accounting scope and measurement methods of natural resources are significantly affected by technological development. With the development of physical technology and measurement technology, an increasing number of natural resources' elements can be included in the accounting scope and reasonably measured. These natural resources should not be excluded from the accounting scope for a long time.

7. Discussion

Sustaining natural resources while promoting economic growth and the quality of life is a significant issue for policymakers. This study addresses the gap in accounting natural resources balance sheet in China. However, achieving a sustainable environment requires more than accounting. Essential actions, including legislation, regulation, mitigation, resource management, enforcement, education, and social responses to environmental challenges, must be implemented. Environmental accounting can only provide information on the outcomes of these actions. Hence, future research must examine how to react to the current environmental condition according to the accounting results.

Acknowledgements

The work was supported by the National Natural Science Foundation of China (Grant Nos. 71471001, 41771568, 71533004, 71503001; 71601170); the National Key Research and Development Program of China (Grant No. 2016YFA0602500; 16YJC630123).

References

Al-Tuwaijri, S.A., Christensen, T.E., Hughes Ii, K.E., 2004. The relations among environmental disclosure, environmental performance, and economic performance: a simultaneous equations approach. Account. Org. Soc. 29 (5–6), 447–471.
Andreoni, J., Levinson, A., 2001. The simple analytics of the environmental Kuznets curve. J. Public Econ. 80 (2), 269–286.
Arrow, K.J., Dasgupta, P., Goulder, L.H., Mumford, K.J., Oleson, K., 2012. Sustainability and the measurement of wealth. Environ. Dev. Econ. 17, 317–353.
Banerjee, O., Cicowiez, M., Horridge, M., Vargas, R., 2018. A conceptual framework for integrated economic – environmental modeling. J. Environ. Dev. 25 (3), 276–305.
Barbier, E.B., 2013. Wealth accounting, ecological capital and ecosystem services. Environ. Dev. Econ. 18 (2), 133–161.
Baskaran, V., Nachiappan, S., Rahman, S., 2012. Indian textile suppliers' sustainability evaluation using the grey approach. Int. J. Prod. Econ. 135 (2), 647–658.
Benston, G.J., Carmichael, D.R., Demski, J.S., Dharan, B.G., Jamal, K., Laux, R., Rajgopal, S., Vrana, G., 2007. The FASB's conceptual framework for financial reporting: a

critical analysis. Account. Horiz. 21 (2), 229–238.
Borissov, K., Pakhnin, M., 2018. Economic growth and property rights on natural resources. Econ. Theor. 65 (2), 423–482.
Bramlett, R.W., 2010. The federal accounting standards advisory board: an introduction for non-accountants. Public Budg. Finance 11 (4), 11–19.
Brock, W.A., Taylor, M.S., 2005. Chapter 28 – economic growth and the environment: a review of theory and empirics. Handb. Econ. Growth 1 (05), 1749–1821.
Brock, W.A., Taylor, M.S., 2010. The green Solow model. J. Econ. Growth 15 (2), 127–153.
Chen, J.C., Cho, C.H., Patten, D.M., 2014. Initiating disclosure of environmental liability information: an empirical analysis of firm choice. J. Bus. Ethics 125 (4), 681–692.
Chiu, S.C., Sharfman, M., 2011. Legitimacy, visibility, and the antecedents of corporate social performance: an investigation of the instrumental perspective. J. Manag. 37 (6), 1558–1585.
Cole, M.A., Rayner, A.J., Bates, J.M., 1997. The environmental Kuznets curve: an empirical analysis. Environ. Dev. Econ. 2 (4), 401–416.
Collis, J., Holt, A., Hussey, R., 2010. The Conceptual Framework for Financial Reporting. International Accounting Standards Board, Cambridge, UK.
Dasgupta, P., 2009. The welfare economic theory of green national accounts. Environ. Resour. Econ. 42 (1), 3.
Demsetz, H., 1974. Toward a theory of property rights. Am. Econ. Rev. 57 (2), 347–359.
Dong, H., Fujita, T., Geng, Y., Dong, L., Ohnishi, S., Sun, L., Dou, Y., Fujii, M., 2016. A review on eco-city evaluation methods and highlights for integration. Ecol. Indicat. 60, 1184–1191.
Dubey, R., Gunasekaran, A., Childe, S.J., Papadopoulos, T., Hazen, B., Giannakis, M., Roubaud, D., 2017. Examining the effect of external pressures and organizational culture on shaping performance measurement systems (PMS) for sustainability benchmarking: some empirical findings. Int. J. Prod. Econ. 193, 63–76.
Ficko, A., Bončina, A., 2019. Public attitudes toward environmental protection in the most developed countries: the environmental concern Kuznets curve theory. Environ. Manag. 231, 968–981.
Galos, K., Nieć, M., Saługa, P.W., Uberman, R., 2015. The basic problems of mineral resources valuation methodologies within the framework of System of Integrated Environmental and Economic Accounts. Gospod. Surowcami Miner.: Mineral Res. Manag. 31 (4), 5–20.
Gray, R., Bebbington, J., 2001. Accounting for the Environment. Sage Publications, Thousand Oaks, CA.
Harris, M., Fraser, I., 2002. Natural resource accounting in theory and practice: a critical assessment. Aust. J. Agric. Resour. Econ. 46 (2), 139–192.
Hartman, R., Kwon, O.S., 2005. Sustainable growth and the environmental Kuznets curve. J. Econ. Dyn. 29 (10), 1701–1736.
Hartwick, J.M., 1990. Natural resources, national accounting and economic depreciation. J. Public Econ. 43 (3), 291–304.
He, J., Wang, H., 2012. Economic structure, development policy and environmental quality: an empirical analysis of environmental Kuznets curves with Chinese municipal data. Ecol. Econ. 76 (1), 49–59.
Hilton, F.G.H., Levinson, A., 1998. Factoring the environmental Kuznets curve: evidence from automotive lead emissions. Discuss. Pap. 35 (2), 126–141.
Holub, H.W., Tappeiner, G., Tappeiner, U., 1999. Some remarks on the “system of integrated environmental and economic accounting” of the united nations. Ecol. Econ. 29 (3), 329–336.
Hu, W., Shi, D., Guo, C., 2015. The framework system of natural resource statement of assets and liabilities: an idea based on SEEA2012, SNA2008 and national statement of assets and liabilities. J. Res. Ecol. 6 (6), 433–437.
Hung, N.M., 1993. Natural resources, national accounting, and economic depreciation: stock effects. J. Public Econ. 51 (3), 379–389.
Jensen, M., Meckling, C., 1976. Theory of the firm: managerial behavior, agency costs, and ownership structure. J. Financ. Econ. 3 (4), 305–360.
Jordan, S.J., Hayes, S.E., Yoskowitz, D., Smith, L.M., Summers, J.K., Russell, M., Benson, W.H., 2010. Accounting for natural resources and environmental sustainability: linking ecosystem services to human well-being. Environ. Sci. Technol. 44 (5), 1530–1536.
Jose, A., Lee, S.M., 2007. Environmental reporting of global corporations: a content analysis based on website disclosures. J. Bus. Ethics 72 (4), 307–321.
Kumar, V., Gunasekaran, A., Singh, K., Papadopoulos, T., Dubey, R., 2015. Cross sector comparison of sustainability reports of Indian companies: a stakeholder perspective. Sustain. Prod. Consum. 4, 62–71.
La Notte, A., Vallecillo, S., Maes, J., 2019. Capacity as “virtual stock” in ecosystem services accounting. Ecol. Indicat. 98, 158–163.
Leiter, A.M., Parolini, A., Winner, H., 2011. Environmental regulation and investment: evidence from European industry data. Ecol. Econ. 70 (4), 759–770.
Li, L., 2001. Encouraging environmental accounting worldwide: a survey of government policies and instruments. Corp. Environ. Strat. 8 (1), 55–64.
Masiga, M., Muramira, E., Kaggwa, R., 2013. Contribution of Uganda's forestry sub-sector to the national economy: natural resource accounting approach. Implement. Environ. Acc. 28, 143–185.
Mia, A.H., 2005. The role of government in promoting and implementing environmental management accounting: the case of Bangladesh. Implement. Environ. Acc. Status Chall. 18, 297–320.
Ministry of Land and Resources of the People’s Republic of China, 2018. The National Statistical Communique of Land, Mineral and Marine Resource in 2017. http://gi.mlr.gov.cn/, Accessed date: 30 April 2018.
Morton, H., Winter, E., Grote, U., 2016. Assessing natural resource management through integrated environmental and social-economic accounting: the case of a Namibian conservancy. J. Environ. Dev. 25 (4), 396–425.
National Forestry and Grassland Administration, 2017. The Forestry Development Report of the People's Republic of China in 2017. . http://www.forestry.gov.cn/%20(4/30/2017.
Obst, C., Vardon, M., 2017. Recording environmental assets in the national accounts. Oxf. Rev. Econ. Pol. 30 (1), 126–144.
Ogilvy, S., Burritt, R., Walsh, D., Obst, C., Eigenraam, M., 2018. Accounting for liabilities related to ecosystem degradation. Ecosyst. Health Sustain. 4 (11), 261–276.
Pulselli, R.M., Pulselli, F.M., Rustici, M., 2008. Emergy accounting of the Province of Siena: towards a thermodynamic geography for regional studies. J. Environ. Manag. 86 (2), 342–353.
Schreyer, P., Obst, C., 2015. Towards Complete Balance Sheets in the National Accounts: the Case of Mineral and Energy Resources. OECD Green Growth Papers No. 2015/02. OECD Publishing, Paris.
Selden, T.M., Song, D., 1994. Environmental quality and development: is there a Kuznets curve for air pollution emissions? J. Environ. Econ. Manag. 27 (2), 147–162.
Song, M., Wang, S., Sun, J., 2018. Environmental regulations, staff quality, green technology, R&D efficiency, and profit in manufacturing. Technol. Forecast. Soc. Change 133, 1–14.
Tang, Z., Tang, J., 2013. Can the media discipline Chinese firms' pollution behaviors? the mediating effects of the public and government. J. Manag. 42 (6), 12–13.
Thwaites, R., Lacy, T.D., Li, Y.H., Liu, X.H., 1998. Property rights, social change, and grassland degradation in Xilingol biosphere reserve, inner Mongolia. China. Soc. Nat. Res. 11 (4), 319–338.
Tutore, I., 2010. Key Drivers of Corporate Green Strategy. Paper Delivered at Edamba Summer School.
UN, E.U., UN, F.A.O., IMF, World Bank, OECD, 2014. System of Environmental-Economic Accounting 2012: Central Framework. United Nations, New York.
Wang, H., Song, M., 2017. Influence of reverse outsourcing on green technological progress from the perspective of a global supply chain. Sci. Total Environ. 595, 201–208.
Wang, S., Yu, H., Song, M., 2018. Assessing the efficiency of environmental regulations of large-scale enterprises based on extended fuzzy data envelopment analysis. Ind. Manag. Data Syst. 118 (2), 463–479.
Yusuf, Y.Y., Olaberinjo, A.E., Papadopoulos, T., Gunasekaran, A., Subramanian, N., Sharifi, H., 2017. Returnable transport packaging in developing countries: drivers, barriers and business performance. Prod. Plann. Contr. 28 (6–8), 629–658.
Zhang, Y., Baral, A., Bakshi, B.R., 2010. Accounting for ecosystem services in life cycle assessment, part ii: toward an ecologically based LCA. Environ. Sci. Technol. 44 (7), 2624–2631.
Zhang, M., Pawar, K.S., Bhardwaj, S., 2017. Improving supply chain social responsibility through supplier development. Prod. Plann. Contr. 28 (6–8), 500–511.