

# VALUATION BASES AND TECHNIQUES FOR NATURAL RESOURCES IN INDONESIA'S CGFS: A LITERATURE REVIEW AND PRACTICAL ILLUSTRATION IN INDONESIA

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**Abstract:** *This study addresses the gap in the Central Government Financial Statements (CGFS), in which natural resource stocks have not been recognised even though their economic benefits are reflected in state revenue. This study uses a structured literature review of publications from 2010 to 2024 in various databases with inclusion criteria related to public sector accounting, natural resource valuation, IPSAS, SEEA, and national regulations. The selection process includes identification, elimination of duplication, abstract selection, and full review. The analysis was conducted through narrative-thematic synthesis to identify the application of the main value bases, namely fair value, net present value, and current replacement cost in natural resource valuation. The results show that the integration of natural resource into the CGFS requires harmonisation of standards, clarity of methodology, and data readiness in order to be reliable, fiscally relevant, and auditable.*

**Keywords:** *Natural resource accounting, SEEA, IPSAS, valuation methods, CGFS*

**Abstrak:** Penelitian ini membahas kesenjangan dalam Laporan Keuangan Pemerintah Pusat (LKPP), di mana stok sumber daya alam (SDA) belum diakui meskipun manfaat ekonominya telah tercermin dalam penerimaan negara. Studi ini menggunakan literature review terstruktur dari publikasi penelitian 2010–2024 pada berbagai basis data dengan kriteria inklusi terkait akuntansi sektor publik, valuasi SDA, IPSAS, SEEA, dan regulasi nasional. Proses seleksi mencakup identifikasi, eliminasi duplikasi, seleksi abstrak, dan telaah penuh. Analisis dilakukan melalui sintesis naratif–tematik untuk mengidentifikasi penerapan basis nilai utama, yaitu fair value, net present value, dan current replacement cost dalam valuasi SDA. Hasil penelitian menunjukkan bahwa integrasi SDA ke dalam LKPP memerlukan harmonisasi standar, kejelasan metodologi, serta kesiapan data agar dapat dilakukan secara andal, relevan secara fiskal dan dapat diaudit.

**Kata Kunci:** Akuntansi sumber daya alam, SEEA, IPSAS, metode penilaian, LKPP

## INTRODUCTION

Natural resources are an important foundation for fiscal resilience and the sustainability of public services in Indonesia. They contribute significantly to state revenue through non-tax state revenue (PNBP). However, to date, the value of NAR stocks has not been recognized in the Central Government Financial Statements (LKPP), while revenue flows have been recorded. As a result, the LKPP lacks a

comprehensive picture of state assets derived from NAR, making it difficult to assess the extent to which NAR utilization impacts long-term fiscal capacity due to exploitation or environmental degradation.

Internationally, the IPSAS (International Public Sector Accounting Standards) framework emphasizes the importance of recognizing and measuring natural resource assets based on auditable values. Meanwhile, the System of Environmental-Economic Accounting (SEEA) developed by the United Nations provides guidance on integrating physical and monetary accounts for natural assets and ecosystems. In Indonesia, the Ministry of Finance, through PMK 173/2020, has established the basis for assessing natural resource assets. Meanwhile, the Central Statistics Agency (BPS) has compiled a Natural Resource Balance Sheet through the Integrated Indonesian Environmental and Economic Balance Sheet System (SISNERLING).

Although Indonesia already has two main instruments for natural resource valuation—BPS's SISNERLING and PMK 173/2020—the results of these two instruments cannot yet be directly integrated into the LKPP as a basis for natural resource asset valuation. The natural resource reporting gap covers three fundamental aspects, as presented in Table 1.

**Table 1. Gap between Natural Resource Valuation and Presentation of Natural Resource Assets in Financial Statements**

No	Form of Gap	Valuation of Natural Resources	Presentation of Natural Resource Assets
1.	Mismatch of unit of account	In the valuation of natural resources, SEEA/SISNERLING uses ecosystem units or commodity reserves at the macro level.	Financial statements, in this case LKPP, require identifiable accounting units such as mining blocks, production permits, or forest concessions.
2.	Audit trail gap	SISNERLING data is calculated for statistical purposes and does not always provide adequate documentation of assumptions for audit trail requirements in public sector accounting.	The presentation of assets in the LKPP needs to be supplemented with evidence to facilitate the audit trail, so that the values presented in the financial statements can be checked for accuracy by auditors.
3	Value basis inconsistencies	There are limitations to the value basis in national practice, as PMK 173/2020 combines FV, NPV, and CRC generically.	IPSAS 46 and ED IPSAS 92 emphasize the selection of a value basis based on market characteristics and the availability of cash flow information.

Source: Processed by researchers (2025)

The three gaps mentioned in Table 1 show that the challenges of integrating natural resource valuation and presenting natural resource assets in financial reports are not merely technical issues, but also relate to methodological suitability and auditability, which to date have not been comprehensively discussed in the literature or national regulations. The lack of integration between natural resource data and

public financial reporting creates a gap between the fiscal benefits obtained and the decline in natural resource value due to exploitation. In fact, information on natural resource stocks is important to support fiscal accountability and sustainable development policies.

Previous studies have discussed natural resource valuation extensively, both globally and nationally. International studies highlight the importance of the fair value (FV), net present value (NPV), and current replacement cost (CRC) approaches to valuing natural assets (Christensen & Nikolaev, 2013; Souliotis & Voulvoulis, 2021; Nolander & Lundmark, 2024). Meanwhile, research in Indonesia is still limited to the valuation of certain commodities such as forests or waters, without explicitly linking them to public sector accounting standards (Jabbar et al., 2021; Sumarga et al., 2023; Talakua, 2019).

Based on this background, this study aims to formulate a consistent, auditable, and relevant basis for valuing and assessing natural resources to be presented in the LKPP and to bridge the international frameworks of SEEA, IPSAS 46, and ED IPSAS 92 with the national instruments of PMK 173/2020 and SISNERLING BPS. The novelty of this research lies in the development of an integrative measurement framework that links environmental-economic statistics with public sector accounting standards to support transparency and long-term fiscal sustainability in Indonesia.

## THEORETICAL REVIEW

### Public Financial Management (PFM) Theory

The theory of public financial management (PFM) emphasizes the importance of full integration in the state financial cycle—from planning, budgeting, implementation, to reporting. In this context, natural resources are an important part of government assets that have long-term economic benefits, so they must be reported to support fiscal transparency and accountability (Cuadrado-Ballesteros & Bisogno, 2022).

PFM provides legitimacy that natural resources need to be measured on a consistent and auditable basis so that financial reports reflect the fiscal position in its entirety. In addition, strong internal auditing (Nerantzidis et al., 2022) is an important element so that SDA valuation does not stop at technical calculations but functions as a tool for public accountability. Thus, the integration of SDA valuation into the PFM system strengthens the role of LKPP as a comprehensive report that describes the fiscal strength and long-term sustainability of the country.

### Valuation Theory

Valuation theory has its roots in economic and accounting traditions that were initially oriented towards historical cost, but since the 1990s it has developed towards fair value in order to increase the relevance of financial information. In the context of natural resources, the fair value (FV) approach is considered to best reflect actual economic conditions, but its application requires the existence of an active market and reliable data (Barth et al., 2014a). In addition to the market approach, there are two other commonly used approaches, namely the income approach and the cost approach. The income approach uses the net present value (NPV) mechanism to calculate the present value of cash flows from the utilization of natural resources, thereby providing a more comprehensive picture of a country's fiscal capacity

(Souliotis & Voulvoulis, 2021). Meanwhile, the cost approach uses current replacement cost (CRC) when the market is inactive or cash flow data is limited.

Several case studies on natural resource valuation, such as mangrove and forest valuation, show that the choice of method produces materially different values depending on cash flow assumptions, market availability, and technical parameters. Malik et al. (2015) used the replacement cost and benefit transfer methods to value mangrove ecosystem services. World Bank (2022) documented the costs of mangrove restoration in Indonesia and the variability of regional economic benefits. The Royal Institution of Chartered Surveyors (RICS), a professional body that develops knowledge and sets standards in the real estate industry, provides professional guidance on the differences between the Discounted Cash Flow (DCF)/NPV approach and the cost approach to forest valuation (RICS, 2023), as well as several contemporary studies analyzing the sensitivity of NPV to discount assumptions and cash flows (Knoke et al., 2020; Juvonen et al., 2024).

The following is an illustration showing the range of results between different methods: A mangrove area provides direct economic benefits/income equivalent to USD 200 per hectare per year for 30 years. Using a discount rate of 5% (a conservative example for public analysis), the net present value (NPV) of these benefits is approximately USD 3,074 per ha. In contrast, the average estimated replacement/restoration cost for mangroves in Indonesia is reported to be around USD 3,900 per ha (World Bank—Economics of Mangrove Conservation). In this example, CRC > NPV, which indicates that if the government uses CRC as the basis for valuation (conservative and auditable), the reported asset value could be higher than if only NPV were used based on the assumed benefit stream. However, if a lower discount rate is used (e.g., 3%) or the benefit stream is greater, NPV can equal or exceed CRC (NPV  $\approx$  USD 3,920/ha at  $r=3\%$ ). Therefore, the choice of value basis has a significant impact on the reported figures and must be balanced with data governance protocols and disclosure of assumptions.

These three approaches form the main framework for SDA valuation. The application of FV, NPV, and CRC in LKPP enables comprehensive measurement of the economic value of SDAs, so that financial reports not only show short-term revenue flows, but also SDA stocks as strategic assets of the state.

### **Natural Capital Theory**

Natural capital (NC) theory views natural resources as a form of natural capital that has economic, social, and ecological value (Costanza et al., 1997). This theory emphasizes that natural resources should be treated as capital stock that supports intergenerational well-being, not merely as production inputs. Through the concept of total economic value (TEV), the value of natural resources includes direct benefits (use value), indirect benefits (non-use value), option value, and existence value. This approach allows for a more comprehensive calculation of ecosystem benefits and environmental services, so that public accounting can reflect ecological costs and the risk of degradation. This theory forms the basis for the development of the System of Environmental-Economic Accounting (SEEA), which integrates the physical and monetary balance sheets of natural resources at the macro level. Many countries, such as the United Kingdom and Australia, have adopted SEEA and natural capital accounting (NCA) to assess environmental assets and improve the transparency of

public policy (Obst et al., 2015). In the Indonesian context, the integration of NC theory with public accounting standards is a strategic step towards achieving fiscal reporting that is oriented towards economic-ecological sustainability.

### **International Framework for Natural Resource Valuation**

The main international frameworks for natural resource valuation include the System of Environmental-Economic Accounting (SEEA) and IPSAS 46 and ED IPSAS 92. SEEA emphasizes the importance of integrating physical and monetary accounts for environmental assets and ecosystems. Through SEEA, countries can present information on natural resource stocks, such as forest area or mineral reserves, in physical units, then convert them into monetary values using consistent methods. These rules also provide guidance on how to record natural resource depletion and degradation, so that financial reports and national statistics can provide a more complete picture of fiscal sustainability. Meanwhile, IPSAS 46 and ED IPSAS 92 provide guidelines for recognizing and measuring natural resource assets in public sector financial reports based on control and economic benefits.

International practice shows that SEEA has been applied to various types of natural resource assets. Several European countries use SEEA to assess the condition of forests and their ecosystem services, including carbon sequestration and timber yields (JRC, 2017). In Australia, SEEA is applied to aquatic ecosystems so that the resulting balance sheet shows not only water stocks but also their economic benefits. In recent years, many countries have also begun to adopt the natural capital accounting (NCA) approach, which integrates economic and environmental values in the recording of natural resource assets. This approach has been shown to increase fiscal transparency and accountability, while providing a new framework for governments to design long-term economic value-based policies, including more effective environmental taxes (Edens & Hein, 2013; Obst et al., 2015; Vardon et al., 2016).

### **RESEARCH METHOD**

This study uses a structured literature review approach to examine the theory, practice, and standards of natural resource asset valuation in the context of public sector accounting. The literature search was conducted on several academic databases, including Scopus, Web of Science, JSTOR, and Google Scholar. The search used a combination of keywords such as “natural resource valuation,” “public sector accounting,” “IPSAS,” “SEEA,” “environmental asset recognition,” and “government financial reporting” with publications ranging from 2010 to 2024. This publication period was chosen because it covers the development of modern IPSAS, the 2012–2024 SEEA update, and the emergence of a new generation of natural capital accounting.

The inclusion criteria include: (1) academic publications, international accounting standards (IPSAS 46, ED IPSAS 92), statistical frameworks (SEEA 2021/2024), and national regulations (PMK 173/2020 and SISNERLING BPS publications); (2) containing natural resource valuation models or practices; and (3) being relevant to the context of public sector financial reporting. Meanwhile, exclusion criteria include publications that only discuss environmental valuation in a corporate context, do not provide an assessment approach that can be adopted by the government, or are not available in full text.

The screening process was carried out in stages, starting from initial identification, removal of duplicates, selection through abstracts, to full content assessment. The synthesis was conducted using a narrative-thematic approach, covering three main stages: (1) identification of concepts and value bases such as FV, NPV, and CRC; (2) comparison of the compatibility between international standards and national regulations; and (3) assessment of the implications of SDA implementation in LKPP, particularly in relation to auditability, methodological consistency, and fiscal relevance.

The results of this synthesis form the basis for the development of a hybrid assessment framework that integrates international approaches and national practices to support transparency and accountability in government financial reporting.

## **RESULTS AND DISCUSSION**

Literature findings confirm that natural resource valuation is not merely an option, but part of accounting practices that support long-term fiscal accountability. SEEA emphasizes the importance of integrating physical and monetary balance sheets in natural resource management. Under this rule, every natural resource stock, such as forests, minerals, or water, is not only calculated in physical terms, but also converted into monetary value using consistent methods. This makes SEEA an internationally recognized standard for measuring the sustainability of environmental assets. IPSAS 46 and ED IPSAS 92 then extend the results of SEEA's application to the realm of public sector accounting. IPSAS emphasizes that natural resource assets can be recognized in government financial statements if the government has control and economic benefits or potential services from these assets. The literature shows that the most commonly used value basis is FV if an active market is available, NPV for natural resources that generate economic benefit flows, and CRC if the market is inactive. Thus, IPSAS provides a conceptual basis that natural resource valuation is not merely a statistic, but should be part of government financial statements.

From a methodological perspective, both SEEA and IPSAS recognize the variety of value bases that can be used. FV is prioritized for use if an active market for natural resources is available, NPV is used if the asset generates an income stream from the estimated utilization of natural resources, while CRC is used when the natural resources market is inactive or income data from natural resources is difficult to obtain. This choice provides flexibility, but also requires consistency and a strong audit trail.

International practice shows that SEEA and IPSAS can be applied concurrently. Australia uses SEEA for aquatic ecosystem valuation, while its fiscal reports integrate this data for fiscal sustainability analysis. In addition, several countries have begun to introduce a natural capital accounting (NCA) approach that incorporates the value of natural resources into national financial reports. NCA has been shown to increase fiscal transparency and accountability while providing a more comprehensive understanding of the long-term economic impacts of natural resource exploitation (Dasgupta, 2021; Edens & Hein, 2013; Vardon et al., 2016). This shows that integration between concepts is not impossible.

In Indonesia, findings show that Indonesia already has the institutional foundation to support natural resource valuation, although its implementation is still

limited. BPS, through SISNERLING, has presented physical and monetary accounts for several strategic commodities, such as coal, oil, gas, and timber. This report follows SEEA standards, so it is methodologically in line with global practices. However, SISNERLING is more geared towards macro statistics and policy purposes, rather than government accounting reports. Meanwhile, the Directorate General of State Assets (DJKN) through PMK 173/2020 has regulated the use of market-based, income-based, and cost-based valuation approaches as the main basis for natural resource valuation. This policy demonstrates a normative recognition that natural resources can indeed be valued as state assets. However, its application to date has been limited to non-natural resource assets, so that natural resource valuation has not been fully adopted into government financial reports.

This comparison shows a gap, in that at the international level, SEEA, IPSAS, and NCA already emphasize the integration of natural resource valuation into government accounting systems. Meanwhile, in Indonesia, SISNERLING and DJKN regulations still run in parallel without an integration mechanism into LKPP. Existing natural resource information has not been optimally utilized for fiscal accountability purposes. This is due to the difference in orientation between SISNERLING and LKPP. SISNERLING focuses on macro statistics, while LKPP requires auditable accounting units. In addition, inter-agency coordination between DJKN, BPS, the Ministry of Energy and Mineral Resources (ESDM), and the Ministry of Environment and Forestry (KLHK) still requires a more solid mechanism to synchronize definitions, assumptions, and assessment methods.

Another obstacle is the difference in units of analysis (unit of account). SEEA uses ecosystem units or natural resource reserves at the macro level, while LKPP requires auditable accounting units such as mining blocks, forest concessions, or production permits. Without compatibility in units of account, integrating SISNERLING data into LKPP is difficult to do directly. Furthermore, limitations in price and cost data are also major obstacles in implementing natural resource valuation methods. In the mineral sector, for example, market prices fluctuate, while production cost data is often not widely available. This condition makes SISNERLING tend to use average estimates, which are not always in line with audit-based accounting requirements. From an accounting perspective, LKPP requires consistency, auditability, and compliance with standards, so that the process and results of natural resource valuation must be verifiable by auditors with clear assumptions and methods. Meanwhile, SISNERLING places greater emphasis on statistical consistency, so that its audit trail is insufficient for accounting purposes.

Despite these various constraints, the integration of the natural resource balance sheet produced by SISNERLING BPS with the valuation provisions applied by DJKN remains an opportunity for the natural resource accounting process at LKPP. Physical data on SDA assets from SISNERLING can be used as a basis for calculation, while the valuation regulations issued by DJKN provide a framework for determining the basis for the value of SDA assets. If these two approaches are combined, the results of SDA valuation can be more comprehensive and SDA assets can potentially be presented in LKPP.

**Table 2. Natural Resource Valuation Methods**

Method	Value basis	Advantages	Limitations	Relevance to LKPP
Fair value (FV)	Current market value	Transparent; easy to understand; relevant for natural resources with active markets	Not all natural resources have active markets; high volatility	Suitable for commercial natural resources (oil, mining)
Net present value (NPV)	Present value of cash flows	Captures long-term service potential	Requires reliable price and cash flow data	Relevant for productive natural resources (HPH, oil and gas)
Current replacement cost (CRC)	Cost of replacing natural resource function	Good auditability; conservative; useful when market and cash flow data are unavailable	Conservative, easy to audit	Suitable for non-market natural resources (forests, ecosystems)
Total economic value (TEV)	Value of use & non-use	Comprehensive, including environmental services	Complex; difficult to audit	Useful for Notes to the Financial Statements (CaLK) disclosure
Hybrid (FV-NPV-CRC)	Combination based on data availability	Flexible; can be aligned with audit trails & official statistics	Requires neat protocols & data governance	Most suitable for the Indonesian context

Source: Processed by researchers (2025)

As a practical illustration, here is an example of coal reserve valuation using the NPV and CRC valuation methods. It is known that there are 10 million tons of coal reserves with a recovery or production efficiency of 80% (8 million tons saleable). The production period is 10 years. Assuming an average market price of US\$50/ton, operating costs of US\$20/ton, royalties of 5%, initial investment of US\$50 million, and a discount rate for fiscal valuation of 8%, the cash flow calculations for different value bases are as follows:

#### **Net Present Value (NPV)**

With an annual production of 800,000 tons, the net cash flow before corporate tax is US\$22 million/year. With a discount rate of 8%, this results in a PV cash flow of US\$147.62 million and an NPV of approximately US\$97.62 million. Under the assumptions described in the illustration, coal reserves with linear production, stable prices, stable costs, and no corporate tax show a positive NPV of US\$97.62 million. This means that from a discounted cash flow valuation perspective, this asset has positive value for its owners, although this figure is highly sensitive to assumptions about price, cost, and discount rate.

#### **Current Replacement Cost (CRC)**

CRC does not represent the value of the mineral reserves themselves, but rather focuses on the cost of replacing infrastructure. Assuming the estimated cost to replace infrastructure such as mine roads, fluid facilities, heavy equipment, and so on is US\$



30,000,000 and the accumulated depreciation is 30%, the net CRC for coal reserves of 8 million tons is US\$ 21,000,000 or US\$ 2,625/ton.

The above illustration confirms that: (1) NPV is suitable for capturing the economic value of reserves that generate cash flows; (2) CRC is relevant for assessing replaceable physical components; and (3) sensitivity analysis of price, discount rate, costs, and environmental liabilities is absolutely necessary before entering values into the LKPP. In financial statements, CRC is more often used to assess fixed assets related to natural resources, while the value of mineral reserves is often assessed using the income (NPV) or fair value approach.

In terms of auditability, the natural resource valuation methods in Table 2 show varying levels of auditability. The FV method with a high level of auditability is used by Australia for natural resource concessions and Canada for mining taxes (Christensen & Nikolaev, 2013). In the NPV method, auditability depends on the quality of assumptions. This method is used by Canada and Norway for oil and gas valuation and royalties (Souliotis & Voulvoulis, 2021). The CRC method with high auditability is practiced in Sweden for forest and ecosystem service valuation (Nolander & Lundmark, 2024). Meanwhile, the TEV method with low auditability due to high uncertainty is used by the European Union for ecosystem service and conservation policies (Barth et al., 2014a; Ignatyeva et al., 2022).

The natural resource valuation methods in Table 2 show that a single approach is insufficient to capture the complexity of natural resources. Hybrid models with SEEA integration provide a balance between the relevance and reliability of reports.

**Table 3. Summary of Supporting Theories**

Theory	Focus/Main Idea	Advantages	Limitations	Relevance to LKPP
Natural Capital Theory	Natural resources are treated as economic, social, and ecological capital	Captures intergenerational benefits	Valuation is difficult without a market	Highly relevant to natural resource stock balance sheets
Sustainability Accounting Theory	Integration of economic-environmental aspects	Promotes green fiscal policy	Public regulations and environmental data are often limited	Supports Green GDP & fiscal transparency
Environmental Accounting Theory	Recognizes ecological impacts in accounting	Expands the role of public accounting	Challenges in measuring degradation	Relevant to Notes to the Financial Statements LKPP
Environmental Accounting System Theory	Integration of physical-monetary accounts of natural resources.	Supported by global standards (SEEA); transparent.	Complex implementation	Synchronization of SAP-IPSAS-SEEA

Sources: Dasgupta (2021), Gray (2010); Bebbington & Larrinaga (2014); Suwanto et al. (2020), (Schaltegger & Burritt, 2000); (Deegan, 2017); United Nations (2021); Obst et al. (2015), processed

The four theories listed in Table 3 form the conceptual basis for integrating natural resources into government financial reports. The summary of the Natural Capital, Sustainability, Environmental, and Environmental Accounting System theories emphasizes the conceptual basis that supports the recognition, measurement, and reporting of natural resources. Table 3 also illustrates that the issue of valuation is not only technical but also inherent in the theoretical perspective that strengthens the legitimacy of natural resource accounting.

**Table 4. Comparison of SEEA-NCA-IPSAS**

Aspect	SEEA	NCA	IPSAS 46/ ED IPSAS 92
Fokus	Environmental-economic statistics standards	Natural capital policy framework	Public sector accounting standards (entities)
Main objective	Integration of physical & monetary accounts of natural resources/ecosystems for statistics & macro analysis	Sustainability assessment	Recognition, measurement, presentation, disclosure of natural resource assets
Unit of Analysis	Ecosystem/commodity	Class of ecosystem assets and services	Assets controlled by entities (mining blocks, permits)
Asset recognition	Does not recognize entity accounting; compiles national accounts	Does not regulate entity recognition; guides value priorities	Determining when to recognize as entity assets
Value basis & techniques	Consistent valuation for national accounts (market, NPV, replacement, etc.)	Emphasizing TEV/ecosystem for policy relevance	Establishing audited value basis + documentation of assumptions
Output	Balance sheet, depletion, degradation, ecosystem services (time series)	Value priority map, natural capital indicators, policy options	Balance sheet, Operational Report (LO)/SALK, Notes to Financial Statements (CaLK) in Central/Local Government Financial Statements (LKPP/LKPD)
Strengths	Statistical consistency	Policy & budgeting relevance	High auditability
Limitations	Cannot be directly audited	Does not define entities & audit trail	Requires strong data
Relevansi di Indonesia	BPS (SISNERLING)	Bappenas/Ministry of Finance	DJKN, DJPB, BPK, KSAP

Role for LKPP	Source of consistent stock & flow figures (comparison, CaLK)	Policy context and fiscal sustainability indicators	Figures recognized/ measured in financial statements (value basis, disclosure)
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Source: Processed by researchers (2025)

Table 4 confirms that SEEA and IPSAS complement each other. SEEA provides physical and monetary data, while IPSAS provides the basis for asset recognition. The combination of the two can be an integrative solution for LKPP. From the overall data in the table, it can be concluded that there is a clear gap between global and Indonesian practices. At the international level, the SEEA and IPSAS frameworks have been used to integrate natural resources into financial reports, while in Indonesia, SISNERLING and DJKN regulations still run in parallel without an integration mechanism into LKPP. Empirical studies in Indonesia show great potential, for example, the valuation of mangrove ecosystem services in Jakarta (Sumarga et al., 2023) and the study of the value of peat ecosystem services in Riau (Yunus et al., 2024).

Based on the analysis of SEEA and IPSAS integration, the integration of SEEA BPS data with DJKN regulations has the potential to produce an auditable natural resource valuation framework. Physical data from SEEA can be used as the basis for calculating asset value using NPV or CRC, depending on data availability. This approach requires harmonization of methodologies between agencies, standardization of units of account, and well-documented audit trails. If implemented, the results can improve the quality of LKPP as a report that not only displays revenue flows but also natural resource stocks that support long-term fiscal capacity.

The recommended strategic steps are:

1. Develop technical guidelines for natural resource valuation based on IPSAS and SEEA;
2. Establish a cross-agency coordination mechanism between the DJKN, BPS, KHLK, and BPK;
3. Conducting a trial valuation of natural resources for priority commodities; and
4. Including information on natural resource stocks in the Notes to the Financial Statements as a preliminary step before full recognition.

**Research Implications**

**Practical Implications**

This research provides practical implications in the form of the need to strengthen the natural resource assessment mechanism so that the valuation results can be directly utilized in the preparation of the LKPP. Natural resource valuation can be used in the preparation of the LKPP by combining SISNERLING and PMK 173/2020 data. For auditors, in this case the Supreme Audit Agency (BPK), this strengthens the auditability of financial reports, while for the Ministry of Finance, the valuation results become the basis for fiscal policies based on state assets.

**Theoretical Implications**

This study enriches the public sector accounting literature by introducing the concept of NRR valuation based on FV, NPV, and CRC, which is in line with natural capital accounting. Until now, public sector accounting literature has tended to focus on cash flows, such as non-tax state revenue, without presenting natural resources

stocks as long-term resources. International studies confirm that valuation has evolved from a historical basis to fair value and total economic value, enabling the integration of ecosystem services into public accounting (Ignatyeva et al., 2022). Recent literature also highlights the importance of the spatial dimension in the valuation of forests and their ecosystem services (Nolander & Lundmark, 2024), as well as the limitations of the ecosystem services market, which requires regulatory support (Bruzzeze et al., 2023).

In addition, a number of studies emphasize that more accurate recording of natural resources can support sustainable fiscal planning while preventing overexploitation (Helm, 2020). Transparency in reporting natural resource assets has also been shown to increase public confidence in government economic policies and strengthen the legitimacy of fiscal governance (Lennox & Francis, 2008). In a broader context, transparency in reporting the value of natural assets is believed to strengthen long-term budget planning and increase investor confidence in government financial governance (Barth et al., 2014b).

By integrating SEEA and IPSAS into the Public Financial Management (PFM) Theory and Valuation Theory frameworks, this study shows that natural resources can not only be valued but also need to be explicitly recognized in government balance sheets. This contribution expands the scope of public accounting from a mere orientation towards short-term cash flows to the presentation of natural resources as strategic stocks that support fiscal sustainability. Thus, the results of this study confirm that the development of more comprehensive accounting standards is urgently needed in order to further improve the transparency and accountability of government financial reports.

### **Policy and Institutional Implications**

The results of this study also have important implications for policy formulation, particularly the need for regulatory harmonization between Government Accounting Standards (SAP), DJKN regulations, and the BPS statistical framework so that natural resource data can be effectively integrated. Without harmonization, the results of natural resource valuation may be difficult to adopt in the LKPP due to differences in methodology and unit of account definitions. A study on mangrove management in Indonesia confirms that weak coordination and diverse approaches can undermine the utilization of valuation results in national policy (Arifanti et al., 2022). Therefore, a more structured inter-agency coordination mechanism is needed, with the formation of a joint working team consisting of BPS, DJKN, the Ministry of Energy and Mineral Resources, and the Ministry of Environment and Forestry.

PMK 173/2020 and SISNERLING, which serve as the regulatory and statistical basis for natural resource valuation, cannot be fully integrated into the LKPP without methodological harmonization and institutional coordination. Furthermore, regulations such as PMK 173/2020 need to be strengthened to explicitly regulate the recognition of natural resources as state assets with reference to IPSAS standards, so that natural resource valuation becomes a valid part of the national accounting framework. The government can start with a pilot project on natural resource valuation (e.g., proven coal reserves) to test the feasibility of the method and institutional coordination.

## Long-Term Implications

The long-term implication of this study is an improvement in the quality of the LKPP as a more comprehensive government financial report. With the valuation of natural resources, the LKPP not only shows short-term revenue flows but also provides an overview of future fiscal capacity through information on stocks and depletion. This will strengthen the transparency, accountability, and legitimacy of state financial management in the eyes of the public and international stakeholders. International studies show that natural capital accounting can significantly support the formulation of more sustainable public policies (Souliotis & Voulvoulis, 2021; Stewart et al., 2022). These findings are consistent with efforts to mainstream forest ecosystem services in development policies in Indonesia (Nugroho et al., 2022). Thus, natural resource valuation is not merely a technical agenda, but a strategic step to ensure fiscal sustainability and equitable development across generations.

## CONCLUSION

This study confirms that the recognition and measurement of natural resource assets in government financial statements are essential to reflect a comprehensive and sustainable fiscal position. The results of the study show that a hybrid valuation approach—combining fair value (FV), net present value (NPV), and current replacement cost (CRC)—is the most appropriate method for the Indonesian context because it balances economic relevance and auditability.

The UN's SEEA framework can be integrated with IPSAS 46/ED IPSAS 92 to provide a basis for recognizing NRA assets in line with international practices. Meanwhile, national regulations such as PMK 173/2020 and SISNERLING BPS already provide a technical foundation, although institutional harmonization is still needed so that valuation results can be directly used in the preparation of LKPP.

Several strategic steps are recommended, such as developing technical guidelines for natural resource valuation, establishing inter-agency coordination mechanisms, conducting natural resource valuation trials, and disclosing natural resource stock information in the CALK. With these steps, Indonesia is expected to improve fiscal transparency, accountability in natural resource management, and public trust in state asset governance. In addition, the integration of natural resource valuation will help the government assess long-term fiscal capacity more realistically, support green economic development, and strengthen the country's fiscal position in the transition to sustainability.

This study has limitations because it is still conceptual and literature-based, so it has not empirically tested the application of specific valuation methods to specific natural resource cases in Indonesia. The data used only comes from secondary reports such as SISNERLING, DJKN regulations, and international documents, without direct verification at accounting units in the field or numerical comparisons across valuation methods (FV, NPV, and CRC) with actual numerical data. Therefore, further research that is more applicable and based on primary data, comparative testing of valuation methods for a specific type of natural resource, and adaptation of the principle of conservatism to natural resource dynamics are important to strengthen the reliability and relevance of natural resource reporting in the LKPP.

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