Safeguarding our roots: natural resources accounting and reporting in the public sector

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Abstract

Purpose – This study aims to explore natural resources from a public sector accounting perspective, focusing on their definitions, classifications, recognition criteria and disclosure requirements provided by different standard-setters and regulators at both international and national levels.

Design/methodology/approach – By reviewing accounting frameworks for natural resources, this study extrapolates accounting dilemmas around the debate on natural resource accounting, using the dialogic accounting perspective as a theoretical framework.

Findings – Natural resources cannot be defined as a single category. Various categories have different characteristics, requiring different standards to recognize multiple orientations. This avoids monetary reductionism. Furthermore, uncertainty, both in existence and measurement, may disqualify some of these resources from being considered assets. Perhaps, concentrating on the flow of services derived from natural resources is better than focusing on their valuation. This may lead to a split-asset approach (flows and underlying assets) for certain resources. This study's findings indicate that public-sector entities should consider preparing a separate non-financial report regarding the management of natural resources with the objective of maintaining inter-generational equity.

Originality/value – This study contributes to the debate on natural resources from an accounting and reporting perspective, highlighting the importance of holding public-sector entities accountable for the use of natural resources.

Keywords Natural resources, Dialogic accounting, Public sector, Monetary reductionism, Existence uncertainty, Measurement uncertainty

Paper type Research paper

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1. Introduction

The environment has been facing significant challenges, which are recognized at local, national and global levels. The UN issued sustainable development goals (SDGs) to address this and other related issues, and several global agreements have been reached, aiming to limit the negative impact of human activities on climate and biodiversity. Environmental accounting is an essential step towards meeting the challenges of sustainable development (Obst and Vardon, 2014). This study explores natural resources (NRs) from a public-sector accounting perspective, focusing on their definitions, classifications, recognition criteria and disclosure requirements.

Public-sector entities often have a blurred understanding of the state and value of NRs in their jurisdictions despite these resources having significant economic and societal considerations. Natural resources accounting (NRA) has gained momentum in recent years (Dabbicco, 2021; Zhu *et al.*, 2021); currently, several standard setters have taken initiatives to prepare specific guidance for the accounting and reporting of NRs. Accounting for NRs is believed to enable citizens to appreciate and understand the services provided by the natural environment and used in our economies; it also allows stakeholders to track the changes in NRs over time, making it possible to assess the impact of NRs' strategies and policies implemented by public-sector entities (Dasgupta, 2021). The World Bank (2022) also emphasizes that governments can use natural capital accounting as a tool to measure their NRs better and subsequently integrate them into national planning and development decisions. Recently, International Public Sector Accounting Standards Board (IPSASB) has taken the initiative to release a consultation paper (IPSASB, 2022) that considers the issues relating to the recognition, measurement and presentation of NRs by public-sector entities.

The complexity and novelty of this topic deserve a broad conceptual and practical approach. Private and public sector reporting on NRs differs significantly; to date, the discussion seems to revolve around analysing, which alternative best fits the public sector. Extensive literature discusses the advancement and role of NRs from an economic perspective (Obst, 2015; Obst and Vardon, 2014). Specific standards and frameworks, such as the system of environmental-economic accounting – ecosystem accounting (SEEA-EA), have recently been scrutinized (Edens *et al.*, 2022). Building on seminal papers on environmental accounting and reporting (Ball, 2005; Marcuccio and Steccolini, 2005), specific environmental issues such as water management (e.g. Hossain *et al.*, 2023) have been investigated, frequently using institutional isomorphisms as a theoretical lens (e.g. Che Ku Kassim *et al.*, 2022). Vinnari and Laine (2013) critically discussed motivations for the "diffusion and decline" of environmental reporting. Nevertheless, scarce studies compare frameworks that account for NRs to draw out any critical differences. Academics and practitioners have recognized a substantial gap in the literature on the development of a suitable reporting framework for NRs from a public-sector accounting perspective (Dabbicco, 2021), which would help to establish clear and consistent disclosures and metrics for mainstream reporting (Elliott and Elliott, 2011).

This study is exploratory because it concerns ongoing developments in public-sector accounting for NRs. Based on the public-sector literature on accounting for NRs, this study compares and analyses definitions and approaches provided by different standard setters and regulators and reflects on several possible characteristics of NRs to identify, which characteristics are potentially useful in defining them. Using existing documentation, guidance and statistical standards at the national and international levels as references, this study aims to address the following research questions. *RQ1: How can NRs be defined and classified from an accounting perspective? RQ2: Should NRs be recognized as public-sector assets? RQ3: Which measurement bases could be adopted, and which disclosures can be*

provided? Considering the interdisciplinary nature of NRs, these research questions refer to calculative practices related to the definition and classification of financial statements' elements, recognition criteria and measurement bases. Accordingly, this study's theoretical framework is based on a dialogic accounting perspective (Brown, 2009; Brorström, 2023; Grossi *et al.*, 2021), considering accounting as a communicative technology, to stimulate discussion and debate regarding environmental issues (Gaia and Jones, 2017; Lehman, 1999; Pallot, 1992; Thomson and Bebbington, 2005).

Section 2 presents the scientific background by reviewing the previous literature, depicts the study's framework and states the research questions. This is followed by a description of the research methods (Section 3) and results (Section 4), which are discussed in Section 5, along with concluding remarks.

2. Background

The sustainable development agenda and the rapid decline in biodiversity necessitate more accurate information on NRs (Jones, 2003), including information on their economic value (Dabbicco, 2021; Hartel, 2003). Kaplan and Ramanna (2022) emphasize the relevance of this issue, although they critically discuss the greenhouse gas protocol, which allows organizations to use average data, rather than specific and traceable data. The taskforce on nature-related financial disclosures (TNFD, 2023) emphasizes that environmental issues should be included in strategy, risk management and capital allocation decisions, recommending *ad hoc* disclosures. Scholars have investigated environmental and social/sustainability reports (Ball, 2005), scrutinizing the motivations for preparing such reports voluntarily (Marcuccio and Steccolini, 2005). Using institutional isomorphism and legitimacy strategies as a theoretical framework and mainly adopting qualitative methodologies, these studies document the relevance of socio-economic and technical factors. Policymakers, government research groups and academics are producing a growing body of literature on NRA (Dasgupta, 2021; Helm, 2019). However, little attention has been paid to the definition and measurement of NRs, and integrating the environment with economic analysis has been hampered by the almost complete absence of proper accounting for natural assets (Natural Capital Committee, 2014).

Missemer (2018) emphasized the controversial uses of the "natural capital", concept, which refers to "natural resources"; or is "perceived" as NRs in terms of value, representing a monetary valuation. Economists tend to refer to NRs generically as natural capital or environmental assets, sometimes using these expressions interchangeably (Dasgupta, 2021). Following Recuero Virto *et al.* (2018), natural capital can be categorized into geophysical capital (abiotic goods and services) and ecosystem capital (biotic goods and ecosystem services). Generally, NRs are classified into two subcategories: renewable resources (such as fisheries) and nonrenewable resources (such as fossil fuels and minerals). Other approaches define natural capital/resources by referring to components of the natural environment that can be used to generate income, goods or services (Barbier, 2011), producing (directly or indirectly) value for people, including ecosystems, species, freshwater, land, minerals, air and oceans, as well as natural processes and functions (Bright *et al.*, 2019; Natural Capital Committee, 2014). Other common classifications distinguish between living/non-living and critical/non-critical resources (Jones, 2003).

The different definitions proposed may depend on the conceptual perspectives used. For instance, according to a general and widely accepted definition, NRs comprise items that exist without human actions/interventions. The IPBES (2022a) proposed adopting a broad perspective, as nature refers to the non-human living world, including the scientific categories of biodiversity, ecosystem structure and functioning, evolution, biosphere,

humankind's shared evolutionary heritage and biocultural diversity. However, from an accounting perspective, a more formal definition is required, which, in turn, may depend on the literature stream to which the research refers (Hussain *et al.*, 2016): national, financial and management accounting [1].

Focusing on the national accounts stream, frameworks on natural capital/resource accounting and related issues concerning the economic evaluation of NRs were developed by the UN Nations' SEEA-EA. Natural capital accounts should be incorporated into the macroeconomic surveillance undertaken by international financial institutions to stimulate governments' reform agendas to safeguard NRs. This could also lead to a revision of traditional economic measures, considering NRs as important as produced and human capital (Dasgupta, 2021).

Recent research provides an overview of the many initiatives and policy commitments in natural capital/resource accounting (Recuero Virto *et al.*, 2018). In 2019, the Oxford Review of Economic Policy dedicated a special issue to natural capital (Helm, 2019), supporting the advance of a critical review of the concept. A study in the UK Government context highlights that natural capital is relevant to many of the UN's SDGs, underlining the need to develop natural capital accounts and related statistics for the UK (Bright *et al.*, 2019).

The financial accounting literature discusses issues related to the inclusion of NRs in financial statements. On the one hand, NRs are "public goods", characterized by the lack of a market; therefore, in most cases, they do not generate revenue (Barton, 1999). On the other hand, NRs are measurable under certain circumstances, and they can be included in financial statements (Costanza *et al.*, 2014). Both positions emphasize the need to hold public-sector entities accountable for the ownership and use of NRs – more generally, to provide information regarding environmental strategies and policies implemented, as well as outcomes achieved (Siddiqui, 2013). Public-sector entities have a moral duty to maintain NRs (Gaia and Jones, 2017) for future generations. In this vein, adopting an open-minded approach towards the different values of nature can support decision-making processes affecting NRs and their contributions to people in diverse contexts, including economic (e.g. investment, production and consumption), political (e.g. recognition of individual and collective rights and duties) and sociocultural (e.g. forming, maintaining or changing people's sociocultural identities) decisions (IPBES, 2022b). Therefore, environmental information is expected to support both internal and external stakeholders' decision-making processes. However, the lack of political interest and support could impede the use of this kind of information (Recuero Virto *et al.*, 2018), obstructing the accountability expected from public-sector entities. Scholars (e.g. Ball *et al.*, 2012; Burritt and Welch, 1997; Gray and Jenkins, 1993; Pallot, 1992; Parker and Gould, 1999) have promoted a communitarian approach to accountability, related to the provision of environmental and biodiversity information.

2.1 Theoretical framework and research questions

A communitarian approach towards accountability emphasizes shared values and trust among different stakeholders. This implicitly suggests developing a dialogue with citizens and stakeholders based on a dialogic accounting perspective (Brown, 2009; Grossi *et al.*, 2021) that considers accounting numbers as a possible arena for debate (Cohen, 2022). Accounting is considered a communicative technology that can stimulate discussions and debates on environmental issues (Gaia and Jones, 2017; Lehman, 1999; Pallot, 1992; Thomson and Bebbington, 2005). Therefore, calculative practices are of specific interest when analysing emerging practices for NRs (Brorström, 2023).

Translating sustainability reporting ambitions into practice can lead to several difficulties (Lamberton, 2000; Marcuccio and Steccolini, 2005). Therefore, following Cohen (2022), this study attempted to translate theoretical frameworks into concrete tools and techniques for both information generation and presentation to assess users' needs, moving beyond the mere compilation of accounts to the use of accounting data in decision-making processes (IPBES, 2022b). Valuation, including the selection of appropriate methodologies, is in part determined by power relations in society that influence what values of nature are recognized and how equitably the benefits and burdens arising from these decisions are distributed (IPBES, 2022a, 2022b). Nonetheless, the impact of organizational activities on the environment cannot be operationalized, and calculative technologies could limit the representation of the use of NRs and the impacts of strategies and policies implemented by public sector entities on the environment. Accordingly, Table 1 proposes the application of the various principles of dialogic accounting to NRA (as discussed in Brown, 2009).

The literature on recognition criteria, monetization and measurement techniques for NRs is sparse. This lacuna has not limited international and national standard setters from considering NRA. In this scenario, the IPSASB's Consultation Paper (2022) was timely and instigated an in-depth debate on NRA across the accounting profession. Referring to calculative practices related to the definition and classification of financial statements' elements, recognition criteria and measurement bases, this study engages with the public-sector accounting literature for NRs and examines and compares the definitions and approaches provided by several standard-setters and regulators at the international and national levels.

The first step in defining and classifying items is crucial, although it is often overlooked. The prerequisite of a process aimed at identifying which items can be considered assets is the development of an asset information register that allows classifying assets (Salah and Bisogno, 2023). Referring to a natural inventory model, Jones (2003) proposed a classification based on the critical nature of NRs, while Siddiqui (2013), using biodiversity accounting, documented the importance of having a complete inventory of natural assets to answer the

Principle of dialogic accounting	Application to NRA
Recognize multiple ideological orientations	Need to discuss conflicting positions regarding the definition of NRs, natural capital, environmental assets and their classification
Avoid monetary reductionism	Need to provide narrative information through enhanced disclosures
Be open about the subjective and contestable nature of calculations	NRA aims to provide information on environmental issues reducing information asymmetry
Enable accessibility for non-experts and ensure effective participatory processes	Enhancing narrative disclosures allow non-experts to understand environmental information, encouraging their active participation
Recognize the transformative potential of dialogic accounting and be attentive to power relations	NRA encourages stakeholders to be more reflective about strategies/policies implemented and the results achieved relating to the environment, reducing the risk of being subject to powerful elites
Resist new forms of monologism	NRA should not adopt "window-dressing" policies when providing environmental information

Source: Adapted from Brown (2009)

Table 1. Principles of dialogic accounting applied to NRA

stakeholders' demand for greater environmental stewardship and accountability. Therefore, the first research question is as follows:

RQ1. How can NRs be defined and classified from an accounting perspective?

The second step was asset recognition. The concept of an asset is central in public-sector accounting (Caruana *et al.*, 2023), because assets used in the public sector are rarely revenue-generating, compared to those used in the private sector. Assets are used for their ability to assist a public-sector entity in achieving its objectives, namely, providing services to citizens. Accordingly, the concept of "service potential" has been introduced to define public-sector assets, although this approach has been subject to debate.

An alternative viewpoint restricts the concept of assets to business-like governmental assets (Christiaens, 2022), as they provide economic benefits to the entity. Consequently, schools, hospitals, heritage items, military equipment and many NRs, should not be considered assets, as the services they provide flow directly to citizens and not to the entity itself. While this approach can be considered internally coherent, it implies focusing only on the ability to generate *economic benefits* and excluding *service potential* from the attributes that an item should have to qualify as an asset in the public sector (Anessi-Pessina *et al.*, 2022). Consequently, many government assets would be removed from the balance sheets. Conversely, emphasizing the importance of service potential, which is coherent with the fundamental mission of public-sector entities (Pallot, 1992), would allow the consideration of NRs as assets for their possible inclusion in the balance sheet.

Considering the different definitions and classifications of NRs, their recognition as assets cannot be assumed. On the one hand, NRs could be considered assets whose monetary value should be assessed using the conventional measurement criteria (Costanza *et al.*, 2014). A gap exists in this respect, as few studies have been conducted on the economic benefits of NRs (Dabbicco, 2021) and their relevance to decision-making processes (IPBES, 2022a, 2022b). On the other hand, if NRs are not assets, extensive use of narratives in environmental reports can be hypothesized, for instance, to represent "biodiversity values" (Gaia and Jones, 2017), postulating that biodiversity supports our economy by providing a wide range of materials derived from plants and animals useful for several industrial sectors. Therefore, this study investigated the following research question:

RQ2. Should NRs be recognized as public-sector assets?

The recognition of an element in financial statements depends on two criteria:

(1) meeting the definition of that element (an asset, in this case); and

(2) the item can be measured in a way that meets the qualitative characteristics required from the information included in the financial statements.

These recognition criteria also apply to NRs, leading to the third issue: selecting appropriate measurement bases.

Measurement in accounting is a difficult topic; to date, it has been discussed principally in the private sector. Scholars and standard setters have devoted more attention to this topic as the implementation of accrual accounting systems emphasized the need for relevant and reliable measurement bases (Caruana *et al.*, 2023). This need is even more intense when measuring NRs, whereby there are frequently no exchange transactions or market values. Furthermore, as IPBES (2022a, 2022b) has highlighted, different values can be attached to NRs depending on the objective of the valuation, meaning that value pluralism should be considered rather than a value-monism approach (Hartel, 2003). When assets cannot satisfy

the recognition criteria, it appears appropriate to refer to NRs in disclosures by providing their non-financial information. Therefore, assets are not overlooked and are managed properly. Accordingly, the third research question was as follows:

RQ3. Which measurement bases could be adopted, and which disclosures can be provided?

3. Research method

The research method is based on a manual content analysis (Prior, 2003; Robson, 2011; Flick, 2015) of consultation papers, exposure drafts, accounting standards, proposals, regulations, conceptual reports and guidance related to NRA and reporting. These documents were selected based on their international relevance and availability. They were retrieved from the websites of both international and national organizations [2] (i.e. standard setters and governmental entities). The choice of countries referred to in this study does not follow a particular pattern, but is the result of a systematic search [3]. It is also based on observed participation in supranational forums (e.g. Lithuania participates in the European Public Sector Accounting Standards working group). An important limitation of this study is that, at the time of the research (2022–2023), several countries (for example, Italy and France) appeared to have only just started considering the design of standards related to NRA.

Content analysis was aimed at scrutinizing each document according to this study's research questions (Prior, 2003; Robson, 2011; Flick, 2015). Two authors first examined the documents to establish their nature, applicability, status and whether the requirements were voluntary or compulsory. The first categorization step is presented in Table 2. Sometimes, it was difficult to identify whether the requirements in a standard or proposal for an NRA were compulsory or voluntary. Legal requirements were assumed to be compulsory.

Each document was then analysed in detail to extract the definitions of NRs and the scope of such definitions, recognition criteria for NRs, including measurement and valuation methods and disclosure requirements. The other two authors examined the developed categorization, which is elaborated based on the analysis results. Several meetings were organized to discuss the categorization and related analysis of each document, considering the scientific background of this study. All the authors agree on the outcome, as illustrated in the following section.

Table 2 lists the documents examined in this study [4].

Several reports (both financial and non-financial) that contained NR information were accessed. However, some documents could not be analysed according to our *RQs* because no explanation was available. Therefore, they were excluded from the study. In addition, several documents issued by private-sector standards setters (such as the international accounting standards board and sustainable accounting standards board), as well as recommendations and proposals released by professional accountancy bodies (such as the Association of Chartered Certified Accountants and the Chartered Institute of Management Accountants) were also taken into account, as they pose important arguments for consideration; however, the focus of this study is on public-sector accounting.

4. Findings

The findings are discussed according to three macro-themes that reflect the three research questions: definition and scope (*RQ1*), recognition criteria (*RQ2*) and valuation methods and disclosures (*RQ3*).

Table 2.
Natural accounting frameworks and standards

Organization	Document	Type of document	Level of government	Status	Voluntary/ compulsory
International organizations					
IPSASB	CP, *Accounting for Natural Resources (2022)*	Consultation paper	Public entities	Issued and closed during 2022. In Dec. 2023, the standard setter was developing a stand-alone standard	CP asks whether information about NR should be voluntary or compulsory
EU, IMF, OECD, UN, WB	(SNA, 2008; SEEA-EA 2021)	Statistical standards. In the EU, the ESA 2010 is a regulation	General government	Completed	Compulsory
Earth Economics	Natural resources accounting: a path forward for the governmental accounting standards board	Advisory	State and local government	Letter dated February 2017	Voluntary
National organizations					
US Federal Accounting Standards Advisory Board (FASAB)	FASAB (2010), SFFAS 38	Standard	Federal	Completed	Compulsory
	FASAB (2011), technical bulletin[a]	Technical bulletin	Federal	Completed	Voluntary
South African Accounting Standards Board (ASB)	ASB (2017), GRAP 110, *living and non-living resources*	Standard	Public entities	Completed	Compulsory (including voluntary parts)
LR Ministry of Finance of the Republic of Lithuania	VSAFAS 16 and 30 on accounting for land and natural resources	Standard	All levels	Completed	Compulsory
Natural Resources Canada	Departmental report	Legal requirement	National government	Annual basis review	Compulsory

(*continued*)

Table 2.

Organization	Document	Type of document	Level of government	Status	Voluntary/ compulsory
Indian Government Accounting Standards Advisory Board (GASAB)	GASAB (2020), concept paper on accounting for natural resources (potentiallyba legal requirement)	Concept paper	Union government; states	Completed	Compulsory if enacted
Australian Minister for Resources	Resources statement[b]	Ministerial report (legal requirement)	Central level	Issued 2019 and updated	Compulsory
Australian Water Accounting Standards Board (WASB)	Australian Water Accounting Standard 1 (Water Accounting Conceptual Framework) and 2 (Assurance Engagements)	Standard	Any form of entity involved in the management of water	Completed	Voluntary
Norwegian Government	A speech by the Norwegian governor on Norwegian accounting practices of gas and oil resources	Refers to a legal requirement	Central government	Completed	Compulsory

Notes: [a]Both documents are applicable to reporting at the federal level; only the first one is compulsory. [b]This is a report released in 2019 and updated on a regular basis. The report explains how natural resources are exploited for the benefit of Australia's economy, including expenditures on research and development. It is based on various scientific studies relating to climate change impact and geology; CP = Consultation paper;
Source: Authors' elaboration

4.1 Definitions and scope

Different streams of the literature on environmental accounting and reporting have been identified (Hussain *et al.*, 2016). This section focuses on national and financial accounting streams.

Regarding national accounts, the SEEA framework focuses on individual environmental assets (i.e. resources such as timber, water and energy). In this context, NRs are defined as "non-produced" assets, focusing essentially on NRs used in economic activities that are subject to ownership rights. The statistical framework is based on accrual methodology, but its application differs from that based on a financial accounting framework (Dabbicco and Caruana, 2023). Accordingly, different definitions of NRs are expected, resulting in different NR measurements. It is worth noting that in the context of the ongoing routine revision of the system of national accounts (SNA, 2008), the main options related to NRs under discussion are as follows (EC, 2023):

- Include depletion of NRs within accounts (thus reflected in the net domestic product).
- Splitting NR assets between the government and extractor balance sheets based on resource rent.
- Adding renewable energy assets (i.e. the potential of land to generate renewable energy).
- Changing the distinction between produced/non-produced assets and migratory/non-migratory assets, thereby bringing all forests within the SNA production and asset boundaries.

From the financial accounting perspective, the IPSASB's consultation paper (IPSASB, 2022) defines an NR as a resource, as described in the IPSASB's conceptual framework: tangible, naturally occurring and in its natural state, including subsoil resources, water and living resources – always in their natural state. The scope of the consultation paper excludes NRs that cannot produce economic benefits or service potential for the reporting entity and those that have been subject to human intervention (even though preservation and conservation activities are allowed). The NRs subjected to human activity were treated using existing International Public Sector Accounting Standards (IPSASs). For example, living organisms that are subject to human intervention are not living resources and their accounting treatment and related activities are likely to fall within the scope of IPSAS 12 (inventory), IPSAS 17 (property, plant and equipment) or IPSAS 31 (intangible assets).

Regarding relevant national experiences, the technical bulletin issued by the FASAB (2011) defines NRs (other than oil and gas reserves) as resources that occur in nature (including non-renewable and renewable NRs) and meet all of the following criteria:

- the federal government may exercise sovereign rights over the resources with respect to exploration and exploitation;
- the federal government has the authority to derive revenue from the resources for its use; and
- the resources are contained in federal lands or the federal government manages and/or controls the resources.

In its advice to the US Government accounting standards board (GASB), Earth Economics (2017) defined NRs as materials or substances such as minerals, forests, water and fertile land that occur in nature and provide economic benefits. Some of the most important

services provided by the state and local governments rely on NRs, such as aquifers, rivers, lakes, forests and parks. NRs provide enormous benefits and require significant funding for maintenance.

> Allowing these natural assets to be degraded or lost will place an incredible burden on future users and add to interperiod and intergenerational inequity issues. Yet, financial and other information about these resources are largely missing from financial reports (Earth Economics, 2017, p. 16).

The South African Accounting Standards Board (ASB, 2017) distinguishes between living and non-living resources. Living resources are living organisms (for example, animals and plants), that is, resources that undergo biological transformations. Conversely, nonliving resources occur naturally and have not yet been extracted. This definition excludes land, water, minerals, oils, gas and other non-regenerative resources that meet the inventory definition. Water found in its natural state, such as in rivers, dams, streams, lakes, boreholes and the sea, is considered a non-living resource.

The Lithuanian standards (LR, 2022) distinguish between biological assets, forests and mineral resources. A further distinction was made between three types of mineral resources:

(1) not explored in detail;

(2) explored in detail but not exploited; and

(3) explored in detail and exploited.

Therefore, the documents examined in this study did not provide a clear definition of NRs. Further, the classifications adopted by standard-setters and government organizations differ in several respects. Classifications based on living versus non-living resources coexist with those based on renewable versus non-renewable resources, which do not help in the NRs definition process. Proper identification and classification of NRs is a basic prerequisite for (attempting to) measure and manage them to provide services to citizens. Indeed, public-sector entities often have a limited understanding of the economic and societal value of NRs, particularly those that are not exploitable until they are extracted [Taskforce (IRSPM A&A SIG, CIGAR Network, EGPA PSG XII), 2022b].

These findings indicate that NRs cannot be considered as a single category. Following the concept of value pluralism (IPBES, 2022a), an open-minded approach should be adopted to avoid focusing only on the utilitarian perspective of the human-nature relationship. A distinction is required between:

- living and non-living NRs; and
- renewable and non-renewable NRs.

These categories have unique requirements and would require different approaches and standards. According to the dialogic accounting perspective, these distinctions could help avoid monetary reductionism, while allowing the recognition of multiple orientations (Brown, 2009).

4.2 Recognition and measurement criteria

Taking a normative accounting perspective, the IPSASB consultation paper (IPSASB, 2022) states that an NR can only be recognized if it meets the definition of an asset, as provided in the conceptual framework and can be measured in a manner that fulfils the qualitative characteristics and considers the constraints on the information. Therefore, these two steps are relevant. The first step regards the criteria to be met to qualify an item as an asset, while

the second one concentrates on the initial measurement; these steps may lead to existence and measurement uncertainties, respectively.

Regarding the first step, three issues must be addressed. Is NR a resource? Is it currently being controlled? Does control result from past events? As already pointed out, a *resource* is defined as an item with *service potential* or the *ability to generate economic benefits*. This approach may lead to uncertainty, making it difficult to qualify NRs as assets. Further complicating the issue, the recent revision of Chapter 5 of the IPSASB's conceptual framework (IPSASB, 2023a, par.5.6A) has introduced a rights-based approach when defining assets. This emphasizes the "existence uncertainty" when applied to NRs and is particularly relevant for unextracted subsoil resources or similar NRs, in which it can be difficult to identify rights over the resource. However, a resource is a storage of services that provides a useful contribution to the achievement of the entity's objectives, and the concept of rights should be used to assess whether and how the entity presently controls the storage of services embodied in an NR [Taskforce (IRSPM A&A SIG, CIGAR Network, EGPA PSG XII), 2022a]. Accordingly, control over an NR may be derived from rights that take several forms.

The second step required for an item to be recognized as an asset is its ability to be measured in a manner that fulfils the qualitative characteristics of information in general-purpose financial reporting while considering information constraints. This step may imply "measurement uncertainty". The IPSASB's consultation paper stresses this aspect, claiming that the measurement basis is as follows:

- *Relevant* if it can fairly reflect the resource's contribution to the cost of services and operational and financial capacities.
- *Faithfully representative* of the quantity and quality of the resource.
- *Verifiable* by different independent, knowledgeable observers, who verify that a method results in a faithful representation of the quantity and quality of the resource or that an appropriate measurement method has been applied without material error or bias.

According to IPSASB's consultation paper (IPSASB, 2022), the initial measurement can be uncertain and challenging, especially for certain NRs, such as living resources, operational capacity or unextracted subsoil resources.

Similar approaches were adopted at the national level. For instance, the US Federal Accounting Standards Advisory Board documents (Statement of Federal Financial Accounting Standards (SFFAS) 38; Technical Bulletin, 2011) insist on the ability of assets to generate economic benefits or service potential so that federal oil and gas resources qualify as federal government assets because the government can obtain these benefits, and a monetary measure is perceived as technically feasible. Accordingly, these assets qualify for initial recognition. The present value is proposed as the measurement criterion.

The South African standard (Generally recognised accounting practice (GRAP) 110) further points out specific indicators to assist control assessment, namely:

- intervention by the entity in the management of the physical condition of resources;
- ability to restrict the movement of resources; and
- ability to use a resource directly.

Regarding the measurement criteria, GRAP 110 refers to cost; more specifically, if NRs are acquired through a non-exchange transaction, its cost shall be measured at its fair value, whereas a deemed cost can be used when the acquisition cost is not known.

Considering the categories identified in Lithuanian standards, only mineral resources explored in detail and exploited can be recognized as assets. The initial measurement is at the "conditional unit value", defined as the present value of future taxes for a particular type of mineral resource divided by their quantity. Resources not explored in detail cannot be recognized because of the "existence uncertainty", while mineral resources explored in detail but not exploited require appropriate disclosures.

The SEEA guidelines prescribe three methodologies for valuing resources:

(1) market price;

(2) basic producers and purchasers' prices; and

(3) net present value (NPV) for environmental assets.

This approach has also been adopted by an Indian concept paper (GASAB, 2020), despite the NPV being preferred for initial recognition. The revenue to royalty method is also allowed to value resources along with the market value.

To summarize, NRs may or may not qualify as assets because of their existence and measurement uncertainty. The "existence uncertainty", in turn, may depend on the concept of assets being used and whether and to what extent service potential is retained as a fundamental pillar (Anessi-Pessina *et al.*, 2022). The biggest hurdle to overcome is the identification of a measurement criterion that fulfils qualitative characteristics while considering information constraints. Therefore, insisting on calculative reasoning based on the value of NRs as a stock of resources may obstruct the provision of information on how NRs are used and how they benefit the community. The dialogic accounting perspective suggests being open about the contestable nature of calculations, which, in this case, means concentrating on the flow of services derived from NRs (Biondi and Oulasvirta, 2023; Hartel, 2003) rather than on their value as a stock.

4.3 Valuation methods and disclosures

Taking a "monological" approach in line with the IPSASB's recognition criteria would lead to two situations:

(1) An NR meets the recognition criteria; therefore, it needs to be measured and disclosed on the face of the financial statements. Additional disclosures would perhaps provide non-financial information about the NR, explain how the recognition criteria were met and describe the valuation method used and the underlying calculations.

(2) An NR does not meet the recognition criteria; therefore, it does not need to be measured. In this case, only nonfinancial disclosures are required. One may need to decide whether to include such disclosures in a financial report or in a separate specific purpose report.

4.3.1 How can natural resources be measured? The IPSASB consultation paper proposes the selection of appropriate bases for initial and subsequent measurements in accordance with the principles set out in Chapter 7 of the conceptual framework. IPSAS 46 (IPSASB, 2023b) proposes three measurement bases that reflect the cost of services, operational capacity or financial capacity of an asset: historical cost, fair value and current operational value.

Historical costs cannot be used when an asset is acquired through a non-exchange transaction. When an NR is acquired through an exchange transaction, the historical cost measure may adequately reflect the asset's operational or financial capacity at the time of

the acquisition. However, historical cost information will generally not facilitate the assessment of the future course of services that involve the use of the asset, as prices are likely to change after the acquisition.

For NRs with operational capacity, the IPSASB consultation paper considers the current operational value as the most appropriate measurement basis because it reflects the asset's current use, assumes that the asset will be used for service delivery rather than being sold and reflects the economic position of the entity using the asset.

Where an entity plans to sell or monetize NRs, the IPSASB's consultation paper further stipulates that fair value is generally the most appropriate measurement basis, as it reflects the financial capacity of NRs in such cases.

In the US SFFAS 38, the present value of future federal royalty receipts on proven reserves (known to exist on the reporting date) is calculated using a risk-free discount rate. The discount rates for the present value measurements of federal oil and gas resources should be based on the interest rates on marketable treasury securities with maturities consistent with discounted cash flows. Alternative measurement methods are fair value or current price. The FASAB's (2011) technical bulletin explains that the estimates that are developed should approximate the present value of future receipts of federal NRs that are:

- under lease, contract or other long-term agreements; and
- reasonably estimable as at the reporting date.

Earth Economics (2017) proposed replacement cost as a more appropriate method.

> Replacement cost is the price that would be paid to acquire an asset with equivalent service potential in an orderly market transaction at the measurement date. For example, what would it cost to restore a forest in the event of a large wildfire that affects a city's drinking water sources? Replacement cost, in the natural capital context, is an objective method because it uses known costs associated with real transactions (Earth Economics, 2017, p. 18).

Earth Economics (2017) acknowledges that difficulties in measurement and valuation are the underlying reasons why financial reports do not address such topics. Similarly, Hartel (2003) emphasizes that referring to the same measurement bases and approaches usually adopted for infrastructure assets is unsuitable (this study refers specifically to trees).

South African GRAP 110 refers to a wide range of valuation methods, including purchase price, cost directly attributable to bringing the resource into location and condition necessary to operate in the intended manner, research costs, price in active, liquid markets (adjusted where needed), price exchanged between willing buyers and sellers and valuation technique (recent prices for sales of similar items or sector benchmarks).

The Indian Government Accounting Standards Advisory Board (GASAB) refers to the SEEA criteria even for valuation methods. Statistical standard setters allow for market prices and the discounted NPV of future returns as valuation methods. The fair value (for biological assets) and NPV (for mineral resources) were also allowed as measurement bases. Changes in both fair and present values were taken directly into reserve/net assets. The proposal in the ongoing revision of the SNA (2008), in line with the SEEA, indicates NPV as an alternative method in the absence of reliable market values. However, concerns have been expressed about NPV, which requires several modelling assumptions with an impact on the estimates due to the volatility/variation in the value of such assets. In this context, the following proposal (EC, 2023) is relevant:

> Biological asset value (valued according to the NPV of future resource rents) should be split into a part representing the "pure" (building up of) inventories (e.g., the maturing of trees), and another part representing the underlying asset (e.g., the value of the forest land) (see also Hartel, 2003).

According to the Lithuanian standards (VSAFAS 16 and 30), historical costs can be used to acquire biological assets (LR, 2022). When an asset is created (e.g. sprouting plants or newborn animals), both the direct and indirect costs incurred to create it should be considered. Conversely, mineral resources are valued using discounted cash flow techniques.

Mirroring the different perspectives on what an NR is (definition), there are different opinions on whether NRs should be valued and if yes, how? The preferred valuation method depends on the purpose of the valuation, that is, what value is purported to be captured (IPBES, 2022a, 2022b).

4.3.2 If not assets, how can natural resources be accounted for? Considering the difficulties in recognizing NRs as assets and assessing their monetary value, disclosure is particularly relevant.

According to the IPSASB's consultation paper, certain information conventionally found in broader general-purpose financial reporting should be presented in relation to recognized or unrecognized NRs that are relevant to an entity's long-term financial sustainability, financial statement discussion and analysis and service performance reporting. Regardless of whether an NR is recognized as an asset, the disclosure of certain non-financial information could be useful for stakeholders in making informed decisions (not necessarily economic decisions). Disclosures could be related to the need for the maintenance and preservation of NRs and the environmental risks that can affect them. According to the dialogic accounting framework (Brown, 2009), this would enable accessibility to non-experts and encourage their involvement.

In the USA, both the compulsory SFFAS 38 and the voluntary technical bulletin require narrative disclosures. At the state and local government levels in the USA, the GASB was advised to issue a standard for NRA, such that resource information was included in financial reports as footnotes or supplementary information (Earth Economics, 2017). The South African GRAP 110 requires extensive disclosure, similar to the disclosure requirements of standards related to other assets. For example, the reporting entity should disclose that the definition or recognition criteria and the nature of custodial responsibilities are not met. The voluntary aspect of GRAP 110 requires the disclosure of methodology, judgements and assumptions applied in valuations; the nature of custodial responsibilities and the legislation or similar means that establish these responsibilities; and the nature and type, liabilities or contingent liabilities and compensation from third parties when given up.

In Lithuania, the statement of financial position shows "Mineral resources and other non-current assets" as a separate line item from property, plant and equipment. The statement of changes in net assets includes mineral resources in the column "Other reserves". The surplus/deficit column reported the use of mineral resources only.

This brief overview of approaches and criteria suggested by different standard-setters clarifies that measuring NRs cannot be taken for granted; rather, frequently disclosing information in the notes or even in a separate (non-financial) report appears to be the only justifiable approach. Table 3 summarizes the main results that emerged from the analysis, documenting that differences exist in all categories of accounting and reporting treatments of NRs.

The analysis shows that NRA is an extensive topic and reveals difficulties (from an accounting perspective) in recognizing NRs in financial position statements. Furthermore, there is increasing pressure from policymakers, such as international institutions and account users, to receive more environmentally relevant information. Consequently, standard setters face the dilemma of slightly easing accounting rules to better show the

Areas of consideration for accounting for NRs	Findings
Definitions and scope	NRs are defined as: • SEEA framework: "non-produced" assets. • IPSASB (2022): resources – as described in the IPSASB's conceptual framework – tangible, naturally occurring and in their natural state. • Earth Economics (2017): materials/substances that occur in nature and provide economic benefits. • FASAB (2011): resources that occur in nature (including non-renewable and renewable NRs) and meet specific criteria. • ASB (2017): living and non-living resources. • VSAFAS 16 and 30 (Lithuanian standards): biological assets, forests and mineral resources (which, in turn, are classified as not explored in detail; explored in detail but not exploited; and explored in detail and exploited). Because of variations in definition and scope extant in the reviewed frameworks, NRs cannot be regarded as one category. This suggests avoiding referring to new forms of "monologism"
Recognition and measurement	Recognition of NRs as assets is based on the following criteria: • SEEA framework: three methodologies to value the resources are proposed: (i) the market price, (ii) the basic producers' and purchasers' prices and (iii) the net present value for environmental assets. • IPSASB (2022): *Step 1*: Is the NR a resource? Is it presently controlled? Does control result from a past event? This approach may cause existence uncertainty. *Step 2*: the ability to be measured in a way that fulfils the qualitative characteristics of information in general-purpose financial reporting while considering information constraints. This step may imply measurement uncertainty. • Earth Economics (2017): proposes the replacement cost as most appropriate. • FASAB, 2011; SFFAS 38: the ability of NRs (oil and gas resources) to generate economic benefits or service potential. The initial recognition is at present value. • GRAP 110: specific indicators are required for control assessment. The initial recognition is at cost. If NRs are acquired through a non-exchange transaction, their cost shall be measured at its fair value, while a deemed cost can be used when the acquisition cost is not known. • VSAFAS 16 and 30 (Lithuanian standards): only mineral resources explored in detail and exploited can be recognized as assets. The initial recognition is at their conditional unit value (namely, the present value of future taxes).
Valuation methods and disclosures	Subsequent measurement: • SEEA framework (and GASAB, 2020): market prices and the discounted net present value of future returns. The fair value (for biological assets) and the net present value (for mineral resources) are also allowed as measurement bases. • IPSASB (2022): subsequent measurement in accordance with the principles set out in Chapter 7 of the conceptual framework; three criteria are proposed: historical cost, fair value and current operational value. • FASAB, SFFAS 38: the present value of future federal royalty receipts on proved reserves.

(*continued*)

Table 3.
Areas of consideration for accounting for NRs: summary of findings

Areas of consideration for accounting for NRs	Findings
	• GRAP 110: purchase price; cost directly attributable to bringing the resource into location and condition necessary to operate in the intended manner; research costs; price in active, liquid markets (adjusted where needed); price exchanged between willing buyer and seller; and valuation technique (recent prices for sales of similar items or sector benchmarks). • VSAFAS 16 and 30 (Lithuanian standards): the historical cost can be used for biological assets acquired. Mineral resources are valued using discounted cash flow techniques. Disclosures: • IPSASB (2022): information conventionally found in broader general-purpose financial reporting should be presented in relation to recognized or unrecognized NRs. • Earth Economics (2017): supports extensive disclosures. • FASAB, SFFAS 38 and technical bulleting require narrative disclosures. • GRAP 110 requires extensive disclosure (disclosure of methodology, judgements and assumptions applied in valuations; the nature of custodial responsibilities and the legislation or similar means that establish these responsibilities; nature and type, liabilities or contingent liabilities and compensation from third parties when given up). • VSAFAS 16 and 30 (Lithuanian standards): the statement of financial position shows "Mineral resources and other non-current assets" as a separate line item from property, plant and equipment. The statement of changes in net assets includes mineral resources in the column of "Other reserves". Only the usage of mineral resources is reported in the surplus/deficit column.

Source: authors' elaboration

Table 3.

environmental angle in the main statements or alternatively keeping everything in separate sustainability standards/reports alongside the statements.

The accounting perspective should perhaps be wider than only expecting NRs to be neatly categorized as an asset or not, avoiding monetary reductionism while resisting new forms of "monologism" (Brown, 2009). This practice demonstrates alternative possibilities. For example, the Norwegian approach does not refer to definitions or valuations; however, it is clear that these resources belong to the country's population. In Norway, the focus is on the main depletable NRs – oil and gas. The law requires that revenue from these NRs be transferred to a sovereign fund managed by the Bank of Norway, according to the investment strategy provided by the Ministry of Finance, following the authorization of Parliament. The focus is not on the balance sheet but on operational flows (the so-called ecosystems; Atkinson and Ovando, 2022; Biondi and Oulasvirta, 2023).

5. Discussion, implications and conclusions

5.1 Discussion and implications

This study contributes to the public-sector accounting literature by examining documents issued by national and international organizations. The analysis focused on the definitions,

recognition criteria, measurement bases and disclosure requirements regarding NRs in the extant frameworks available for public-sector entities.

The review of academic and practical literature on the interconnections between traditional accounting and NRs explores the complexity of associating a useful monetary value with NRs – a monetary value that could be considered in economic decision-making. The study's results have both practical and academic value in social and environmental accounting.

Regarding the first research question (*How can NRs be defined and classified from an accounting perspective?*), the differences among the different frameworks, such as national accounts and financial accounting, were not as accentuated as expected. Conversely, a broad difference emerges from our analysis on how NRs can be identified and classified within the financial accounting stream. Concretely, harmonization is lacking: classifications based on living versus non-living resources coexist with those based on renewable versus non-renewable resources, while their critical/non-critical nature (Jones, 2003; Siddiqui, 2013) was not considered. The Lithuanian approach is particularly interesting, as it first identifies different classes of NRs and then provides a sub-classification of some of them to explore whether and to what extent they could be recognized as assets in financial statements. Our findings are consistent with the IPBES (2022a, 2022b) reports, which emphasize the challenge of implementing a universally valid approach. The dialogic accounting perspective (Brown, 2009) suggests interpreting these findings as a result of the calculative reasoning of standard-setters, meaning that calculative technologies may have limitations. Therefore, it can be questioned whether monetization is the right path to follow or whether it would be more effective to adopt an "open-minded" approach regarding the contestable nature of what can be included in the balance sheet as an asset and how information can be provided to stakeholders. Multiple approaches and orientations should be considered (Grossi *et al.*, 2021).

Generally, the proper identification and classification of assets is a fundamental step (Jones, 2003; Salah and Bisogno, 2023). Being "communitarian", public-sector entities are accountable for providing services to their citizens (Pallot, 1990); therefore, they are responsible for properly managing NRs (Siddiqui, 2013), using them in the light of their service potential (Gaia and Jones, 2017). Classifications for reporting and information disclosure should be harmonized, as a gap in accounting and reporting guidance on these issues may indirectly affect the depletion of NRs and threaten inter-generational equity [Dabbicco, 2021; Taskforce (IRSPM A&A SIG, CIGAR Network, EGPA PSG XII), 2022b]. However, the accounting perspective may surpass the normative asset categorization to consider the intrinsic difficulties in translating environmental accounting issues into calculative practices (Lamberton, 2000; Marcuccio and Steccolini, 2005).

Regarding the second research question (*Should NRs be recognized as public-sector assets?*), the analysis emphasized the need to refer to the service potential due to NRs, even though several NRs may provide economic benefits. This implies that assessing the monetary value of an NR is not easy because of existence and measurement uncertainties. Therefore, the recognition of NR as an asset is problematic because of the difficulty in finding a reliable measurement basis that satisfies qualitative characteristics. NRs' valuation processes should also bear in mind that the type and quality of information obtained depends on how they are expected to support decision-making processes regarding alternative projects or policies for the conservation and sustainable management of NRs (IPBES, 2022a). Monetary reductionism should be avoided (Brown, 2009) while bearing in mind the most relevant issue: encouraging stakeholders to be more reflective about the strategies and policies implemented and the achieved outcomes.

The difficulty in assessing the monetary value of NRs leads to the third research question (*Which measurement bases could be adopted and which disclosures can be provided?*). Different criteria (historical cost, fair value, NPV and current operational value) have been proposed by various national and international bodies. However, these criteria do not consider the specificity of NRs (Hartel, 2003). Recent reports (IPBES, 2022a, 2022b) have proposed referring to different "method-families", although they recognize that challenges can emerge when comparing different values to support decision-making processes. However, scholars have documented several unsuccessful attempts to financialize nature (Dempsey, 2016); therefore, it is (nearly) impossible to financialize NRs.

The non-financial characteristics of assets, such as NRs, are the principal reason for the difficulties in applying various valuation models, bases and techniques. Measurement in public-sector accounting is challenging, and mimicking approaches and criteria (such as fair value) from the private sector could impede the proper consideration of public value (Caruana *et al.*, 2023).

The question is not whether and to what extent NRs can be expressed in monetary terms, but how financialization can incentivize human beings to protect and preserve them (Arjaliès and Gibassier, 2022). If recognizing NRs as assets and assigning them a monetary value means considering NRs as "passive objects" to be calculated and marketized, the financialization process becomes an end in itself, being unsuccessful or irrelevant. Accordingly, a "value pluralism" approach should be preferred to a "value monism" paradigm, which frequently means focusing on a non-reliable monetary value (IPBES, 2022a). According to Biondi and Oulasvirta (2023), recognizing NRs as assets and representing them on a balance sheet in a supposedly reliable monetary amount is not a necessary condition for preserving NRs for future generations. This perspective suggests that the issue is not (only) assessing the monetary value of NRs as assets but also measuring flows (Atkinson and Ovando, 2022; Hartel, 2003) derived from this stock or resource, as the Norwegian case suggests.

Conceptually, insisting prevalently on measuring the value of NRs as a stock of resources would mean preferring a static approach, which, in turn, is essentially based on current values; this demonstrates how strong the re-introduction of new forms of "monologism" could be. Conversely, there is a need to move beyond the compilation of accounts and use accounting data in decision-making processes (IPBES, 2022b), adhering to a "dialogism" accounting idea (Brown, 2009). Considering flows, namely, expenditures devoted to the preservation and maintenance of NRs, could make it possible to share these flows across different generations of taxpayers (Biondi and Oulasvirta, 2023). Disclosures can provide adequate information on these flows, which may be considered as intangible assets attached to NRs.

Rather than placing value on NRs, it would be more fruitful to account for their preservation and ensure that any exploitation benefits generations over time (as in Australia). Complications may occur when such flows arise from environmental assets included in balance sheets, such as the recognition of a lease, licence or permit to exploit them. Other IPSASs should be considered in these cases; however, in some instances, it is preferable to recognize balance sheet assets even ahead of the issue of permits (as in the case of radio spectrum for mobile phone licences).

5.2 Conclusions, limitations and future research

In summary, the relevance of valuation may be questionable. A valuation places monetary boundaries on an item, which may not be useful and it could have negative consequences because it would not justify the costs required to maintain it. Furthermore, from a dialogic

accounting perspective, measurement may not be necessary for the reporting entity to shoulder its responsibilities and fulfil its accountability obligations. NRs need not necessarily be monetized for such purposes. However, it would be ideal to maintain an inventory of NRs (Jones, 2003; Siddiqui, 2013), and publish regular specific-purpose reports on the state of NRs and their net public funds expended by them.

This study on the accounting and reporting of NRs in the public sector has limitations that should be addressed in future research. Firstly, it examines the documents and approaches adopted by certain countries. A broader analysis should consider other (developing) experiences, compare them and assess their implications. Secondly, this study did not examine additional streams of literature that could be relevant if one considered the interdisciplinary nature of the topic (Small *et al.*, 2023). Despite these limitations, this study contributes to the literature on NRs and NRA as it provides a picture of state of the art, clarifying the different approaches proposed, the implications derived from them and the effects due to a lack of harmonization regarding the definition and classification of NRs. Considering the growing interest in biodiversity and its role in a sustainable economy, future research could focus on the distinction between NRs and biodiversity, as well as on the interconnections between private-sector sustainability/environmental reporting and public-sector natural capital and NRs (Rockström *et al.*, 2009).

Notes

1. The management accounting stream is not considered in this study.
2. Most of the documents were available in English except for the Lithuanian standards for which the authors provided an analysis based on their own translation.
3. A systematic search is an organized and structured approach to sift through a large database, taking into consideration particular search terms as the defined criteria. In our case, we selected the database according to the accessibility to information made publicly available by standard setters (both national and international) for accounting and reporting by public-sector entities. We then honed on standards and publications that refer to NR assets. The pre-defined steps of the search are aimed to support reliability and consistency in the process of finding relevant information (Robson, 2011; Flick, 2015).
4. It is worth observing that, at the European level, the EU Commission is developing a proposal aiming at including ecosystem accounting as a mandatory data collection across all EU member countries. The proposal will pass through the European Parliament; thus, it can take several years before it has legal force.

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