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Green Accounting: A global initiative for economic transformation toward a green economy

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Abstract

Traditional national accounting systems, which focus primarily on marketed economic output, fail to capture the critical costs associated with environmental degradation and the depletion of natural capital. Green Accounting (GA) emerges as the indispensable corrective methodology, providing the necessary statistical infrastructure for the global transition to a sustainable Green Economy (GE). Central to this global initiative is the United Nations System of Environmental-Economic Accounting (SEEA), which measures resource depletion and the costs of environmental preservation. The ultimate quantitative output of this methodology is the Environmental Domestic Product (EDP), which redefines net domestic product by incorporating the net accumulation or depletion of non-produced natural assets. The adoption of SEEA Ecosystem Accounting (SEEA EA) in 2021 marks a critical milestone, demonstrating high-level political commitment to moving "beyond GDP". This article examines the framework, implementation, and convergence of SEEA with corporate standards (such as the ISSB), while critically analysing the conceptual and practical challenges inherent in this global undertaking, particularly concerning the contentious issue of monetary valuation of ecosystem services. GA is found to be crucial for operationalizing the GE principles of Wellbeing and Justice, although its success hinges on addressing data complexity and high implementation costs, especially for smaller enterprises.

Keywords: Green Accounting, SEEA (System of Environmental-Economic Accounting), Green Economy, Natural Capital Accounting, Environmental Domestic Product (EDP)

Introductions

The Paradigm Shift in National Accounting

The origins of conventional financial accounting trace back to the 19th century, a period defined by assumptions of boundless economic expansion and resource availability ^[6]. However, the latter part of the 20th century introduced a profound realization: environmental limits constrain economic activity. This understanding catalysed the development of methodologies, collectively termed Green Accounting (GA) also referred to as Resource Accounting or Environmental Accounting aimed at measuring the influence of human endeavours on the Earth's ecological systems and resources ^[6].

GA fundamentally addresses the statistical invisibility of nature within traditional economic metrics. The global standardized methodology for implementing GA at the national level is the System of Environmental Economic Accounting (SEEA) ^[1]. The SEEA framework systematically focuses on the depletion of scarce natural resources and quantifies the associated costs of environmental degradation and its prevention ^[1]. By doing so, the SEEA provides the critical information required for measuring the true environmental costs of economic production, information that traditional Net Domestic Product (NDP) metrics inherently exclude.

The Quantitative Shift: From NDP to Environmental Domestic Product (EDP)

The most significant quantitative contribution of Green Accounting is the conceptual and statistical shift from NDP to Environmental Domestic Product (EDP), sometimes known as Green NDP. This transformation involves internalizing the depreciation of natural capital into the national accounts. The standard formula for calculating EDP explicitly accounts for the changes in non-produced natural assets.

The mathematical relationship is defined as:

$$\text{EDP} = \text{Net Exports} + C + \text{NAnp. ec} + (\text{NAnp. cc} - \text{NAnp. n})$$

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Where,

- EDP = Environmental Domestic Product
- C = Final Consumption
- NAp. ec = Net Accumulation of Produced Economic Assets
- NAnp. ec = Net Accumulation of Non-produced Economic Assets
- NAnp. n = Net Accumulation of Non-produced Natural Assets

The inclusion of the 'NAnp. n' term signifies a profound philosophical break from classical economic measurement. By systematically deducting the cost of depleted natural assets, GA corrects the traditional economic mismeasurement where environmental damage or resource exhaustion is often treated as a positive contribution to GDP or, at best, is ignored. This statistical infrastructure provides the politically robust foundation necessary to transition the Green Economy (GE) from a set of aspirational principles to a measurable, accountable policy framework.

Defining the green economy

The Green Economy is not merely an environmentally conscious version of the existing economy; it represents a comprehensive structural transformation. It is fundamentally defined by core principles that prioritize holistic well-being over narrow financial metrics.

The *Wellbeing Principle* asserts that the GE is people-centred, aiming to create genuine, shared prosperity. This requires focusing on wealth that supports wellbeing, encompassing not just financial wealth but the full spectrum of capital: human, social, physical, and natural capital. This Wellbeing Principle mandates prioritizing investments in sustainable natural systems, infrastructure, and education to enable prosperity for all people.

Secondly, the *Justice Principle* dictates that the GE must be inclusive and non-discriminatory. It promotes the equitable distribution of opportunities and outcomes, actively reducing disparities while protecting space for wildlife. Furthermore, it demands a long-term economic perspective, building resilience for future generations, while simultaneously acting urgently to tackle contemporary poverty and injustice. This involves ensuring a fast and fair transition, supporting social protection, and guaranteeing democratic accountability and transparency in all institutions.

Thus, the Green Accounting (GE) may be defined as the process to measure ecological losses and gains, and thus calculate the EDP

This process is critical because it operationalizes these GE principles, ensuring that economic decisions are rooted in the measurable reality of natural resource limits and environmental health.

Importance of the study

The study of Green Accounting, particularly its global implementation through the SEEA framework, holds substantial importance for global governance, macroeconomic policy, and corporate accountability

resulting in measuring true prosperity.

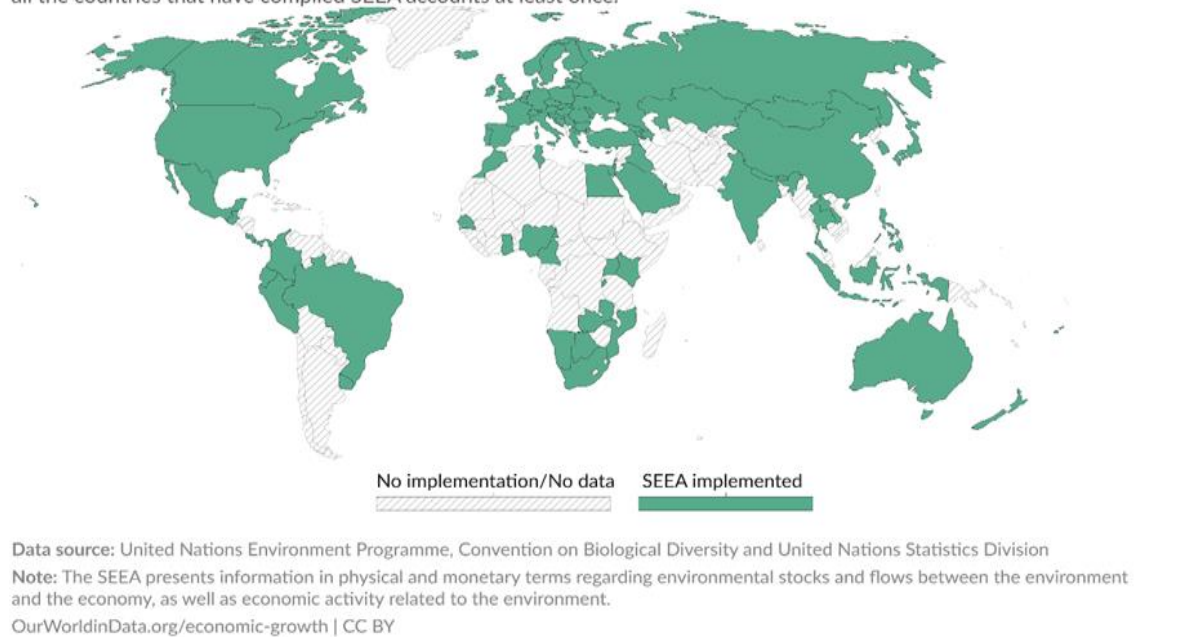
- **Operationalizing the Green Economy and Policy Alignment:** Green Accounting is indispensable because it translates the abstract goals of sustainability into verifiable economic metrics, making natural capital and its degradation visible to policymakers. The SEEA framework allows governments to integrate environmental concerns directly into national planning, a development that high-level officials have recognized as vital. For instance, the UN Secretary General, António Guterres, called the SEEA EA adoption a "historical step towards transforming the way how we view and value nature", while the European Commission Executive Vice President stated that the SEEA EA "moves beyond GDP and takes better account of biodiversity and ecosystem in national economic planning". The capacity to measure changes in natural capital enables effective policy design and resource management that is directly linked to the GE objectives.
- **Global Harmonization and Accountability:** Standardized national accounting systems that explicitly incorporate environmental and natural resources are essential for international cooperation and accountability. They provide crucial, common metrics during negotiations concerning national commitments to maintain or restore natural capital. Although enforcement mechanisms like trade restrictions have historically not been widely used regarding excessive trans-boundary discharges of pollutants (such as carbon, sulphur, or nitrogen oxides), the difficulty in determining the effects of these pollutants on industry costs underscores the need for standardized data. GA provides the essential statistical baseline to overcome this difficulty, enabling nations to assess and negotiate mitigation costs based on verifiable environmental data.
- **Driver of Corporate Responsibility and Stakeholder Engagement:** At the microeconomic level, GA methodologies drive corporate responsibility. Enterprises today face intense external scrutiny from investors, financial advisors, regulatory bodies, and the public regarding their environmental performance. This pressure compels corporations to re-examine and modify both their internal managerial processes and their external reporting mechanisms in response to environmental and social concerns.

This pressure is strongly rooted in stakeholder theory (R. Edward Freeman, 1984). Corporations are ethically and practically responsible for providing relevant environmental data to their constituents. Effective disclosure, facilitated by GA practices, helps eliminate information disparities between the company and its stakeholders. When businesses adopt sustainability and green accounting practices, they are better equipped to assess their influence on the environment and develop resilient, long-term strategies that benefit all stakeholders, including the natural environment. Empirical evidence confirms that stakeholder pressure for sustainable methods is a major determinant driving corporate responses to ecological challenges.

Countries using the System of Environmental-Economic Accounting, 2023

Our World in Data

The System of Environmental-Economic Accounting (SEEA) is a framework that integrates economic and environmental data, to provide a more comprehensive view of the relationships between the economy and the environment. Shown are all the countries that have compiled SEEA accounts at least once.



Data source: United Nations Environment Programme, Convention on Biological Diversity and United Nations Statistics Division

Note: The SEEA presents information in physical and monetary terms regarding environmental stocks and flows between the environment and the economy, as well as economic activity related to the environment.

OurWorldinData.org/economic-growth | CC BY

Objectives of the study

This study is designed to provide an expert analysis of Green Accounting as the primary statistical mechanism for achieving a Green Economy. The specific objectives are as follows:

- **Objective 1:** To critically analyse the structure and significance of the System of Environmental-Economic Accounting (SEEA), specifically the SEEA Ecosystem Accounting (SEEA EA).
- **Objective 2:** To evaluate the status of global and national implementation of SEEA.
- **Objective 3:** To identify and analyse the critical conceptual and practical limitations.
- **Objective 4:** To propose policy solutions to accelerate the GA-GE transition.

Research Methodology

This descriptive research employs a systematic policy and academic review methodology. The approach relies on comprehensive analysis and critical synthesis of authoritative international statistical frameworks and contemporary corporate sustainability standards.

The primary data sources include official international statistical documents, most notably those related to the UN System of Environmental-Economic Accounting (SEEA) and its implementation strategies.

Secondary data sources involve a critical synthesis of academic literature, industry reports, and corporate governance documents covering Environmental Management Accounting (EMA), emerging corporate sustainability reporting standards (such as those developed by the International Sustainability Standards Board, ISSB,

and the EU's CSRD), and national case studies related to SEEA adoption (e.g., the NCAVES project).

The core analytical technique utilized is comparative policy analysis. This method is applied to bridge the gap between national statistical frameworks (SEEA) and corporate reporting requirements (IFRS S1/S2). The analysis assesses the alignment, drivers, and barriers to widespread adoption across both macro- and micro-economic scales. A significant portion of the analysis focuses on extracting deeper implications regarding policy effectiveness and conceptual challenges, such as the epistemological debate surrounding monetary valuation, thereby moving beyond a simple descriptive recounting of facts.

Findings

The global implementation of Green Accounting demonstrates a synchronized, multi-layered effort, spanning high-level international statistical standards down to mandatory corporate disclosure rules.

- **The SEEA Framework and its Components (Global Adoption and Multilayered Integration):** The SEEA represents the culmination of decades of research into environmental accounting. A pivotal moment occurred in March 2021 when the United Nations Statistical Commission (UNSC) adopted the SEEA Ecosystem Accounting (SEEA EA). This adoption provided a necessary and integrated statistical framework for organizing data concerning habitats and landscapes, measuring ecosystem services, tracking changes in ecosystem assets, and subsequently linking this information to economic activity and human endeavours. This rigorous standardization was met with high-level political endorsement, with the Executive

Vice President of the European Commission noting that the SEEA EA is a "major development in changing the way we think about prosperity and well-being".

accounts, designed to transition measurement from physical extent to final monetary valuation. These accounts require the compilation of spatially explicit data related to ecosystem functions and the services they produce.

The SEEA EA framework is structured around five core

Table 1: SEEA Ecosystem Accounting: The Five Core Accounts

Account Type	Measurement Focus	Purpose and Insight Provided
Ecosystem Extent	Total area of each ecosystem type (measured over time)	Tracks spatial changes and loss of specific ecosystems (e.g., forests, wetlands) ^[10]
Ecosystem Condition	Health metrics based on selected characteristics (at specific points in time)	Provides information on ecosystem health, degradation, and resilience over the accounting period ^[10]
Ecosystem Services Flow (Physical/Monetary)	Supply of services by ecosystem assets and use by economic units	Quantifies the physical and monetary benefits derived from nature (e.g., cubic meters of water, carbon sequestration) ^[10]
Monetary Ecosystem Asset	Stocks and changes in stocks (additions and reductions) of ecosystem assets (monetary valuation)	Records additions and reductions to the <i>value</i> of natural capital stocks, supporting EDP calculation ^[10]

Source: United Nations <https://seea.un.org/ecosystem-accounting>

The SEEA EA employs 'thematic accounting' to structure environmental data for policy, covering areas like biodiversity, climate change, oceans, and urban spaces, as well as features such as wetlands and forests. Crucially, ecosystem accounting allows the value of these ecosystem

contributions to society to be quantified in monetary terms. This enables an easier, apples-to-apples comparison of the ecosystems' role in well-being against other standard goods and services.

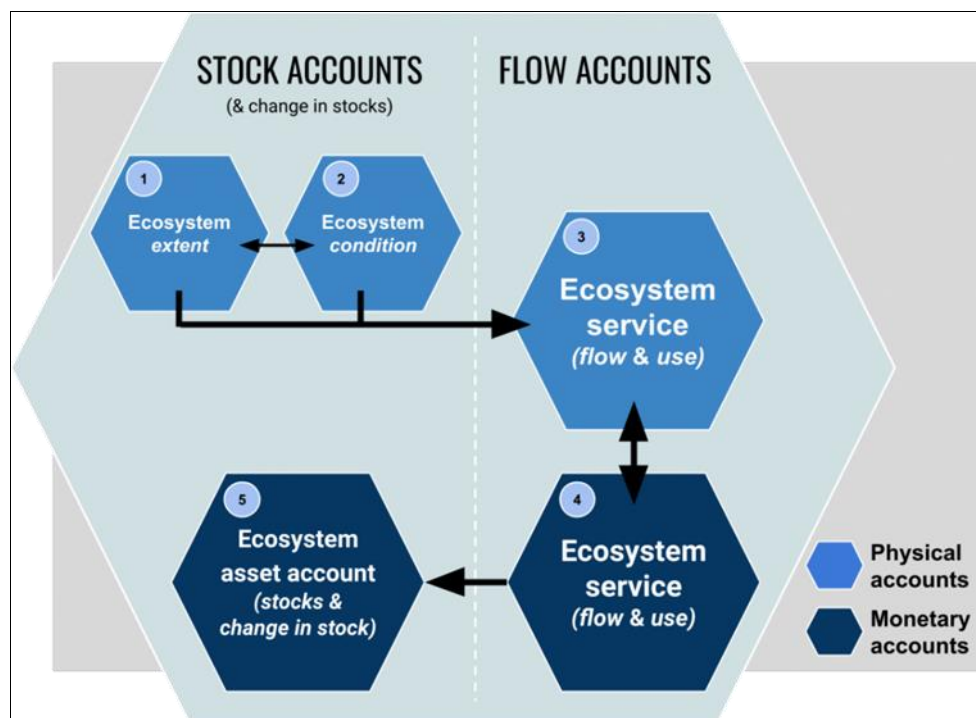


Fig 1: Ecosystem accounts and how they relate to each other ^[10]

- **Evidence of National Implementation:** The adoption of the SEEA EA has been swiftly followed by calls for immediate implementation globally, emphasizing the urgency of complementing traditional GDP metrics with comprehensive environmental measures. Already, ecosystem accounts based on the SEEA framework have been utilized to inform policy development in more than 34 countries.

A major strategic driver of this adoption is the Natural Capital Accounting and Valuation of Ecosystem Services (NCAVES) project. Launched in 2017, the NCAVES project-initiated pilot testing of the SEEA EA in five strategically chosen partner countries: Brazil, China, India,

Mexico, and South Africa. These nations were selected due to the importance of their natural capital, their diverse ecosystems, their adherence to the commitments of the Convention on Biological Diversity (CBD), and their strategic partnership with the European Union. The primary objectives of NCAVES include improving measurement, mainstreaming biodiversity into national and sub-national policy planning, and refining the internationally agreed methodology.

- **Convergence with Corporate Standards (Macro to Micro Linkage):** The standardization of environmental accounting is not limited to national statistics; it is being rapidly institutionalized within corporate finance and disclosure requirements. This coordination across

scales from macro-level SEEA to micro-level corporate reporting is critical for achieving GE goals by ensuring information symmetry throughout the economy.

The IFRS Foundation's International Sustainability Standards Board (ISSB), established in 2021, has developed IFRS S1 and IFRS S2 (*IFRS S1 sets general requirements for disclosing all sustainability-related risks and opportunities, while IFRS S2 provides specific, detailed requirements for disclosing climate-related information, such as greenhouse gas emissions and scenario analysis*), which represent an inaugural set of global sustainability disclosure standards. These standards, which build upon

previous market-led initiatives such as the Task Force for Climate-related Financial Disclosures (TCFD), aim to establish a high-quality global baseline for investor-focused sustainability disclosures. Endorsed by the International Organisation of Securities Committees (IOSCO), the standards are deemed fit for use in global capital markets. The key principles underpinning the IFRS Sustainability Disclosure Standards (SDS) are financial materiality, connectivity to financial statements, and proportionality. Crucially, jurisdictions representing over 60% of total global GDP are moving toward the adoption of the ISSB standards.

Table 2: Bridging Macro (SEEA) and Micro (ISSB/CSRD) Reporting

Standard/Framework	Level of Application	Primary Focus & Materiality
SEEA (System of Environmental-Economic Accounting)	National (Macro)	Integrating environmental costs into official economic statistics (e.g., EDP). Focuses on national welfare and natural capital stocks.
IFRS S1 & S2 (ISSB Standards)	Corporate (Micro/External)	Sustainability risks/opportunities financially material to investors. Focuses on disclosure connectivity to financial statements.
EMA (Environmental Management Accounting)	Corporate (Internal)	Decision-support tool for maximizing internal financial benefits from pollution prevention, waste reduction, and efficiency ^[8]

Source: United Nations <https://www.un.org/esa/sustdev/publications/policiesandlinkages.pdf>

The synchronized emergence of the SEEA EA and mandatory corporate standards (such as the ISSB and the EU's Corporate Sustainability Reporting Directive, CSRD) demonstrates a systemic, global effort to address information asymmetry. If firms are required to measure their environmental risks and opportunities rigorously using common standards (ISSB/CSRD), and governments adopt similar frameworks for national accounts (SEEA), the accuracy and robustness of both policy design and investment valuation are dramatically improved. This linkage ensures that national statistical priorities are reflected in the market signals received by corporate decision-makers.

- **Corporate Environmental Management Accounting (EMA):** Environmental Management Accounting (EMA) serves as an essential internal business tool for implementing environmental strategy at the corporate level. EMA facilitates the integration of sustainability

by incorporating tools such as energy accounting and carbon management accounting.

EMA is instrumental in creating internal demand within businesses for less wasteful and cleaner production processes. By properly identifying, allocating, and inventorying social and environmental costs over an investment's life, EMA repositions pollution prevention activities. It transforms the motive for environmental protection from one of mere compliance or market access into one of clear financial self-interest, yielding immediate financial benefits and avoiding high costs associated with waste management and regulatory uncertainty. Early corporate initiatives, such as the 1995 AT&T "Green Accounting" case study, defined the practice as identifying and measuring environmental costs for effective internal environmental management decisions.

Table 3: Green Accounting Components

Component	Description
Environmental Management System (EMS)	A framework for managing environmental impacts and complying with environmental regulations. An EMS involves establishing policies and procedures for environmental management, conducting regular environmental audits, and implementing continuous improvement measures.
Environmental Performance Indicator (EPI)	Metrics are used to track and report on environmental performance, such as greenhouse gas emissions, energy consumptions, and water use. EPIs enable businesses to monitor progress toward environmental goals and targets.
Life Cycle Assessment (LCA)	A method for evaluating the environmental impacts of a product or service throughout its entire life cycle, from raw material extraction to disposal. LCA can help businesses identify opportunities to reduce environmental impacts at all stages of the product life cycle.
Full Cost Accounting (FCA)	An accounting approach that includes both the direct costs (such as materials, labour, and overhead) and indirect costs (such as environmental and social costs) of business activities. FCA can help businesses make more informed decisions by accounting for the full costs of their activities.
Environmental Reporting and Disclosure	Reporting on environmental impacts and performance to stakeholders, such as investors, regulators, and customers. Environmental reporting can take the form of sustainability reports, environmental impact assessments, and other disclosures.
Environmental Auditing	A systematic review of an organisation's environmental performance to identify areas for improvement and compliance with environmental regulations. Environmental audits can be conducted internally or externally and can help businesses identify opportunities to reduce environmental impacts and comply with regulations.

Source: Sakshi Gupta <https://www.studyiq.com/articles/green-accounting>

The implementation of EMA by the private sector offers significant benefits to governments. If industry can

recognize and justify environmental protection expenditures based on financial self-interest, the financial, political, and

regulatory burden on the government is consequently reduced. Furthermore, governmental policies and regulations can be strengthened because EMA reveals the true environmental costs that those policies impose, ensuring that resource taxes or higher prices for energy and water actively encourage improved corporate environmental performance.

Suggestions

To fully realize the potential of Green Accounting in driving the Green Economy, policymakers must adopt targeted strategies that address regulatory gaps, Incentivization failures, and capacity constraints.

- **Mandating Bolder Standards and Incentivization (Accelerating the GA-GE Transition):** The severity of the environmental challenge necessitates ambitious governmental policies that clearly signal market priorities and mandate radical change. Governments must move beyond reliance on voluntary disclosure and compliance. Effective action requires mandating comprehensive carbon accounting for businesses, ensuring the capture of both direct and indirect emissions across complex supply chains. This must be complemented by common, mandatory reporting standards to reliably track environmental impact. Such policies should employ a mix of incentives and penalties to encourage businesses to align their investments and economic activities directly with established climate goals.
- **Strengthening Policy Through EMA Promotion:** Active governmental involvement is essential in promoting managerial accounting systems that fully internalize environmental costs. Governments should strategically encourage and motivate businesses to adopt EMA systems, not merely as a corporate compliance tool but as a means of rationalizing a firm's managerial accounting practices. This promotion is critical because the data generated by EMA can provide a vital feedback loop for policymakers. Implementation of EMA strengthens the effectiveness of existing environmental regulations by ensuring that companies fully recognize the costs imposed by these policies in their management decision-making. Moreover, the aggregated business-related EMA data can be used directly by government bodies for policy design. For example, data on the true costs and benefits of various industrial environmental management strategies can assist governments in assessing the potential financial impact of alternative regulations before implementation.
- **Capacity Building for Inclusive Implementation:** A significant barrier to GA adoption is the high cost and complexity associated with implementation. Implementing GA systems requires developing new infrastructure, training personnel, and collecting detailed, often complex environmental data across factors like energy use, emissions, waste, and resource consumption.

This cost burden is particularly challenging for small and medium-sized enterprises (SMEs), where the initial investment may seem to outweigh the perceived financial benefits, leading to reluctance in adopting GA practices. To ensure that the transition to the Green Economy, guided by

the Justice Principle, leaves no one behind, policies must include targeted capacity building measures. This involves providing financial support, subsidized training programs, and simplified, sector-specific reporting templates to make comprehensive GA systems accessible and viable for SMEs.

Challenges: Conceptual and Practical Hurdles

While Green Accounting represents the global statistical consensus for sustainability, its widespread implementation faces several critical conceptual and practical barriers that must be acknowledged and addressed.

- **High Costs and Data Complexity:** Implementation costs remain a dominant practical barrier. Developing and maintaining the complex systems required for GA, along with the extensive personnel training and detailed environmental data collection, involves significant expenditures. The sheer complexity of accurately measuring and allocating environmental costs and benefits presents substantial technical hurdles. Environmental data collection must track a broad range of factors from specific resource consumption metrics to trans-boundary pollutants making it challenging for businesses to ensure accurate and reliable reporting.
- **The Monetary Valuation Paradox:** The most significant conceptual and technical hurdle within the SEEA EA framework involves the monetary valuation of ecosystem services and assets. The attempt to assign monetary values to natural capital is challenged from multiple academic and ethical perspectives including ethical, philosophical, economic, and technical concerns. Experts contend that these arguments challenge the fundamental meaning and validity of monetary estimates of ecosystem values.

Crucially, ecosystem services values are considered meaningful only when they quantify *changes* in services compared to a defined baseline; they are not inherently meaningful when summed over entire, intact ecosystems. This limitation means that attempts to monetize total natural capital stocks may be misleading or subject to significant methodological pitfalls. Reliance on robust economic analysis requires engaging non-market valuation experts alongside ecologists to ensure sound methodology. Given the instability and debate surrounding monetary asset accounts, policymakers may need to prioritize the robust physical accounts (Extent and Condition) to guide ecological management, using monetary valuation more pragmatically for assessing specific, marginal policy interventions or trade-off scenarios.

- **Mixed Empirical Results on Corporate Value:** A final limitation concerns the variable empirical evidence regarding the direct benefits of GA adoption for individual firms. While GA is often promoted to improve environmental ratings and satisfy stakeholders, some empirical studies have yielded mixed results regarding its direct impact on firm value. For instance, certain research has indicated that adopting green accounting practices has not consistently improved firm value in highly scrutinized sectors, such as Southeast Asia's mining and agricultural industries. This variability undermines the corporate argument for voluntary adoption based purely on financial self-interest, highlighting the critical need for mandatory regulatory frameworks to drive widespread compliance.

Table 4: Principal challenges in green accounting implementation

Challenge Domain	Description	Policy Impact
Monetary Valuation Validity	Ethical and philosophical debates challenge the suitability of assigning monetary values to nature; values are only meaningful for <i>quantified changes</i> from a baseline, not entire ecosystems ^[4] .	Risk of inaccurate or politically contested policy formulation if valuations are misused or lack legitimacy.
High Implementation Costs (SMEs)	Significant financial strain for developing and maintaining GA systems, training staff, and collecting detailed environmental data ^[18] .	Limits widespread adoption, leading to incomplete or biased national data aggregation and slowing the overall GE transition.
Mixed Empirical Results	Studies show that GA adoption has not consistently improved direct firm value in some key sectors (e.g., mining, agriculture) ^[19] .	Reduces the incentive for voluntary adoption, necessitating regulatory mandates to ensure compliance and market-wide adoption.

Source: Femia, Aldo, (2020) ^[4], Alaika, Abdullah Aziz and Firmansyah, Amrie (2024) ^[19]

Conclusion

Green Accounting, formalized through the United Nations System of Environmental-Economic Accounting (SEEA), represents the indispensable statistical tool required for the global transformation toward a Green Economy defined by the principles of Wellbeing and Justice. The shift in national metrics from Net Domestic Product (NDP) to the Environmental Domestic Product (EDP) fundamentally ensures that the true costs of environmental depletion and degradation are internalized into macroeconomic planning. The global initiative is characterized by significant momentum, evidenced by the high-level adoption of the SEEA Ecosystem Accounting (SEEA EA) in 2021 and the successful piloting of the framework across diverse economies through projects like NCAVES. This macro-level standardization is critically augmented by the rapid emergence of globally accepted corporate disclosure standards, such as IFRS S1 and S2 from the ISSB. This convergence of SEEA and ISSB standards signals a synchronized global effort to bridge the measurement gap between national economic welfare and corporate sustainability performance. To sustain this transition, governments must move past cautious approaches and implement bolder, mandated standards for environmental reporting, especially concerning carbon accounting and supply chain emissions. Furthermore, actively promoting Environmental Management Accounting (EMA) in the private sector is essential, as EMA leverages the internal financial benefits of efficiency and pollution prevention to enhance the effectiveness of external regulations. Finally, the long-term credibility and political weight of Green Accounting systems, and specifically the viability of the EDP as a replacement metric for GDP, depend on overcoming the identified conceptual and technical hurdles. The most pressing challenge is the ongoing debate surrounding the monetary valuation of ecosystem assets. While the rigorous physical accounts (Extent and Condition) provide robust data for policy, resolving the methodological and ethical constraints associated with monetary valuation is paramount to ensuring the full integration and accuracy of natural capital measurement in the decades ahead.

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