Earth: Environmental Sustainability
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Mini Review

Environmental-Economic Accounting-Ecosystem Accounting (SEEA-EA) in Tourism

Eglė Baltranaitė *, Miguel Inacio and Paulo Pereira

Environmental Management Laboratory, Mykolas Romeris University, LT-08303 Vilnius, Lithuania
* Correspondence: egle.baltranaite@gmail.com

How To Cite: Baltranaitė, E.; Inacio, M.; Pereira, P. Environmental-Economic Accounting-Ecosystem Accounting (SEEA-EA) in Tourism. *Earth: Environmental Sustainability* **2026**, *2*(1), 29–36. https://doi.org/10.53941/eesus.2026.100003

Received: 1 September 2025
Revised: 23 November 2025
Accepted: 24 December 2025
Published: 14 January 2026

Abstract: Tourism is one of the fastest-growing industries in the global economy. It influences policies and strategies of many destinations at different spatial scales. It also has a significant impact on the environment and ecosystem services (ES). This effect further impacts the sustainability of tourism and the achievement of the Sustainable Development Goals (SDGs), contributing to biodiversity loss and habitat destruction. The System of Environmental-Economic Accounting—Ecosystem Accounting (SEEA-EA) was adopted as a global statistical standard in 2021, providing a comprehensive framework for integrating physical and monetary ecosystem accounts to support sustainable management and informed policy and development. This mini-review aimed to summarise and synthesise existing research and emphasise new developments in the use of SEEA-EA for the governance and planning of the tourism industry. We highlighted the key components of SEEA-EA (ecosystem extent, condition, services and asset valuation) relevant to tourism. The limited scope of existing tourism studies was evident in their primary focus on ES valuation and a restricted geographical scale. We further emphasise the potential for interoperability between SEEA-EA, tourism statistics, and the SDGs. The review underscores the current lack of data harmonisation across frameworks and the scarcity of data at the destination level. Despite its limitations, the SEEA-EA integration offers an opportunity to quantify the costs and benefits of tourism and to support monitoring of the SDGs. Prospective applications include utilising SEEA-EA at destination scale for management, enhancing the valuation of the travel & tourism sector's environmental costs and economic benefits, and addressing gaps in tourism statistics. To advance sustainable tourism through effective adoption of the SEEA-EA, it requires enhanced data quality, increased institutional capacity, and global collaboration.

Keywords: SEEA-EA; TSA; ecosystem services; physical accounts; monetary accounts

1. Introduction

Tourism is one of the fastest-growing economic sectors. The total travel & tourism industry's contribution to Gross Domestic Product (GDP) represents a 10.7% share of the global economy, both in absolute and relative terms (World Travel & Tourism Economic Impact Research Factsheet, World Travel and Tourism Council 2025). Global international tourist (overnight stays) flows are growing and were estimated at 1.4 billion in 2024 [1]. Protected areas receive at least 8 billion visitors annually [2,3]. Tourism is also one of the largest economic sectors that relies on the environment (e.g., beaches, forests, mountains) and cultural landscapes (e.g., national parks). This relationship affects the benefits that people derive from the environment, specifically ecosystem services (ES), as defined by the Millennium Ecosystem Assessment [4]. The provision of goods and services relies on healthy

ecosystems [5]. Meanwhile, tourism has a substantial negative impact on ES, including land-use change [6], habitat destruction [7], resource overuse [8], an increase in invasive species [9], and pollution of water [10], air [10], and soil [11] from various sources. On the other hand, tourism can positively contribute to the three pillars of sustainability: economic growth (e.g., GDP, new job creation), social development (e.g., preservation of local culture), and environmental protection (e.g., ecotourism, establishment of new conservation areas). At the same time, if managed appropriately in terms of resources [12] (e.g., energy, food, water, waste), tourism may have a vital role in ensuring long-term sustainability and impact on the achievement of the United Nations Sustainable Development Goals (SDGs) (https://www.un.org/sustainabledevelopment/sustainable-development-goals/ (accessed on 10 August 2025). Achieving a balance between tourism benefits and environmental protection is essential to achieving SDG [13].

ES are classified into provisioning (e.g., fish, reed biomass), regulating & maintenance (e.g., air quality, climate regulation), and cultural (e.g., recreation) sections following the Common International Classification on Ecosystem Services (CICES) [14]. Multiple efforts to assess ES value have emerged over time. Initial efforts emerged with the establishment of modern ecological economics in the 1960s, alongside a new environmental agenda [15]. Even prior approaches, such as the Travel cost method [16,17], paved the way for ES value assessment. The System of Environmental Economic Accounting—Ecosystem Accounting (SEEA-EA) (https://seea.un.org/sites/seea.un.org/files/documents/EA/seea_ea_f124_web_12dec24.pdf (accessed on 10 August 2025) was adopted in 2021 as a global statistical standard by the United Nations [18] and as a reference framework in the European Union (EU). It complements the other two parts of the System of Environmental Economic Accounting (SEEA): SEEA Central Framework (https://seea.un.org/content/seea-central-framework (accessed on 10 August 2025)) that quantifies the environmental inputs used in producing tourism goods and services and their residuals (e.g., pollution, waste) generated by tourism production and consumption; and SEEA Applications and Extensions (https://seea.un.org/applications-extensions (accessed on 10 August 2025)) informing on the ways of applying gathered data to decision-making, policy, analysis and research. SEEA Central Framework and SEEA-EA complement the System of National Accounts (SNA) (https://unstats.un.org/unsd/nationalaccount/sna2025.asp (accessed on 10 August 2025)), integrating accounting principles on environment-related physical and monetary measures to allow for comparison with data from SNA.

SEEA-EA provides a comprehensive framework that considers a broader perspective of physical accounts, encompassing ecosystem extent, condition, and services. Moreover, it considers the valuation of monetary accounts: ecosystem services and asset accounts. The “core intent of ecosystem accounting is to mainstream ecological data in economic planning and decision-making”. The subject is relevant as few studies have applied the SEEA-EA guidelines in tourism. Current studies on tourism impacts primarily focus on ecosystem services but lack a holistic, integrative perspective essential to environmental planning and governance. This review highlights the limited application of SEEA-EA in tourism and the potential to connect environmental and socio-economic data to pursue sustainable governance.

This mini-review aims to summarise and synthesise current research, emphasising new developments for the use of SEEA-EA in the governance and planning of the tourism industry. The objectives are to (1) summarise key components of SEEA-EA relevant to tourism; (2) review current tourism studies using SEEA-EA and identify gaps; (3) explore links between SEEA-EA and tourism-related statistical frameworks; (4) highlight challenges in data and implementation; and (5) suggest a development perspective.

2. Discussion

The monetary and physical perspectives of SEEA-EA complement each other for a more comprehensive understanding of ecosystem use in tourism. The SEEA-EA framework can ensure tracking of economic, social, and environmental impacts and directly inform tourism-related environmental and economic policies. As ecosystem accounting is increasingly applied in research, decision-making, and policy-making [19], it can provide a statistical foundation for sustainable management, supporting informed policy and development by quantifying both the costs and benefits of the industry (Table 1). The body of research on SEEA-EA implementation has grown since 2021. Areas of focus are primarily concentrated in environmental science, agricultural and biological sciences. Leading research is focused on SEEA-EA implementation in Australia, with European countries (e.g., Italy, Spain, the UK, and the Netherlands) showing increasing research efforts. This may be connected to data availability or to a predominant data structure based on geographical units rather than on ecosystem types [20,21]. A significant gap remains in tourism-focused research. This can be due to the complex nature of the tourism industry, where data is combined from several industries (e.g., food & beverage and accommodation), leading to double-counting. SEEA-EA, when integrated with Tourism Satellite Accounts (TSA), can help better represent

the economic impact of tourism. This can be achieved by linking tourism to ES value. The current studies primarily focus on specific local or country-scale (e.g., Sleza Landscape Park, Poland [22]) and case studies (e.g., Italy [23]). Studies vary in scale and focus, ranging from sectoral nation-wide assessments (e.g., Marine-Based Tourism (MBT) in Italy [23] and the impact of surfing on the economy in Australia [24]) to project-based ES accounting efforts. Nevertheless, ES-specific studies can be scaled up to broader applications (e.g., national and international). Data limitations in these studies, which are sometimes based on experimental statistics, can highlight challenges in data collection and procurement. SEEA-EA addresses the longstanding challenges of data procurement and harmonisation. It is structured to provide a standard statistical framework and guidelines to facilitate data collection and harmonisation with targeted data to be included in the SEEA-EA accounts. Aligning the SEEA-EA framework with business accounting frameworks of natural capital presents opportunities to enhance data sharing and harmonisation across public and private sectors [25]. This may foster reporting that supports sustainable business and policy decisions [25]. Continued production of accounts would also address data availability and foster trust between account producers and users [26].

Table 1. Key components of SEEA-EA relevant to tourism.

Ecosystem extent (physical) accounts	Provide a common basis for presenting other data on ecosystems. It can be mapped to record the total area of each ecosystem, classified by type (e.g., terrestrial) within a specified area (e.g., a country or destination), and presented in a time series to illustrate changes in extent over time. Ecosystem extent can help map and monitor natural assets over time, such as beaches or mountain areas. Identify pressure points or hot spots and plan measures to mitigate or prevent adverse impacts.
Ecosystem condition (physical) accounts	Gather data on the condition of ecosystem assets for selected characteristics and specific points in time. Over time, they record the changes to the condition of ecosystem assets while providing essential information on ecosystem health. They build upon data from existing monitoring systems and can further optimise them. In the case of tourism, ecosystem condition indicators (e.g., water quality) are critical and related to the provision of ES that tourism relies on.
ES flow (physical and monetary) accounts	Serve as a link between ecosystem assets and the production and consumption activities of economic units, ranging from governments to businesses and households. Quantifying physical ES flows (e.g., recreation) can help assess how tourism impacts ecosystems or depends on them. Monetary ES accounts support tourism management by quantifying both the economic benefits and the costs associated with ecosystem degradation or loss.
Monetary ecosystem asset (monetary) accounts	Track data on ecosystem assets stocks and changes in stocks, accounting for both ecosystem degradation (e.g., reduced pollution) and enhancement (e.g., improved beaches). This dimension can help measure the contribution of ecosystem assets to the generation of recreational experiences enjoyed by visitors.

The case of tourism is specific, as its statistics are collected by several industries (e.g., accommodation, food & beverage, transportation). Moreover, tourism statistics are based on short-term tourism demand (visitor and tourist expenditures on goods and services) and the supply (industries offering tourism products). This short-term impact, in combination with tourism seasonality, negatively affects economic and socio-cultural conditions in non-peak seasons, leading to environmental impacts in peak season [27], which in turn affect both physical and monetary accounts. As defined by the statistical office of the European Union (Eurostat), tourism is "the activity of visitors taking a trip to a main destination outside the usual environment, for less than a year, for any main purpose, including business, leisure or other personal purpose, other than to be employed by a resident entity in the place visited" (https://ec.europa.eu/eurostat/documents/3859598/6454997/KS-GQ-14-013-EN-N.pdf/166605a a-c990-40c4-b9f7-59c297154277?t=1420557603000 (accessed on 10 August 2025)). To measure the size of economic sectors not defined as industries in the SNA, the United Nations (UN) developed Satellite Accounts as an extension of SNA [28]. Specifically, TSAs provide a standardised method for measuring the direct economic contribution of tourism to the economy, using satellite accounts in line with the SNA. TSA is an internationally recognised framework for measuring tourists' activity and their importance to national (or regional) economies. The framework excludes indirect contributions (e.g., agriculture, insurance), and only the direct output is counted toward tourism [29]. Traditionally, tourism statistics have primarily focused on flows (e.g., the number of visitors); meanwhile, TSA provides information on the extent of tourism's contribution to the economy and the creation of jobs [30]. It can help quantify the extent to which ES contribute to the economy by supporting tourism-related activities and jobs. The TSA quantifies the direct economic impact of tourism, while the SEEA-EA provides

complementary insights into the environmental dimensions that sustain tourism. This includes ecosystem health and the availability of ES. In combination, the frameworks provide a more comprehensive understanding of the industry's socio-economic and environmental footprint and support the sustainable development of tourism policies.

In an attempt to link SEEA and TSA, the World Tourism Organisation (UNWTO) and the UN Statistics Division opened a discussion on a proposed Statistical Framework for Measuring Sustainable Tourism (MST) (https://webunwto.s3-eu-west-1.amazonaws.com/2019-08/tsaseeatechnote.pdf (accessed on 10 August 2025)) in 2018 and an updated version (SF-MST) in 2024 [31]. This was done to link economic and environmental aspects to improve the organisation and dissemination of tourism information and to provide a solid statistical base to support monitoring progress towards achieving SDG [32]. However, this framework neglected to include wellbeing outcomes related to tourism development [32,33]. While several researchers emphasise its importance as the foundation of economics, and for achieving the SDGs. This information is crucial for evaluating the state of the local host communities. Moreover, connections to previous frameworks and the SDGs are still lacking [33].

Furthermore, UN member states are encouraged by the 2030 Agenda for Sustainable Development (United Nations Transforming our World: The 2030 Agenda for Sustainable Development, United Nations, New York (2015)) to "conduct regular and inclusive reviews of progress at the national and sub-national levels, which are country-led and country-driven". Most countries worldwide conduct voluntary national reviews (VNRs) to report on their progress in implementing the SDGs. Currently, SEEA frameworks support 40 indicators for 9 SDGs [34]. Among these are the goals most related to tourism: "decent work and economic growth" (SDG 8), "responsible consumption and production" (SDG 12), and "life below water" (SDG 14). Moreover, tourism can contribute to all the SDGs, directly or indirectly. However, UNWTO states that tourism has the potential to contribute to all 17 SDGs (https://www.undp.org/sites/g/files/zskgke326/files/publications/UNWTO_UNDP_Tourism%20and%20the%20SDGs.pdf (accessed on 10 August 2025)). From an environmental perspective, tourism contributes to significant degradation of ES through pollution (SDG 2, SDG 3, SDG 14), resource overexploitation (SDG 1), urban sprawl (SDS 1, SDG 2, SDG 15), and biodiversity loss (SDG 15), while it increases vulnerability to climate change (SDG 1, SDG 13) and natural disasters (SDG 11, SDG 13) [35]. From a socio-economic perspective, tourism strains the provision of local services (SDG 1, SDG 11), fragments and destroys communities (SDG 11, SDG 14), deepens inequalities (SDG 2), and threatens cultural and natural heritage (SDG 11) [35].

A conceptual framework connecting ecosystem accounting, tourism economic statistics, and sustainable development monitoring is presented in Figure 1. In the context of tourism, the interplay among the SNA, TSA, and SEEA-EA frameworks focuses on tourism consumption, employment, production, and visitor flows. They are based on harmonised classifications and definitions for comparability at national and international levels. SEEA-EA and TSA utilise the SNA for harmonisation, integration, and comparability. SEEA-EA applies the SNA exchange value in the context of monetary valuation. All these frameworks emphasise interoperability and integration of ecosystem data (SEEA-EA), sector statistics (TSA), and network protocols (NSA). The interoperability of SEEA-EA with multiple environmental policies supports its recognition as a global ecosystem accounting standard [20], thereby facilitating the integration of environmental policies across various sectors. Allocation of ecosystem degradation and enhancement based on the ownership of economic units (e.g., those that receive SNA benefits or contribute to non-SNA benefits) can aid in identifying the responsible unit and enforcing the responsibility for pollutants. SEEA-EA can provide a more comprehensive set of metrics than GDP-based [36]. ES are counted in addition to GDP, providing a broader context of nature's economic value.

The adopted frameworks offer a comprehensive system for data sharing and data-driven decision-making at the international level. However, accounting methods and data limitations hinder the accuracy of accounting for specific segments, such as tourism carbon emissions [37]; environmental and socio-cultural data are of inferior quality, less available, and not as frequently updated in comparison to economic [38,39]. This is explained by the dominance of economic rationale in the development of tourism [38,39]. ES research often focuses on specific sectors (e.g., diving, accommodation) while neglecting others. This may lead to an incomplete understanding of the full impact of tourism. The same applies to geographical extent. Focusing on the SEEA-EA application to a limited local or national scale leaves gaps in knowledge about tourism and ES in less-studied regions. SEEA-EA level of implementation varies among the countries; therefore, there is a need for initiatives promoting the adoption of the SEEA-EA framework on a global scale [20,40]. Additionally, local and municipal access to tourism statistical data is very limited, impacting decision-making [33], as it is based on generalised regional or national insights. There is a lack of harmonised and detailed data at a destination level, as well as limited achievements in comparability to international data [33]. This can be attributed to a lack of funding for comprehensive data collection, as well as a shortage of tools and limited person-hours available to implement the frameworks.

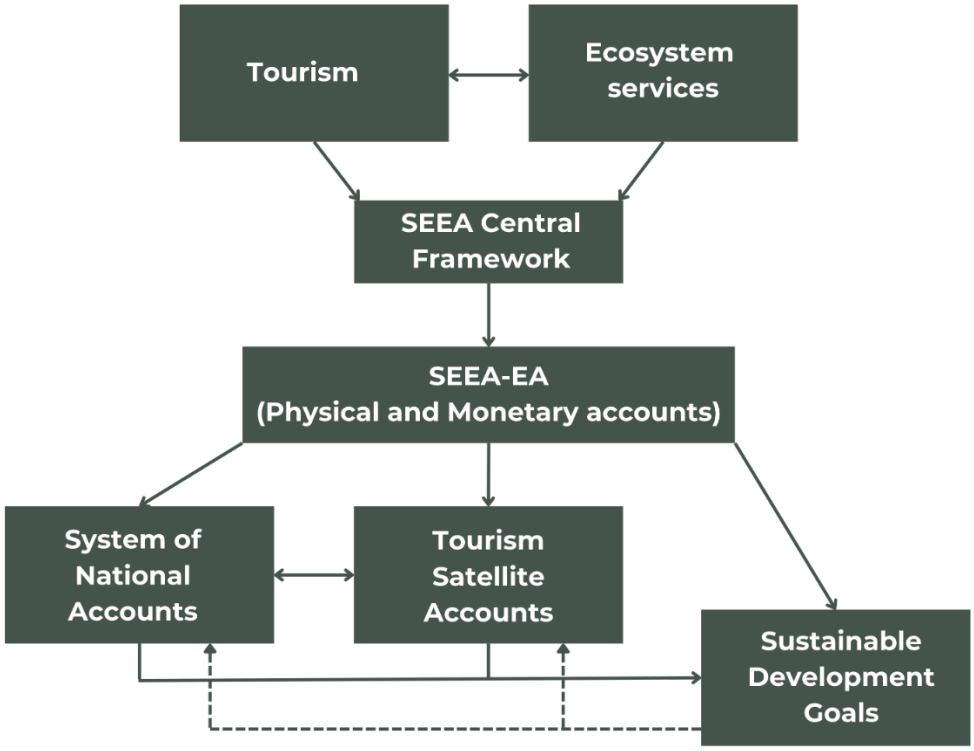

Figure 1. Conceptual framework linking SEEA-EA, tourism statistics, and sustainable development goals. Dashed arrows represent SDGs informing the statistical frameworks on which indicators are needed.

In the travel & tourism industry, trends (e.g., technology, big data, social media, the sharing economy) [41] and user behaviour are changing rapidly. Therefore, future efforts are needed to harmonise tourism data and ES valuation for better comparability and synthesis of knowledge [35,42,43].

While not explicitly researched, familiarity with the terminology related to SEEA-EA and even ES is limited. It is not common knowledge [44]. ES and their economic impact can be challenging topics to communicate due to the complexity of their conceptualisation and valuation [45], especially for stakeholders at the local level. The concept of ES, however, is easily understood once explained [46]. This is a separate issue that needs to be addressed through effective communication, dissemination of the terms, and stakeholder involvement during the implementation of the framework. As a result, the lack of familiarity with these concepts delays the application of these frameworks. In the case of SEEA-EA, it may affect the UN goal that at least 60 countries would compile at least one account by 2025 (https://seea.un.org/sites/seea.un.org/files/documents/EA/seea_ea_implementation_strategy_march_2022.pdf (accessed on 10 August 2025)).

3. Conclusions

Integrating both physical and monetary ecosystem accounts, SEEA-EA provides a framework for quantifying and valuing ecosystem assets and the ES they produce, supporting tourism. However, the application of SEEA-EA in tourism research remains limited, with a primary focus on the local or national scale, revealing a gap in its global implementation. There is a lack of harmonisation with established economic data-based statistical frameworks, such as TSA, to comprehensively integrate environmental-economic data with tourism statistics. To address these challenges, the global application of the SEEA-EA framework is necessary, incorporating integrated, standardised protocols based on harmonised, comparable data across various environmental monitoring systems and tourism statistics platforms. SEEA-EA-based data may support monitoring of SDG indicators that have direct (e.g., “Tourism direct GDP as a proportion of total GDP and growth rate” (https://www.undp.org/sites/g/files/zskgke326/files/publications/UNWTO_UNDP_Tourism%20and%20the%20SDGs.pdf (accessed on 10 August 2025))) or indirect links to tourism (e.g., “Change in the extent of water-related ecosystems over time” (https://www.unwater.org/our-work/sdg-6-integrated-monitoring-initiative/indicator-661-change-extent-water-related (accessed on 10 August 2025))), and enhance the evidence base for governance decisions at multiple scales. Future research is needed to focus on valuation methods tailored to tourism, as well as on improving spatio-temporal analysis across different scales to support comprehensive ecosystem accounts that facilitate sustainable tourism development.

4. Prospective

SEEA-EA could better inform specific tourism or conservation policies and improve the assessment of SDG progress in VNRs by providing a standardised framework for organising and integrating specific environmental and economic data. Moreover, the SEEA-EA framework offers flexibility and can be applied at a smaller destination scale, depending on available data, institutional capacity, and stakeholders' willingness to contribute. Destination-scale SEEA-EA accounts can help local authorities manage natural resources and monitor changes more effectively, supporting policy decisions that lead to more sustainable tourism.

Author Contributions

E.B., M.I. and P.P.: conceptualisation, methodology; E.B.: data curation, writing—original draft preparation; E.B.: visualisation, investigation; P.P.: supervision; M.I. and P.P.: writing—reviewing and editing. All authors have read and agreed to the published version of the manuscript.

Funding

This research received no external funding.

Data Availability Statement

Data will be made available on request.

Conflicts of Interest

Given the role as Editor-in-Chief, Paulo Pereira had no involvement in the peer review of this paper and had no access to information regarding its peer-review process. Full responsibility for the editorial process of this paper was delegated to another editor of the journal.

Use of AI and AI-Assisted Technologies

During the preparation of this work, the authors used Grammarly to check grammar and spelling and to improve the clarity of the text. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the published article.

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