

Sustainable Peatland Ecosystem Balance: A System of Environmental-Economic Accounting Perspective

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Research aims: This study analyzes the accountability of natural resource assets in peatland ecosystems within the framework of the System of Environmental-Economic Accounting – Ecosystem Accounting (SEEA EA).

Design/Methodology/Approach: The study uses a qualitative case study of community agricultural activities in Kubu Raya Regency, West Kalimantan. Data were collected through in-depth interviews with farmers, government reports, agricultural statistics, and environmental documents. Data analysis used an interactive model based on the SEEA Ecosystem Accounting interpretive approach.

Research findings: The results indicate that peatlands function as ecosystem assets that generate various ecosystem services, particularly provisioning services, such as agricultural produce serving as a source of community income. Existing accountability patterns remain dominated by program reporting and budget utilization, and information about the condition of peat assets, ecosystem services, and environmental benefits has not been systematically integrated.

Theoretical contribution/Originality: This study proposes the concept of ecological accountability as a form of public accountability that positions the condition of ecological assets, ecosystem services, and natural resource sustainability as integral components of the accountability system. The findings reinforce the relevance of implementing SEEA Ecosystem Accounting to support peatland management that is more transparent, sustainable, and oriented toward community well-being.

Keywords: Ecological Accountability; Kubu Raya Regency; Natural Resource Assets; Peatlands; SEEA Ecosystem Accounting

Article History

Submitted:
20 August 2025

Revised:
07 April 2026

Accepted:
16 April 2026



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Citation: Heniwati, E., & Sedah, E. (2026). Sustainable Peatland Ecosystem Balance: A System of Environmental-Economic Accounting Perspective. *APPSAI Accounting Review*, 6(1), 1-10.

Introduction

Transitions in the global growth paradigm have heightened attention to the spirit of sustainable natural resource management (Burritt, 2012; R. Hines, 1991; R. D. Hines, 1988). For decades, development success was largely measured by conventional economic indicators such as Gross Domestic Product (GDP) growth, while the contribution of ecosystems to societal well-being was often inadequately reflected in public accounting and reporting systems. This situation led to various forms of environmental degradation that were not fully recorded as a depletion of development assets.

Against this background, the concept of natural capital emerged as an approach that treats natural resources as assets generating sustainable economic, social, and ecological benefits (Kareiva et al., 2011). Jones (1996) introduced the concept of "natural inventory" and elaborated on its operationalization through environmental accounting (Jones, 2003, 2010). Further developments led to the introduction of the System of Environmental-Economic Accounting—Ecosystem Accounting (SEEA EA), which has been adopted by the United Nations as the international standard for environmental and ecosystem accounting. The SEEA EA enables measurement of ecosystem extent, condition, and services, as well as the value of ecosystem assets in both physical and monetary terms (Russell et al., 2017).

Kubu Raya Regency in West Kalimantan Province is one of the regions in Indonesia possessing extensive peatland ecosystems. Usually, local communities utilize these ecosystems to support various community livelihoods (Glenk & Martin-Ortega, 2018) through agriculture, plantations, and natural resource-based commodities. The agricultural crops cultivated on these peatlands are integral to the local economy, yet their viability depends on the continued functioning of the peatland ecosystem.

However, utilizing peatlands for economic gain imposes environmental pressures, including land conversion, peat fires, hydrological alterations, and natural resource exploitation, that threaten to degrade the quality of these ecosystem assets. As the ecosystem degrades, the community's long-term economic benefits will inevitably decline. This situation demonstrates that agricultural output from peatlands is inextricably linked to the condition of the ecological assets that sustain it.

On the other hand, public accountability systems at the local level remain largely oriented toward financial reporting and government program achievements. Information regarding changes in the condition of ecosystem assets, the capacity to provide ecosystem services, and the value of natural resources has not yet been systematically integrated into public accountability mechanisms. Consequently, a gap exists between natural resource management and local government accountability systems.

The SEEA Ecosystem Accounting framework provides a means to understand peat assets as ecosystem assets that can be measured, monitored, and accounted for more comprehensively (United Nations, 2025). Within this framework, agricultural produce derived from peatlands is considered part of the provisioning ecosystem services provided by peat ecosystem assets. Thus, the success of natural resource management is assessed not only by the volume of agricultural production but also by the ability to maintain the ecosystem conditions that support such production.

This research is significant given the limited number of accounting studies that integrate public accountability, natural resource assets, and ecosystem accounting in the context of Indonesian peatlands. Furthermore, studies on the implementation of the SEEA at the local government level remain scarce, despite Indonesia's development of pilot accounts for peat ecosystems in Sumatra and Kalimantan.

This study aims to develop a concept of natural resource asset accountability for peatland ecosystems using a case study of agricultural activities on peatlands in Kubu Raya Regency, West Kalimantan. The concept is developed based on the SEEA perspective. Specifically, the research objectives are to identify the characteristics of peat ecosystem assets in the study area, analyze agricultural output as a provisioning ecosystem service, examine accountability

practices for managing peat natural resource assets, and enhance understanding of the sustainable application of SEEA Ecosystem Accounting in the context of local environmental accountability.

Theoretically, this research can advance the concept of ecological accountability by linking public accountability with SEEA-based ecosystem asset accounting. The findings may also provide valuable input for local governments, regional development planning agencies (Bappeda), agriculture and environmental agencies, and other stakeholders in the development of ecosystem-based natural resource reporting systems. From a policy perspective, the research findings can offer insights into how information regarding peat assets and ecosystem services can be integrated into regional development decision-making.

Natural Capital Theory, Public Accountability, and SEEA Ecosystem Accounting

This study employs the concept of Natural Capital Theory, which views natural resources as capital that generates a sustainable flow of economic, social, and environmental benefits (Kareiva et al., 2011). From this perspective, peatlands are viewed not merely as land or a space for production, but as assets capable of providing a range of ecosystem services. Agricultural produce obtained by communities from peatlands represents a form of benefit derived from this natural capital; consequently, the sustainability of agricultural production is heavily influenced by the condition of the peatland ecosystem assets.

Public accountability entails the obligation of those entrusted with a mandate to explain, justify, and report their actions and performance to the mandating party (Schillemans, 2013), and the process is inherently complex (Baker & Free, 2026). The accountability, for natural resources, encompasses budget utilization, the condition of managed resources, the environmental impact of policies, and the sustainability of the benefits the community receives. In other words, the environment becomes a subject of public accountability; thus, it is known as ecological accountability. This emphasizes that governments and stakeholders bear responsibility for the sustainability of the ecological assets that underpin community economic activities (Atkins et al., 2023).

SEEA Ecosystem Accounting is an international standard that integrates environmental and economic information into a single accounting system. This framework consists of four ecosystem accounts: extent, condition, services, and assets. The ecosystem extent account measures ecosystem area and changes, and the ecosystem condition account measures ecosystem quality and health. Moreover, the ecosystem services account measures ecosystem services in both physical and monetary terms, and the ecosystem asset account measures the value of ecosystem assets and changes in that value over time (United Nations, 2025).

Peatland ecosystems perform ecological functions such as carbon storage, hydrological regulation, biodiversity conservation, and the provision of economic resources for local communities. Within the SEEA framework, peatlands are treated as ecosystem assets possessing both ecological and economic value (Glenk & Martin-Ortega, 2018). In the SEEA, agricultural outputs that rely on ecosystem functions are classified as provisioning ecosystem services. Agricultural production is influenced not only by technical cultivation factors but also by the ecological condition of the peatlands that support these activities

Research on natural capital accounting (Burritt & Cummings, 2002; Cuckston, 2013, 2017, 2018) indicates that measuring environmental assets can enhance the quality of information for development decision-making. A pilot study on Indonesian peatland ecosystem accounts, conducted by BPS and the World Bank, demonstrates that the SEEA approach can capture changes in peat ecosystem conditions and their linkages to economic activities. Other studies show that ecosystem services contribute significantly to community well-being yet are often not reflected in conventional accounting systems; the ecosystem accounting approach was developed to address these limitations.

However, research linking public accountability, peatland agricultural output, and SEEA Ecosystem Accounting at the local government level remains relatively limited. This research gap presents an opportunity for the current study to make a contribution. Thus, this study develops its conceptual framework as follows: peat ecosystem assets are positioned as the primary source of ecosystem services. Agricultural produce generated by the community is a provisioning ecosystem service that depends on the condition of peat assets. Information regarding asset conditions, ecosystem services, and economic benefits is then analyzed within the SEEA framework to assess the nature of accountability in natural resource management.

Methodology

This study employs a qualitative case study approach. The case study approach was selected because the research seeks an in-depth understanding of natural resource asset accountability in peat ecosystems, specifically in the social, economic, and environmental context of Kubu Raya Regency. The study was conducted in Kubu Raya Regency, West Kalimantan, an area characterized by extensive peatlands utilized for various community agricultural activities. The study's objective is the natural resource asset, specifically, the peatland ecosystem, which serves as the production base for local agricultural output. The units of analysis in this study include agricultural commodities cultivated on peatlands, the condition of the peat ecosystem that supports agricultural activities, the forms of accountability for natural resource management by the government and stakeholders, and environmental information available in official reports and documents.

The study uses primary and secondary data. The first was collected through in-depth interviews with peatland farmers, and the second was gathered through document analysis. The documents consist of the BPS (Statistics Indonesia) documents, KLHK (Ministry of Environment and Forestry) reports, BRGM (Peatland and Mangrove Restoration Agency) documents, agricultural statistics reports, official government websites, SEEA-related publications, scholarly articles, and research reports.

The in-depth interview data were utilized to gain insight into peatland management, agricultural yields, and the forms of accountability practiced by the various actors involved. Meanwhile, document analysis was used to identify information on peat conditions, land area, agricultural production, policies, restoration programs, and natural resource reporting across various official documents.

The analysis employed an interactive model (Miles et al., 2014) comprising data condensation, data display, and conclusion drawing and verification. Subsequently, the data were analyzed using the SEEA Ecosystem Accounting framework as an interpretive lens, following these analytical stages: 1) Identifying the peat ecosystem assets serving as the basis

for agricultural activities. 2) Identifying the ecosystem services generated, specifically provisioning ecosystem services in the form of agricultural produce. 3) Analyzing the methods of measuring and reporting natural resource assets found in documents and institutional practices. 4) Interpreting the nature of natural resource asset accountability based on the concepts of ecological accountability and SEEA Ecosystem Accounting.

To validate the findings, several data validation procedures were implemented, including source triangulation, method triangulation, document triangulation, and member checking with key informants. Throughout this process, the researcher served as the primary research instrument, directly conducting data collection, interpretation, and analysis while maintaining reflexivity and academic objectivity.

Results and Discussions

Kubu Raya Regency is a region in West Kalimantan Province characterized by extensive peatland areas. Local communities utilize parts of this territory for agriculture, plantations, and other natural resource-based enterprises. These geographical conditions position peatlands as a vital environmental asset that contributes to both the regional economy and community livelihoods.

Observations and documentation indicate that various agricultural commodities, such as vegetables and corn, are cultivated on these peatlands. Such agricultural activity is supported by the peatlands' ecological functions: serving as a plant growth medium, a water reservoir, and a source of specific nutrients that enable sustainable cultivation. From the perspective of SEEA Ecosystem Accounting, this situation demonstrates that peatlands function not merely as spaces for production but also as ecosystem assets that generate diverse economic and environmental benefits for the community.

Characteristics of Peatland Ecosystem Assets as Natural Capital

Research findings indicate that farmers view peatlands as a primary source of livelihood. However, the majority of informants do not yet grasp that peatlands are environmental assets possessing simultaneous ecological and economic value.

An analysis of local government documents reveals that peatland management has historically focused more on land utilization than on the management of ecosystem assets. Available information generally covers agricultural land area, commodity production, and the agricultural sector's contribution to the regional economy. Within the framework of Natural Capital Theory, these findings demonstrate that although the functions of natural capital have been harnessed to generate economic benefits, recognition of the assets' ecological value remains relatively limited.

The SEEA views peat ecosystems as ecosystem assets characterized by two key attributes: the capacity to generate ecosystem services and the ability to maintain ecological functions over time. Consequently, the sustainability of agricultural production is heavily dependent on the condition of the peat assets themselves. These findings highlight a gap between asset utilization and asset management; the government and the community tend to focus on production output rather than on the condition of the assets that generate that output.

Agricultural Produce as Provisioning Ecosystem Services

Research indicates that all agricultural commodities produced by the community are direct benefits of peatland ecosystems. Interviews reveal that farmers derive their primary income from crops cultivated on peatlands. Production success is heavily influenced by peat hydrology, soil moisture levels, and groundwater table stability. From the perspective of SEEA Ecosystem Accounting, these agricultural products fall under provisioning ecosystem services, services provided by ecosystems to humans.

These findings demonstrate that the economic value realized by the community is essentially a flow of benefits (ecosystem services) derived from the stock of ecological assets (ecosystem asset stock). This concept is significant because, to date, the value of agricultural produce has been recorded solely as economic output, while the contribution of the ecosystem generating that output has not been reflected in local government reporting systems. Consequently, agricultural produce can be viewed as a tangible indicator of the economic benefits generated by peatland assets.

Accountability in the Management of Peatland Natural Resource Assets

Research findings indicate that the form of accountability practiced by local governments remains dominated by program reporting and budget utilization. Information regarding the condition of peat ecosystems, changes in land quality, carbon storage capacity, and the value of ecosystem services is not yet systematically available. The government documents analyzed contain more administrative performance indicators than indicators reflecting the condition of environmental assets.

These findings demonstrate that current accountability practices operate primarily at the levels of financial and program accountability. From the perspective of Public Accountability Theory, public accountability should encompass information on managed resources, changes in their condition, and the benefits generated for the community. Since peatlands are public assets that yield both economic and ecological benefits, information on changes in their condition should be an integral part of local government accountability.

Analysis of Accountability within the SEEA Ecosystem Accounting Framework

Based on interviews and document reviews, the study found that the key elements of the SEEA are already partially available across various government documents. Information on peatland area is available in spatial and land-use reports; agricultural production data is available in agricultural statistics; and information on fires and environmental conditions is available in regional environmental reports. However, this information has not yet been integrated into a unified ecosystem asset accounting system.

Within the SEEA framework, accountability for peatland assets can be realized through four types of accounts: the ecosystem extent account, the ecosystem condition account, the ecosystem services account, and the ecosystem asset account. This study demonstrates that implementing the SEEA has the potential to broaden the concept of accountability, shifting it from mere reporting on activities to reporting on the condition of the ecological assets that underpin regional development.

Development of the Ecological Accountability Concept

Research findings indicate that the success of peatland management cannot be measured solely by increases in agricultural production; it must also be gauged by the ability to maintain the ecosystem conditions that generate those benefits. These findings have led to the development of the concept of "ecological accountability."

Ecological accountability is a form of accountability that positions the state of ecological assets as the primary focus of reporting and performance evaluation for local governments. Under this concept, the government not only accounts for resource utilization but also commits to, and accepts responsibility for, the sustainability of those resources for future generations (Virto et al., 2018). Furthermore, the developed model must be capable of signaling environmental degradation (Negash, 2012). This represents an expression of the government's ethical accountability to the broader public regarding environmental management (Boiral, 2016; Liempd & Busch, 2013; Ogilvy, 2015).

SEEA-Based Peatland Ecosystem Assets Accountability Model

Based on research findings, the conceptual model for peatland ecosystem assets encompasses ecosystem services, agricultural production, community economic benefits, SEEA measurement and reporting, ecological accountability, and sustainable peatland management (Figure 1). This model demonstrates that agricultural output is a manifestation of ecosystem services derived from peatland assets and, consequently, requires accountability within the public accountability system.

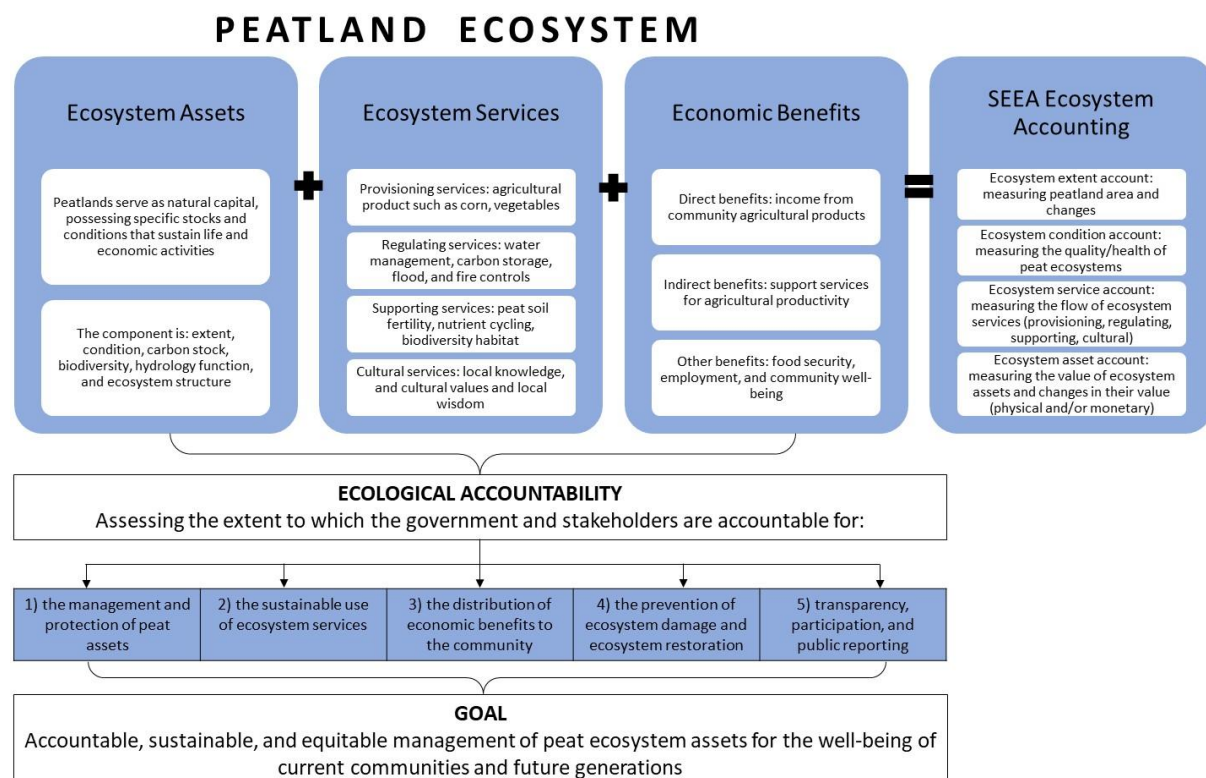


Figure 1 Peatland Ecosystem Balance Sheet Model (2026)

Conclusions

This study demonstrates that peatlands in Kubu Raya Regency are natural resource assets serving both economic and ecological functions. Through community agricultural activities, these peatland assets generate economic benefits that fall under the provisioning ecosystem services category within the SEEA Ecosystem Accounting framework.

The research findings indicate that agricultural output from peatlands is inseparable from the condition of the supporting ecosystem assets. Agricultural productivity is affected by the peat's ecological characteristics, including hydrological conditions, soil quality, and the ecosystem's capacity to maintain its environmental functions. The study also reveals that local government accountability practices remain focused on program reporting and budget utilization. Information regarding the state of peatland assets, changes in ecosystem quality, and the value of ecosystem services has not yet been integrated into the public accountability system. Analysis using the SEEA Ecosystem Accounting framework shows that data on peatland assets are available in various government documents but remain fragmented and have not been consolidated into an ecosystem asset accounting system. Based on these findings, the study develops the concept of ecological accountability, a form of accountability that positions the condition of ecological assets, ecosystem services, and natural resource sustainability as the primary subjects of public accountability.

This study advances Public Accountability Theory by incorporating an ecological dimension into the concept of public accountability. It also reinforces Natural Capital Theory by demonstrating that agricultural output from peatlands represents an economic benefit derived from natural capital, whose sustainability must be preserved. Furthermore, the study contributes to the environmental accounting literature by integrating the concepts of SEEA Ecosystem Accounting and ecological accountability within the context of peatland management.

In practical terms, the findings imply that local governments need to develop a natural resource asset reporting system capable of presenting information on peatland extent and condition, ecosystem services generated, the economic value of ecosystem benefits, risks of degradation and fire, and restoration and conservation programs. Integrating such information can enhance the quality of regional development decision-making. The findings also have policy implications, suggesting that local governments could adopt the SEEA Ecosystem Accounting approach as a foundation for developing regional environmental accountability systems. Implementing the SEEA framework can also support the formulation of policies for low-carbon development, peatland conservation, and more sustainable natural resource management.

This study employs a case study approach; therefore, the findings are not intended for statistical generalization. Furthermore, the study did not conduct a quantitative monetary valuation of all the peat ecosystem services generated. Future research could focus on developing economic valuations of peat ecosystem services using the SEEA framework, measuring peat carbon accounts at the regional level, modeling natural resource asset reporting for local governments, integrating the SEEA with public-sector sustainability reporting, and developing a local government ecological accountability index.

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