

Reframing Environmental Accounting Through Indigenous-Based Asset Valuation and Socio-Ecological Integration

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ABSTRACT

Conventional environmental accounting practices still have significant limitations because they mainly emphasize monetary valuation while neglecting the socio-cultural and ecological dimensions embedded in indigenous asset systems. This research aims to develop an indigenous-based asset valuation and environmental accounting model that integrates economic, ecological, and socio-cultural values within indigenous community enterprises. This study employs a mixed-methods approach using Participatory Action Research (PAR), combining qualitative techniques (in-depth interviews, participatory observation, and collective reflection) with quantitative valuation based on the Total Economic Value (TEV) framework. The findings reveal that indigenous assets are perceived as collective socio-ecological trusts, where non-use values, especially existence and bequest values, are central alongside direct and indirect use values. The study proposes an indigenous-based environmental accounting model that generates ecological financial statements covering natural resource assets, social and environmental liabilities, and non-financial reports. This model has practical implications for improving accountability, sustainability, and policy formulation in indigenous economic governance, but it is context-specific and requires adaptation for broader application in different indigenous settings.

Keywords: Asset Valuation; Environmental Accounting; Indigenous-Based Accounting; Participatory Action Research; Total Economic Value

INTRODUCTION

Indigenous communities in Papua have long practiced sustainable natural resource management, particularly in preserving forests, biodiversity, and ecological balance. This sustainability is reflected in the relatively low deforestation rates in customary territories compared to non-customary areas, as reported by the World Resources Institute (WRI, 2023). Such outcomes are closely associated with traditional governance systems that regulate resource use through customary restrictions, seasonal practices, and community-based conservation mechanisms. These systems demonstrate a strong ecological relationship between indigenous communities and their environment, where natural resources are managed as shared assets intended to support both present and future generations.

In addition to conservation practices, indigenous communities in Papua have developed adaptive agroforestry systems that integrate food production with forest ecosystems. Crops such as sago, taro, red fruit, and vegetables are cultivated under forest canopies in ways that maintain ecological balance and support food security. These practices indicate that indigenous resource management systems are not only environmentally sustainable but also socially and economically resilient.

Despite this long-standing sustainability, natural resource governance in Papua has faced increasing pressure in recent decades. The expansion of extractive industries, including mining, large-scale plantations, and illegal logging, has accelerated deforestation and ecosystem degradation. These activities threaten tropical forests while simultaneously undermining the livelihoods, cultural identity, and land rights of indigenous communities. Furthermore, the economic benefits derived from resource exploitation are often distributed unequally, resulting in widening disparities and reduced access to customary land.

In response to these challenges, Indigenous Community-Owned Enterprises, known as *Badan Usaha Milik Masyarakat Adat* (BUMMA), have emerged as institutional mechanisms to strengthen indigenous control over natural resource management. Established through collective decision-making and supported by regional regulations, BUMMA are designed to promote transparent, accountable, and sustainable economic activities while safeguarding customary land rights and improving community welfare.

However, the implementation of BUMMA faces significant challenges, particularly in the valuation and recognition of indigenous assets in accounting. Existing accounting studies and practices largely rely on conventional frameworks that emphasize market-based valuation, financial measurability, and individual ownership (Chowdhury, 2020; Patma et al., 2025). While these approaches are effective in formal economic systems, they remain inadequate for capturing the communal, ecological, and cultural characteristics of indigenous assets such as forests, biodiversity, and ecosystem services (Bebbington & Campbell, 2015; Milne & Gray, 2013). Previous studies in environmental accounting have attempted to incorporate environmental costs and benefits into financial reporting; however, they tend to prioritize quantifiable economic values and often overlook non-use values such as existence and bequest values, which are central to indigenous perspectives (Costanza et al., 2014; Patma & Kambuaya, 2024).

This limitation reveals a clear research gap: current accounting frameworks have not sufficiently developed models that integrate indigenous worldviews, communal ownership structures, and socio-ecological values into asset valuation and reporting systems. As a result, the performance of BUMMA is frequently assessed in subjective or

incomplete ways, limiting accountability, access to financing, and evidence-based decision-making (Maulana & Prasetyo, 2025; Weerathunga et al., 2020).

Environmental accounting offers a broader perspective by integrating ecological and social dimensions into economic reporting (Shakil et al., 2019). Within this approach, the Total Economic Value (TEV) framework provides a comprehensive method for valuing ecosystems by incorporating direct use, indirect use, option, existence, and bequest values. However, the application of TEV within indigenous-based accounting systems remains limited, particularly within institutional frameworks such as BUMMA.

Accordingly, this study aims to develop a comprehensive valuation model for indigenous wealth assets based on the TEV framework and to examine its integration into environmental accounting for the management of BUMMA. This study contributes to the literature by addressing the gap between conventional accounting approaches and indigenous value systems, while also providing a contextual and participatory model for asset recognition. In practice, the findings are expected to enhance transparency, accountability, and sustainability in indigenous economic governance, as well as inform policy development on natural resource management in indigenous contexts.

LITERATURE REVIEW

Indigenous Natural Resource Management and Customary Land Rights

Indigenous communities have long developed governance systems that regulate access to and use of natural resources based on customary norms, collective decision-making, and intergenerational responsibility. These systems reflect adaptive and sustainable resource management practices that maintain ecological balance and social cohesion (Folke et al., 2021). In Papua, customary land rights are managed through locally embedded practices such as land rotation, seasonal harvesting restrictions, and collective enforcement mechanisms, which demonstrate a strong socio-ecological relationship between communities and their environment. Such practices are widely recognized for their effectiveness in conserving forests and biodiversity while supporting livelihoods (Agrawal & Benson, 2011).

However, in recent decades, customary land rights have faced increasing pressure due to the expansion of extractive industries, including mining, large-scale plantations, and commercial logging. These activities often occur without meaningful consultation, resulting in environmental degradation and weakening indigenous governance systems. The marginalization of customary institutions within formal economic systems reflects a structural gap between indigenous governance and modern accounting frameworks, which often fail to capture non-market and communal values (Hazaea et al., 2023; Mishra et al., 2024).

Indigenous Community-Owned Enterprises and Asset Governance

Indigenous Community-Owned Enterprises, commonly referred to as BUMMA, have emerged as institutional mechanisms to strengthen indigenous control over natural resource management. These enterprises aim to transform communal assets into sustainable economic opportunities while preserving ecological and cultural values. Unlike conventional firms, indigenous enterprises pursue multiple objectives, including economic, social, and environmental goals (Cerciello et al., 2023; Soomro et al., 2024).

Despite their growing importance, indigenous enterprises face significant challenges in asset recognition and valuation (Fondevila et al., 2019). Natural assets such as forests, biodiversity, and ecosystem services are difficult to quantify using conventional

accounting systems that prioritize financial and market-based values (Sameer, 2021). This limitation reduces transparency and weakens accountability, ultimately constraining access to financial resources and policy support (Khan & Gupta, 2024; Scarpellini et al., 2020).

Environmental Accounting and Indigenous Asset Valuation

Environmental accounting has emerged in response to the limitations of traditional accounting systems, which overlook ecological and social dimensions (Abhishek et al., 2025). It integrates environmental costs, sustainability indicators, and ecosystem services into accounting practices to improve transparency and decision-making (Bustos-Contell et al., 2022; Christensen et al., 2021).

Recent studies highlight that environmental accounting contributes positively to corporate value, sustainability performance, and accountability by incorporating non-financial disclosures (Dhar et al., 2022; Mondal et al., 2023). However, most environmental accounting frameworks remain rooted in corporate and market-oriented perspectives, limiting their ability to capture communal, cultural, and spiritual values inherent in indigenous resource management systems (Hazaea et al., 2023; Sundarassen et al., 2024).

As a result, there is a growing need for context-sensitive accounting approaches that can integrate ecological, social, and cultural values into a comprehensive valuation system, particularly for indigenous institutions (Ashok et al., 2019).

TEV as a Valuation Framework

The TEV framework provides a comprehensive approach to valuing ecosystems by incorporating both use and non-use values (Chen et al., 2020). TEV includes direct use values, indirect use values, option values, existence values, and bequest values, offering a more holistic representation of environmental assets (Dhar et al., 2022; Mondal et al., 2023).

Recent literature emphasizes that TEV is highly relevant in sustainability and environmental accounting contexts, as it enables the inclusion of non-market values in decision-making processes (Sundarassen et al., 2024). In indigenous contexts, TEV aligns closely with holistic worldviews that recognize nature as a socio-cultural and spiritual entity rather than merely an economic resource (Burritt et al., 2019).

However, empirical applications of TEV remain largely limited to project-based valuation and have not been fully integrated into formal accounting systems, particularly within indigenous enterprises (Abhishek et al., 2024). This gap highlights the need to adapt TEV into an institutional accounting framework that reflects indigenous governance structures and value systems (Comello et al., 2023).

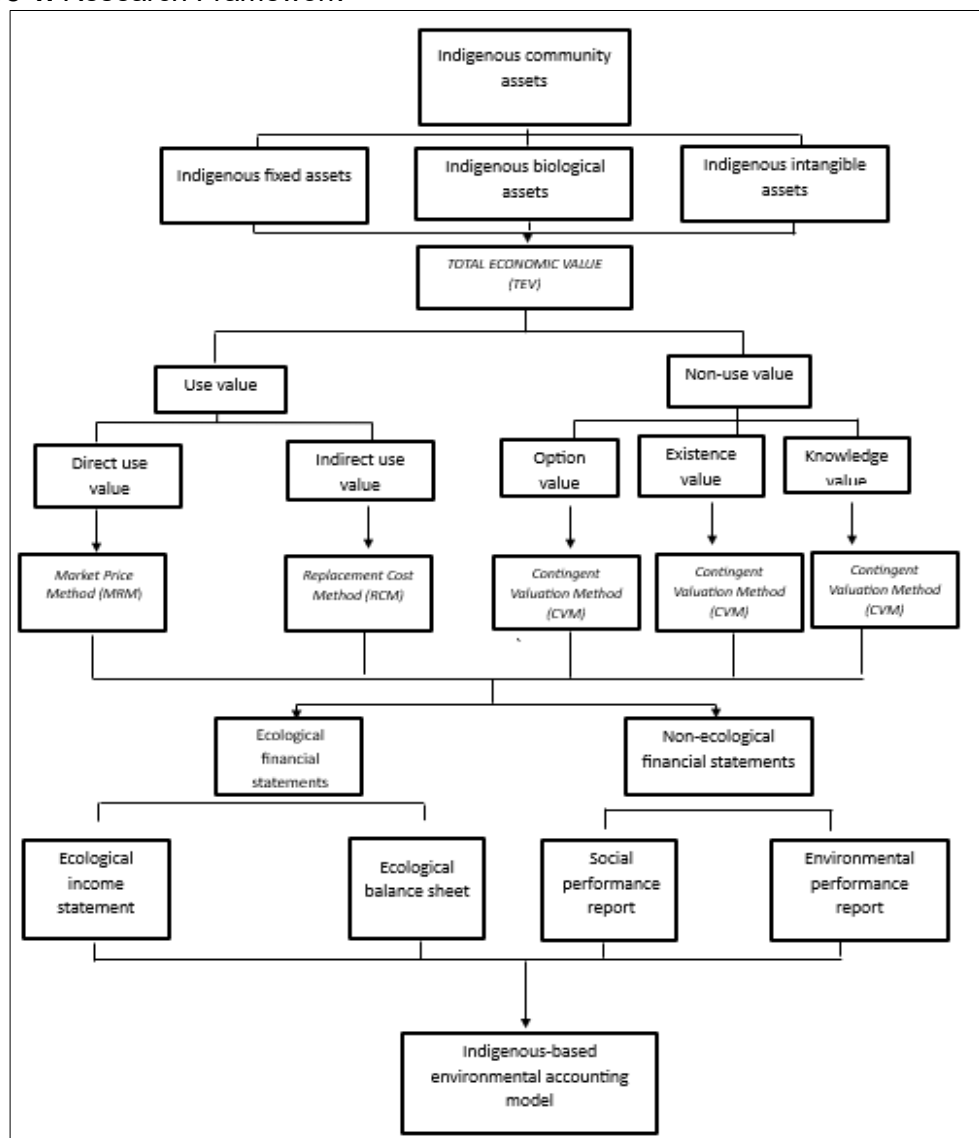
Conceptual Development and Framework

Drawing on the reviewed literature, this study conceptualizes indigenous asset valuation as an integrated function of environmental accounting and the TEV framework. Environmental accounting is expected to enhance the recognition, transparency, and disclosure of indigenous assets (Bustos-Contell et al., 2022; Khan & Gupta, 2024), while TEV provides a comprehensive valuation structure that captures not only economic benefits but also ecological, social, and cultural dimensions (Sundarassen et al., 2024). Improved valuation practices are further anticipated to strengthen accountability, institutional legitimacy, and sustainability performance within indigenous community-owned enterprises (Cerciello et al., 2023; Soomro et al., 2024). Accordingly, this study

posits that environmental accounting positively influences the quality of indigenous asset reporting, that the application of TEV enhances the comprehensiveness of valuation, and that these improved valuation practices contribute to stronger institutional legitimacy and sustainable resource governance.

As illustrated in Figure 1, the framework integrates these relationships into a unified model by classifying indigenous community assets into fixed, biological, and intangible categories, which are subsequently valued using the TEV approach. TEV differentiates between use values (direct and indirect) and non-use values (option, existence, and knowledge values), measured respectively through the Market Price Method (MPM), Replacement Cost Method (RCM), and Contingent Valuation Method (CVM). The resulting valuations are then incorporated into two complementary reporting streams: ecological financial statements (including ecological income statements and ecological balance sheets) and non-ecological financial statements (comprising social and environmental performance reports). Through this integrated process, the framework demonstrates how indigenous asset valuation can be systematically translated into an indigenous-based environmental accounting model that reflects a holistic, context-sensitive understanding of economic, ecological, social, and cultural values.

Figure 1. Research Framework



RESEARCH METHOD

Research Design

This study adopts a mixed-methods approach that integrates exploratory qualitative methods and descriptive quantitative analysis, with Participatory Action Research (PAR) as the primary research design. This approach is employed to generate both in-depth contextual understanding and systematic economic valuation of indigenous community assets that are often excluded from formal accounting and economic systems. Qualitative methods are used to explore cultural, spiritual, social, and ecological values embedded in indigenous assets through participatory engagement. In contrast, quantitative methods are used to identify and estimate the economic value of ecosystem services using the TEV framework.

The selection of PAR is grounded in the need to position indigenous communities as active research participants rather than passive objects of observation. PAR enables community members to engage in problem identification, indicator formulation, valuation processes, and the development of action-oriented recommendations. This participatory process enhances the scientific validity, social relevance, and contextual legitimacy of the research outcomes. Within the context of indigenous communities that have established BUMMA, PAR facilitates the co-production of knowledge and strengthens institutional capacity for developing indigenous-based ecological financial reporting systems.

Furthermore, PAR allows indigenous communities to interpret and articulate the value of their assets through a contextualized TEV approach that incorporates ecological, social, cultural, and intergenerational dimensions. In this framework, TEV functions not only as a valuation tool but also as an educational and advocacy instrument that supports ecological awareness, institutional learning, and indigenous economic sovereignty.

Research Context, Population, and Sampling

The research is conducted in two indigenous communities in Papua, Indonesia, where BUMMA has been formally established. The study sites include the Mare indigenous community in Maybrat Regency, Southwest Papua Province. These locations were selected for their active implementation of community-based natural resource management and the presence of indigenous economic institutions that manage customary assets.

The target population comprises all indigenous community members affiliated with BUMMA Mare, representing 46 clans. A purposive sampling strategy is employed to ensure representation across key social roles and governance structures within each community. A total of 27 participants were selected, consisting of four customary leaders, 10 clan heads, four indigenous women, four indigenous youth, one BUMMA manager, two civil society facilitators, and two local government representatives. The units of analysis include these groups to capture diverse perspectives on asset governance, valuation practices, and institutional accountability within indigenous economic systems. This sampling approach is designed to ensure balanced representation while maintaining depth of contextual insight.

Data Collection

Data collection combines primary and secondary sources to ensure analytical depth and triangulation. Primary data are obtained through participatory valuation processes, in-depth semi-structured interviews, focus group discussions, and participatory observation

within the Namblong and Mare communities. These methods enable the documentation of social, cultural, spiritual, and ecological meanings attached to indigenous assets such as forests, water resources, and customary land.

In-depth interviews are conducted using open-ended guides to explore lived experiences, governance practices, sustainability principles, and intergenerational knowledge related to indigenous asset management. Focus group discussions facilitate collective reflection and consensus-building regarding asset classification, benefit distribution, and shared values. At the same time, participatory observation allows direct engagement with customary rituals, communal decision-making processes, and ecological practices that shape asset governance.

Secondary data include institutional documents of BUMMA, such as statutes, internal financial reports, activity reports, customary land maps, and program planning documents. In addition, relevant policy documents, regional regulations on indigenous recognition, and previous research outputs from academic institutions and civil society organizations are reviewed to strengthen contextual and institutional analysis.

Measures and Data Analysis

Qualitative data are analyzed using thematic analysis supported by NVivo 12 Plus software. Interview transcripts, focus group discussions, and observational notes are coded to identify ecological, social, cultural, and spiritual value dimensions associated with indigenous assets. This process enables the construction of a structured indigenous value database that informs the development of ecological and non-financial reporting components within the indigenous-based environmental accounting model.

Quantitative analysis applies the TEV framework to estimate the comprehensive economic value of indigenous community assets. TEV is calculated as the sum of direct use value, indirect use value, option value, existence value, and bequest value. Direct use values are estimated using the MPM, reflecting the actual economic benefits derived from the use of tangible resources. Indirect use values are calculated through the RCM, representing the cost of substituting ecosystem services such as flood control or carbon sequestration. Option, existence, and bequest values are estimated using the CVM based on community members' stated willingness to pay for future use, continued existence, and intergenerational preservation of indigenous assets.

The integrated qualitative and quantitative findings serve as the empirical foundation for constructing indigenous-based ecological financial statements, including ecological income statements, ecological balance sheets, and social and environmental performance reports. Through this approach, the study advances a participatory, context-sensitive, and methodologically robust model of environmental accounting grounded in indigenous values and ecological sustainability.

Based on qualitative data collected through in-depth interviews, participatory observation, and collective reflection forums, this study employed NVIVO-assisted analysis to systematically trace patterns of meaning, thematic relationships, and value structures embedded within the Mare and Namblong indigenous communities. Coding processes, case classification, word frequency analysis, and relational modeling demonstrate strong consistency between community narratives and the quantitative results of asset valuation. These findings confirm that indigenous economic practices cannot be separated from social structures, customary legitimacy, and holistic ecological relationships.

The qualitative findings were subsequently synthesized with the TEV, based valuation results, generating an integrated understanding of how economic, socio-cultural, and ecological values are intertwined within BUMMA's institutional practices. Drawing from this integration of empirical evidence, community reflection, and NVIVO analysis, this study formulates an Indigenous-Based Accounting Model that reflects indigenous perspectives on asset management in a contextual, participatory, and equitable manner.

RESULTS

Demographic Profile of Respondents

Table 1. Demographic Profile of Respondents

No	Category	Number of Respondents	Percentage (%)
1	Customary Leaders	4	14.8%
2	Clan Heads	10	37%
3	Indigenous Women	4	14.8%
4	Indigenous Youth	4	14.8%
5	BUMMA Managers	1	3.7%
6	Civil Society Facilitators	2	7.4%
7	Local Government Representatives	2	7.4%
Total		27	100%

Table 1 presents the demographic composition of respondents involved in this study. The majority of participants are clan heads (37%), followed by equal representation of customary leaders, indigenous women, and indigenous youth (each 14.8%). This distribution indicates that the study captures a balanced perspective across key social structures within the indigenous community. The inclusion of BUMMA managers, civil society facilitators, and local government representatives, although smaller in proportion, ensures institutional and governance perspectives are also represented. Overall, this composition reflects a purposive and contextually appropriate sampling strategy that supports the participatory nature of the research.

Classification of Indigenous Assets Based on TEV Components: BUMMA Mare

Table 2. Types of Indigenous Assets Based on TEV Components – BUMMA Mare

TEV Component	Type of Indigenous Asset	Examples of Assets	Unit and Rational Scale	Analytical Meaning
Direct Use Value	Collective indigenous community gardens	Local Papuan vegetables (topinong, yamen, taro), chili, tomato, bitter melon, mustard greens, red ginger, passion fruit, hydroponic vegetables (greenhouse)	Approximately 155.5 ha of collective gardens managed by indigenous farmer groups	Foundation of food security, collective productive economy, and professionalization of indigenous assets
Direct Use Value	Seasonal fruits	Red fruit, Papuan matoa, areca	Aggregate seasonal production of	Periodic income, nutritious food

		nut, wild durian	approximately 638,300 kg per year	source, and cultural value
Direct Use Value	River resources and hunted wildlife	River and swamp fish, wild boar, deer	Approximately 450 traditional fishers and 410 active hunters per year	Primary protein source and subsistence-based indigenous economy
Direct Use Value	Indigenous livestock	Pigs, free-range chickens, ducks	Collective community livestock units (living assets)	Economic value reserve, social function, and customary status symbol
Direct Use Value	Non-Timber Forest Products (NTFPs)	Rattan, resin, forest honey, medicinal plants	Approximately 58,000 units of NTFP products per year	Sustainable utilization and forest-based indigenous economy
Indirect Use Value	Environmental services	Water regulation, soil fertility, microclimate regulation	Entire customary management landscape	Ecosystem support functions and quality of life
Indirect Use Value	Carbon stock	Indigenous forest biomass	Approximately 11,200 tons CO ₂ e	Contribution to climate change mitigation
Indirect Use Value	Oxygen production	Indigenous forest vegetation cover	Approximately 11,600 ha of forest	Macro-ecological value and global significance
Non-Use Value	Spiritual and existence assets	Ancestral land, ritual sites, sacred forests	Approximately 1,020 ha of sacred indigenous territory	Collective identity, cultural heritage, and existence value
Option Value	Future indigenous reserves	Unutilized indigenous forests	Approximately 2,100 ha	Potential for sustainable future utilization

Table 2 presents the classification of indigenous community assets managed by BUMMA Mare by TEV components: direct use value, indirect use value, option value, and non-use value. The classification is based on participatory valuation processes involving indigenous community members and reflects both tangible and intangible dimensions of customary assets.

Direct use values dominate among observable economic activities, particularly through collective agriculture, seasonal fruit harvesting, subsistence fishing, hunting, livestock rearing, and non-timber forest product utilization. These assets provide tangible contributions to food security, household income, and the strengthening of collective economic institutions within the indigenous community.

Indirect use values highlight the critical ecological services provided by customary-managed forests and landscapes, including water regulation, soil fertility maintenance, microclimate stabilization, carbon sequestration, and oxygen production. With an estimated carbon stock of approximately 11,200 tons CO₂e and forest coverage of about 11,600 ha, these assets contribute not only to local ecological resilience but also to broader environmental and global sustainability objectives. Although these benefits do not generate immediate market income, they represent high avoided costs and long-term welfare gains for both the community and society at large.

To systematize these diverse value dimensions, the study applies the TEV framework as an integrative analytical tool to translate qualitative community perceptions into a structured quantitative framework. This process does not reduce indigenous complexity but bridges local knowledge with institutional and policy needs. Using community-based instruments, field data, and participatory methods, TEV components were estimated through the MPM, RCM, and CVM. The findings demonstrate that TEV serves as a socially embedded valuation approach, providing an empirical basis for understanding the role of indigenous assets in community welfare while reinforcing sustainable, accountable, and culturally grounded asset governance.

Table 3 presents a recapitulation of the annual economic value of indigenous assets managed by BUMMA Mare, based on the TEV framework. The table aggregates the estimated values of direct use value, indirect use value, and non-use value derived from participatory valuation processes and field-based calculations.

Table 3. Annual Economic Value Recapitulation Based on TEV Components

TEV Component	Type of Asset / Service	Annual Economic Value (IDR)
Direct Use Value	Indigenous community gardens (fields and collective gardens)	12,506,859,000
	Seasonal fruits	3,669,500,000
	Timber	2,463,731,100
	River resources and hunted wildlife	15,106,225,000
	Livestock	1,554,400,000
	Indigenous weaving and handicrafts	684,190,000
	Non-Timber Forest Products (NTFPs)	699,000,000
	Subtotal Direct Use Value	36,683,905,100
Indirect Use Value	Environmental services	500,400,000
	Carbon stock	334,130,082
	Oxygen production services	1,116,078,750,000
	Other indirect use values	1,945,961,160
	Subtotal Indirect Use Value	1,118,859,241,242
Non-Use Value	Spiritual, existence, and bequest values	207,076,870
	Subtotal Non-Use Value	207,076,870
Total Economic Value		1,155,750,223,212

The results presented in Table 3 provide a comprehensive overview of the economic, ecological, and socio-cultural contributions of indigenous assets managed by BUMMA Mare. Based on the series of economic valuation calculations conducted across direct use, indirect use, and non-use components, the TEV framework integrates these diverse value dimensions into a single, coherent analytical structure. This integration allows the complex indigenous value system to be represented more holistically than would be possible through a single monetary or market-based approach.

Direct use values amount to IDR 36,683,905,100 annually, reflecting tangible economic benefits derived from indigenous community gardens, seasonal fruits, timber, river resources, wildlife, livestock, handicrafts, and non-timber forest products. These values represent the immediate contribution of customary assets to household income, food security, and the collective productive economy. The prominence of river resources, hunting, and collective agriculture highlights the continued importance of subsistence-based and community-managed livelihoods within the indigenous economic system.

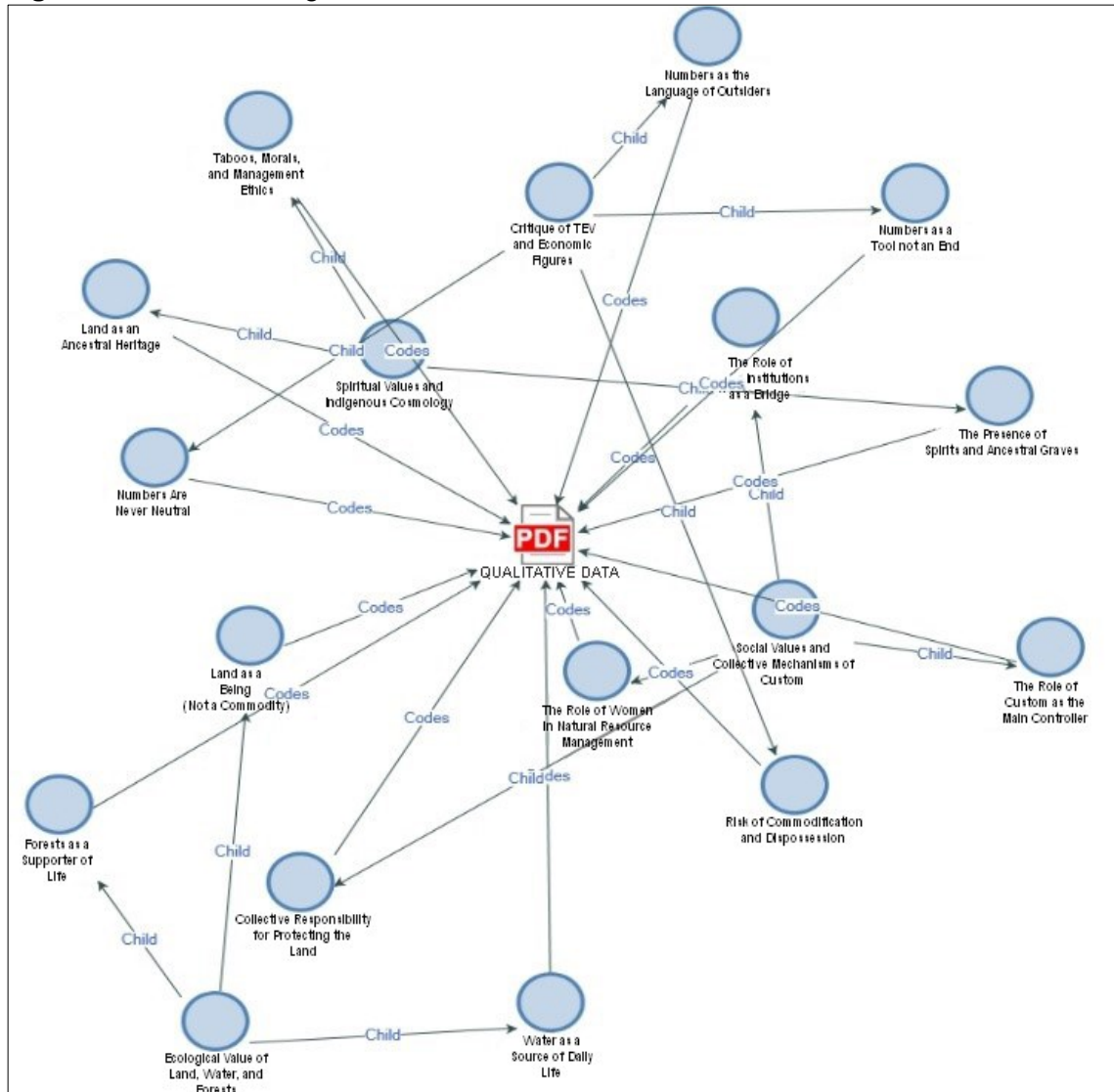
Indirect use values dominate the overall TEV, totaling IDR 1,118,859,241,242 per year. This substantial figure is primarily driven by oxygen production services provided by indigenous forest ecosystems, followed by environmental regulation services and carbon stock values.

Non-use values, amounting to IDR 207,076,870 annually, capture the spiritual, existence, and intergenerational significance of indigenous assets. Although monetarily smaller compared to indirect use values, these components are critically important in sustaining collective identity, cultural continuity, and ethical commitments to future generations. The inclusion of non-use values through the CVM reinforces the understanding that indigenous asset management is deeply rooted in moral, spiritual, and cultural considerations that extend beyond economic rationality.

Overall, the TEV recapitulation confirms that indigenous ecological assets constitute the foundation of community welfare, ecological sustainability, and social legitimacy in indigenous-based economic governance. By systematically quantifying these values, the study demonstrates how the TEV framework can function as a bridge between indigenous knowledge systems and formal economic and institutional planning, thereby strengthening the strategic role of BUMMA in sustainable and culturally grounded asset management.

According to [Figure 2](#), NVIVO coding results illustrate that indigenous asset valuation is structured around interconnected spiritual, ecological, social, and economic meanings. Spiritual values and indigenous cosmology emerged as dominant themes, positioning land and forests as living entities rather than commodities. Economic values were interpreted instrumentally, with valuation figures viewed as tools for communication and advocacy rather than decision-making determinants.

Figure 2. NVIVO Coding Results



The coding also highlights BUMMA’s institutional role as a bridge between indigenous values and formal governance systems, ensuring that economic figures remain embedded within customary narratives and collective deliberation. Overall, the findings confirm that BUMMA’s valuation model is multidimensional, reflective, and aligned with environmental accounting principles that integrate ecological sustainability, social relations, and cultural legitimacy.

Structure of Indigenous-Based Ecological Financial Statements

The ecological balance sheet positions natural resource assets as core components, reflecting BUMMA’s territorial-based asset management. Equity represents collective indigenous capital, while social and environmental liabilities acknowledge ecological restoration and customary obligations. Similarly, the ecological income statement expands the concept of income by incorporating social and environmental costs alongside ecosystem service values. Ecological net surplus is interpreted not as extractable profit, but as an indicator of strategic asset value and sustainability.

Structure of the Indigenous-Based Ecological Balance Sheet

Table 4. Structure of the Indigenous-Based Ecological Balance Sheet

Account Group	Main Components
Current Assets	Cash and cash equivalents, trade receivables
Fixed Assets	Production facilities, indigenous infrastructure
Natural Resource Assets (TEV-based)	Customary forests, rivers, biodiversity
Social and Environmental Investments	Indigenous education, conservation activities, customary rituals
Current Liabilities	Operational obligations
Social and Environmental Liabilities	Ecosystem rehabilitation, customary restoration
Long-Term Liabilities	Protection of customary territories
Indigenous Community Equity	Indigenous social capital, retained ecological surplus

Table 4 presents the ecological balance sheet structure, positioning natural resource assets as a core component, reflecting BUMMA's territory-based asset management. Equity is recognized as collective indigenous ownership, while social and environmental liabilities represent acknowledged ecological and customary responsibilities.

Structure of the Indigenous-Based Ecological Income Statement

Table 5. Structure of the Indigenous-Based Ecological Income Statement

Component	Description
Direct Economic Revenue	Agricultural products, fisheries, Non-Timber Forest Products (NTFPs)
Production Costs	Operational production expenses
Operating Expenses	Administrative and management costs
Indigenous Social Costs	Customary rituals, community strengthening
Environmental Costs	Ecosystem conservation and protection
Operating Ecological Surplus	Surplus after social and environmental costs
Ecosystem Service Value (TEV)	Carbon sequestration, oxygen production, biodiversity
Net Ecological Surplus	Total ecological contribution value

Table 5 presents the structure of the indigenous-based ecological income statement, outlining how economic, social, and environmental components are systematically integrated into the reporting framework. The ecological income statement expands the conventional profit concept by incorporating social and environmental costs alongside ecosystem service values. Net ecological surplus is interpreted not as extractable profit, but as an indicator of the strategic and sustainability value of indigenous assets.

Ecological Income Statement of BUMMA Mare as of December 2025

Table 6. Ecological Income Statement of BUMMA Mare

Component	Amount (IDR)
Direct Economic Revenue	
Field and Garden Production	12,506,859,000
River Resources, Hunting, and Livestock	16,660,625,000
Handicrafts and Non-Timber Forest Products (NTFPs)	1,383,190,000
Total Revenue	30,550,674,000
Production Costs	(5,250,000,000)
Gross Profit	25,300,674,000
Operating Expenses	(4,950,000,000)

Operating Profit	20,350,674,000
Social and Environmental Costs	
Indigenous Social Costs	(2,100,000,000)
Environmental Conservation Costs	(3,250,000,000)
Operating Ecological Surplus	15,000,674,000
Ecosystem Service Value (TEV)	
Oxygen, Carbon, and Ecological Services	1,120,804,842,484
Net Ecological Surplus	1,135,805,516,484

Table 6 presents the ecological income statement of BUMMA Mare. The results show that total direct economic revenue amounts to IDR 30,550,674,000, primarily derived from agricultural production and the utilization of natural resources. After deducting production and operational costs, the operating profit is recorded at IDR 20,350,674,000. The inclusion of social and environmental costs further reduces the operating ecological surplus to IDR 15,000,674,000, which incorporates social and environmental cost components into the financial structure. When ecosystem service values are incorporated, the net ecological surplus increases significantly to IDR 1,135,805,516,484, indicating that the overall contribution of indigenous assets extends far beyond direct economic benefits. Overall, the results demonstrate a substantial difference between conventional financial outcomes and ecologically adjusted valuation.

Ecological Balance Sheet of BUMMA Mare as of December 2025

Table 7. Ecological Balance Sheet of BUMMA Mare

Assets		Amount (IDR)
Current Assets	Cash and Cash Equivalents	1,850,000,000
	Trade Receivables	980,000,000
Fixed Assets	Production Facilities and Infrastructure	2,950,000,000
Natural Resource Assets (TEV-based)	Ending Stock of Natural Resources (TEV)	1,155,750,223,212
	Social and Environmental Investments	14,250,000,000
Total Assets		1,175,780,223,212
Liabilities & Equity		Amount (IDR)
Current Liabilities	Operational Obligations	620,000,000
Social & Environmental Liabilities	Forest Rehabilitation Obligations	1,050,000,000
Long-Term Liabilities	Customary Territory Protection Fund	2,100,000,000
Total Liabilities		3,770,000,000
Indigenous Community Equity (Mare)	Indigenous Social Capital	860,000,000,000
	Retained Ecological Surplus	292,230,223,212
Total Liabilities & Equity		1,175,780,223,212

Table 7 presents the ecological balance sheet for BUMMA Mare, illustrating the composition of assets, liabilities, and indigenous community equity within the TEV framework. The ecological balance sheet of BUMMA Mare indicates that its financial and ecological structure is predominantly composed of natural resource assets managed collectively under customary governance. Natural resource assets valued through the TEV approach constitute the largest share of total assets, reflecting both BUMMA Mare's dependence on and responsibility for the sustainability of forests, rivers, and customary territories. This structure underscores that BUMMA Mare functions not merely as an economic entity, but as an institutional steward of ecological assets and indigenous

values, integrating financial accountability with long-term environmental and customary obligations.

The ecological income statement of BUMMA Mare demonstrates economic performance derived from the sustainable direct use of indigenous assets, including agricultural fields, gardens, river resources, livestock, and culturally based handicrafts. This direct economic revenue reflects the role of BUMMA as an instrument for strengthening the local economy through indigenous production systems and subsistence-based livelihoods. However, the report extends beyond conventional profit calculation by explicitly recognizing social and environmental costs as deliberate deductions from operating profit. This approach underscores that economic performance is inseparable from social obligations and ecological responsibilities, and that net ecological surplus represents the total contribution of indigenous assets to long-term community welfare and ecosystem sustainability rather than extractable financial gain.

DISCUSSION

Interpreting Indigenous-Based Valuation Through Environmental Accounting and TEV

This study proposes an integration of environmental accounting, and TEV provides a more comprehensive approach to indigenous asset valuation. Such an approach not only improves transparency and accountability but also contributes to long-term sustainability performance and institutional legitimacy (Li et al., 2022; Mishra et al., 2024). It further contributes to the development of an indigenous-based environmental accounting model that aligns economic valuation with socio-ecological realities. The findings further reveal that indigenous asset valuation is not merely a technical or monetary process, but a socially embedded practice shaped by cultural values, collective memory, and ecological relationships.

In this study, environmental accounting serves as a bridging mechanism, translating socio-ecological relationships into accountable reporting structures. This is particularly important in indigenous contexts, where communal and nature-based assets are often excluded from conventional financial systems. These findings emphasize that the largest contribution of indigenous assets lies not in extractive or consumptive uses but in the ecological functions that sustain environmental stability, reduce long-term development costs, and contribute to global environmental goods such as climate regulation and atmospheric balance.

Complementing this perspective, the TEV framework enables a more comprehensive representation of both use and non-use values. The application of TEV further strengthens this approach by enabling a comprehensive representation of both use and non-use values. The findings confirm that indigenous communities perceive natural resources not only as economic assets but also as ecological, cultural, and intergenerational entities, with non-use values playing a central role (Hazaea et al., 2023; Mishra et al., 2024). Importantly, valuation does not necessarily lead to commodification; instead, when grounded in participatory processes, it reinforces stewardship ethics and supports sustainability transformation (Cerciello et al., 2023; Soomro et al., 2024). Meanwhile, non-use and option values emphasize the spiritual, cultural, and future-oriented significance of sacred lands, ancestral forests, and reserved areas, indicating that asset management is guided not only by economic considerations but also by customary norms and ethical values.

However, this study also highlights the limitations of economic valuation, as spiritual, symbolic, and identity-based values cannot be fully quantified. This supports critiques regarding the limits of monetary approaches in capturing the full spectrum of environmental and cultural values (Khan & Gupta, 2024; Li et al., 2022). Furthermore, the participatory reflection process shows that legitimacy in indigenous valuation depends on inclusiveness and cultural relevance rather than technical rigor alone (Dhar et al., 2022; Mondal et al., 2023). Overall, the study demonstrates that integrating environmental accounting and TEV within a participatory framework enhances accountability, transparency, and sustainable governance while aligning formal systems with indigenous knowledge.

Indigenous-Based Accounting Model for BUMMA

This model reflects the empirical findings of this study, which highlight the importance of aligning accounting practices with indigenous value systems. The Indigenous-Based Accounting Model is grounded in the view that assets are not merely economic entities but are embedded within social, spiritual, and ecological relationships. In the BUMMA context, biological and ecological assets are understood as ancestral trusts that must be safeguarded for future generations. Accordingly, accounting is positioned not only as a financial control mechanism but also as a medium for collective reflection and social legitimacy. This foundation is reinforced by NVIVO analysis, where dominant nodes such as intergenerational responsibility, ecosystem stewardship, and customary values indicate that accounting recognition and reporting must align with local value systems.

Indigenous-Based Ecological Financial Reporting Model

The indigenous-based ecological financial reporting model was developed to represent how indigenous communities perceive, manage, and account for customary assets holistically. This model responds to the limitations of conventional accounting, which typically treats nature solely as a production factor and overlooks ecological, social, and spiritual values. In BUMMA Mare and BUMMA Namblong, the primary managed assets consist of customary territories and their associated ecological and social systems. Therefore, financial reporting functions not only as economic documentation, but also as an instrument of customary legitimacy, ecological protection, and intergenerational accountability.

The integration of the TEV approach enables recognition of direct use, indirect use, option, and non-use values within the accounting structure. However, these values are not incorporated through technocratic procedures, but through participatory, customary-based processes that reflect local knowledge systems and collective agreements. Thus, this model does not replace conventional accounting but expands its scope to more fairly and contextually represent indigenous asset governance.

Conceptual Distinction between Conventional and Indigenous-Based Accounting

Compared to conventional accounting, indigenous-based accounting adopts a broader conceptual scope. Nature is recognized as an entity with intrinsic value rather than merely a production input; ownership is understood as collective rather than individual; and reporting objectives extend beyond financial performance to include ecological sustainability and social justice. Profit is reinterpreted as ecological and social surplus, while accountability is oriented toward long-term and intergenerational responsibility.

Role of Non-Financial Reporting

Non-financial reports constitute an integral component of the indigenous-based accounting system. Financial statements alone are insufficient to convey the social, ecological, and spiritual meanings underlying valuation figures. Accordingly, social and

environmental performance reports serve as interpretive complements, articulating customary values, participatory processes, and ecological impacts that cannot be reduced to monetary units.

Collectively, the ecological balance sheet, ecological income statement, social performance report, and environmental performance report form an integrated reporting system. This model underscores that BUMMA's accountability is assessed not solely by financial indicators but by its capacity to uphold customary values, maintain social cohesion, and ensure ecological sustainability.

CONCLUSION

This study concludes that the BUMMA asset valuation model represents a context-specific, indigenous-based approach that integrates environmental, social, and economic values within a unified framework. The findings highlight that indigenous asset valuation is not merely a technical or monetary process but a participatory and socially embedded practice in which values are collectively constructed through customary deliberation. This approach enables the recognition of ecological, cultural, spiritual, and intergenerational dimensions that are often excluded from conventional accounting systems.

From a theoretical perspective, the study contributes to the advancement of environmental accounting by extending its scope toward a more inclusive and culturally grounded framework. The integration of environmental accounting with the TEV approach demonstrates that both use and non-use values, particularly existence and bequest values, are central to indigenous valuation practices. This finding strengthens the relevance of TEV in socio-cultural contexts. It supports the development of an Indigenous-Based Environmental Accounting model that bridges formal accounting systems and local knowledge, aligning with sustainability principles.

From a practical perspective, the proposed model offers important implications for policymakers, practitioners, and indigenous institutions by enhancing transparency, accountability, and sustainable governance in community-owned enterprises such as BUMMA. However, as the model is developed within a specific context, future research is needed to test its applicability across regions and to explore its integration with quantitative methods and broader sustainability reporting frameworks.

LIMITATION

This study is limited by its context-specific focus on the Mare indigenous communities, whose distinct social structures, customary systems, and asset management practices shape the development of the indigenous-based valuation and environmental accounting model. As a result, the findings are not intended for direct generalization, and the model's transferability to other indigenous communities requires careful contextual adaptation. While its core principles, such as participatory valuation, recognition of non-economic values, and customary legitimacy, are conceptually applicable, their implementation depends on local social dynamics, including power relations, levels of participation, and evolving community capacities. Accordingly, the valuation outcomes reflect community interpretations at a particular time, underscoring that the model is adaptive and process-oriented rather than fixed, with flexibility as its main strength. However, this study is limited to a specific indigenous context, which may affect the generalizability of the findings. Future research may explore the application of this framework across different indigenous and institutional settings.

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DECLARATION OF CONFLICTING INTERESTS

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