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Research Article

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Analysis of the Application of Environmental Accounting in Managing Costs for the Prevention and Mitigation of Haze Caused by Forest and Land Fires in Kalimantan

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Abstract: *Forest and land fires in Kalimantan generate environmental costs that go far beyond fire-suppression expenditures because haze creates health impacts, economic disruption, ecosystem damage, carbon emissions, and post-fire restoration needs. This study analyzes the application of environmental accounting to the management of prevention and haze-control costs associated with forest and land fires in Kalimantan and develops a cost-classification model to strengthen environmental accountability. A descriptive qualitative approach with a document-study design was employed. Data were drawn from official reports issued by Indonesia's environmental and forestry authorities, laws and regulations, World Bank documents, Environmental Management Accounting (EMA) guidance, and relevant scientific articles published during 2001-2025. Data were analyzed through reduction, thematic coding, environmental quality-cost classification, and cross-source triangulation. The findings indicate that wildfire-related costs have substantively been incurred by government institutions, business entities, and communities, yet the information remains fragmented across agencies, programs, and expenditure categories and therefore does not constitute an integrated environmental-cost information system. In 2023, the five Kalimantan provinces recorded approximately 508.4 thousand hectares of burned areas, concentrated in South, Central, and West Kalimantan. The analysis identifies four principal cost categories: prevention, detection, internal-failure/suppression, and external-failure/restoration costs. The latter includes social costs that are often not recorded by the causative entity, including health expenditures, productivity losses, transport disruption, ecosystem degradation, and emissions. This study proposes the Forest-and-Land-Fire Environmental Cost Accounting Integration Matrix (MIABK), which combines monetary and physical information, funding source, responsible actor, location, and response phase. The model supports a shift from predominantly reactive spending toward preventive expenditure and provides a more measurable basis for implementing the polluter-pays principle.*

Keywords: *environmental accounting; environmental costs; forest and land fires; haze; Kalimantan; environmental management accounting.*

Introduction

The transformation toward sustainable development places environmental information as an important component of economic decision-making. From an accounting perspective, ecological impacts should not merely be treated as compliance or social responsibility issues that stand outside the cost system. Environmental Management Accounting (EMA) emphasizes the identification of physical and monetary information related to resource use, waste, emissions, and environmental management costs so that management can assess the economic consequences of an activity more comprehensively (United Nations Division for Sustainable Development [UNDSD], 2001; International Federation of Accountants [IFAC], 2005).

This context is highly relevant to forest and land fires in Kalimantan. Forest and land fires not only remove land cover but also generate haze that can cross administrative and even national borders. In

peatlands, fires can continue below the surface and produce large amounts of particulate matter and pollutant gases.

Official data indicate that the risk is material. The 2023 Performance Report of the Ministry of Environment and Forestry (KLHK) recorded a national forest and land fire area of 1,161,192 hectares, with several Kalimantan provinces among those with the highest figures. South Kalimantan recorded approximately 190,394.58 hectares, Central Kalimantan 165,896.44 hectares, West Kalimantan approximately 111,848 hectares, East Kalimantan 39,494.41 hectares, and North Kalimantan 796.39 hectares. In aggregate, the five provinces accounted for approximately 508.4 thousand hectares. Statistics from the Ministry of Forestry also recorded a national forest and land fire area of 376,805.05 hectares in 2024, indicating that fire risk remains a recurring environmental management issue (KLHK, 2024; Ministry of Forestry, 2025).

The magnitude of the economic costs of forest fires has also been documented. The World Bank (2016) estimated that Indonesia's 2015 fire crisis caused losses of approximately US$16.1 billion, or around 1.9–2.0% of GDP at the time. These losses were not limited to burned assets but included agriculture, forestry, trade, tourism, health, transportation, as well as environmental damage and emissions. These findings demonstrate a gap between the costs that are readily visible in firefighting budgets and the broader social and environmental costs that often fall outside the accounting records of the organizations generating the risk.

From a regulatory perspective, Presidential Instruction No. 3 of 2020 regulates forest and land fire management through prevention, firefighting, and post-fire response. Financing may come from the state budget (APBN), regional budgets (APBD), and other lawful sources. The instruction also emphasizes law enforcement and the payment of compensation required for rehabilitation and recovery. This framework intersects with Law No. 32 of 2009 on Environmental Protection and Management, which requires persons responsible for businesses or activities that cause pollution or environmental damage to pay compensation and/or undertake specific measures, as well as Government Regulation No. 22 of 2021, which operationalizes environmental protection and management.

However, the existence of environmental obligations does not automatically produce an integrated environmental-cost recording system. In practice, spending on patrols, hotspot monitoring, firebreaks, community training, ground firefighting, water bombing, health services, land rehabilitation, environmental litigation, and productivity losses may be recorded by different organizations, budget codes, and reporting periods. As a result, management does not always obtain a comprehensive picture of the total cost of environmental risk needed to compare the effectiveness of prevention costs with response and recovery costs.

The EMA literature in Indonesia is still dominated by the manufacturing sector and non-financial organizations and focuses on the relationship between EMA implementation and corporate performance (Nagari & Anugrah, 2023). Fadillah, Widyowati, and Nasution (2023) demonstrate the benefits of environmental-cost classification and disclosure for corporate sustainability, while Ningrum et al. (2025) have begun to link green accounting with forest-fire mitigation in West Kalimantan. Ramdhoni, Farihah, and Mahfuzah (2024) also found that integrating environmental accounting into Kalimantan wetland ecosystems faces challenges involving valuation methods, physical data, standards, human-resource capacity, and institutional coordination. Nevertheless, studies specifically linking environmental-cost classification with the prevention–firefighting–recovery cycle of forest and land fires and haze at the regional scale of Kalimantan remain limited.

Based on this gap, this study aims to: (1) identify forms of environmental accounting application relevant to the management of forest and land fire and haze costs in Kalimantan; (2) map prevention, detection, response, and recovery activities into environmental-cost categories; (3) analyze weaknesses in fragmented cost-information management; and (4) formulate an environmental-cost integration model that can be used as an accountability framework for both government and business actors.

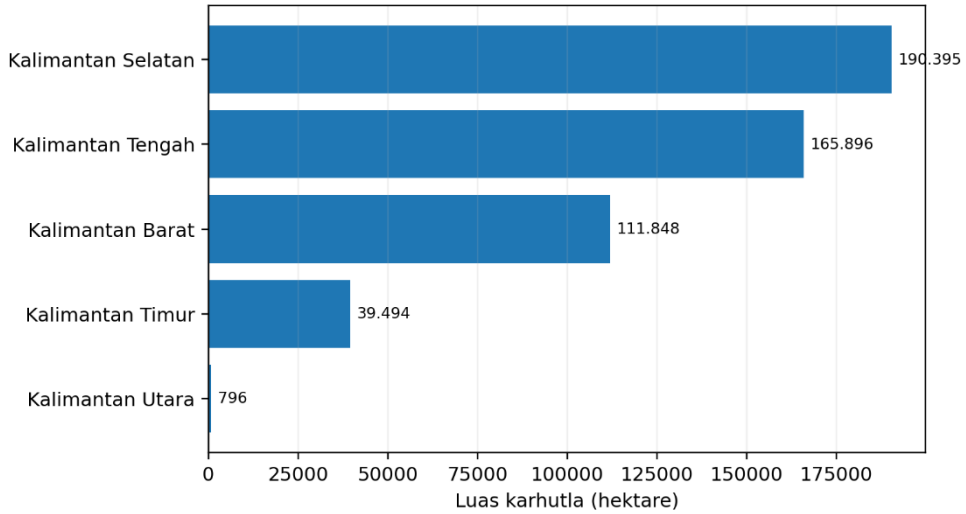

Figure 1. Area affected by forest and land fires in five Kalimantan provinces in 2023 (processed from KLHK data)

Literature Review

Environmental Accounting and Environmental Management Accounting

Environmental accounting is an approach that expands the boundaries of accounting information by incorporating costs and impacts arising from an organization's interaction with the environment. At the managerial level, EMA combines monetary environmental management accounting and physical environmental management accounting. Monetary information indicates environmental-related costs, revenues, investments, provisions, or obligations, while physical information includes material, energy, and water flows, emissions, waste, affected areas, and other operational indicators (UNDSD, 2001; IFAC, 2005). The combination is important because cost figures without physical indicators are difficult to use to evaluate environmental effectiveness, while physical indicators without monetary consequences often fail to receive priority in budgeting.

In the Indonesian context, Nagari and Anugrah (2023) show that EMA research is developing but remains uneven and concentrated in certain business organizations. Common implementation limitations include the lack of integration of environmental data into accounting systems, insufficient measurement standards, and reporting orientations that still classify environmental costs as overhead costs. This condition is relevant to forest and land fire management because a single fire incident generates activities across institutions and actors, making cost classification and cost responsibility centers more complex.

Environmental Quality Cost Classification

The widely used environmental quality cost framework classifies costs into prevention costs, detection costs, internal failure costs, and external failure costs (Hansen & Mowen, 2009). Prevention costs arise to avoid environmental damage before it occurs; detection costs are used to monitor compliance and

detect potential problems; internal failure costs arise when an environmental event has occurred but its impacts can still be controlled before spreading beyond organizational or site boundaries; while external failure costs arise after impacts reach external parties or the public environment.

This classification is useful for forest and land fires because it enables a clearer separation between patrol and prevention costs, hotspot and air-quality monitoring costs, firefighting and containment costs, and costs related to health, ecosystem recovery, compensation, economic disruption, and emissions. Fadillah et al. (2023) demonstrate that such classification helps organizations identify external failure costs that are often not budgeted or directly linked to the triggering activity.

Haze as an Externality and an Accountability Issue

Haze is a form of externality because some of its economic and health impacts are borne by communities that were not involved in decisions concerning burning or land management. Quah and Johnston (2001) emphasize that fires and haze in Southeast Asia require the allocation of responsibility among stakeholders because the costs and benefits of fire are not distributed equally. The World Bank (2016) also shows that fire-related costs can spread to sectors far from the fire location, meaning that counting only firefighting costs would result in substantial underestimation.

From a stakeholder theory perspective, organizations and governments need to account for impacts on communities, workers, local governments, concession holders, and users of public services. Legitimacy theory, meanwhile, explains organizations' incentives to demonstrate that their activities comply with environmental norms accepted by society. In the context of forest and land fires, legitimacy cannot be achieved through environmental-program narratives alone but needs to be supported by quantitative evidence regarding prevention costs, compliance, recovery, and impacts that have been minimized.

Regulatory Framework and the Polluter-Pays Principle

Presidential Instruction No. 3 of 2020 explicitly divides forest and land fire management into prevention, firefighting, and post-fire response. The instruction also regulates the synchronization of planning and budgeting and permits financing from APBN, APBD, and other lawful sources. From an environmental accounting perspective, this structure provides a basis for activity-based responsibility: each activity can be linked to the implementing institution, funding source, location, period, and environmental objective.

Law No. 32 of 2009 contains obligations for compensation and/or specific measures for persons responsible for businesses or activities that cause pollution or environmental damage. Government Regulation No. 22 of 2021 complements the regulation of environmental protection and quality management, damage control, restoration of environmental functions, supervision, and sanctions. Thus, the polluter-pays principle can be viewed as a bridge between environmental-cost information and legal accountability: external costs that have been dispersed across communities and government should be identified so that they can serve as a basis for evaluation, compensation, recovery, or the strengthening of guarantee funds when legally required.

Conceptual Framework of the Study

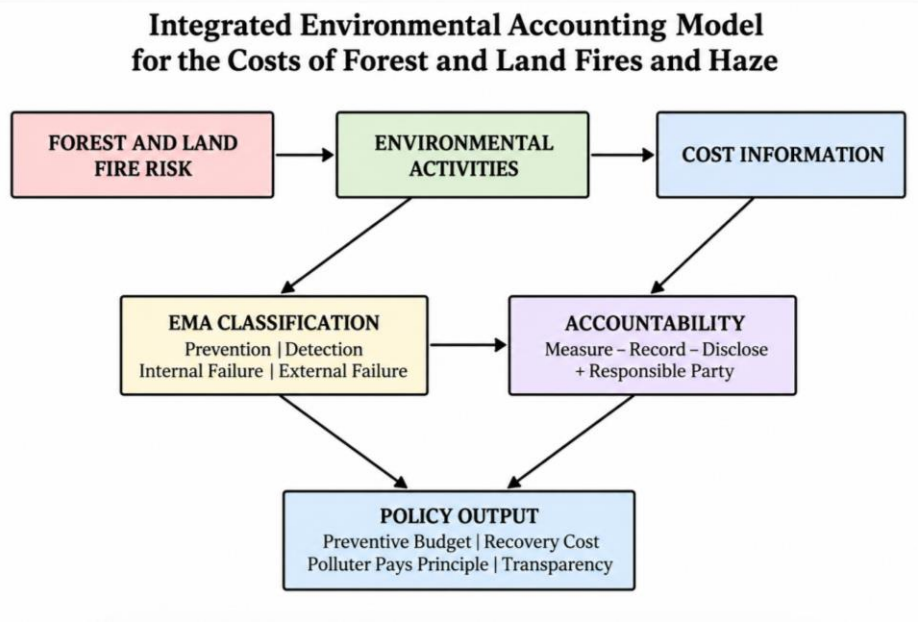

Figure 2. Conceptual framework for integrating environmental accounting into forest and land fire cost management

Method

This study employs a descriptive qualitative approach with a documentary research design. The design was selected because the research objective is not to test statistical relationships, but to understand how environmental costs associated with forest and land fires can be identified, classified, and integrated based on regulatory evidence, performance reports, official statistics, and scientific literature. The study does not use interviews or field observations; therefore, the findings represent documentary analysis and are not claimed to represent the internal accounting system of any particular company or local government.

The units of analysis are information concerning (a) forest and land fire events and impacts in Kalimantan; (b) prevention, monitoring, firefighting, haze management, and recovery activities; (c) forms of costs or losses that can be associated with those activities; and (d) rules concerning financing and environmental recovery. The documentary horizon focuses primarily on the 2015–2024 period. The year 2015 is used as a benchmark for major national losses, while 2023–2024 are used to represent the latest official conditions for which final statistics are available.

Sources were selected purposively. Documents were prioritized if they met at least one of three criteria: they were published by government institutions or international organizations with authority or a strong reputation on environmental issues; they were peer-reviewed scientific articles relevant to forest and land fires, haze, EMA, or green accounting; or they were regulations governing environmental prevention, response, recovery, and financing responsibilities.

Table 1. Main data sources and analytical functions

Source Group	Example Documents	Period	Function in Analysis
Official statistics/reports	KLHK Performance Report 2023; Ministry of Forestry Statistics 2024	2023–2024	Identify the extent of forest and land fires and the control context

Source Group	Example Documents	Period	Function in Analysis
Regulations	Law 32/2009; Presidential Instruction 3/2020; Government Regulation 22/2021	2009–2021	Determine obligations, financing, recovery, and responsibility
Environmental accounting guidance	UNDSD (2001); IFAC (2005); Hansen & Mowen (2009)	2001–2009	Develop monetary-physical information and environmental-cost categories
Economic reports	World Bank (2016)	2015–2016	Identify the spectrum of economic losses and externalities
Scientific articles	Uda et al. (2019); Nagari & Anugrah (2023); Fadillah et al. (2023); Suri et al. (2024); Ningrum et al. (2025)	2019–2025	Triangulate health impacts, EMA practices, and the Kalimantan context

Data analysis was conducted in four stages. First, data reduction was performed by selecting information directly related to costs, control activities, impacts, and responsibilities. Second, open coding was applied to activities such as patrols, firebreaks, hotspot monitoring, ground firefighting, water bombing, health services, rehabilitation, and economic losses. Third, axial coding placed activities into the categories of prevention, detection, internal failure, and external failure. Fourth, thematic synthesis was used to assess patterns of cost-information fragmentation and formulate an integration model.

The validity of the findings was strengthened through source triangulation. Information on the extent of forest and land fires was checked against official reports/statistics; the cost framework was compared between EMA guidance and accounting literature; health impacts were verified through scientific studies; and financing and recovery responsibilities were verified through regulations. An analytical audit trail was established through mapping tables showing the relationships among activities, cost types, physical indicators, cost bearers, and forms of disclosure.

Results and Discussion

Materiality of Forest and Land Fire Risk in Kalimantan

Table 2. Area affected by forest and land fires in Kalimantan provinces in 2023

Province	Area (ha)	Proportion of total Kalimantan (%)	Risk interpretation
South Kalimantan	190,394.58	37.45	Very high; priority for strengthening prevention and response
Central Kalimantan	165,896.44	32.63	Very high; peatland issues and haze exposure are highly material

Province	Area (ha)	Proportion of total Kalimantan (%)	Risk interpretation
West Kalimantan	111,848.00	22.00	High; risk of fires and cross-regional haze
East Kalimantan	39,494.41	7.77	Moderate; continued preparedness and concession monitoring are required
North Kalimantan	796.39	0.16	Lower in 2023, but a preventive system is still needed
Total	508,429.82	100.00	Demonstrates regional materiality

Table 2 shows that the fire burden in 2023 was concentrated in South Kalimantan, Central Kalimantan, and West Kalimantan. From an environmental accounting perspective, the size of the burned area is a physical indicator that should be paired with monetary information. Without such a pairing, organizations know only the magnitude of activities or actual expenditures but cannot calculate cost per hectare protected, cost per hotspot prevented, cost per hectare suppressed, or recovery cost per unit of damage.

The materiality of forest and land fires also cannot be assessed solely from burned area. Fires in peatlands can produce longer-lasting haze and greater health costs. Uda et al. (2019) found an increase in average PM2.5 concentrations caused by peatland fires in Central Kalimantan and estimated long-term premature mortality impacts. This confirms that physical EMA indicators for forest and land fires should include at minimum burned area, land type (mineral/peat), number of hotspots, event duration, air-quality/PM2.5 index, exposed population, and restored area.

Cost-Information Fragmentation as a Major Weakness

Documentary findings show that, normatively, financing for forest and land fire control is cross-institutional and cross-governmental. Presidential Instruction No. 3 of 2020 assigns financing to ministries/agencies through the APBN, local governments through the APBD, and other lawful sources. This structure is necessary because prevention and response genuinely involve multiple parties. However, from an environmental accounting perspective, the financing structure creates a risk of fragmentation if each institution reports expenditure realization only according to its organizational function without consolidating costs by a single event or risk area.

For example, patrols and Manggala Agni personnel may be recorded under fire-control programs; weather and air-quality monitoring may be recorded by different institutions; health services and mask distribution fall within the health sector; water bombing and weather-modification operations may be recorded under emergency response items; peatland recovery and land rehabilitation may be included in other programs; while business losses, transport disruptions, and household health costs may even fall outside the government budget system. Consequently, there is no single environmental cost statement that answers a simple question: what is the total cost of a particular forest and land fire episode, who pays it, and what proportion of the cost is allocated to prevention compared with external failure?

This condition is consistent with the findings of Ramdhoni et al. (2024) that integrating environmental accounting into Kalimantan wetlands faces problems involving physical and quantitative data, valuation methods, human-resource capacity, and institutional coordination. This fragmentation also explains why environmental external failure costs easily become invisible social costs. The World Bank (2016) shows that the losses from the 2015 fires spread across health, agriculture, forestry, transportation, trade, and tourism. In other words, a large portion of the losses does not necessarily appear in the ledger of the party generating the risk.

Mapping Prevention, Detection, Response, and External Failure Costs

Table 3. Mapping forest and land fire activities into environmental-cost categories

Cost category	Relevant activities	Physical indicators	Potential cost bearer	Accounting objective
Prevention costs	Integrated patrols; firebreaks; peatland wetting/rewetting; reservoirs; no-burn land clearing; community training; equipment maintenance before the dry season	km of patrols; number of villages; ha wetted; number of reservoirs; training hours	Central/regional government; concession holders; communities through support programs	Measure investment to reduce the probability of fire
Detection costs	Hotspot/SiPongi systems; monitoring towers; weather analysis; PM2.5 monitoring; compliance inspections; risk audits	number of hotspots; monitoring stations; inspection frequency; air-quality index	Ministries/agencies; local governments; companies	Assess the effectiveness of early warning and compliance
Internal failure/response costs	Ground firefighting; pumps; logistics; personnel; water bombing to contain fires; command posts; responder protection	operating hours; liters of water; sorties; ha of fire controlled; number of personnel	Government; companies holding the affected area; emergency support	Assess failure costs before impacts spread and response efficiency

Cost category	Relevant activities	Physical indicators	Potential cost bearer	Accounting objective
External failure/recovery costs	Health services; masks; disrupted schools/transportation; lost productivity; ecosystem rehabilitation; peatland restoration; carbon losses; compensation/damages	cases of acute respiratory infection; school/work days lost; ha rehabilitated; tCO2e; claim value	Polluter/damaging party when proven; government; communities; affected business sectors	Disclose full social and environmental cost and provide a basis for recovery

The mapping in Table 3 shows that prevention and detection expenditures have the potential to create avoided costs. In the logic of cost of quality, effective increases in prevention costs should reduce failure costs. Therefore, forest and land fire budgets should not treat prevention spending merely as an additional cost. Such spending should be compared with avoidable failure costs, including firefighting, recovery, health, and economic losses.

External failure costs are the most important but also the most difficult component to measure. Quah and Johnston (2001) frame haze as a problem of allocating responsibility among stakeholders. In environmental accounting, public health costs, lost income, flight cancellations, lost ecosystem services, and emissions constitute external failure costs even though not all of them become explicit costs of a single company. The absence of accounting records does not mean that these costs do not exist; rather, the costs are shifted to other parties.

This is where EMA expands the concept of cost. Monetary information needs to be paired with physical information so that social costs can be estimated consistently. For example, PM2.5 and the number of exposed people provide a basis for health assessment; the area and depth of burned peat provide a basis for estimating damage and emissions; while days of disrupted airport or school operations can provide a basis for estimating service losses.

Recognition, Measurement, and Disclosure of Environmental Costs

Table 4. Recommended treatment of environmental-cost information for forest and land fires

Stage	Recommended practice	Example for forest and land fires	Accountability note
Identification	Establish account codes/cost objects for forest and land fires based on phase and location	Central Kalimantan prevention; West Kalimantan detection; South Kalimantan firefighting; peatland recovery	Prevent environmental costs from being hidden in general overhead

Stage	Recommended practice	Example for forest and land fires	Accountability note
Monetary measurement	Measure actual costs, commitments, recovery estimates, and attributable losses	Fuel, personnel, helicopters, equipment, health services, rehabilitation	Separate direct, indirect, and external costs
Physical measurement	Record cost drivers and environmental outputs	ha burned/prevented; hotspots; PM2.5; tCO2e; operating hours	Enable efficiency and cost-effectiveness analysis
Financial recognition	Follow applicable reporting standards for expenses, assets, and provisions/liabilities when criteria are met	Rehabilitation or recovery obligations arising from legal or constructive obligations	EMA does not replace financial accounting standards; EMA enriches managerial information
Disclosure	Present policies, costs by category, physical indicators, funding sources, and recovery obligations	Annual/regional environmental cost statement for forest and land fires	Increase comparability and stakeholder transparency

In business organizations, recovery obligations that have a legal basis or arise from constructive obligations need to be evaluated in accordance with applicable financial reporting standards. IAS 37, as an international reference for provisions and contingent liabilities, explicitly recognizes the cleanup of contaminated land or restoration of facilities as examples of provisions when the recognition criteria are met. In Indonesia, implementation must follow the accounting standards applicable to the relevant entity. This article does not state that all social costs of forest and land fires can automatically be recognized as a liability of a single entity; recognition still requires an obligation basis, the probability of an outflow of resources, and a reliably measurable estimate.

For government, the main objective is not merely liability recognition, but strengthening cost tracing and performance budgeting. Forest and land fire costs need to be tagged or coded across programs so that they can be consolidated analytically. For example, a fire episode in a particular district can be assigned an event identifier used by environmental, health, disaster-management, forestry, and other units. In this way, cost realization can be linked to environmental and social outcomes.

Environmental Accounting as a Prevention Instrument, Not Merely Reporting

The main benefit of environmental accounting is that it changes decision-making patterns. If an organization looks only at firefighting costs incurred after a fire has already spread, decisions tend to be reactive. Conversely, if the system can show that additional spending on patrols, peatland hydrological restoration, training, and prevention equipment reduces expected external failure costs, preventive budgets have a stronger economic justification.

This principle is consistent with IFAC (2005), which positions EMA as a tool for improving managerial decisions through cost and physical-flow information. In the context of forest and land fires,

indicators that can be used include the prevention cost ratio (prevention costs/total environmental costs), failure cost ratio (failure costs/total environmental costs), cost per hectare protected, cost per high-confidence hotspot responded to, and external cost recovery ratio (external costs successfully recovered from responsible parties compared with total measured external costs). These indicators are not mandatory standards but management tools that can be adapted to data availability.

A shift in orientation from response to prevention is also important because health costs and ecosystem damage cannot always be fully restored through compensation. Uda et al. (2019) show that the health impacts of peatland fires are long term. Therefore, prevention effectiveness has a value that is not fully reflected in annual budgets.

Forest and Land Fire Cost Accounting Integration Matrix (MIABK)

Based on the synthesis, this study proposes the Forest and Land Fire Cost Accounting Integration Matrix (MIABK). MIABK is not a new accounting standard but an analytical tool for linking cost data with environmental data and responsibility centers. Each activity is recorded using at least eight attributes: (1) location; (2) period/event; (3) response phase; (4) environmental-cost category; (5) monetary value; (6) physical indicator; (7) funding source; and (8) the party legally or operationally responsible.

MIABK enables the consolidation of cross-entity information without requiring changes to the accounting structures of individual institutions. Existing activity codes can be mapped into a single environmental taxonomy. At the company level, the same taxonomy can be used to distinguish preventive, compliance, response, recovery, and liability/compensation costs. At the government level, MIABK can serve as an analytical layer above the APBN/APBD to assess cost effectiveness and cost-recovery needs.

Table 5. Minimum structure of the Forest and Land Fire Cost Accounting Integration Matrix (MIABK)

Element	Minimum content	Example
Event identification	Province/district, period, event ID	Central Kalimantan–Palangka Raya–2023-01
Phase	Prevention, detection, response, recovery	Detection
Cost category	Prevention, detection, internal failure, external failure	Detection cost
Activity	Description of the activity generating the cost	Hotspot and air-quality monitoring
Monetary value	Actual/estimated cost and currency	IDR ...
Physical driver	Measure of activity or impact	number of hotspots; PM2.5; ha
Funding source	APBN/APBD/company/recovery fund/other	Provincial APBD
Responsibility center	Institution/unit/company/actor	Environmental Agency/Regional Disaster Management Agency/concession holder
Recovery status	Self-borne, compensation, damages, not yet recovered	Not yet recovered

Implications for Government and Business Actors

For government, the first implication is the need to harmonize cross-institutional cost classifications. Presidential Instruction No. 3 of 2020 provides a basis for policy and budget coordination, but environmental accounting requires an information-consolidation mechanism. Local governments in Kalimantan can develop an environmental-cost dashboard combining budget realization, burned area, hotspots, air quality, health costs, and recovery. The dashboard can be used in post-dry-season evaluations and in preparing the following year's budget.

The second implication is strengthening the polluter-pays principle. Article 87 of Law No. 32 of 2009 regulates compensation and/or specific measures for parties responsible for pollution or environmental damage. For this principle to be economically effective, government needs a traceable cost basis. MIABK can help identify costs incurred by government for response and recovery, although the determination of legal responsibility remains a separate process based on evidence and applicable legislation.

For businesses in plantation, forestry, mining, and other concession-based sectors with fire risks, EMA can be used to measure the cost of prevention as an investment in asset and reputation protection. Costs for pumps, reservoirs, monitoring towers, patrols, training, rewetting, and compliance audits should not be combined opaquely within overhead. Clearer disclosure will demonstrate an entity's preparedness to prevent fires and fulfill environmental obligations.

The third implication is the need to standardize physical indicators. Without minimum standards for units of area, hotspots, exposure duration, PM2.5, emissions, and recovery, monetary information is difficult to compare across regions. Such standards do not have to wait for the establishment of a dedicated accounting standard; the government can begin through environmental management reporting guidelines and data interoperability.

Conclusion

This study concludes that applying environmental accounting to the management of forest and land fire and haze costs in Kalimantan is highly important because the impacts of fires are cross-sectoral and involve multiple actors. Data for 2023 show that approximately 508.4 thousand hectares were burned across five Kalimantan provinces, with the largest concentrations in South Kalimantan, Central Kalimantan, and West Kalimantan. This area is only an initial physical indicator; total environmental costs also include health, productivity, transportation, ecosystem, emissions, recovery, and other social costs that are often not recorded by the entities causing the risk.

Substantively, various control activities have generated environmental costs, but cost information remains potentially fragmented because prevention, detection, firefighting, health, recovery, and law enforcement are handled through different budget systems and organizations. The EMA framework enables these costs to be classified into prevention cost, detection cost, internal failure cost, and external failure cost. This classification clarifies the trade-off between prevention investment and failure costs and prevents external costs from being 'lost' from managerial analysis.

The proposed MIABK integrates monetary values, physical indicators, location, response phase, funding source, responsibility center, and cost-recovery status. The model can be used as an analytical layer over existing accounting systems to support budget-effectiveness evaluation, recovery transparency, and implementation of the polluter-pays principle.

Recommendations

First, provincial and district/city governments in Kalimantan that are vulnerable to forest and land fires should develop cross-institutional environmental-cost classifications compatible with existing budget codes. Cost data should be linked to forest and land fire event IDs and physical indicators so that the total cost of a single event can be traced.

Second, businesses in land-based sectors should prepare an internal environmental cost statement that separates prevention, detection, response, and recovery costs. This information can be used to evaluate the efficiency of prevention investments, operational readiness, and potential environmental obligations.

Third, the government should develop guidelines for valuing priority external costs, particularly health costs, ecosystem rehabilitation, emissions, and economic disruption. The guidelines do not have to monetize all ecological values at once, but should at minimum establish standardized physical indicators and transparent estimation methods.

Fourth, future research should conduct multi-case field studies involving local governments and companies in Kalimantan through in-depth interviews, analysis of budget documents, and reconciliation of actual cost data. Such research could test whether MIABK can be implemented and produce more preventive budget decision-making.

Research Novelty

The novelty of this study lies in integrating three domains that are generally discussed separately: environmental management accounting, the forest and land fire control cycle, and the principle of environmental cost accountability. Previous EMA studies in Indonesia have focused more on companies/manufacturing, whereas forest-fire studies have predominantly addressed ecological impacts, health, or policy. This study positions a single forest and land fire episode as an environmental cost object that can be traced across institutions and actors.

The second novelty is the development of MIABK, which pairs the prevention–detection–internal failure–external failure categories with attributes for location, event, funding source, physical indicators, responsibility center, and cost-recovery status. Thus, the model does not stop at green accounting disclosure but is directed toward evaluating the effectiveness of prevention costs and supporting recovery of external costs from parties that are legally responsible when such responsibility can be established.

The third novelty is the emphasis on haze-related external failure costs as information that should be estimated even though not all of them can be recognized as expenses or liabilities of a single entity. Distinguishing financial accounting recognition from social-cost measurement in EMA is important so that the article does not equate all community losses with a company's accounting liabilities while still promoting visibility of costs that have historically remained outside the books.

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