

Green Accounting and Hospital Sustainability: A Quadruple Bottom Line Analysis at XKP Cirebon Hospital

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Submitted: 4 Mei 2026

Accepted: 25 Mei 2026

Published: 1 Juli 2026

ABSTRACT

Background: Hospitals produce medical and non-medical waste, contributing 28.6-36% of global healthcare carbon emissions paradoxical for health-protecting institutions. Yet green accounting practices for measuring and disclosing environmental costs remain underdeveloped in Indonesian hospitals. **Objective:** This study explores green accounting implementation at a private hospital in Cirebon, analyzes its contribution to sustainability via the Quadruple Bottom Line framework, and formulates optimization strategies. **Method:** A qualitative interpretive case study design was employed. Data were collected through in-depth interviews with five key informants, non-participatory observation of the waste management system, and analysis of financial reports, hazardous waste recapitulation data, and operational environmental documents covering 2023-2024. Thematic analysis was performed using an interactive model with source and method triangulation. **Results:** Total identified environmental costs increased from IDR 341.66 million in 2023 to IDR 383.14 million in 2024, representing a 12.14% rise and comprising approximately 0.81% of total operating costs below the international sustainability benchmark of 1.5-2.0% for committed hospitals (Dolcini et al., 2025), yet consistent with comparable studies in Indonesian hospital settings. These costs, however, remain undisclosed in formal financial statements. Quadruple Bottom Line analysis confirms positive contributions across all dimensions: a 10% reduction in wastewater treatment costs, zero infectious waste accidents with 85% staff environmental awareness, 95-100% hazardous waste compliance, and strong institutional ethical governance rooted in a holistic service philosophy. **Conclusion:** Green accounting supports hospital sustainability but remains unsystematized. This study proposes a Quadruple Bottom Line-based model to guide Indonesian private hospitals toward integrated green accounting.

Keywords: Environmental Costs; Green Accounting; Hospital Sustainability; Quadruple Bottom Line; Qualitative Case Study.

INTRODUCTION

The global healthcare sector faces a fundamental paradox: institutions entrusted with protecting human health are simultaneously contributing to the environmental degradation that undermines it. A systematic review by Dolcini et al. (2025) of 22 international publications confirms that the healthcare sector accounts for approximately 5.2% of total global greenhouse gas emissions, with hospitals as the primary contributors at 28.6-36% of the sector's total. Sarcone et al. (2025) further note that the ecological footprint of healthcare facilities encompassing intensive energy use, high water consumption, and continuous generation of hazardous medical waste places these institutions in a structurally paradoxical position. This paradox is not merely rhetorical; it has material consequences, as the environmental degradation generated by hospitals ultimately feeds back into the public health burdens those same institutions are tasked with alleviating.

Green accounting offers a systematic framework for addressing this challenge. By integrating

environmental and social dimensions into financial reporting, it enables organizations to identify, measure, and disclose the true costs of their ecological impact (Andi, K. Petta Lolo et al., 2020). A two-decade review of Environmental Management Accounting demonstrates that organizations adopting these practices achieve average operational cost savings of 8-15% by surfacing hidden inefficiencies in material and energy flows (Burritt et al., 2023). Yet in Indonesia's rapidly expanding healthcare sector green accounting remains critically underdeveloped. Evidence from Indonesian hospitals consistently reveals the same structural gap: environmental costs are absorbed into general administrative accounts without separate disclosure, producing low transparency and limited accountability (Muhammad Mualiyin & Fitriyah, 2024; Nihayah & Fitriyah, 2024; Rospani & Handajani, 2024). This pattern risks reducing green accounting to what Gray & Bebbington (2000) warn against a compliance ritual without substantive organizational change a pattern this study addresses through systematic identification, measurement, and analysis of environmental costs as a foundation for genuine green accounting practice.

Two critical gaps motivate this study. First, virtually all green accounting research in Indonesia's healthcare sector employs the Triple Bottom Line framework, which is insufficient for institutions whose identity is constitutively ethical and moral. Hospitals operate within a value architecture grounded in humanitarian obligations, professional ethics, and public service commitments that demands a fourth dimension beyond profit, people, and planet. The Quadruple Bottom Line framework, which integrates a purpose dimension encompassing ethical, spiritual, and governance values, directly addresses this deficiency (Burke & Logsdon, 1996; Rafinda et al., 2025). Second, quantitative approaches have explained less than 15% of sustainability variability in prior hospital studies (Ashari & Anggoro, 2020), indicating that contextual qualitative inquiry is not merely preferable but methodologically necessary to understand the institutional dynamics that drive or obstruct implementation in practice.

This study was therefore conducted at XKP General Hospital, a Type C private hospital in Cirebon Regency, West Java, selected because it represents a typical mid-tier private hospital in Indonesia currently building an environmental management system, with sufficiently comprehensive financial and operational data for in-depth analysis. Over the two-year study period (2023-2024), the hospital invested more than IDR 380 million annually in environmental management activities, yet none of this information appears in its formal financial reports a gap that epitomizes the broader problem this study addresses. The study pursues four objectives: (1) to document the actual implementation of green accounting across the stages of identification, recognition, measurement, recording, presentation, and disclosure of environmental costs; (2) to analyze its contribution to sustainability across the four dimensions of the Quadruple Bottom Line; (3) to identify contextual enablers and barriers to implementation; and (4) to formulate evidence-based optimization strategies analytically generalizable to other private hospitals in Indonesia.

LITERATURE REVIEW

Green Accounting as a Strategic Management Tool

Green accounting, or environmental accounting, integrates environmental considerations into an organization's financial information and reporting systems. Gray & Milne (2002) define it as a systematic effort to incorporate environmental costs and benefits into economic decision-making at both the firm and national levels a definition that positions green accounting not as peripheral disclosure but as a core analytical instrument. Its development stems from a fundamental critique of conventional accounting, which externalizes environmental degradation by treating it as a cost borne by society rather than by the organization responsible for generating it.

The strategic significance of this reframing has been empirically validated. Swalih et al. (2024) in a systematic review of 89 Environmental Management Accounting studies published between 2000 and 2023, document a decisive paradigm shift: environmental accounting practices have migrated from reactive compliance toward proactive strategic decision-making, integrating into capital budgeting, pricing, and performance evaluation systems. Huynh & Nguyen (2024) through structural equation modeling of 397 firms in Vietnam, demonstrate that Environmental Management Accounting functions as a significant mediator between external organizational pressures and environmental performance confirming its role as a mechanism for organizational

transformation, not merely a reporting tool. In the healthcare sector specifically, Dolcini et al. 2025 propose 18 environmental key performance indicators to standardize hospital sustainability measurement, while Aboueid et al. (2023) show that leadership and organizational culture more than budget availability determine whether sustainability transitions succeed.

Green Accounting in Indonesian Hospitals: A Critical Synthesis

Research in Indonesian hospitals consistently reveals a gap between regulatory compliance and systematic environmental accounting. Three structural deficiencies recur across the available evidence. First, environmental costs are dispersed across general administrative accounts rather than classified in dedicated environmental cost categories, making systematic analysis impossible (Batara et al., 2024). Second, accounting staff lack specialized environmental competence, leaving environmental cost management to generalists without the analytical framework to identify or interpret it. Third, professional associations and regulatory bodies have not issued technical guidelines for environmental cost recording in the health sector, leaving individual hospitals to develop idiosyncratic solutions without reference to sector-wide standards.

The consequences of these deficiencies are measurable. Ashari & Anggoro (2020) found that green accounting implementation explained only 12.7% of sustainability variability in public hospitals in Malang Raya a figure so low that it signals systematic underidentification rather than a genuine finding about the relationship between green accounting and sustainability. Nihayah & Fitriyah (2024) and Rospani & Handajani (2024) confirm that even where waste management complies with regulations, it remains descriptive and unintegrated into a financial accounting framework capable of supporting strategic decisions. The more instructive counterexamples are the studies that reveal what systematic integration can achieve: Maulina & Nugraha (2022) found that structured waste cost accounting at a major Indonesian public hospital generated eco-efficiency gains that contributed to overall financial efficiency, and Arieftiara et al. (2021) demonstrated through Material Flow Cost Accounting that up to 23% of input materials in hospital service production become waste an inefficiency entirely invisible within conventional accounting systems. Taken together, this evidence positions the present study: the problem in Indonesian hospitals is not the absence of environmental management activity, but the absence of an accounting architecture capable of rendering that activity analytically visible.

Environmental Cost Classification: Hansen and Mowen's Framework

This study employs the Hansen & Mowen (2005) framework to classify environmental costs into four functional categories. Prevention costs are incurred to forestall negative environmental impacts, including employee training, personal protective equipment procurement, and environmentally sound procedure development. Detection or appraisal costs cover the identification and measurement of environmental impacts through laboratory testing, environmental audits, and periodic monitoring. Internal failure costs arise from environmental failures before they reach the external environment, such as excess waste treatment expenditures or internal remediation. External failure costs result from environmental damage that has already impacted the outside world, including regulatory fines, pollution cleanup, and community compensation.

This classification framework is not applied mechanically in this study. Bebbington et al. (2021) add a fifth dimension hidden and contingent costs, encompassing reputational damage, community trust erosion, and long-term liabilities that resist monetary quantification which is incorporated into the governance dimension of the Quadruple Bottom Line analysis. The framework's value in this context lies precisely in its ability to surface costs that are present in hospital operations but absent from formal financial statements: a diagnostic tool for the structural underreporting that the preceding section identified as the central problem in Indonesian hospital green accounting (Saadah & Falikhatun, 2021).

The Quadruple Bottom Line: Adapting the Framework to the Hospital Context

Elkington (1994) Triple Bottom Line framework evaluating organizational performance across economic (profit), social (people), and environmental (planet) dimensions has dominated

sustainability research for three decades. For commercial enterprises, this framework offers sufficient analytical coverage. For hospitals, it does not. Hospitals are not primarily commercial institutions that have adopted social and environmental responsibilities as strategic add-ons; they are institutions whose founding purpose is the protection of human health, from which all commercial, social, and environmental responsibilities derive. This distinction is not semantic it has structural implications for how sustainability should be analyzed and measured.

Burke & Logsdon (1996) introduced the purpose dimension to capture ethical values, moral commitment, and governance responsibility within corporate sustainability frameworks. Applied to the hospital context where institutional identity is constitutively ethical rather than merely aspirationally so this dimension takes on qualitatively different significance. In Indonesian private hospitals, purpose is not a governance layer added to a commercial enterprise but the founding rationale of the institution itself, typically rooted in religious values, professional healthcare ethics, and a conception of community service that explicitly transcends financial calculation. This adaptation extends Burke & Logsdon (1996) original corporate framework into mission-driven service organizations a move supported by Rafinda et al. (2025), who demonstrate that hospitals measuring performance across all four Quadruple Bottom Line dimensions show greater organizational resilience in financial and reputational crises, and consistent with Bester (2021) argument that Sustainable Development Goal-aligned purpose is now a structural component of organizational sustainability rather than an aspirational statement. Maharani & Akbar (2025) further show that green accounting plays a critical role in enhancing sustainability report quality as a manifestation of this multidimensional accountability connecting the accounting instrument examined in this study directly to the governance dimension of the Quadruple Bottom Line framework.

Indonesia's regulatory framework for hospital waste management spanning environmental protection legislation (Government Regulation No. 22/20211), hazardous waste management regulations (Ministry of Environment and Forestry Regulation No. 6/2021), wastewater quality standards (Ministry of Environment and Forestry Regulation No. 68/2016), and healthcare facility solid waste requirements (Ministry of Health Regulation No. 2/2023) creates compliance obligations that are structurally accounting-intensive. The data hospitals already collect for regulatory submission wastewater testing frequencies, hazardous waste manifests, and CSR expenditure records constitutes the raw material for systematic environmental cost accounting. Yet most Indonesian hospitals fulfill these regulatory reporting obligations without translating them into integrated internal financial disclosure, representing a missed institutional opportunity that this study directly addresses. Specific regulations governing XKP General Hospital are referenced where relevant in the Results section.

METHOD

Research Approach and Design

This study employs a qualitative approach using an interpretive case study design. This choice is based on the epistemological premise that the implementation of green accounting is a socially meaningful and context-rich phenomenon; it cannot be fully understood through numbers and statistics alone, but rather through an in-depth exploration of how organizational actors construct meaning, make decisions, and shape practices amidst regulatory complexities, market pressures, and institutional values (Creswell, 2024). Busetto et al. (2020) assert that for research questions focused on "how" and "why" a phenomenon occurs within a specific organizational context, the qualitative approach offers analytical depth that cannot be matched by quantitative approaches. Meanwhile, Sugiyono (2020), in his book on exploratory and interpretive qualitative research methods, emphasizes that the primary value of this approach lies in its ability to generate substantive theory rooted in field data (grounded theory), rather than merely testing pre-existing hypotheses

Research Location and Informants

The study was conducted at XKP General Hospital in Cirebon, located in Cirebon Regency, West Java. The location was selected purposively based on four criteria: (1) a private hospital with a

minimum operational track record of 5 years; (2) an active environmental management unit with wastewater treatment facilities; (3) two years of accessible financial data for triangulation; and (4) management's willingness to fully participate in the research process.

There were five key informants selected using purposive sampling with the principle of maximum variation to ensure representation of perspectives from various organizational levels and functions, consisting of: (1) the Hospital Director, who holds strategic decision making authority and safeguards the institutional vision; (2) the Head of the Finance Department, responsible for financial reporting and decision-making regarding environmental budget allocation; (3) the Head of the Environmental Health Unit, the technical implementer and designer of the waste management system; (4) an Accounting/Finance Staff member, the operator of daily cost recording who is familiar with the technical details of record keeping; (5) a Field Sanitation Officer (Environmental Health Staff), the operational implementer at the ground level who directly faces the realities of waste management. All interviews were conducted in January 2026 at XKP General Hospital in Cirebon.

Data Collection Techniques

Data collection was conducted using three complementary and mutually reinforcing methods constituting methodological triangulation. First, in-depth semi-structured interviews lasted between 45 and 90 minutes per session, using an interview guide developed around the six stages of green accounting identification, recognition, measurement, recording, presentation, and disclosure and the four dimensions of the Quadruple Bottom Line. All sessions were audio-recorded with informants' permission and transcribed verbatim to preserve data accuracy. Second, non-participatory observation was conducted across three site visits on separate dates, covering the wastewater treatment plant, the hazardous waste temporary storage facility, and the internal documentation workflow, to ensure observational consistency across different operational conditions. Third, document analysis encompassed: (a) complete financial statements including balance sheets and income statements for 2023 and 2024; (b) monthly hazardous waste summaries for 2023 and 2024; (c) technical approval application forms for wastewater utilization; (d) structured interview result sheets; and (e) environmental cost calculation data compiled by the researcher.

Data Analysis

Data analysis was conducted thematically using the interactive model of Miles et al. (1996), which comprises four iterative components operating simultaneously: data collection, data condensation, data display, and conclusion drawing and verification. The thematic analysis framework employed the four Quadruple Bottom Line dimensions as primary analytical categories, with the six green accounting stages used as subcategories within the economic dimension, and the Hansen & Mowen (2005) classification applied to organize environmental cost findings (Patton, 2015).

The coding process proceeded in three progressive stages. In the first stage open coding all transcript segments and document excerpts were read line by line, and descriptive codes were assigned to every meaning unit relevant to green accounting practices or sustainability outcomes, producing an initial codebook of 87 open codes. In the second stage focused coding thematically related open codes were grouped into broader categories corresponding to the six green accounting stages and four Quadruple Bottom Line dimensions, reducing the codebook to 24 focused codes organized within a structured analytical matrix. In the third stage, axial coding relationships between focused codes were systematically examined to identify patterns, contradictions, and causal links within each Quadruple Bottom Line dimension, enabling the construction of interpretive propositions that went beyond description toward explanation. Coding was conducted independently by both researchers, followed by structured discussion to resolve discrepancies, achieving an inter-coder agreement rate of 89% on the final focused codebook a level consistent with qualitative research standards for thematic analysis reliability (Patton, 2015).

Data Validity

The validity of this qualitative study was ensured through four layered strategies, each applied to

specific aspects of the analytical process rather than as a general methodological gesture.

First, source triangulation. Every substantive claim was cross-verified across at least two informants at different organizational levels before inclusion in the findings. For example, the Head of Finance's characterization of environmental cost dispersal across general accounts was independently confirmed by the Accounting Staff member, who provided the specific Chart of Accounts codes under which environmental costs were recorded corroborating not only the claim but its operational mechanism. Similarly, the Head of the Environmental Health Unit's assertion about waste segregation discipline was verified against the Field Sanitation Officer's description of daily sorting procedures and against the hazardous waste manifest records in the document analysis.

Second, method triangulation. All key findings from interviews were required to be independently corroborated by either documentary evidence or direct field observation before being treated as established findings. The claim of 12-times-per-year wastewater quality monitoring representing a shift from quarterly to monthly testing was verified against laboratory invoice records in the 2024 financial documents, which showed corresponding increases in environmental laboratory service costs of 106.89%. Conversely, the claim of zero infectious waste accidents was accepted as an internal reporting outcome rather than a verified epidemiological finding, and is interpreted accordingly in the Discussion section.

Third, negative case analysis. Rather than seeking only confirmatory evidence, the researchers actively searched for instances where data contradicted emerging findings. The most analytically significant negative case was the simultaneous decrease in staff training costs (-71.66%) and increase in total environmental commitment (+12.14%): rather than treating this as an inconsistency to be resolved, the researchers retained it as a finding that complicated the simple assumption that environmental commitment is proportional to training expenditure, and incorporated it into the Discussion as evidence of a more nuanced relationship between investment type and sustainability outcome.

Fourth, member verification and audit trail. Member verification was conducted in February 2026, approximately three weeks after data collection was completed. A summary document containing key findings organized according to the Quadruple Bottom Line dimensions, selected verbatim quotes along with analytical comments, and the researchers' interpretive propositions, was sent to the Hospital's Director and Head of Finance. Both reviewed the document within one week and provided written feedback. Head of Finance requested one factual correction: the increase in wastewater treatment plant maintenance costs in the draft was attributed to equipment failure in 2024, whereas the actual cause was a delay in scheduled preventive maintenance from 2023 a correction that impacted the interpretation of efficiency and was incorporated into the final analysis. No objections were raised to any of the interpretive conclusions. The complete research record is stored in a research file, which contains: the five audio recordings, the five verbatim transcripts, field observation notes from three field visits, and all primary documents used in the analysis.

RESULT

Overview of RSU XKP Cirebon

RSU XKP Cirebon is a Type C private general hospital operating in Cirebon Regency, West Java. The hospital provides a wide range of medical specialties, including inpatient care, outpatient services (obstetrics, pediatrics, dentistry, ophthalmology, internal medicine, surgery, ENT, urology, neurology, and medical check-ups), an Emergency Department (ED), as well as support services such as laboratory, radiology, and pharmacy. In terms of environmental infrastructure, RSU XKP Cirebon has a Wastewater Treatment Plant (WWTP) with a design capacity of 50 m³/day and a maximum operational capacity of 40 m³/day, and has established a partnership with a certified third party (PT WSTG, operating in Cilegon and Semarang) for the management of hazardous waste through incineration.

Financially, based on the analyzed financial statements, RSU XKP Cirebon recorded total operating revenue of IDR 54.88 billion (2023) and IDR 54.63 billion (2024), with operating profit after tax of IDR 6.65 billion (2023) and IDR 5.46 billion (2024). Revenue from the National Health Insurance Agency (BPJS) dominates the revenue structure, contributing 81.69% (2023) and 85.97% (2024), reflecting significant reliance on national social security funding. Meanwhile, total

assets grew from IDR 45.31 billion (2023) to IDR 50.12 billion (2024), an increase of 10.62%, reflecting the hospital’s ongoing expansion of service capacity. Table 1 presents a summary of the financial performance of RSU XKP Cirebon for the 2023-2024 period.

Table 1. Summary of Financial Performance of RSU XKP Cirebon for 2023-2024

Financial Indicators	2023 (IDR)	2024 (IDR)	Change (%)
Total Business Revenue	54,882,376,697	54,625,753,435	-0.47%
BPJS Revenue	44,831,315,474	46,963,313,770	+4.76%
BPJS of Total	81.69%	85.97%	+4.28 percentage points
Total Operating Expenses	46,298,598,907	47,509,916,881	+2.62%
Operating Profit Before Tax	8,691,003,781	7,278,985,099	-16.25%
Net Profit After Tax	6,649,950,741	5,462,797,061	-17.88%
Total Assets	45,310,803,088	50,120,322,729	+10.62%

Source: Financial Report of RSU XKP Cirebon 2023-2024, processed by the researcher

Implementation of Green Accounting: Stages and Current Practices

Identification of Environmental Costs

The first stage of green accounting is identifying and separating costs related to environmental activities from overall operating costs. Based on an in-depth analysis of RSU XKP Cirebon 2023 and 2024 financial statements, the researcher successfully identified nine cost items substantially related to environmental management activities as confirmed through interviews with Head of Finance and Accounting Staff.

Head of Finance stated in the interview: “Costs related to environmental management, such as waste treatment costs, wastewater treatment plant (IPAL) maintenance costs, and costs related to Occupational Safety, Health, and Environment (K3L), do exist in our books; however, they have not yet been specifically recorded in separate dedicated accounts. Some of these costs are still categorized under general operational expenses.”

The Accounting Staff added that to trace the total environmental costs: “...they must be traced one by one from various accounts. Costs for the education and training of environmental officers are included in HR education and training costs; costs for preventive maintenance of the wastewater treatment plant are included in building repair and maintenance costs; and costs for environmental laboratory services are included in laboratory service costs.”

This situation reflects what Batara et al. (2024) refer to as ‘hidden environmental costs’ costs that are actually present and significant but are not visible in formal reporting because they lack a dedicated account. Consequently, the identification of environmental costs at Cirebon XKP General Hospital is conducted in an unsystematic and ad hoc manner, relying on the manual tracing capacity of the finance staff.

Recognition and Measurement of Environmental Costs

Although recording is not systematized in a specific account, the recognition of environmental costs at RSU XKP Cirebon is carried out consistently on an accrual basis. The Head of Finance explained: “We recognize environmental costs on an accrual basis. For example, for third-party waste disposal services, we recognize the expense in the month the waste is transported and disposed of, even though payment is made the following month in accordance with the payment terms in the contract.”

An Accounting staff member provided a more concrete illustration using an actual transaction: “In October 2025, we received an invoice from PT WSTG for IDR 8,082,798 for the disposal of hazardous waste (B3) from the September period. We immediately recognize it as an October expense even though payment is scheduled for early November. This aligns with the matching principle, where expenses are recognized in the same period as the benefits received.” The journal entry made is: Debit Waste Treatment Expense (5707) and Credit Income Tax Article 23 and Bank

an accountable recording even though it is not specifically classified as 'environmental costs.'

Cost measurement is based on actual transaction values: contract prices for third-party services, purchase prices for waste treatment chemicals, and acquisition costs including installation expenses for wastewater treatment plant (IPAL) assets. Head of Finance emphasized: "All environmental costs are measured based on the actual transaction values that occur... For assets such as IPAL machinery, they are recorded at acquisition cost including installation expenses."

Presentation and Disclosure of Environmental Costs

In formal financial statements, environmental costs are not presented as a separate line item. Head of Finance explained: "In our income statement, environmental costs are not presented separately because it is not required under the accounting standards we use. These costs are part of the hospital's total operating expenses. If the board of directors or stakeholders wish to know the total environmental costs, we can prepare a special report detailing them from various accounts."

The absence of this specific disclosure, according to the Director, does not imply a lack of transparency: "Although we have not disclosed environmental costs in detail in our financial statements, this does not mean we are not transparent. We always report all waste management activities to the relevant authorities in accordance with regulations. And if any party wishes to know more details about our environmental costs, we are ready to provide the information."

This situation reflects the distinction between external regulatory accountability (which has been fulfilled) and financial public accountability (which has not yet been implemented). As argued by Gray & Milne (2002), the disclosure of environmental information in formal financial reports serves as an accountability instrument that benefits not only regulators but also shareholders, the community, and future generations.

Classification and Analysis of Identified Environmental Costs

Through systematic identification and reclassification of XKP General Hospital's financial statements for 2023-2024, nine cost items substantially related to environmental management were mapped and classified using the Hansen & Mowen (2005) framework. Table 2 presents the results. The column for absolute change in IDR has been removed from the table and incorporated into the narrative below, where it carries analytical weight rather than serving as raw tabulation.

Table 2. Summary and Analysis of Environmental Costs at RSU XKP Cirebon for 2023-2024

Cost Category & Component	2023 (IDR)	2024 (IDR)	Change (%)
A. Prevention Costs			
Education & Training for Environmental Management Staff	7,057,000	2,000,000	-71.66%
Personal Protective Equipment for Infection Prevention & Control	854,450	293,900	-65.60%
Infection Prevention & Control Consumables	60,129,200	60,347,500	+0.36%
B. Detection / Appraisal Costs			
Environmental Laboratory Services (Wastewater Quality Testing)	24,837,000	51,381,500	+106.89%
C. Regulatory Compliance Costs			
Environmental Permitting Costs	24,500,000	2,500,000	-89.80%
Other Environmental Costs (Environmental CSR)	-	37,900,000	n/a
D. Management & Infrastructure Costs			
Hazardous Waste Temporary Storage Equipment & Supplies	95,235,250	90,666,245	-4.80%

Third-Party Medical Waste Treatment Services	122,255,150	107,344,400	-12.20%
Wastewater Treatment Plant Maintenance & Repair	6,794,000	30,705,200	+351.95%
Total Environmental Costs	341,661,050	383,138,745	+12.14%
Total Hospital Operating Expenses	46,298,598,907	47,509,916,881	+2.62%
Environmental Costs as % of Operating Expenses	0.74%	0.81%	+0.07 pp
Environmental Costs as % of Net Profit After Tax	5.14%	7.01%	+1.87 pp

Source: Data processed by the researcher from the Financial Statements and Internal Documents of RSU XKP Cirebon 2023-2024

Three cost changes are reported here as factual findings; analytical interpretation is reserved for the Discussion section. First, environmental laboratory service costs increased by IDR 26,544,500 (+106.89%, from IDR 24.84 million to IDR 51.38 million). This increase corresponds to a documented operational change: the hospital shifted from quarterly to monthly wastewater quality monitoring in 2024, increasing the number of laboratory tests from four to twelve per year. Second, environmental permitting costs fell by IDR 22,000,000 (-89.80%, from IDR 24.5 million to IDR 2.5 million). Document analysis shows that 2023 included a major permit renewal requiring external environmental consultants, while 2024 required only routine annual renewal. Third, third-party medical waste treatment costs decreased by IDR 14,910,750 (-12.20%, from IDR 122.26 million to IDR 107.34 million) while total hazardous waste volume simultaneously increased by 16.62%. The Head of Environmental Health reported that improved at-source waste segregation reduced the proportion of material formally classified as hazardous requiring third-party incineration. The cost-volume divergence is documented as a factual finding; its analytical interpretation as evidence of eco-efficiency is developed in the Discussion section.

Operational Waste Management Profile of Cirebon XKP General Hospital

RSU XKP Cirebon generates three main types of waste in its operational activities: (1) Infectious Hazardous Waste (B3), (2) Liquid Waste (Wastewater), and (3) Domestic Waste (Non-B3). Table 3 presents the waste volume and management profile based on official 2024 summary data confirmed through field observations.

Table 3. Waste Management Profile of XKP Cirebon General Hospital in 2024

Waste Type	Volume	Management Method	Compliance Rate	Regulations
Infectious Hazardous Waste (Solid, Sharps, Liquid)	Total 14,227 kg/year (Average 562.17 kg/month; 1,185 kg/month total manifest)	Incineration by certified PT WSTG (Cilegon/Semarang); TPS storage <90 days; complete manifest system	95-100%	Ministry of Environment and Forestry Regulation No. 6/2021; Ministry of Health Regulation No. 7/2019

Liquid Waste (Wastewater)	34.87 m ³ /day (out of total water usage of 47.18 m ³ /day)	Wastewater treatment plant with a design capacity of 50 m ³ /day; multi-stage: equalization, aeration, sedimentation, biofilter, effluent pond; discharge to river 23.3 m ³ /day plus infiltration 11.57 m ³ /day	≥95% (effluent quality standards met; live fish bioindicators)	Ministry of Environment and Forestry Regulation No. 68/2016; Government Regulation No. 22/2021
Domestic Waste	Regularly transported by the Cirebon Regency Environmental Agency	3 color sorting: yellow (hazardous waste), black (domestic), safety box (sharp objects); collection by the Environmental Agency at least 3 times per week	100%	Ministry of Health Regulation No. 2/2023

Source: Summary of Hazardous Waste at XKP Cirebon General Hospital 2024 processed by the researcher

The summary data on hazardous waste for the 12 months of 2024 shows seasonal variations consistent with patient visit patterns. The highest volume of infectious hazardous waste occurred in May (1,433 kg) and the lowest in February (969 kg), reflecting fluctuations in inpatient load associated with seasonal disease patterns. Total B3 waste for 2024 reached 14,227 kg compared to 12,200 kg in 2023 (including 10,167 kg of solid waste, 1,520 kg of sharps, and 490 kg of liquid waste, plus 23 kg of electronic waste). This approximately 16.6% increase in volume parallels the growth in the number of patients served, particularly from the BPJS segment, which grew from IDR 44.83 billion (2023) to IDR 46.96 billion (2024).

Table 4. Comparison of Hazardous Waste Volumes at XKP Cirebon General Hospital, 2023-2024

Waste Category	2023 (Kg)	2024 (Kg)	(%)
Solid Infectious Hazardous Waste (A337-1)	10,167	11,518	+13.29%
B3 Sharp Objects (A337-1 Sharp Objects)	1,520	1,973	+29.83%
B3 Infectious Liquids (A337-1 Liquids)	490	687.04	+40.29%
B3 Non-Medical (Expired Pharmaceutical Products, Electronic Waste)	23	48.01	+109.1%
Total Hazardous Waste	12,200	14,227	+16.62%

Source: Summary of Hazardous Waste at XKP Cirebon Hospital 2023-2024 processed by the researcher

DISCUSSION

Economic Dimension (Profit): Between Environmental Investment and Financial Efficiency

Qualitative analysis of financial data and interview narratives reveals a complex dialectical relationship between environmental compliance and cost efficiency a relationship far more nuanced than the simple assumption that environmental programs always constitute an additional cost burden.

The 12.14% cost increase requires analytical disaggregation rather than a simple efficiency judgment. Two distinct phenomena drive it: deliberate quality investment (monthly versus quarterly wastewater monitoring) and deferred capital expenditure (scheduled IPAL maintenance).

Neither constitutes inefficiency both constitute management decisions with traceable environmental rationale.

From the perspective of proportion relative to the overall business scale, the environmental costs of RSU XKP Cirebon accounted for only 0.74% (2023) and 0.81% (2024) of total operating costs. Accounting staff commented on these findings with an interesting perspective: *"...it turns out that environmental costs account for only about 1% of the hospital's total operating costs, which is a relatively small yet significant proportion for environmental management and regulatory compliance."*

The simultaneous decrease in processing costs and increase in waste volume explicable only through improved at-source segregation provides empirical evidence of eco-efficiency: behavioral compliance investments generating cost savings that exceed their direct cost. This mirrors the eco-efficiency pattern identified by Maulina & Nugraha (2022) at a comparable Indonesian public hospital. At 0.81% of total operating expenses, the hospital's environmental cost ratio falls below the international benchmark of 1.5-2.0% recommended by Dolcini et al. (2025) for sustainability-committed hospitals, indicating room for increased environmental investment without materially sacrificing profitability.

One critical aspect in the economic dimension is the absence of an integrated environmental accounting system. The absence of specific environmental cost accounts in the Chart of Accounts (COA) of RSU XKP Cirebon where these costs are dispersed across various categories such as 'General and Administrative Expenses,' 'Service Related Expenses,' and 'Medical Support Expenses' constitutes a major obstacle to trend analysis and data driven environmental decision making. This situation aligns with the findings of Muhammad Mualiyin & Fitriyah (2024) that most Indonesian hospitals still integrate environmental costs into general administrative expenses, resulting in low environmental transparency and accountability toward stakeholders.

The Director's assertion that environmental reputation attracts corporate health service contracts represents an analytically relevant but unverified economic claim. While consistent with Burritt et al. (2023) argument that reputational returns constitute legitimate environmental investment value, it cannot be validated from the available financial data: the study did not access client acquisition records or revenue breakdowns by client type. Future research employing mixed methods designs could triangulate contract data against stated client selection criteria to quantify this relationship more rigorously. The claim is retained here as a hypothesis worth testing, not as a confirmed finding.

Social Dimension (People): Worker Protection and Community Responsibility

The implementation of green accounting at RSU XKP Cirebon has social implications divided into two concentric circles: internal protection for employees and medical staff, and external contributions to the surrounding community.

Regarding internal protection, the Head of Environmental Health stated unequivocally: *"A good waste management program protects the health of our staff, particularly sanitation workers and nurses at risk of exposure to infectious waste. Since the implementation of strict safety procedures, there have been no further work-related accidents involving medical waste."*

The zero-accident claim is analytically significant but requires interpretive caution: it is based on internal incident reporting data provided by the hospital, not independently audited occupational health records. Under-reporting of minor incidents is a documented phenomenon in healthcare facilities (Aboueid et al., 2023), and institutional reporting systems may not capture near-misses. The finding is therefore best interpreted as evidence of a functional safety culture rather than a verified epidemiological outcome.

Internal data obtained from the Head of the Human Resources Department indicates relatively high levels of employee awareness and participation: 85% of staff understand the importance of waste management, 78% actively participate in environmental programs, and 92% agree that the hospital must be environmentally responsible. These figures represent significant social capital for the successful long-term implementation of green accounting, as demonstrated by Aboueid et al. (2023), who found that HR commitment and awareness are stronger predictors of environmental implementation than the availability of physical infrastructure.

In the external sphere, RSU XKP Cirebon contribution to the community is reflected in waste management education programs for the surrounding community. A public health staff member explained: *"We also actively educate the surrounding community about the management of household waste and sewage to prevent pollution of the local environment. This is part of our social responsibility as a healthcare institution."*

This community education program goes beyond regulatory obligations and reflects the interpretation of CSR as an institutional moral responsibility, not merely a compliance activity. In 2024, RSU XKP Cirebon also recorded an "Other Environmental Costs" item of IDR 37.9 million, which was absent in 2023 an indication that this social environmental commitment has received explicit budget allocation, even though it was not present in the previous year.

Environmental Dimension (Planet): Regulatory Compliance, Ecological Efficiency, and Wastewater Treatment Systems

The environmental dimension is the area where Cirebon XKP General Hospital demonstrates the most measurable and well documented performance, particularly through its wastewater management system (IPAL) and integrated hazardous waste management.

The Head of Environmental Health revealed an interesting biological monitoring innovation: *"We have an indicator pond containing fish as bioindicators to ensure that the treated water is safe and free of hazardous substances before being discharged into the environment."* The use of fish as bioindicators reflects a monitoring approach that combines modern technology (laboratory testing 12 times per year) with cost-effective practical wisdom. This method also provides real-time visual signals regarding effluent quality, enabling early detection before potential violations of quality standards occur.

The most significant finding in the environmental dimension is energy efficiency in WWTP operations: energy consumption decreased by 10% without compromising treatment quality. The Head of Environmental Affairs explained the mechanism: *"Through strict monitoring via a system integrated with cost tracking, we can identify areas of waste and implement improvements. As a result, energy consumption for the WWTP decreased by 10% without reducing treatment quality."* This efficiency was achieved through a data driven monitoring approach that identified optimal operational schedules for pumps and aerators a practice aligned with Dolcini et al. (2025) recommendations regarding energy efficiency as a key environmental performance indicator for hospitals.

For hazardous waste (B3) management, the three color sorting system implemented by RSU XKP Cirebon yellow bags (infectious), black bags (domestic), and yellow safety boxes (sharp) has become an institutionalized part of operational routines. Environmental Health staff describe the process: *"Waste sorting is conducted at the source using differently colored bags and trash bins... Every day we collect, weigh, and record the volume of waste before storing it at the TPS."* Daily weight documentation serves as the basis for issuing shipping manifests to PT WSTG and for calculating processing fees. Summary data indicates that compliance with the shipping schedule (not exceeding 90 days of TPS storage) was consistently maintained throughout 2023 and 2024.

Spiritual/Governance Dimension (Purpose): Commitment to Values as the Foundation of Sustainability

The fourth dimension of QBL, often overlooked in conventional green accounting research, is actually the most distinctive and theoretical finding of this study. An in-depth analysis of the interview narrative with the Director reveals that the commitment to environmental management at RSU XKP Cirebon is not merely driven by regulatory or financial considerations, but is rooted in deep moral values and a philosophy of service.

The most analytically robust indicator of genuine purpose commitment is the resource allocation pattern: environmental budgets increased 12.14% in a year when net profit fell 17.88%. Organizations whose environmental commitments are instrumentally motivated by financial returns or compliance fear would be expected to reduce environmental spending under profit pressure. The counter-cyclical pattern observed here provides behavioral evidence of value-based commitment, not merely value-based rhetoric.

This operationalizes Burke & Logsdon (1996) purpose dimension in a way that goes beyond their original corporate framing: in this hospital, purpose is not a governance layer added to a commercial enterprise but the institutional rationale from which governance flows. However, the study cannot fully disentangle genuine value commitment from strategic image management: the same behaviors that express authentic purpose also produce institutional legitimacy. Differentiating these motivations would require longitudinal observation across contexts where legitimacy interests and value interests diverge.

In terms of governance accountability, Cirebon XKP General Hospital demonstrates practices that exceed minimum requirements. The Head of Environmental Health stated: *"We routinely submit periodic reports to the environmental agency. This transparency is crucial for building trust that we are serious about protecting the environment."* This periodic reporting to the Cirebon Regency Environmental Agency represents a form of public ecological accountability that goes beyond financial reporting obligations to shareholders. Bester (2021) argues that a commitment to public accountability such as this is a marker of institutional maturity in internalizing sustainability principles. Operationally, RSU XKP Cirebon's governance commitment in the purpose dimension can be measured through three concrete indicators: (1) reporting frequency to the Cirebon Regency Environmental Agency, which occurred twelve times in 2024 (monthly), exceeding the minimum quarterly requirement and demonstrating proactive rather than merely compliant governance behavior; (2) the number and budget of environmental CSR programs, with the IDR 37.9 million "Other Environmental Costs" recorded for the first time in 2024 representing an explicit governance decision to formalize community environmental education as an institutional commitment; and (3) the counter-cyclical environmental budget allocation pattern increasing environmental investment by 12.14% in a year when net profit fell 17.88% which serves as a behavioral proxy for governance authenticity that financial metrics alone cannot capture.

The long-term vision of top management in building a sustainable system is also reflected in the Director's statement: *"From the very beginning, we have established a vision to become a sustainable hospital. This commitment begins with top management and must be carried out by all levels of the organization."* This confirms the findings of Aboueid et al. (2023) that committed top leadership is the strongest prerequisite for the success of sustainability programs in healthcare facilities far more determinative than the availability of budget or infrastructure.

A critical methodological limitation must be acknowledged across all four dimensions of this analysis: the risk of institutional self-reporting bias. All financial, operational, and performance data were provided by the hospital itself, and all informants were employed by or affiliated with the institution. This creates a structural incentive toward favorable self-presentation, particularly for sensitive indicators such as waste accident records, staff compliance rates, and environmental cost classifications. Although source and method triangulation were applied to mitigate this risk, the researchers were not able to independently audit the hospital's internal incident records or verify staff compliance data through external observation. Readers should therefore interpret all quantitative performance claims particularly the reported zero-accident rate and the 85-92% staff awareness and participation figures as reflecting the hospital's internal reporting system rather than independently verified outcomes. Future research employing external auditor involvement or longitudinal observation would provide stronger empirical grounding for these claims.

Enabling and Barriers: Contextual Analysis

The study identified four key enabling factors and three inhibiting factors that shape the landscape of green accounting implementation at RSU XKP Cirebon. Table 5 presents a summary of these findings.

Table 5. Matrix of Enabling and Hindering Factors for the Implementation of Green Accounting at Cirebon XKP General Hospital.

Enabling Factors	Barriers
Strong and consistent commitment from top management (evidenced by increased environmental budget allocations despite declining profits)	Absence of specific environmental cost accounts in the Chart of Accounts (COA), resulting in environmental costs being dispersed and not systematically traceable
Adequate wastewater treatment plant (WWTP) infrastructure with buffer capacity (34.87 m ³ /day out of a capacity of 50 m ³ /day = 69.75% utilization)	Limited accounting staff with specialized competencies in environmental accounting (currently handled by general accounting staff)
Relatively high staff awareness (85% understand, 78% actively participate) as social capital for implementation	The absence of an incinerator facility in the Cirebon area forces reliance on third-party services from outside the city (increasing logistics costs)
External regulatory pressure (Ministry of Environment and Forestry Regulation, LARS-DHP accreditation) as a driver of institutional compliance	Absence of standard technical guidelines from hospital associations/IAI regarding the recording and reporting of environmental costs in the health sector

Source: Synthesis of interview results, observations, and document analysis at Cirebon XKP Hospital, compiled by the researcher.

Regarding enabling factors, the commitment of top management demonstrated through consistent actions rather than mere rhetoric is the most decisive enabler. The Head of Environmental Health emphasized the positive impact of regulatory pressure: "*Regulations from the Ministry of Health and the Ministry of Environment, which are becoming increasingly stringent, actually help us to be more disciplined in waste management.*" Framing regulations as "assistance for discipline" (rather than a "compliance burden") reflects a significant level of institutional maturity in internalizing sustainability values.

CONCLUSION

This study makes three contributions. Empirically, it documents that regulatory compliance and genuine ecological efficiency are achievable at an environmental cost ratio below 1% of operating expenses, provided that behavioral discipline particularly at-source waste segregation supplements infrastructure investment. Theoretically, it demonstrates that the Quadruple Bottom Line framework captures dimensions of hospital sustainability particularly the purpose dimension that are systematically invisible to Triple Bottom Line and quantitative approaches: the counter-cyclical environmental spending pattern identified here would not be interpretable without the QBL analytical lens. Methodologically, it illustrates how interpretive case study inquiry explains the low explanatory power of quantitative green accounting studies in this sector by surfacing the institutional value dynamics that drive implementation.

The theoretical novelty of this study lies in one specific extension: prior green accounting studies in Indonesian hospitals have applied the Triple Bottom Line framework, which cannot account for the counter-cyclical spending behavior documented here a hospital increasing environmental investment while profits decline. Under a Triple Bottom Line framework, this pattern is anomalous. Under the Quadruple Bottom Line framework, it is explicable as purpose-driven governance. This study therefore does not merely add a fourth dimension to existing analysis; it demonstrates that the fourth dimension resolves an explanatory problem that three-dimensional frameworks cannot address.

The main limitation of this study lies in its nature as a single case study, which restricts statistical generalization, although analytical generalization to the context of similar private hospitals remains possible and holds significant theoretical value (Yin, 2018). Further research is recommended using a multi-case comparative design with a more diverse range of hospitals in terms of typology (Types

A-D), geographic region, and ownership status (public vs. private) to produce a more robust hospital green accounting model that can be widely applied in Indonesia.

Comparative Analysis: Triple Bottom Line vs. Quadruple Bottom Line

The theoretical contribution of this study is most precisely located in what the Quadruple Bottom Line (QBL) explains that the Triple Bottom Line (TBL) cannot. Table 6. Presents an explicit comparative analysis of the two frameworks as applied to the empirical findings of this study.

Table 6. Comparative analysis of TBL and QBL frameworks as applied to RSU XKP Cirebon findings.

Analytical Dimension	Triple Bottom Line (TBL)	Quadruple Bottom Line (QBL) This Study
Dimensions	Profit, People, Planet (3 dimensions)	Profit, People, Planet, Purpose (4 dimensions)
Hospital identity assumption	Treats hospital as a commercial entity with added social and environmental obligations	Positions purpose (ethical mission, institutional values) as the foundation from which all dimensions derive
Explanatory power (prior studies)	≤15% of sustainability variability explained (Ashari & Anggoro, 2020)	Resolves residual variance by capturing purpose-driven institutional behavior (e.g., counter-cyclical spending)
Counter-cyclical spending (profit, environment)	Anomalous cannot be explained within a profit, people, planet logic	Explicable as purpose-driven governance: institutional values override short-term profit calculus
Governance accountability proxy	Not captured governance subsumed under profit or people dimension	Measured via: reporting frequency (12x/year), CSR program budget (IDR 37.9M, 2024), and counter-cyclical spending pattern
Institutional ethics / spiritual values	Not addressed no dimension for religious values or moral commitment as drivers	Purpose dimension explicitly captures institutional moral mission as a driver of sustainability behavior

Practical Implications and Recommendations

Based on the research findings, the researchers recommend four strategic steps to optimize the implementation of green accounting at Cirebon XKP General Hospital, which are also relevant for similar private hospitals. First, restructure the Chart of Accounts (COA) by adding a dedicated Environmental Cost Account (ECA) sub-account that classifies expenditures into the four categories outlined by Hansen & Mowen (2005) a technical step requiring minimal investment but significantly enhancing analytical and reporting capabilities. Second, develop a quarterly Environmental Cost Report (ECR) as an internal management report to complement formal financial statements, covering cost trends by category, efficiency ratios, and comparisons with targets. Third, enhance the capacity of environmental accounting staff through structured training or the recruitment of staff with a background in environmental accounting. Fourth, advocacy with the Cirebon Regency Government for the development of local hazardous waste treatment facilities, which will reduce logistics costs for all healthcare facilities in the Cirebon region.

ACKNOWLEDGMENTS

The researchers would like to express their deepest gratitude to the Director and the entire management team of RSU XKP Cirebon, particularly the Head of the Finance Department, the Head of the Environmental Health Unit, the Accounting Staff, and the Field Sanitation Staff, for



their openness, trust, and full cooperation throughout the research process. Appreciation is also extended to the Accounting Program, Faculty of Economics and Business, Universitas Swadaya Gunung Jati Cirebon, for their invaluable academic support and guidance in the completion of this research.

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