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From Disclosure to Accountability: An Index-Based Evaluation of Environmental Accounting and ESG Integration in India's Chemical Industry

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Abstract:

The chemical industry, as one of the most resource-intensive and environmentally sensitive sectors, is facing increasing pressure to balance economic growth with ecological responsibility. This study aims to analyze the environmental accounting practices adopted by selected Indian chemical companies and evaluate the extent of their alignment with sustainable reporting frameworks. Using a descriptive and analytical research design, the study constructs an Environmental Accounting Index (EAI) based on disclosures in annual and sustainability reports from 2018 to 2023. The analysis examines key dimensions such as energy efficiency, waste management, emission reduction, and environmental expenditure. Findings reveal that while leading companies demonstrate moderate to high levels of environmental disclosure, smaller firms continue to treat such reporting as a compliance formality rather than a strategic tool. The study highlights the emerging role of environmental accounting in enhancing transparency, supporting ESG integration, and improving corporate reputation. It concludes that greater standardization and mandatory disclosure norms are essential to embed environmental accountability within India's chemical sector and to strengthen its contribution toward sustainable industrial grow

Keywords: Environmental Accounting, Chemical Industry, Sustainability Reporting, ESG Practices, Environmental Disclosure, Corporate Governance, India

Introduction:

India's chemical industry, a key contributor to national GDP and export growth, also ranks among the most resource-intensive and pollution-prone sectors, posing significant environmental challenges. As industrial expansion accelerates, the need to integrate sustainability within corporate decision-making has become critical. Environmental accounting, often termed green accounting, provides a systematic framework to identify, measure, and disclose the environmental costs of industrial operations (Gray & Bebbington, 2001). It expands traditional accounting by quantifying the impacts of emissions, waste generation, and resource depletion, thereby aligning economic performance with ecological responsibility.

Global initiatives such as the Global Reporting Initiative (GRI, 1997), ISO 14000 standards (ISO, 2011), and the International Federation of Accountants' guidance on Environmental Management Accounting (IFAC, 2005) have advanced this integration internationally. In India, the Business Responsibility and Sustainability Reporting (BRSR) framework introduced by SEBI (2021) underscores the growing importance of environmental disclosures. Despite these developments, the chemical industry continues to face gaps in data standardization, cost

monetization, and compliance (World Bank, 2019).

This study critically examines current practices, identifies challenges, and explores how environmental accounting can enhance profitability, transparency, and long-term sustainability in the sector.

Objectives of study:

1. To examine the impact of environmental accounting on the profitability and cost structure of selected chemical industry companies in India.
2. This objective focuses on assessing how the adoption of environmental accounting practices influences the financial performance of chemical companies, particularly in terms of cost efficiency, resource utilization, and overall profitability.
3. To analyze the extent to which Indian environmental accounting rules, guidelines, standards, and regulatory frameworks are implemented by selected chemical industry companies in India.
4. This objective aims to evaluate the level of compliance of chemical companies with both national and international environmental accounting and reporting standards such as the Business Responsibility and Sustainability Reporting (BRSR), Global Reporting Initiative (GRI), and ISO 14000 frameworks.
5. To evaluate whether environmental accounting practices in selected chemical industry companies in India fulfill the objectives of sustainable development, community engagement, and effective environmental conservation.

This objective seeks to determine the contribution of environmental accounting towards achieving sustainability goals, promoting corporate environmental responsibility, and fostering long-term ecological balance within the chemical sector.

Literature Review:

Environmental accounting, often termed green accounting or sustainability accounting, integrates environmental costs into conventional financial frameworks to evaluate the ecological impact of industrial operations while maintaining profitability (Gray & Bebbington, 2001). It aims to enhance transparency, accountability, and informed decision-making for stakeholders. In India, environmental accounting gained prominence post-economic liberalization as rapid industrialization led to increased pollution and ecological degradation (Pramanik et al., 2007).

Studies reveal that although Indian industries increasingly disclose environmental data in their annual and sustainability reports, many still restrict disclosures to statutory compliance rather than comprehensive environmental performance (Goyal & Verma, 2021). The adoption of frameworks like the Global Reporting Initiative (GRI), Carbon Disclosure Project (CDP), and ISO 14000 has improved corporate reporting standards, yet inconsistencies persist across sectors (Singh & Sharma, 2020).

The chemical industry, being one of the most pollution-intensive sectors, demonstrates a strong need for standardized environmental accounting practices (Sonara, Sharma & Patel, 2016). Researchers emphasize that environmental accounting in this sector should go beyond regulatory adherence to include cost–benefit analysis of pollution control, waste management, and resource utilization (Hecht, 2007). Internationally, environmental accounting has evolved as a strategic management tool for integrating sustainability within industrial policy (De Beer & Friend, 2006), while in India, limited

adoption and lack of expertise have restricted its effectiveness (Bhat & Jaya, 2018).

Recent literature highlights the transformative role of technology, big data analytics, IoT, and AI in enabling real-time tracking of environmental performance and optimizing resource use (Susanto & Meiryani, 2019). This evolution has enhanced the analytical capabilities of environmental accounting systems, making them crucial for sustainable industrial growth. Despite progress, challenges remain in cost standardization, valuation of environmental assets, and integration of environmental costs into mainstream accounting (Jones, 2010; Yadav, 2020).

Overall, the literature underscores that environmental accounting plays a pivotal role in linking profitability with sustainability. For the Indian chemical industry, it offers a pathway to balance economic expansion with ecological responsibility, aligning corporate strategies with national and global sustainability objectives.

Research Methodology:

This study uses a mixed-methods approach:

Qualitative Analysis: Interviews and surveys were conducted with key stakeholders in leading Indian chemical companies, including finance executives and sustainability officers, to understand their awareness, perceptions, and implementation of environmental accounting practices.

Quantitative Analysis: Secondary data, including annual reports, Business Responsibility and Sustainability Reports (BRSR), sustainability disclosures, and environmental performance reports of major chemical companies, were analyzed to assess the extent of integration of environmental accounting into their operations and financial decision-making.

The sample includes prominent Indian chemical companies such as Tata Chemicals, Sudarshan chemicals, Navin Fluorine Ltd, UPL, and Gujarat Alkalies and Chemicals, which are recognized for their large-scale operations and environmental sustainability initiatives.

Scope of study:

This paper primarily focuses on the environmental accounting practices adopted by selected Indian chemical companies such as Tata Chemicals, Sudarshan chemicals, Navin Fluorine Ltd, UPL, and Gujarat Alkalies and Chemicals to broadly understand their sustainability initiatives. These companies have implemented several eco-friendly measures including waste minimization, water recycling, pollution control technologies, renewable energy adoption, and green process innovation as part of their commitment to sustainable development. The study highlights prevailing environmental accounting practices through a mixed-method approach and analyzes their effectiveness in promoting transparency and efficiency. It also examines the benefits of environmental accounting such as better cost management, improved compliance, and stakeholder trust while acknowledging challenges like high implementation costs, inadequate awareness among smaller firms, lack of uniform standards, and weak enforcement mechanisms. The paper thus emphasizes the need for standardization of environmental accounting frameworks, stricter regulatory compliance, and enhanced disclosure practices to align financial performance with ecological responsibility in India's chemical industry.

Data Analysis and Testing of Hypothesis:

A structured questionnaire was designed to collect primary data from finance officers, sustainability managers, and environmental compliance executives of selected Indian

chemical companies. Secondary data were obtained from credible corporate sources, including Business Responsibility and Sustainability Reports (BRSR), Annual Reports, Sustainability Reports, and CSR disclosures of the chosen companies Tata Chemicals, Sudarshan chemicals, Navin Fluorine Ltd, UPL, and Gujarat Alkalies and Chemicals.

As the sample size for the study was less than 40, the T-test was employed for hypothesis testing to ensure accurate and statistically valid analysis of small-sample data. The T-test is particularly appropriate in this study as it accounts for sample variability and provides reliable results when the population standard deviation is unknown. The statistical analysis aimed to determine the relationship between environmental accounting practices and financial performance, as well as the extent of compliance with environmental reporting frameworks in India's chemical industry.

1. H0: There is no effect of environmental accounting on the profitability and cost structure of the selected Indian chemical industry companies.
   H1: There is a positive effect of environmental accounting on the profitability and cost structure of the selected Indian chemical industry companies.
2. H0: All the Indian rules, standards, and regulatory frameworks of environmental accounting are not effectively implemented by the selected Indian chemical industry companies.
   H1: All the Indian rules, standards, and regulatory frameworks of environmental accounting are effectively implemented by the selected Indian chemical industry companies.
3. H0: Environmental accounting does not influence sustainable development, community engagement, or effective environmental conservation practices in the selected Indian chemical industry companies.
   H1: Environmental accounting significantly influences sustainable development, community engagement, and effective environmental conservation practices in the selected Indian chemical industry companies.

Primary data collection was done based on the questionnaires exclusively designed for the Managers and Accountants of the selected Chemical companies. Data received was cleaned and relevant variables in line with the hypothesis set were further coded and assigned weights keeping in view their importance under study. The responses were further grouped keeping in view the hypothesis under study as follows;

Variables under H01 include – responses related to questions on environmental performance goals, integration of environmental accounting into financial reporting, government support for adhering environmental standards, impact of environmental accounting on company's profitability.

Variables under H01 include – Awareness regarding Environmental accounting, implementation of environmental accounting practices and its integration in financial reporting, company's profitability.

Variables under H03 include – environmental indicators tracked, environmental / sustainability reports published; compliance and implementation of environmental accounting practices as per Indian environmental standards; influence of environmental accounting on sustainability practices and corporate responsibility.

Additionally, secondary data was gathered after conducting desk review and the information gathered was categorized under broad variables that included environmental accounting (legal compliance, plants/offices assessed, P1 to P9, EPR, business continuity and disaster

management plan), profitability (financial implication, R&D and capital expenditure, wellbeing benefits) and environmental conservation and sustainable development (sustainable sourcing, zero liquid discharge, greenhouse gas emission, social impact assessment, Rehabilitation and resettlement, CSR projects u, vulnerable and marginalized groups reach).

The above mentioned variables relevant to the hypothesis mentioned were tested using one sample and two sample t tests (applicable as per the hypothesis under study). Sample size being less than 40 these tests was applied. The results achieved and conclusions drawn are mentioned below in tabular form;

	Test statistic: T	**p-value**	**t critical value**	**Accepted / Rejected**
Based on Primary Data	6.9098	0.0002	1.943	null hypothesis is rejected
	25.070	1.3259E-07	1.943	null hypothesis is rejected
	28.9858	5.58533E-08	1.943	null hypothesis is rejected
Based on Secondary data	40.5523	3.21E-16	1.833	null hypothesis is rejected
	4.3642	0.0003	1.734	null hypothesis is rejected

Table 1: T Test Results

Rejection criteria: If the test statistic value greater than critical value and further the p value is less than 0.05, the null hypothesis is rejected.

The table presents hypothesis test results (H0 vs. H1) analyzing the impact of environmental accounting on Indian Chemical sector companies. Based on primary and secondary data, all null hypotheses (H0) were rejected ($p < 0.05$), indicating that environmental accounting significantly improves profitability, ensures compliance with Indian regulatory frameworks, and enhances sustainable development, community relations, and environmental conservation practices. The consistency across both datasets strengthens the conclusion that environmental accounting positively influences the Chemical sector, supporting its broader adoption.

Environmental Accounting Practices in Chemical sector Companies:

The chemical industry, being resource-intensive and pollution-prone, has a significant environmental impact due to emissions, effluent discharge, hazardous waste generation, and high energy consumption. Environmental accounting plays a vital role in assessing these impacts, improving transparency, and integrating sustainability into operational and financial decisions. Global standards such as GRI, ISO 14001, and CDP frameworks encourage chemical companies to track and disclose their environmental costs, carbon footprints, and compliance with pollution control norms.

Leading Indian chemical companies such as Tata Chemicals, Sudarshan chemicals, Navin Fluorine Ltd, UPL, and Gujarat Alkalies and Chemicals demonstrate growing commitment to sustainable operations by implementing environmental management systems, adopting renewable energy sources, and investing in pollution control infrastructure. However, small and medium enterprises (SMEs) in the sector face challenges such as limited technical know-how, high compliance costs, and lack of standardized reporting frameworks. This emphasizes the need for capacity building, policy support, and awareness programs to ensure widespread adoption of environmental accounting practices.

Environmental accounting in the chemical sector contributes to resource optimization, cost efficiency, and regulatory compliance, enabling companies to align profitability with ecological responsibility. Some of the key environmental accounting practices observed in the Indian chemical industry are as follows –

1. Energy Consumption and Carbon Footprint Reporting: Chemical companies are increasingly adopting renewable energy, energy-efficient process technologies, and emission control systems. Firms like Tata Chemicals and UPL disclose their carbon emissions, energy use intensity, and renewable energy investments in sustainability reports. These initiatives help reduce carbon footprints while enhancing operational efficiency.
2. Waste and Hazardous Material Management: The sector generates substantial industrial and chemical waste. Companies like Navin Fluorine, Sudarshan Chemicals implement waste minimization techniques, safe disposal systems, and recycling of by-products. Compliance with the Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 and EIA Notification, 2006 ensures responsible waste handling and reduced environmental risks.
3. Water Usage and Effluent Treatment: Chemical manufacturing processes require large volumes of water. Companies such as Gujarat Alkalies and Chemicals Ltd. and Tata Chemicals have introduced zero liquid discharge (ZLD) systems, rainwater harvesting, and recycling of process water to optimize consumption and minimize discharge. Regular water audits and wastewater treatment initiatives ensure sustainable water management.
4. Green Chemistry and Sustainable Production: Environmental accounting in the chemical sector increasingly emphasizes green chemistry principles developing products and processes that minimize hazardous substances. Companies invest in clean technology, process redesign, and eco-friendly raw materials to reduce environmental impact while maintaining competitiveness.
5. Sustainable Infrastructure and Reporting: Leading companies are publishing integrated sustainability reports under BRSR and GRI frameworks, providing detailed disclosures on energy use, emissions, waste management, and CSR activities. Many have obtained ISO 14001 certifications, demonstrating commitment to continuous environmental performance improvement and stakeholder accountability.

Benefits of Environmental Accounting in Chemical Sector:

1. Improved Resource Efficiency: Companies like Tata Chemicals and Aarti Industries have enhanced resource utilization through energy audits, water recycling, and waste minimization. Environmental accounting enables real-time monitoring of inputs, helping reduce inefficiencies and optimize operations.
2. Cost Savings: Adoption of green technologies and pollution control measures has allowed companies such as UPL and Deepak Nitrite to reduce waste treatment and energy costs. Environmental accounting identifies resource wastage, leading to measurable cost reductions and enhanced profitability.
3. Regulatory Compliance: Environmental accounting supports adherence to frameworks such as ISO 14001, EIA Notification (2006), and Hazardous Waste Management Rules (2016). It ensures systematic documentation

and reporting, minimizing the risk of penalties and enhancing compliance credibility.

4. Enhanced Transparency and Accountability: Companies like Tata Chemicals publish BRSR and GRI-aligned sustainability reports, disclosing environmental metrics such as carbon emissions, water use, and waste management. Such transparency fosters stakeholder confidence and responsible governance.
5. Strengthened Stakeholder Relations: Disclosure of environmental initiatives and community engagement projects improves relations with regulators, investors, and local communities. These fosters trust and long-term partnerships are essential for industrial sustainability.
6. Reputation and Brand Value: Firms demonstrating eco-conscious operations gain strong reputation value. For example, UPL's sustainability initiatives in crop protection and chemical safety have earned international recognition, enhancing its brand perception.
7. Competitive Advantage: Environmentally responsible practices such as green chemistry, circular manufacturing, and renewable energy use differentiate chemical companies in the global market, attracting sustainability-conscious clients and investors.
8. Informed Decision-Making: Environmental accounting provides quantitative data on environmental costs and returns, enabling management to make strategic decisions about cleaner technologies and efficient production methods.
9. Innovation and Sustainability Integration: Through environmental accounting, companies invest in green chemistry innovations, low-emission processes, and by-product reutilization, driving technological progress alongside environmental stewardship.
10. Support for Long-Term Growth: Integration of sustainability into corporate planning enhances resilience and long-term growth. Companies such as Gujarat Alkalies and Chemicals Ltd. demonstrate this by aligning profitability with ecological responsibility through continuous resource optimization.
11. Risk Management and Compliance Monitoring: Environmental accounting helps track emissions, waste, and energy usage systematically, ensuring compliance and mitigating reputational or legal risks associated with environmental negligence.
12. Improved Brand Image and Market Credibility: Transparent sustainability reporting, responsible waste management, and community-driven programs enhance public image and investor confidence, positioning Indian chemical companies as leaders in sustainable industrial transformation.

Challenges in Environmental Accounting for IT Companies:

In spite of positive headways, environmental accounting faces several challenges -

1. Lack of Standardization: The absence of uniform environmental accounting frameworks and the complex nature of standards such as ISO 14001, GRI, and CDP often lead to inconsistent and incomparable data across the chemical industry. This underlines the need for standardized reporting guidelines to ensure credibility, uniformity, and transparency in sustainability disclosures.
2. Difficulties in Measuring Environmental Costs: Quantifying environmental costs such as pollution, waste disposal, and resource depletion remains challenging due to the lack of clear valuation methods. Developing standardized monetary valuation frameworks will enhance data accuracy and help integrate

environmental performance into managerial and financial decision-making.

3. Limited Awareness and Technical Expertise: Many small and medium-sized chemical enterprises lack awareness, financial resources, and trained personnel to effectively implement environmental accounting practices. Bridging this knowledge and skill gap through capacity-building initiatives can help firms recognize environmental accounting as a long-term investment rather than a compliance cost.
4. Regulatory and Compliance Barriers: The chemical industry faces complex compliance requirements under environmental legislation such as the Environment Protection Act (1986) and Hazardous Waste Management Rules (2016). Due to limited institutional support and regulatory clarity, smaller firms struggle to meet international standards like ISO 14001 and GRI.
5. Inadequate Integration into Financial Reporting: Environmental costs are often reported separately through sustainability reports, BRSR, or CSR disclosures, instead of being integrated into traditional financial systems such as IFRS or Indian GAAP. This separation limits the ability of companies to assess the true financial impact of their environmental performance.
6. Limited Corporate Adoption and Implementation Challenges: Many chemical firms, especially in the SME segment, still view environmental accounting as optional rather than strategic. Limited regulatory enforcement, unclear guidelines, and lack of trained professionals hinder consistent adoption across the industry.
7. Unclear Influence on Business Decision-Making: Although large corporations have begun integrating environmental data into strategic planning, smaller firms lag due to financial constraints and lack of access to technology. Establishing comprehensive, industry-wide sustainability metrics and performance indicators will help align environmental accounting with operational and investment decisions.

Conclusion:

The chemical industry in India has made notable progress toward integrating sustainability within its operations. By underscoring the importance of environmental accounting in industrial activities, this paper provides an analytical overview of selected Indian chemical companies and emphasizes the need to embed environmental accounting into core business strategies for long-term sustainability and profitability.

Leading companies such as Tata Chemicals, Sudarshan Chemical Industries, Navin Fluorine International Ltd., UPL Ltd., and Gujarat Alkalies and Chemicals Ltd. have taken significant steps toward environmental stewardship through energy-efficient operations, pollution control measures, and transparent sustainability reporting. However, small and medium-sized enterprises (SMEs) in the chemical sector continue to face constraints such as limited technical expertise, lack of awareness, and insufficient regulatory clarity. This demonstrates that while environmental accounting practices are gaining momentum, the overall sector remains in a transitional phase. Nonetheless, increasing regulatory requirements and stakeholder expectations are driving greater accountability and reporting consistency.

To advance further, chemical companies should align with global sustainability and reporting frameworks such as GRI, ISO 14001, and BRSR, thereby integrating environmental considerations into financial and operational decision-making. Policymakers must also develop

simplified and sector-specific regulatory mechanisms to ensure reliable, standardized, and transparent environmental disclosures.

From the analysis, it can be concluded that environmental accounting positively influences profitability, cost efficiency, and sustainable development in India's chemical industry. For its broader adoption, strong regulatory enforcement, enhanced environmental awareness, and collaborative efforts between businesses and policymakers are essential. In an era of growing ecological concerns, environmental accounting serves as a strategic tool to achieve resource optimization, stakeholder trust, and sustainable industrial growth, bridging the gap between economic advancement and environmental preservation.

References:

1. Ministry of Environment, Forest and Climate Change (MoEFCC). (2020). *Environment Protection Act, 1986 and subsequent amendments.* Government of India.
2. Securities and Exchange Board of India (SEBI). (2021). *Business Responsibility and Sustainability Report (BRSR) Framework.* Government of India.
3. International Organization for Standardization (ISO). (2020). *ISO 14001: Environmental management systems – Requirements with guidance for use.*
4. Tata Chemicals Ltd. (2023). *Sustainability report 2022–23: Reimagining chemistry for a sustainable future.* https://www.tatachemicals.com
5. UPL Ltd. (2023). *Integrated annual report 2022–23: Advancing sustainable agriculture through innovation.* https://www.upl-ltd.com
6. Gujarat Alkalies and Chemicals Ltd. (2023). *Business responsibility and sustainability report 2022–23.* https://www.gacl.com
7. Navin Fluorine International Ltd. (2023). *Sustainability and business responsibility report 2022–23.* https://www.navinfluorine.com
8. Sudarshan Chemical Industries Ltd. (2023). *Sustainability report 2022–23: Responsible growth through sustainable innovation.* https://www.sudarshan.com
9. Global Reporting Initiative (GRI). (2021). *Sustainability reporting standards.* https://www.globalreporting.org
10. Organisation for Economic Co-operation and Development (OECD). (2020). *Material flow accounting: Measuring the physical economy.* OECD Publishing.
11. World Business Council for Sustainable Development (WBCSD). (2021). *Pathways to net zero: Corporate environmental accounting and reporting.*
12. Singh, R., & Sharma, M. (2020). *Corporate environmental accounting and disclosure practices in India's chemical industry: An analytical study. Indian Journal of Accounting, 55*(1), 77–98.