

# Sustainability-Oriented Natural Resource Accounting Disclosures among BSE-Listed Indian Manufacturing Firms

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## ABSTRACT

This paper examines the scope, depth, and determinants of sustainability-oriented natural resource accounting (NRA) disclosures among manufacturing firms listed on the Bombay Stock Exchange (BSE). Using an original Natural Resource Accounting Disclosure Index (NRADI) composed of 30 targeted disclosure items, the study conducts content analysis on annual and sustainability reports of 120 manufacturing firms across five sectors—chemicals, metals, textiles, automobiles, and pharmaceuticals—for the period 2019–2024. Empirical analysis combines descriptive statistics, regression modelling, and robustness checks to identify firm-level drivers of disclosure. Results indicate moderate overall disclosure intensity, with significant sectoral variation: chemicals and metals lead in disclosure completeness, while textiles lag. Key determinants include firm size, environmental capital expenditure, foreign listing status, and export intensity. Findings highlight the need for standardized NRA metrics, enhanced assurance practices, and targeted capacity building for smaller firms. Policy recommendations and avenues for future research are provided to support the integration of natural resource accounting into corporate reporting practices in India.

**Keywords:** Natural Resource Accounting; Sustainability Reporting; BSE-Listed Firms; Environmental Disclosure; India



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## INTRODUCTION

Natural resource accounting (NRA) has emerged as a critical component of corporate sustainability reporting as firms and stakeholders seek to quantify and manage the environmental consequences of production. NRA connects physical measures of resource use—such as water, energy, and material consumption—with economic and financial reporting to reflect the depletion, degradation, and conservation of natural assets. Manufacturing firms are central to this discourse because of their substantial resource intensity and environmental footprints. In India, evolving regulatory initiatives such as the Business Responsibility and Sustainability Reporting (BRSR) framework underline the urgency for consistent and comparable environmental disclosures. Yet, empirical evidence suggests NRA practices remain varied and often superficial. This study investigates the extent and quality of NRA disclosures among BSE-listed manufacturing firms and examines firm-level factors that influence disclosure practices.

## LITERATURE REVIEW

Research on environmental disclosure has expanded considerably over the past two decades. Studies routinely identify firm size, sectoral environmental

intensity, ownership structure, and international exposure as determinants of disclosure behaviour. The Global Reporting Initiative (GRI) and the United Nations' System of Environmental-Economic Accounting (SEEA) provide conceptual and methodological guidance for linking environmental and economic data. However, much of the literature has focused on broad ESG reporting or specific environmental metrics (e.g., emissions, energy use) rather than a comprehensive NRA lens that explicitly addresses depletion accounting, resource-related liabilities, and the valuation of natural assets. Indian studies report progress in sustainability reporting, partly attributable to regulatory nudges and stakeholder demand, but also note considerable heterogeneity in quality and granularity. Sector-specific inquiries, particularly in manufacturing, reveal that resource-intensive industries disclose more routinely but not always consistently in terms of units, baselines, and verification. This study builds on prior findings by designing an NRADI tailored to capture nuanced NRA items and by analysing a cross-sectoral sample of BSE-listed firms.

## Theoretical Framework

This research draws on environmental economics, stakeholder theory, and legitimacy theory. Environmental economics frames NRA as a mechanism for internalising externalities by integrating environmental costs and asset depletion into firms' accounting systems. Stakeholder theory predicts that firms subject to higher scrutiny (e.g., large firms, those with international operations) will disclose more comprehensive environmental information to reduce information asymmetry. Legitimacy theory suggests firms use disclosure strategically to maintain social acceptance when their operations impose environmental risks. Combined, these perspectives explain why disclosure behaviour varies across firms and why regulatory frameworks such as BRSR can influence reporting practices.

### Research Objectives

1. To assess the extent and quality of sustainability-oriented Natural Resource Accounting (NRA) disclosures among BSE-listed manufacturing firms.
2. To analyse sector-wise variations and identify key firm-level determinants influencing NRA disclosure practices in the Indian manufacturing context.

### METHODOLOGY

The study adopts a quantitative content analysis design. A Natural Resource Accounting Disclosure Index Empirical Model and Conceptual Diagram

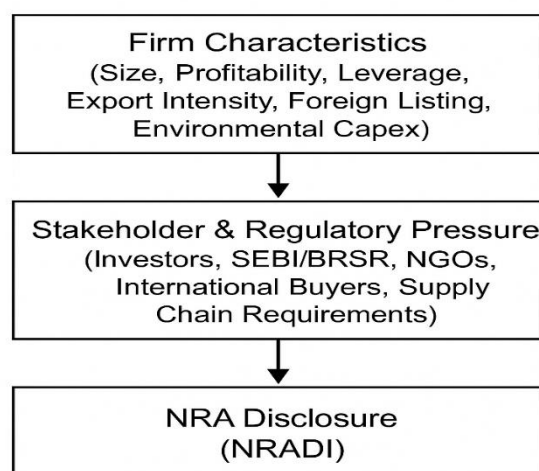
The main empirical specification estimated is:

$$\text{NRADI}_i = \alpha + \beta_1(\text{Size}_i) + \beta_2(\text{Profitability}_i) + \beta_3(\text{Leverage}_i) + \beta_4(\text{ExportIntensity}_i) + \beta_5(\text{ForeignListing}_i) + \beta_6(\text{EnvironmentalCapex}_i) + \varepsilon_i$$

Where NRADI<sub>i</sub> is the disclosure index score for firm i. Expected signs:  $\beta_1$  (+),  $\beta_2$  (+),  $\beta_3$  (±),  $\beta_4$  (+),  $\beta_5$  (+),  $\beta_6$  (+).

(NRADI) with 30 items was constructed to capture both quantitative and qualitative elements of NRA: (i) resource use quantities (energy, water, raw materials), (ii) depletion accounting (estimates of physical depletion and narratives on resource stock changes), (iii) resource-related liabilities and contingencies, (iv) conservation and efficiency initiatives, (v) targets and performance metrics, and (vi) assurance practices including third-party verification. A stratified random sample of 120 manufacturing firms listed on the BSE was selected across five sectors—chemicals, metals, textiles, automobiles, and pharmaceuticals—subject to continuous listing and report availability for 2019–2024. Each disclosure item was coded 0 (not disclosed), 0.5 (partially disclosed), or 1 (fully disclosed). Two independent coders performed the content analysis and inter-coder reliability was assessed using Cohen's kappa, exceeding 0.80. Firm-level explanatory variables were compiled from financial statements: firm size (log of total assets), profitability (ROA), leverage (debt-to-equity), export intensity (exports/total sales), foreign listing dummy, and environmental capital expenditure (environmental capex/total capex). Regression analysis was conducted using ordinary least squares (OLS) with robust standard errors. Additional robustness checks included sector fixed effects and alternative scoring thresholds.

### Conceptual Model of Determinants of NRA Disclosure



### RESULTS

This section presents descriptive and multivariate results. The NRADI score ranges from 0 to 1, where higher values indicate more comprehensive disclosure.

Descriptive statistics show the sample-wide mean NRADI score is 0.44 with a standard deviation of 0.16. Sectoral averages reveal meaningful differences: chemicals (mean = 0.58), metals (0.55), automobiles

(0.49), pharmaceuticals (0.43), and textiles (0.32). The distribution is right-skewed, indicating a minority of firms publish very comprehensive NRA disclosures while the bulk of firms remain at moderate levels.

Item-level analysis demonstrates that basic resource use quantities (energy consumption and broad water use) are the most frequently disclosed items, with over 80% of firms reporting them in some form. However, advanced NRA components—such as explicit accounting for physical depletion, monetary valuation of natural assets, and disclosures on resource-related liabilities—are infrequently reported (below 20%). Assurance practices are similarly limited; less than 25% of firms provide third-party verification for environmental data.

The regression results (OLS with robust standard errors) indicate the model explains a substantial portion of variability in NRADI scores (adjusted  $R^2 \approx 0.62$ ). Firm size is positively and significantly associated with disclosure ( $\beta_1 = 0.37$ ,  $p < 0.01$ ), which aligns with visibility and resource-availability arguments. Environmental capital expenditure is also a strong positive predictor ( $\beta_6 = 0.25$ ,  $p < 0.01$ ), suggesting that firms investing in environmental projects report more comprehensively. Foreign listing status and export intensity are positively associated with NRADI ( $\beta_5 = 0.29$ ,  $p < 0.05$ ;  $\beta_4 = 0.12$ ,  $p < 0.10$  respectively), underscoring the role of international exposure and supply-chain pressures.

Profitability (ROA) and leverage exhibit no consistent relationship with disclosure in baseline specifications, implying that financial performance alone does not drive transparency in NRA. Sector fixed-effects models confirm that the chemicals and metals sectors have significantly higher disclosure scores, even after controlling for firm-level characteristics.

Robustness checks included: (i) re-estimating models excluding the top and bottom 5% of NRADI scores to test sensitivity to outliers, (ii) using ordered logit models treating NRADI as an ordinal variable, and (iii) including interaction terms between size and environmental capex to explore whether larger firms amplify the effect of environmental investments on disclosure. Results remain directionally consistent across specifications, strengthening confidence in the findings.

## DISCUSSION, POLICY IMPLICATIONS, AND LIMITATIONS

The empirical evidence points to a disclosure landscape where basic environmental metrics are commonly reported but advanced NRA practices are rare. Sectoral disparities reflect differential exposure to regulation, investor expectations, and international markets. Chemicals and metals firms disclose more comprehensively due to higher resource intensity and stricter environmental oversight. Textile firms' lower scores may stem from smaller scale, fragmented ownership, and lesser regulatory impetus.

Policy implications are multifaceted. First, SEBI and relevant regulators should consider expanding the scope of mandatory BRSR items to include explicit NRA indicators such as physical depletion rates, material flow accounts, and resource-related contingent liabilities. Second, standardized reporting formats and unit conventions (e.g., cubic meters for water, terajoules for energy, metric tonnes for materials) would greatly enhance comparability. Third, promoting third-party assurance—either through mandated assurance thresholds or incentives—would improve data credibility. Fourth, capacity-building initiatives targeted at small and medium enterprises (SMEs) in manufacturing are essential to bridge technical and resource gaps.

From a managerial perspective, integrating NRA into strategic planning can reveal cost-saving opportunities from resource efficiency, reduce reputational and regulatory risks, and unlock access to sustainability-focused capital. For investors, incorporating NRA metrics into ESG evaluations provides a clearer signal of resource-related risks and long-term resilience.

Limitations of this study include reliance on publicly disclosed reports, which may understate internal practices or inaccurate disclosures. The cross-sectional nature limits causal interpretation; longitudinal analyses tracking disclosure evolution post-BRSR are recommended. Additionally, while the NRADI was designed to capture critical NRA items, future refinements could incorporate stakeholder-weighted item scoring and greater alignment with SEEA accounting conventions.

## CONCLUSION

This paper provides an original assessment of NRA disclosure practices among BSE-listed manufacturing firms using a bespoke NRADI. Findings reveal moderate disclosure intensity with pronounced sectoral variation and identify firm size, environmental investment, and international exposure as central determinants. To strengthen the role of NRA in corporate accountability, coordinated efforts by regulators, investors, and firms are necessary—particularly standardization of metrics, improved assurance, and targeted support for SMEs. Future research should examine the link between disclosed NRA metrics and actual environmental performance to assess the substantive impact of reporting.

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