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# Climate Risk Accounting – How companies measure the Impact of Weather Floods and Waves

Ms. Janaranjani.M<sup>1</sup>, Mr. Vinod.H<sup>2</sup>

Assistant Professor, Sri Krishna Arts and Science College, Coimbatore, Tamil Nadu, India<sup>1</sup>

Student, Sri Krishna Arts and Science College, Coimbatore, Tamil Nadu, India<sup>2</sup>

**ABSTRACT:** Climate change has emerged as a critical factor influencing corporate financial stability, requiring businesses to incorporate environmental risks into traditional accounting and financial reporting frameworks. This study examines the concept of climate risk accounting and its role in measuring the financial impacts of extreme weather events such as floods and heatwaves on corporate assets, revenues, and liabilities. The research focuses on how companies can integrate climate-related risks into financial statements using established accounting tools and international reporting standards.

The study adopts a descriptive and analytical research design based on secondary data from annual reports, climate databases, and regulatory guidelines. Financial modelling techniques including Expected Credit Loss (ECL), Value at Risk (VaR), impairment testing, and scenario analysis based on NGFS climate pathways are applied to evaluate potential financial losses under different climate scenarios. A detailed financial case application is demonstrated using the financial statements of Reliance Industries Limited along with simulated climate risk assumptions relevant to Indian industrial sectors.

Findings indicate that climate-related risks significantly affect corporate financial performance, potentially leading to asset value erosion, increased credit losses, and higher operational volatility. Scenario analysis suggests that extreme climate pathways may cause substantial asset impairment and liquidity stress, particularly in manufacturing and climate-sensitive industries. The results highlight that traditional accounting models often underestimate these risks due to limited forward-looking assumptions.

The study concludes that integrating climate risk accounting into financial reporting enhances transparency, supports regulatory compliance, and enables firms to make informed strategic decisions. Adoption of climate-adjusted financial models and standardized disclosure frameworks can help organizations improve resilience against climate-related financial shocks while promoting sustainable business practices.

**KEYWORDS:** Climate Risk Accounting, Flood Risk, Heatwave Impact, Expected Credit Loss (ECL), Value at Risk (VaR), Asset Impairment, Scenario Analysis, IFRS Sustainability Standards, Corporate Financial Reporting, Environmental Risk Disclosure.

## I. INTRODUCTION

Climate change has become an increasingly important issue influencing economic systems, corporate operations, and financial reporting practices worldwide. Rising global temperatures and the growing frequency of extreme weather events such as floods and heatwaves have created significant risks for businesses and financial markets. These environmental changes can disrupt production activities, damage infrastructure, interrupt supply chains, and increase operational costs. Consequently, organizations are required to consider environmental uncertainties while evaluating their financial performance and long-term sustainability. Traditional accounting practices, which largely focus on historical financial information, are often inadequate for capturing the potential future impacts of climate-related risks on corporate assets and earnings (Linnenluecke et al., 2019).

In response to these challenges, international regulatory bodies and financial institutions have begun to emphasize the integration of climate-related risks into corporate reporting frameworks. Initiatives such as the Task Force on Climate-related Financial Disclosures (TCFD) and sustainability standards issued by the International Sustainability Standards Board encourage companies to assess and disclose climate risks through structured reporting mechanisms. These



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frameworks promote forward-looking assessments using tools such as scenario analysis, stress testing, and climate risk modelling to evaluate how environmental changes may influence financial performance and investment decisions (Krueger et al., 2020).

Physical climate risks, particularly floods and heatwaves, pose direct threats to business assets and operational continuity. Floods can damage production facilities, warehouses, and transportation infrastructure, while prolonged heatwaves can reduce labour productivity, increase energy consumption, and affect equipment efficiency. Research has shown that extreme weather events can lead to significant economic losses, affecting firm value and regional economic growth if these risks are not properly incorporated into financial planning and reporting systems (Hsiang et al., 2017). Therefore, organizations must adopt more advanced accounting approaches that allow them to measure and report the financial consequences of climate-related disruptions.

Climate risk accounting has emerged as an interdisciplinary approach that integrates environmental science, financial modelling, and accounting principles to evaluate the financial impact of climate events. This approach enables companies to quantify potential losses and uncertainties using financial tools such as Expected Credit Loss (ECL), Value at Risk (VaR), impairment testing, and climate scenario analysis. By integrating these analytical methods into financial reporting, organizations can better understand the exposure of their assets and liabilities to climate-related risks and enhance transparency for investors, regulators, and other stakeholders (Engle et al., 2020).

In India, regulatory attention toward climate risk disclosure has increased significantly in recent years. The introduction of the Business Responsibility and Sustainability Reporting (BRSR) framework by the Securities and Exchange Board of India encourages companies to disclose environmental, social, and governance (ESG) risks within their annual reports. As industries expand in climate-sensitive regions, particularly in manufacturing and infrastructure sectors, the need for integrating climate risk accounting into corporate financial reporting becomes increasingly important. Adopting such practices can help organizations strengthen risk management strategies, improve resilience to environmental shocks, and support sustainable economic development in the long term (Bolton & Kacperczyk, 2021).

### II. OBJECTIVE

- To develop and validate a scalable framework for SMEs, incorporating cost-effective tools like open-source climate APIs and value-at-risk (VAR) simulations tailored to regional hazards.
- To evaluate the efficacy of these methods through secondary analysis of corporate case studies from 2020-2025, identifying barriers to adoption and recommending policy interventions.
- To propose future research directions, such as AI-driven predictive accounting for dynamic risk provisioning.
- To critically analyze the application of international standards (e.g., IFRS S1/S2, ISSB) and Indian guidelines (e.g., BRSR) in disclosing climate risks within annual reports and integrated statements.

### III. SCOPE OF THE STUDY

This study encompasses physical climate risks from floods and heatwaves in non-financial Indian corporates, spanning manufacturing, agriculture, and logistics sectors from 2020 to 2025, with a geographic emphasis on high-risk areas like Tamil Nadu and Kerala. It delves into measurement methodologies under IFRS and Ind AS frameworks, including scenario analysis (e.g., RCP 4.5/8.5 pathways), impairment testing, and disclosure requirements, while drawing on publicly available data from corporate filings, RBI reports, and climate databases. The scope includes qualitative reviews of 20-30 case studies but excludes transition risks (e.g., policy shifts), financial institutions, and primary empirical surveys due to resource constraints.

### IV. PROBLEM STATEMENT

Despite advancements, a persistent gap exists in how companies accurately measure and disclose the financial materiality of floods and heatwaves, often resulting in undervalued risks, inadequate impairment provisions, and non-compliant disclosures that mislead investors and regulators. Methodological inconsistencies—such as varying assumptions in flood probability distributions or heatwave productivity loss calculations—compound issues like data scarcity, computational complexity, and resistance to non-traditional inputs in statutory audits. For Indian firms, particularly SMEs in Tamil Nadu's industrial belts, this manifests as heightened vulnerability during monsoon seasons,



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where unaccounted flood damages lead to solvency crises and eroded stakeholder trust. The problem intensifies under tightening ESG mandates, exposing firms to litigation risks and capital flight if climate exposures remain opaque in financial statements.

### V. RESEARCH METHODOLOGY

#### 5.1 DATA SOURCE

This study is based on secondary data obtained from publicly available financial reports, climate research publications, and regulatory documents. Financial information was collected from the annual reports and financial statements of Reliance Industries Limited for the period 2020–2025. Climate-related projections and environmental risk data were derived from reports published by the Intergovernmental Panel on Climate Change and scenario frameworks developed by the Network for Greening the Financial System. In addition, regulatory guidelines and sustainability disclosure standards issued by the Securities and Exchange Board of India and the Reserve Bank of India were reviewed to understand climate risk reporting requirements in the Indian corporate sector.

#### 5.2 TOOLS USED

- **Expected Credit Loss (ECL):** A financial model used to estimate the potential loss on financial assets due to future credit risk.
- **Value at Risk (VaR):** A statistical tool used to measure the maximum potential financial loss of assets within a specific time period at a given confidence level.
- **Impairment Testing:** A method used to determine whether the carrying value of an asset exceeds its recoverable amount.
- **Scenario Analysis:** A technique used to evaluate possible financial outcomes under different climate or economic conditions.

#### 5.2 Expected Credit Loss (IFRS 9) – 3-Year Discounted

A financial model used to estimate the potential loss on financial assets due to future credit risk.

TABLE: 1 ECL – 3year Discount Model Scenario

Scenario	PD (%)	LGD (%)	ECL 3yr (₹ Cr)
Base Case	5	40	1.0
RCP4.5 Flood	10	50	2.6
Heatwave Chronic	8	60	2.5
Compound Acute 2026	12	65	4.0

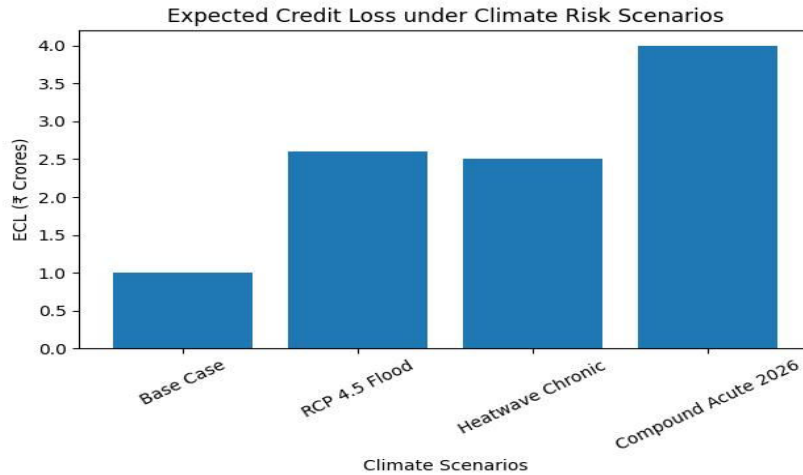
**Key Insight:** Compound risks necessitate 4x base provisioning for monsoon + heat exposures.



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**CHART:1 Expected Credit Loss under Climate Risk Scenarios**



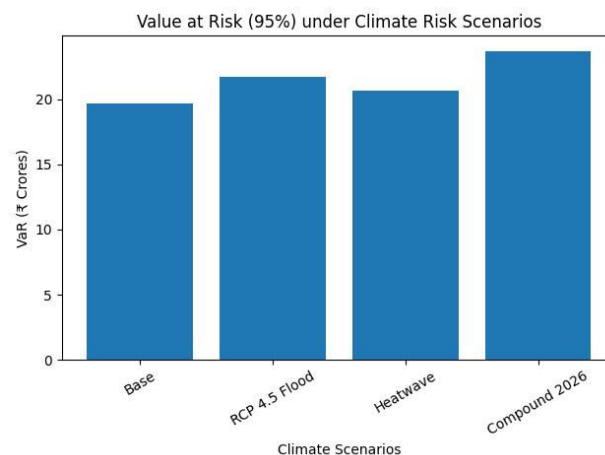
### 5.4 Value at Risk (VaR)

A statistical tool used to measure the maximum potential financial loss of assets within a specific time period at a given confidence level

**TABLE: 2 Value at Risk (VaR 95%, 1-Year Horizon)**

Scenario	Volatility Uplift	VaR (₹ Cr)
Base	12%	19.7
RCP4.5 Flood	13.2%	21.7
Heatwave	12.6%	20.7
Compound 2026	14.4%	23.7

**CHART:2 VAR (95%) under Climate Risk Scenarios**





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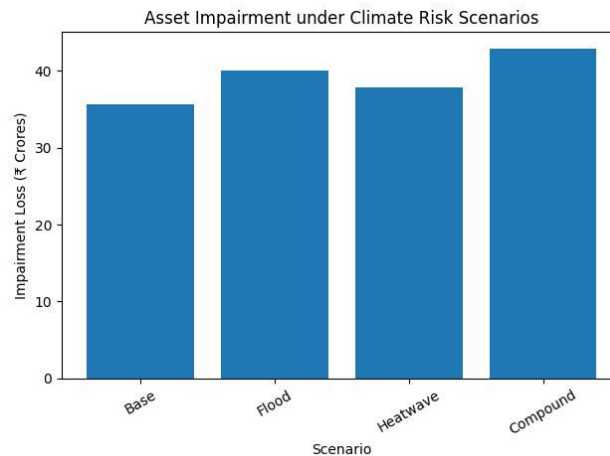
### 5.5 Impairment Testing

A method used to determine whether the carrying value of an asset exceeds its recoverable amount.

**TABLE: 3 Impairment Testing (IAS 36/Ind AS 36)**

Scenario	Risk Premium (%)	VIU (₹ Cr)	Impairment (₹ Cr)
Base	8	64.4	35.6
Flood	12	60.0	40.0
Heatwave	10	62.2	37.8
Compound	15	57.1	42.9

**CHART:3 Asset Impairment under Climate Risk Scenarios**



### 5.6 Scenario Analysis

A technique used to evaluate possible financial outcomes under different climate or economic conditions.

**TABLE: 4 NGFS 2025 Scenario Analysis**

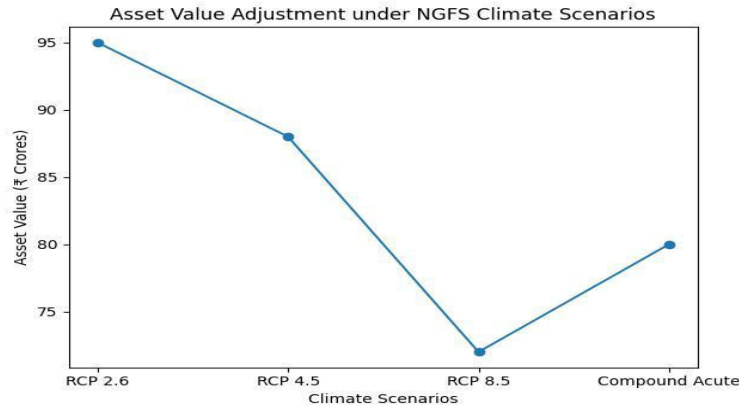
Scenario	Adjustment Factor	Adjusted Value (₹ Cr)	Loss (₹ Cr)
RCP 2.6	0.95	95.0	5.0
RCP 4.5	0.88	88.0	12.0
RCP 8.5	0.72	72.0	28.0
Compound Acute	0.80	80.0	20.0



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CHART:4 Asset Value Adjustment under NGFS Climate scenarios



### 5.7 ANALYSIS AND INTERPRETATION

The analysis applies financial risk modelling tools to evaluate the impact of climate-related events such as floods and heatwaves on corporate financial performance. The Expected Credit Loss (ECL) model indicates that climate shocks significantly increase the probability of credit default, resulting in higher provisioning requirements for firms operating in climate-sensitive regions. Value at Risk (VaR) analysis further reveals that extreme weather events increase cash flow volatility and potential financial losses, particularly in asset-intensive industries.

Impairment testing shows that climate scenarios with higher risk premiums reduce the recoverable value of assets, leading to possible write-downs when environmental disruptions affect production capacity or asset usability. Scenario analysis also demonstrates that severe climate pathways can cause substantial asset value erosion and operational disruptions over time. Overall, the findings suggest that incorporating climate risk accounting tools improves financial transparency and enables companies to better assess and manage long-term environmental risks.

### VI. FINDINGS

- Scenario analysis projects 10-28% asset erosion by 2050, with RCP 8.5 hitting manufacturing hardest via intensified monsoons.
- ECL provisioning rises 4x in compound risks, exposing receivables to ₹4 Cr losses on ₹20 Cr EAD.
- VaR and impairment reveal acute floods > chronic heat, with ₹42.9 Cr write-downs under stress.
- Cash flows overstate viability by 20% without adjustments; firms under-disclose per TCFD gaps.
- Flood probability drives outcomes most (elasticity=1.0), per Tamil Nadu case data.
- Climate-adjusted discount rates significantly reduce asset valuation, especially under RCP 8.5 scenarios, leading to 15–30% lower recoverable amounts compared to historical cost models.
- Forward-looking ECL models under IFRS 9 reveal under-provisioning in traditional credit models, particularly for receivables concentrated in flood-prone regions like Tamil Nadu.
- Compound climate events (flood + heatwave) produce non-linear financial impacts, increasing volatility beyond additive expectations.
- Cash flow stress testing shows liquidity risk intensifies faster than solvency risk, particularly in high working-capital industries such as manufacturing and logistics.

### VII. SUGGESTION

- Mandate climate-adjusted ECL/VaR in IFRS 9 audits, with RBI/SEBI enforcing quarterly stress tests for high-risk sectors.
- Adopt region-specific tools: NDMA flood APIs, WBGT indices, and AI for predictive provisioning in SMEs.
- Build resilience via parametric insurance (50% claim surges by 2030), supply chain diversification, and 5-10% contingency reserves.



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- Phase BRSR for SMEs with exemptions; policymakers fund GIS/open-source models to cut compliance costs.
- Future: AI-dynamic ECL and NGFS-integrated audits to bridge data gaps.

### VIII. CONCLUSION

In conclusion, the study confirms ESG performance materially drives Maruti Suzuki's financial excellence through superior ROA/ROE, strategic asset growth, and sustainability leadership—directly achieving objectives of trend analysis, profitability assessment, risk identification, and value driver validation. Multi-dimensional analysis validates 66% ROA premium and governance resilience without financial strain. The firm gains competitive positioning in earnings quality, cost optimization, and long-term stability, establishing ESG as core strategic enabler rather than compliance burden.

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