CHAPTER 4

Blockchain-Enabled Retrospective Green Clearances: Sustainability Significance and Environmental Governance Impacts

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ABSTRACT

Retrospective or ex-post facto environmental clearances have become a recurring feature of regulatory practice in India, despite persistent criticism from the Supreme Court of India, the National Green Tribunal (NGT), and environmental scholars. The practice raises deep concerns about rule of law, environmental justice, and the weakening of the preventive architecture envisioned under the Environment (Protection) Act, 1986 and the EIA Notification, 2006. At the same time, India has been exploring digital public infrastructure approaches across governance sectors—from GST and CoWIN to National Single Window Systems—signalling readiness for digitally verifiable regulatory systems. This paper examines whether blockchain technology can be engineered to transform retrospective green clearances from a governance weakness into a transparent, auditable and sustainability-aligned regulatory instrument. Drawing on Indian judicial decisions such as Common Cause v. Union of India (2017), Sterlite Industries v. Tamil Nadu Pollution Control Board, and Alembic Pharmaceuticals Ltd. v. Rohit Prajapati (2020), as well as MoEFCC policy amendments, this study proposes a blockchain-enabled architecture for managing project histories, violations, remedial monitoring, and public participation. Using doctrinal analysis, policy review and conceptual system design, the paper articulates how immutable ledgers, permissioned nodes, smart contracts, sensor-driven monitoring, and public dashboards can improve compliance incentives and transparency. The analysis finds blockchain can significantly enhance traceability, public oversight, and deterrence—provided that strong legal safeguards and participatory governance models accompany the technology. The paper concludes by offering India-specific recommendations for regulatory reforms, institutional design, and digital ecosystem requirements for integrating blockchain into environmental clearance systems without normalising non-compliance.

Keywords: Blockchain; Retrospective clearance; Environmental governance; NGT; MoE-FCC; EIA 2006; sustainability; India.

1.0 Introduction

Environmental governance frameworks, particularly the Environmental Impact Assessment

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(EIA) process, are designed to prevent harm by ensuring that environmental and social impacts are assessed *before* development projects receive approval. In India, this preventive architecture is grounded in the Environment (Protection) Act, 1986 and operationalised through the EIA Notification, 2006. However, systemic regulatory gaps, administrative inefficiencies, political economy pressures and weak enforcement have led to the proliferation of projects operating without prior environmental clearance. Retrospective or ex-post facto clearances—where approvals are granted after the commencement of operations—have emerged as a contentious regulatory practice. Landmark judgments such as *Common Cause v. Union of India (2017)* sharply criticised such clearances as "contrary to fundamental environmental norms." Similarly, in *Alembic Pharmaceuticals Ltd. v. Rohit Prajapati (2020)*, the Supreme Court held that retrospective clearances "compromise the integrity of environmental rule-of-law." Despite judicial reservations, regulatory authorities—including the MoEFCC—continue issuing retrospective clearances, arguing that they are necessary for economic continuity, especially in cases involving legacy industries, MSMEs, or SEZ infrastructure. The lack of traceable records, opaque decision-making, fragmented institutional oversight and weak monitoring worsen governance outcomes.

Parallelly, India's digital governance ecosystem is undergoing rapid transformation. Blockchain—character by distributed ledgers, cryptographic verification, and tamper-proof audit trails—has been explored for land titles, public procurement, carbon markets, agricultural traceability and financial compliance. This signals an emerging opportunity to embed digital verifiability in environmental regulation. This paper evaluates whether blockchain can be used to transform retrospective clearances into a transparent, rule-bound and sustainability-oriented instrument, specifically within the Indian environmental governance context. The approach is not techno-utopian; instead, it recognises blockchain as a socio-technical tool whose outcomes depend on legal design and institutional capacity.The study integrates:

- Indian environmental jurisprudence,
- MoEFCC institutional mechanisms,
- NGT enforcement patterns,
- blockchain and RegTech literature.

The objective is to propose a blockchain-enabled architecture that addresses governance failures in retrospective clearances without normalising non-compliance.

2.0 Literature Review

2.1 Environmental governance in India

Environmental governance in India operates under multiple statutory instruments, including:

- Environment (Protection) Act, 1986,
- Water (Prevention and Control of Pollution) Act, 1974,

- Air (Prevention and Control of Pollution) Act, 1981,
- Forest Conservation Act, 1980,
- Wildlife Protection Act, 1972.

EIA 2006 mandates prior environmental clearance for 39 categories of projects. However, several CAG audits, Parliamentary Committee reports and NGT cases highlight failures such as:

- non-functional monitoring committees,
- reliance on self-reporting by project developers,
- inadequate baseline studies,
- delays in enforcement actions,
- inconsistent public hearing quality.

2.2 Retrospective clearances in Indian jurisprudence

Indian courts have repeatedly scrutinised retrospective clearances:

- Common Cause v. Union of India (2017): Supreme Court held that ex-post facto approvals defeat environmental safeguards.
- Alembic Pharmaceuticals Ltd. v. Rohit Prajapati (2020): Court ruled that retrospec- tive clearances cannot be used to condone long-term illegal operations.
- Sterlite Industries v. TNPCB (2013): Highlighted the consequences of non-transparent regulatory processes.

Despite judicial criticism, MoEFCC Office Memoranda (2017, 2018, 2021) introduced pro- cedures for dealing with violation cases, arguing practicality.

2.3 Blockchain in regulatory and environmental governance

Blockchain has been deployed globally in:

- land registration (Sweden, Georgia),
- carbon credit tracking (IBM–Veridium),
- renewable energy certificate markets,
- biodiversity registries.

Academic literature identifies blockchain benefits such as:

- immutable audit trails,
- reduced information asymmetry,
- automated compliance triggers,
- multi-stakeholder verification.

However, concerns remain about:

- data quality,
- over-centralisation of permissioned networks,
- interoperability challenges,
- institutional capacity.

The intersection of blockchain and environmental clearance governance remains underexplored, especially in the Indian context where retrospective clearances are frequent yet poorly documented.

3.0 Research Methodology

This research adopts a qualitative and doctrinal methodology, integrating legal analysis with digital governance conceptualisation. It examines statutory provisions, judicial decisions, official memoranda, CAG reports, Standing Committee observations, and scholarly literature on blockchain-enabled regulation. The methodology has four components:

3.1 Doctrinal legal review

The legal analysis focuses on:

- EIA Notification 2006 and amendments (2009–2022),
- MoEFCC Office Memoranda on violation cases (2017, 2018, 2021),
- Supreme Court decisions restricting retrospective clearances,
- NGT case law mandating transparency and compliance monitoring.

3.2 Policy and institutional analysis

This involves assessment of:

- institutional capacity of State Environment Impact Assessment Authorities (SEIAAs),
- coordination challenges between MoEFCC, Pollution Control Boards (PCBs), and district administrations,
- technological infrastructure gaps in environmental monitoring.

3.3 Conceptual blockchain architecture development

A blockchain-enabled governance model is designed by integrating:

- distributed ledgers,
- hashed document repositories,
- IoT-sensor data pipelines,
- smart contract enforcement mechanisms,
- multi-agency permissioned node governance.

3.4 Comparative analysis

Conventional retrospective clearance processes are compared with the proposed blockchain model based on:

- transparency,
- traceability,
- participation,
- deterrence,
- monitoring enforcement.

4.0 Data Analysis and Blockchain Architecture

4.1 Governance failures in current retrospective clearances

Based on MoEFCC records and NGT judgments, the major weaknesses include:

Table 1: Governance Failures in Retrospective Clearances in India

Issue	Description
Opaque Timelines	Start dates of illegal operations often missing or disputed.
Fragmented Records	SEIAA, SPCB, and District Collector data rarely synchronised.
Weak Public Access	Clearance histories often unavailable online; RTI requests face delay.
Inconsistent Penalties	Projects fined without proportionality to duration of violation.
Monitoring Gaps	No verifiable evidence of adherence to remedial measures.
Legal Ambiguity	MoEFCC office memoranda conflict with judicial directions.

Such governance gaps justify exploring blockchain as a structural intervention.

4.2 Proposed blockchain framework for India

The architecture comprises five layers:

4.2.1 Layer 1: Project identity and ledger registration

Each project receives a cryptographic project ID linked to:

- company name,
- GPS coordinates,
- land title details,
- sector classification as per Schedule I of EIA 2006.

4.2.2 Layer 2: Immutable records of violations

Events recorded on-chain include:

- satellite-detected land-use change,
- SPCB inspection reports,
- violation notices,
- show-cause responses,
- penalty recommendations.

4.2.3 Layer 3: Smart contract–based clearance

Smart contracts can:

- encode deadlines for filing remedial EIAs,
- lock financial penalties in escrow,
- send alerts to regulators and communities,
- trigger mandatory third-party audits.

4.2.4 Layer 4: Sensor-to-ledger monitoring

IoT devices for:

- effluent discharge,
- particulate matter emissions,
- groundwater abstraction,
- noise levels

upload encrypted readings to the blockchain.

4.2.5 Layer 5: Public transparency dashboard

Citizens can view:

- violation history,
- clearance timelines,
- monitoring results,
- pending remedial measures.

4.3 Conceptual Diagram

Figure 1: Proposed Blockchain Architecture for Retrospective Clearances

Blockchain-Enabled Environmental Clearance System Architecture:
Project ID → Violation Detection → Smart Contract Penalty → On-Chain Remedial EIA → Public Disclosure → IoT Monitoring → Compliance Ledger → Closure/Enforcement

5.0 Case Study: Indian Industrial Cluster (Hypothetical)

To demonstrate applicability, consider an MSME-intensive industrial cluster in Gujarat (modeled after documented NGT violation cases).

5.1 Stage 1: Violation

Satellite imagery shows land conversion for chemical units before EC approval. SPCB confirms operations have commenced illegally.

5.2 Stage 2: Blockchain registration

All units are assigned unique project IDs. Violation flags recorded on chain.

5.3 Stage 3: Retrospective regularisation application

Units upload:

- retrospective EIA,
- environmental damage assessment,
- compensation calculations (per "Polluter Pays"),
- remediation plan.

5.4 Stage 4: Smart contract enforcement

- Penalties deposited in a blockchain-enabled escrow.
- Third-party audits auto-triggered every 90 days.
- Zero Liquid Discharge obligations monitored via sensors.

5.5 Stage 5: Community interface

Villagers receive SMS alerts via a dashboard when:

- pollution levels cross safe limits,
- remedial deadlines are missed,
- new clearance conditions are approved.

5.6 Outcome

The blockchain-enabled process:

- reduces data manipulation,
- improves public trust,
- enhances deterrence for future violations.

6.0 Findings and Results

6.1 Finding 1: Improved traceability

Immutable records eliminate disputes regarding:

- illegal start dates,
- frequency of violations,
- completion of remedial conditions.

6.2 Finding 2: Strengthened deterrence

Developers know:

- violations remain on-chain permanently,
- lenders and insurers can view compliance ratings,
- reputational risk increases due to public visibility.

6.3 Finding 3: Greater judicial reviewability

Courts reviewing MoEFCC decisions have:

- full audit trails,
- data-based reasoning,
- reduced reliance on contested affidavits.

6.4 Finding 4: Enhanced community participation

Blockchain dashboards democratise access to environmental data—aligning with:

- Principle 10 of the Rio Declaration,
- India's constitutional "Right to Know."

6.5 Finding 5: Risk of technocratic legitimisation

Without strong legal limits, blockchain may:

- sanitise illegalities,
- legitimise retrospective clearances,
- weaken preventive environmental law.

7.0 Conclusion and Implications

This study concludes that blockchain has transformative potential to address chronic weak- nesses in India's retrospective clearance system. However, technology must not become a substitute for strong regulatory norms. The preventive logic of EIA cannot be diluted by digital sophistication.

Blockchain's real value lies in:

- transparency,
- verifiable monitoring,
- improving auditability,
- empowering affected communities.
- Yet, it cannot alone solve governance failures rooted in:
- political economy pressures,
- institutional understaffing,
- inconsistent legal interpretations.

A blockchain-enabled system must be embedded within a strong legal and participatory framework to avoid legitimising non-compliance.

8.0 Recommendations

8.1 Legal reform

- Amend EIA Notification to define strict limits for retrospective clearance.
- Mandate blockchain-based recordkeeping for violation cases.
- Recognise ledger entries as admissible evidence under the Evidence Act.

8.2 Institutional design

- MoEFCC, CPCB, SPCBs, SEIAAs to operate permissioned blockchain nodes.
- Establish environmental data management units at state level.
- Standardise smart contracts for penalties, audits, and monitoring.

8.3 Technology and Participation

- Integrate IoT-sensor monitoring with blockchain.
- Enable multilingual public dashboards.
- Provide community environmental literacy training.

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Appendix A: Blockchain Monitoring Fields

Table 2: Illustrative Blockchain Monitoring Parameters

Parameter	**Description**
Emission Data	PM2.5, PM10, SOx, NOx readings from sensors.
Effluent Quality	COD, BOD, TSS, pH logs.
Water Use	Groundwater extraction logs.
Energy Use	Renewable/non-renewable energy consumption.
Violation Alerts	Automated triggers for exceedances.