



Regulating the Regulators: Legal and Ethical Frameworks for the Use of AI in Environmental Monitoring and Compliance

Dileep Kumar Singh

Research Scholar of Dr. Bhimrao Ambedkar University, Agra, Email- dileep.singh121@gmail.com

DOI : <https://doi.org/10.5281/zenodo.15857639>

ARTICLE DETAILS

Research Paper

Accepted: 26-06-2025

Published: 10-07-2025

Keywords:

*Artificial Intelligence (AI),
Environmental Law,
Regulatory Compliance,
Legal Framework, Ethical
Governance,
Environmental Monitoring,
AI Regulation.*

ABSTRACT

This paper explores the transformative role of Artificial Intelligence (AI) in environmental monitoring and regulatory compliance, with the objective of examining how AI serves both as a regulatory tool and as an entity needing regulation, especially in environmental governance. The study adopted a comparative legal methodology framework and practices in India European Union, and the United States to promote a balanced approach that protects both environmental integrity and individual rights. It also references global instruments such as the OECD AI Principles, the EU AI Act, and the Rio Declaration. Key findings reveal that while AI enhances regularity efficiency through technologies like remote sensing and predictive analysis, it simultaneously raises complex concerns around transparency, accountability, due process, and privacy rights. There is a significant legal gap in addressing how AI decisions can be reviewed, challenged, and held accountable, especially when environmental violations are automatically detected and penalized. The major conclusion is that the current legal system is not fully equipped to manage the ethical and procedural risk posed by AI. The paper advocates for a flexible right-based legal framework that ensures AI tools are used in ways that promote environmental justice, uphold constitutional protections, and



reinforce public trust in regulatory institutions.

Introduction

“Earth provides enough to satisfy every man's needs, but not every man's greed.”

- Mahatma Gandhi

The above quote highlights an important issue regarding how we consume resources and their impact on our environment. It draws a clear line between our basic needs for survival and well-being and the excessive desires that lead to unsustainable practices. The Earth has a wealth of resources like clean water, fresh air, fertile soil, and rich biodiversity, which support all of humanity if used wisely and fairly. This idea is in line with sustainable development, which aims to meet our needs without jeopardizing the ability of future generations to meet theirs, and ensure a healthy life for everyone.

Gandhi's quote highlights the importance of nurturing nature rather than exploiting it, calling for responsible stewardship and fairness for future generations. In the current discussions on environmental responsibility, social justice, and sustainability, his message is increasingly relevant. It serves as a moral framework for evaluating modern technologies like Artificial Intelligence (AI) in environmental governance, which has the potential to combat this by enhancing transparency, accountability, and efficiency in monitoring and compliance.

AI, a branch of computer science, focuses on the creation of machines and systems capable of performing tasks that typically require human intelligence, such as learning, reasoning, and problem-solving. These systems use algorithms and data to simulate cognitive functions and adapt their behaviour based on experience and new information.

Moreover, AI is increasingly reshaping the landscape of environmental governance. With its capacity to process vast datasets, detect anomalies, and enable real-time monitoring, it has emerged as a powerful tool for addressing complex environmental challenges such as pollution control, deforestation, biodiversity loss, and climate change mitigation. Governments and regulatory bodies worldwide are adopting AI-driven technologies like satellite surveillance, machine learning algorithms, and smart sensors to enhance environmental compliance and enforcement. These tools not only promise efficiency and precision but also enable predictive capabilities that could prevent environmental harm before it occurs.



However, the deployment of AI in the regulation of the environment also raises profound legal and ethical concerns, such as transparency, accountability, due process, and the rule of law. AI Systems often function as Black Boxes where the reasoning behind decisions is not easily accessible or understandable by humans, which complicates judicial review and administrative oversight. Furthermore, the use of AI in regulatory processes can infringe upon fundamental rights, such as the right to privacy and the right to a clean and healthy environment, both of which are constitutionally protected in many jurisdictions, including under Article 21 of the Indian Constitution.

Despite the growing reliance on AI, there remains a significant regulatory gap. Existing environmental laws and administrative procedures were not designed with automated decision-making in mind, and there is little legal clarity on issues such as liability, data governance, algorithmic bias, and public participation. Furthermore, international instruments like the Organisation for Economic Co-operation and Development (OECD) AI principles and the European Union (EU) AI Act advocate for trustworthy and ethical AI, but their implementation in the context of environmental compliance remains limited.

This work seeks to bridge that gap by examining how legal and ethical frameworks can be developed and applied to regulate the use of AI in environmental monitoring and compliance. It explores how these technologies can be harnessed responsibly while ensuring that their use does not compromise core legal values, environmental justice, or public trust.

Objectives

- Examination of the current legal status of AI deployment in environmental monitoring and regulatory enforcement across different jurisdictions.
- To identify key legal and ethical risks associated with the use of AI in environmental governance, particularly those affecting transparency, accountability, and fundamental rights.
- To analyse the implications of algorithmic opacity on due process, judicial review, and regulatory fairness in environmental compliance systems.
- To propose a comprehensive legal and ethical framework that ensures responsible, rights-based, and equitable use of AI in environmental regulation.

A. The Role of AI in Environmental Monitoring and Compliance

Technological Capabilities: The deployment of AI in environmental monitoring has introduced a paradigm shift in how regulatory agencies can detect, analyse, and respond to ecological changes and



violations. These technologies are capable of processing vast amounts of data derived from remote sensing tools like satellites and drones, as well as from ground-based sensors that continuously monitor air and water quality. Through machine learning algorithms, these data are analysed to identify patterns, anomalies, or deviations from environmental standards, enabling early detection of pollution events, deforestation, illegal mining, and other environmentally harmful activities. For example, Global Forest Watch uses satellite imagery and machine learning algorithms to detect tree cover loss in real-time across tropical forests. These alerts are then used by local governments and NGOs to take immediate action against illegal logging activities. Similarly, AI models can process sensor data to identify industrial plants discharging pollutants into rivers or emitting excessive greenhouse gases, supporting more efficient environmental enforcement.

Moreover, predictive modelling powered by AI is enhancing risk assessment and resource planning in environmental governance. For instance, AI can forecast future pollution levels, events, or biodiversity loss based on historical and real-time environmental data. This may assist regulators in prioritizing inspection efforts, optimizing compliance schedules, and implementing preventive measures rather than merely reactive enforcement.

Additionally, by employing Natural Language Processing (NLP) and robotic process automation (RPA), these tools can efficiently analyse, review, interpret, and summarize vast volumes of environmental regulations, compliance documents, and corporate disclosures, which reduces administrative burden and helps identify discrepancies or omissions that may indicate non-compliance. These systems can also automate the generation of compliance reports, facilitating more efficient regulatory workflows. For example, companies like Enablon and Sphera offer enterprise-level AI tools that automatically track environmental compliance across multinational operations, flagging potential violations before regulatory penalties are incurred.

The technology has advanced significantly, moving beyond just monitoring to include sophisticated decision-support systems. These systems can help us make informed, proactive choices in managing our environment while being cost-effective. However, it is also necessary to ensure legal responsibilities and ethical concerns while deploying them to harness the full potential of AI responsibly.

Administrative Benefits

The integration of digital tools into environmental governance has significantly enhanced the speed and accuracy of regulatory enforcement. Since there was a lacuna in traditional methods of inspection, like



delayed action and incomplete coverage of vast geographical areas. AI can analyse satellite images, drone surveillance, and real-time sensor data to detect environmental violations and ensure more efficient regulatory oversight. For example, the Department of Forest Survey of India employs AI algorithms to compare satellite images over time and quickly identify forest encroachments or illegal logging activities, enabling faster intervention.

Again, as the manual management and analysis of enormous volumes of environmental data is resource-intensive and prone to inefficiencies, AI-driven cloud computing and machine learning platforms offer budget-friendly options by automating the processes of sorting, analysing, and visualizing extensive datasets. For instance, the European Space Agency (ESA) utilizes AI-driven earth observation systems to monitor land use, detect environmental anomalies, and inform policy decisions across EU nations, all at a much lower cost compared to conventional manual techniques. These digital tools reduce the administrative burden and operational expenses associated with large-scale environmental data processing.

Additionally, Digital automation helps reduce the scope for corruption and human error in environmental regulation and compliance processes. Manual processes often involve discretionary powers, which can lead to data manipulation, bribery, or inconsistent enforcement. But automated systems ensure transparent and tamper-proof data collection and dissemination. For example, several Indian cities have adopted automated Continuous Ambient Air Quality Monitoring Stations (CAAQMS), which directly upload air quality data to central government dashboards, minimizing human interference and enhancing data reliability.

B. Legal Gaps and Challenges

Absence of Specific Legal Frameworks

A major challenge in using AI for environmental governance is the lack of a clear legal framework that outlines the acceptable boundaries and extent of AI application in regulatory activities. Although many countries are embracing AI to improve administrative efficiency but they lack specific laws or guidelines for the implementation of AI in decision-making processes. For example, in India, although AI tools are used in pollution monitoring and forest surveillance, there is no dedicated statute regulating their use in public administration, which raises concerns over accountability and ethical oversight.



A significant issue is the uncertain legal status regarding the enforceability of decisions made by AI in administrative law, decisions require human agency, accountability, and the possibility of appeal or review. However, when decisions are partially or wholly made by AI systems, like issuing notices for environmental violations based on automated surveillance, there is uncertainty about their legal standing and how affected parties can challenge such outcomes.

Threat to Fundamental Rights

Using AI in regulatory decisions can jeopardize important principles like fairness and due process. This system may impose fines or penalties without allowing people to respond to their actions. This approach threatens essential rights to be heard, the right to explanation, and judicial review, which are vital to democratic legal systems.

AI systems can sometimes feel like “black boxes” because it is tough to understand how they make decisions, even for the people who create them. This lack of clarity can lead to big worries about transparency and accountability. When someone gets unfairly punished due to a biased or faulty algorithm, it is challenging to figure out why that happened or to find a way to correct it through legal channels. For instance, in many jurisdictions, AI-driven risk scoring in environmental compliance lacks standardized legal procedures for review or redress, leaving affected parties without adequate legal channels.

C. Ethical Considerations in AI Deployment

Bias and Discrimination

AI systems rely heavily on historical data to make decisions, but if the data itself contains existing social or environmental biases, the algorithms may perpetuate or even amplify those inequalities. For instance, if environmental monitoring AI is trained on datasets that disproportionately focus on urban areas, while the environmental degradation occurs in those underrepresented regions.

Similarly, AI-driven environmental governance can unintentionally harm vulnerable groups who already face systemic disadvantages. In Brazil, satellite-based deforestation surveillance has sometimes been used to justify land seizures from indigenous communities without their consultation, based on AI-generated "risk assessments" that lack local context or cultural sensitivity. Such outcomes show how



algorithmic decisions, when not grounded in inclusive data or legal safeguards, can deepen environmental injustice and marginalization.

Transparency and Accountability

Transparency in AI systems is essential to ensure that decisions affecting public rights and interests are explainable and justifiable. Explainable AI refers to models that provide understandable reasons behind their outputs, which is crucial in regulatory and legal contexts. Without transparency, the aggrieved person cannot assess the fairness or legality of the decision. For instance, if an AI system identifies a company as violating pollution norms, but the reasoning is obscured by complex algorithms, it becomes nearly impossible to contest or correct the decision.

Moreover, the public agencies deploying AI systems must be held accountable for their design, deployment, and outcomes. Governments and institutions cannot abdicate responsibility by attributing decisions solely to algorithms. For example, if an AI tool used by a local environmental board erroneously penalizes a low-emission factory due to a model error, the institution must provide redress and be liable for the oversight. Thus ethical aspect demands traceable decision-making pathways to uphold due process and public trust.

D. Bridging the Gaps: Towards a Legal and Ethical Framework

Legal Proposals

To ensure responsible AI use in environmental governance, existing laws must be updated to explicitly include provisions regulating AI systems. This means incorporating AI-specific clauses into environmental protection regulation laws and administrative codes, defining the scope, limits, and accountability structures for AI-driven tools. India's Environment (Protection) Act 1986 could include clauses on how AI can be used for pollution tracking or forest surveillance, with guidelines for data handling, decision-making, and public disclosure.

Regulatory sandboxes are like safe testing grounds for new technologies, where they can be tried out under close supervision before they are fully launched. When it comes to environmental AI systems, these sandboxes help regulators evaluate potential risks, ensure fairness, and check that everything is legal, all without putting the public at risk. For instance, the UK's Centre for Data Ethics and Innovation



(CDEI) has promoted AI sandboxes where algorithmic tools are tested for ethical compliance before real-world use.

Furthermore, it is important for laws to recognize the idea of algorithmic accountability. This means that decisions made by AI should be open to human review, and people should have the right to challenge automated decisions. Additionally, agencies should explain how their AI tools affect outcomes, which will ensure that technology serves us fairly and transparently. For example, the European Union's AI Act proposes mandatory human oversight and redress procedures for high-risk AI applications, including those in environmental monitoring.

Ethical Guidelines

Development of dedicated AI ethics charters that uphold values like environmental justice, sustainability, and non-discrimination is necessary to ensure AI serves the public good. These charters act as normative frameworks guiding the ethical use of AI in ecological decision-making. The UNESCO recommendation on the ethics of AI stresses the need for ethical AI that promotes fairness, ecological responsibility, and inclusion across all sectors, including environmental governance.

Ethical audits and algorithmic impact assessments should be legally mandated before the deployment of AI systems in environmental contexts. This tool evaluates potential risks such as bias, transparency gaps, and social or ecological harms. Such pre-deployment evaluations are crucial for ensuring AI aligns with public values and avoids reinforcing systemic injustices. For example, an AI tool used to prioritize pollution inspections should be audited to ensure it does not unfairly target low-income or high-density communities based on flawed historical data.

Global Cooperation

As AI continues to shape environmental governance, there is a need for international legal frameworks and treaties that oversee its development and usage across different nations. Environmental challenges such as climate change, loss of biodiversity, and transboundary pollution are inherently global issues, just like the AI solutions created to tackle them. If countries adopt varying and potentially conflicting AI practices, it can hinder collaborative efforts to address these challenges. Establishing a treaty at the international level to provide a foundation for shared principles around transparency, accountability, and the ethical use of AI in environmental matters, similar to how the Paris Agreement established guidelines for climate action.



Further, International organizations like the UN, Organisation for Economic Co-operation and Development (OECD), and regional alliances like the European Union play a critical role in norm-setting and capacity-building. These bodies can coordinate efforts to develop shared guidelines, ethical codes, and policy tools for AI deployment in environmental regulation. For example, the OECD has already released AI principles advocating for trustworthy and human-centric AI, which are now endorsed by over 40 countries. Similarly, the UN's AI for Good initiative promotes collaborative global solutions that utilize AI to support sustainable development and environmental protection.

Conclusion

As AI becomes a vital part of environmental governance, it brings with it the potential to revolutionize monitoring, compliance, and decision-making. However, the deployment of AI must be guided by strong legal, ethical, and institutional frameworks to ensure justice, transparency, and sustainability. Addressing risks such as algorithmic bias, lack of accountability, and threats to fundamental rights is not only a legal imperative but a moral responsibility.

Looking ahead, the way forward lies in embracing a collaborative and inclusive approach. All nations must update their environmental laws to reflect technological realities, while international institutions like the UN and OECD should lead in creating binding global norms. Simultaneously, the development of explainable, equitable, and audited AI systems will build public trust and promote fairness. Ethical charters, regulatory sandboxes, and public participation must become central pillars of AI governance in the environmental sector.

Lastly, if guided wisely, AI can be a powerful ally in our fight against climate change, pollution, and biodiversity loss, helping build a greener, fairer, and more sustainable future for all, and will make the world *Vasudhaiva Kutumbakam*, which means “the world is one family.”

References

Books

- Pasquale, F. (2015). *The black box society: The secret algorithms that control money and information*. Harvard University Press.
- Russell, S., & Norvig, P. (2021). *Artificial intelligence: A modern approach* (4th ed.). Pearson.



Journal Articles

- Burrell, J. (2016). How the machine ‘thinks’: Understanding opacity in machine learning algorithms. *Big Data & Society*, 3(1), 1–12. <https://doi.org/10.1177/2053951715622512>
- Chander, A. (2021). Administrative law in the age of algorithm. *Harvard Law Review Forum*, 134, 476–495.
- Hansen, M. C., Potapov, P. V., Moore, R., Hancher, M., Turubanova, S. A., Tyukavina, A., ... & Townshend, J. R. G. (2013). High-resolution global maps of 21st-century forest cover change. *Science*, 342(6160), 850–853. <https://doi.org/10.1126/science.1244693>
- Joppa, L. N., Roberts, D. L., & Pimm, S. L. (2021). How AI is transforming environmental protection. *Nature Sustainability*, 4(3), 200–206. <https://doi.org/10.1038/s41893-021-00684-y>
- Kumar, A., & Joshi, S. (2020). Digital governance and anti-corruption potential of AI in environmental monitoring. *Journal of Environmental Policy and Planning*, 22(4), 523–539.
- McQuillan, D. (2018). Data science as machinic neoplatonism. *Philosophy & Technology*, 31(2), 253–272. <https://doi.org/10.1007/s13347-017-0263-1>
- Vinuesa, R., Azizpour, H., Leite, I., Balaam, M., Dignum, V., Domisch, S., ... & Nerini, F. F. (2020). The role of artificial intelligence in achieving the Sustainable Development Goals. *Nature Communications*, 11(1), 233. <https://doi.org/10.1038/s41467-019-14108-y>
- Wachter, S., Mittelstadt, B., & Floridi, L. (2017). Why a right to explanation of automated decision-making does not exist in the General Data Protection Regulation. *International Data Privacy Law*, 7(2), 76–99. <https://doi.org/10.1093/idpl/ipx005>
- Zerilli, J., Knott, A., Maclaurin, J., & Gavaghan, C. (2019). Transparency in algorithmic and human decision-making: Is there a double standard? *Philosophy & Technology*, 32(4), 661–683. <https://doi.org/10.1007/s13347-018-0330-6>

Reports and White Papers

- ESA. (2022). AI and Earth Observation: Unlocking sustainability with data. European Space Agency.
- OECD. (2019). OECD Principles on Artificial Intelligence. <https://www.oecd.org/going-digital/ai/principles/>
- OECD. (2021). The role of regulatory sandboxes in the governance of AI. OECD Publishing. <https://doi.org/10.1787/5f4f2ee3-en>



- UNEP. (2021). Environmental rule of law: Tracking progress and charting future directions. United Nations Environment Programme. <https://www.unep.org/resources/publication>
- UNESCO. (2021). Recommendation on the ethics of artificial intelligence. United Nations Educational, Scientific and Cultural Organization. <https://unesdoc.unesco.org/ark:/48223/pf0000381137>
- United Nations. (2020). AI for Good: Using artificial intelligence to advance Sustainable Development Goals. <https://aiforgood.itu.int/>

Case

- Justice K.S. Puttaswamy v. Union of India, AIR 2017 SC 4161.

Reprint / Working Papers

- Rolnick, D., Donti, P. L., Kaack, L. H., Kochanski, K., Lacoste, A., Sankaran, K., ... & Bengio, Y. (2019). Tackling climate change with machine learning. arXiv. <https://arxiv.org/abs/1906.05433>