

Ethical AI for Environmental Sustainability: A Responsible Computing Framework for Green and Equitable Futures

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Abstract

Artificial Intelligence (AI) is increasingly applied to environmental sustainability through air-quality forecasting, water-quality prediction, soil-health assessment, precision agriculture, and climate-risk analysis. However, AI systems also create environmental and ethical challenges because they require electricity, cooling water, data-centre infrastructure, electronic devices, and large data resources. This paper examines the role of ethical AI and responsible computing in achieving environmental sustainability, with special attention to Indian applications in soil, water, and air monitoring. The study follows a conceptual and case-based research method based on published literature, government reports, and policy documents. Three application areas are reviewed: AI-supported soil and crop monitoring, water-quality and irrigation management, and urban air-quality forecasting. The paper identifies major concerns, including carbon emissions, water use in data centres, electronic waste, biased data, lack of transparency, unequal access, and unclear accountability. A practical **GREEN-AI framework** is proposed: Green by Design, Responsible and Accountable, Equitable and Inclusive, Explainable and Transparent, and Nature-Positive and Sustainable. The framework recommends life-cycle assessment, energy and water reporting, model transparency, human oversight, community participation, and e-waste management. The paper concludes that AI can support environmental sustainability only when its own environmental footprint and social consequences are considered. Researchers, institutions, industries, and governments should adopt measurable ethical and sustainability practices while designing and using AI systems.

Keywords: Ethical AI, Responsible Computing, Green AI, Environmental Sustainability, Air Quality Monitoring, Water Quality, Soil Health, India, E-waste.

1. Introduction

Artificial Intelligence (AI) has become an important tool in environmental science and sustainability studies. AI methods such as machine learning, deep learning, remote sensing, geographic information systems, Internet of Things (IoT) sensors, and predictive analytics can process large environmental datasets quickly. These technologies support the monitoring of pollution, prediction of climate events, crop-health assessment, water-resource planning, and identification of environmental risks.

In India, AI has strong potential because the country faces serious environmental challenges, including air pollution, groundwater depletion, river pollution, soil degradation, irregular rainfall, climate change, and increasing urban waste. AI-based environmental monitoring can help researchers and government agencies make faster and more informed decisions. For example, air-quality forecasting models can provide early warnings of high pollution levels, while AI-based irrigation systems can help farmers reduce unnecessary water use.

However, AI is not automatically sustainable. Training and operating AI systems need computing hardware, data centres, electricity, network systems, and cooling facilities. These resources can cause carbon emissions, water consumption, electronic waste, and pressure on local infrastructure. India's data centres account for about 0.5% of national electricity consumption and use approximately 150 billion litres of water annually; both values are expected to more than double by 2030. Therefore, a responsible approach is needed so that AI used for environmental protection does not create additional environmental harm.

Ethical AI means developing and using AI in a way that is fair, safe, transparent, accountable, and respectful of human rights and environmental values. Responsible computing extends this idea by considering the full life cycle of digital systems, including hardware production, electricity use, water consumption, data processing, e-waste disposal, and social impacts. This paper proposes a simple framework for ethical AI and responsible computing in environmental sustainability, with a focus on Indian soil, water, and air-monitoring applications.

2. Objectives of the Study:

The objectives of this paper are:

- To explain the importance of ethical AI and responsible computing for environmental sustainability.

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- To review selected Indian applications of AI in soil, water, and air monitoring.
- To identify ethical, environmental, and social challenges associated with AI-based environmental systems.
- To propose a practical GREEN-AI framework for responsible environmental AI projects.
- To recommend policy measures for researchers, educational institutions, industry, and government agencies.

3. Methodology:

This paper uses a **conceptual, descriptive, and case-study-based methodology**. No primary experimental data were generated. The study is based on secondary sources such as research articles, government reports, policy documents, institutional publications, and sustainability reports.

3.1 Literature Review:

Relevant publications on ethical AI, Green AI, responsible computing, environmental monitoring, data-centre sustainability, and AI applications in India were reviewed. The review focused on recent developments in the areas of AI energy use, water consumption, carbon footprint, e-waste, environmental data ethics, and environmental governance. Ethical AI research increasingly emphasizes that social concerns and environmental impacts should be studied together rather than separately.

3.2 Case Study Selection:

Three environmental sectors were selected:

- Soil and agricultural monitoring
- Water-quality and water-resource management
- Air-quality monitoring

These sectors were selected because they are scientifically important, relevant to chemistry and environmental science, and strongly connected with Indian sustainability challenges. The cases were assessed using the following parameters:

- Environmental purpose
- Type of AI or digital technology used
- Expected benefits
- Energy, water, and hardware requirements
- Ethical and social concerns
- Need for transparency and human oversight

3.3 Detailed Case Studies

The following case studies illustrate how AI is being used in Indian environmental monitoring and highlight the ethical and sustainability issues that arise in practice.

Case Study 1: AI-Based Air-Quality Forecasting in Delhi (SAFAR System)

Background

Delhi and other major Indian cities face severe air pollution, especially during winter months. The System of Air Quality and Weather Forecasting and Research (SAFAR) was developed by the Indian Institute of Tropical Meteorology (IITM), Pune, in collaboration with the India Meteorological Department (IMD) and the Ministry of Earth Sciences. It uses numerical weather prediction models, air-quality monitoring stations, and machine-learning techniques to forecast air quality up to 48 hours in advance.

AI Methods Used

- Machine-learning models trained on historical PM_{2.5}, PM₁₀, NO₂, SO₂, CO, O₃, and meteorological data
- Integration of satellite data on aerosol optical depth and fire events
- Real-time inputs from ground-based air-quality monitoring stations
- Statistical post-processing to convert model outputs into categorical forecasts (Good, Moderate, Poor, Very Poor, Severe)

Environmental Benefits

- Early warnings allow authorities to implement graded response measures such as traffic restrictions, construction bans, and school advisories.
- Citizens can plan outdoor activities, use masks, or limit exposure during severe pollution episodes.

- Long-term data support research on pollution sources, seasonal patterns, and policy effectiveness.

Resource Requirements

- Continuous operation of air-quality monitoring stations with sensors, power supply, and data-transmission systems
- High-performance computing servers for model runs and data processing
- Electricity for data centres, networking equipment, and cooling systems
- Regular calibration, maintenance, and replacement of sensors and hardware

Ethical and Sustainability Concerns

- Monitoring stations are concentrated in urban areas; rural and peri-urban populations may receive less accurate or delayed information.
- If electricity for data centres is sourced from coal-based power plants, the system indirectly contributes to carbon emissions.
- Forecasts are probabilistic; incorrect predictions may lead to unnecessary panic or, conversely, complacency.
- Data ownership, public access, and clarity of communication are critical to maintain trust.

Lessons for Responsible AI

- Forecasts should be accompanied by clear explanations of uncertainty and confidence levels.
- Monitoring networks should be expanded to include underrepresented areas.
- Energy-efficient computing and renewable energy sources should be prioritized for air-quality modelling infrastructure.
- Public advisories should be issued in simple language and multiple local languages.

Case Study 2: AI-Supported River Water-Quality Monitoring (Yamuna and Godavari)

Background

The Yamuna and Godavari rivers face pollution from domestic sewage, industrial effluents, agricultural runoff, and religious activities. Continuous monitoring of parameters such as dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD), pH, turbidity, total coliform, and heavy metals is essential for assessing river health.

AI Methods Used

- Machine-learning models trained on historical water-quality data from Central Pollution Control Board (CPCB) and State Pollution Control Boards
- Integration of real-time sensor data from automated water-quality monitoring stations
- Use of upstream discharge data, weather forecasts, and industrial activity patterns
- Prediction of key parameters (e.g., DO, BOD, coliform) 48–72 hours in advance

Environmental Benefits

- Early identification of pollution spikes allows faster response from pollution-control authorities.
- Supports planning of river-cleaning programs, sewage-treatment capacity, and industrial inspections.
- Helps prioritize locations for additional monitoring stations and laboratory testing.

Resource Requirements

- Installation and maintenance of automated water-quality sensors and telemetry systems
- Electricity for sensors, data loggers, communication networks, and data centres
- Regular calibration of instruments and validation with laboratory analysis
- Skilled personnel for data management, model training, and interpretation

Ethical and Sustainability Concerns

- Water-quality data may affect industries, municipalities, farmers, and local communities; transparency and fairness in data use are essential.
- If predictions are inaccurate, they may lead to unnecessary restrictions or, conversely, underestimation of risks.
- Continuous sensor networks and cloud-based AI processing increase energy and water use for cooling.
- Communities living near polluted stretches should receive understandable information, not only technical reports.

Lessons for Responsible AI

- AI predictions should be validated regularly with standard laboratory methods.
- Data should be made publicly accessible in user-friendly formats.
- Local communities, NGOs, and academic institutions should be involved in interpreting and using the data.
- Energy-efficient sensors and low-power communication systems should be preferred.

Case Study 3: AI-Based Groundwater Monitoring and Irrigation Advisory

Background

Groundwater is a critical resource for agriculture and drinking water in India, but over-extraction has led to declining water tables in many states. Sustainable groundwater management requires accurate data on water levels, recharge rates, extraction patterns, and climate variability.

AI Methods Used

- IoT-based piezometric sensors installed in borewells and observation wells
- Machine-learning models to predict groundwater levels under different extraction and rainfall scenarios
- Integration of satellite data on soil moisture, vegetation health, and rainfall
- AI-based irrigation advisory systems that recommend optimal irrigation schedules and water-saving practices

Environmental Benefits

- Helps farmers reduce unnecessary irrigation and save water.
- Supports planning of sustainable extraction limits and recharge programs.
- Contributes to long-term aquifer health and reduced energy use for pumping.

Resource Requirements

- Installation of sensors, data loggers, and communication modules in wells
- Electricity for sensors, network infrastructure, and data processing
- Maintenance, calibration, and periodic replacement of hardware
- Training for farmers and local agencies on using AI-based advisories

Ethical and Sustainability Concerns

- Small and marginal farmers may lack access to smartphones, internet, or training needed to use AI advisories.
- Data on groundwater levels and extraction may affect water rights, pricing, and regulations; governance must be fair and transparent.
- Hardware production and disposal contribute to e-waste.
- Incorrect irrigation advice may lead to crop stress or yield loss.

Lessons for Responsible AI

- AI advisories should be tested in field conditions and compared with traditional practices.
- Extension services, Krishi Vigyan Kendras, and local institutions should support farmer training.
- Data governance should protect farmer interests while enabling research and planning.
- Hardware should be durable, repairable, and recycled through authorized e-waste channels.

Case Study 4: Satellite-Based Crop-Health Monitoring and Soil Assessment

Background

Agricultural productivity depends on soil health, nutrient availability, moisture content, and pest/disease pressure. Remote sensing and AI can provide large-scale, timely information on crop conditions and soil status.

AI Methods Used

- Machine-learning classification of satellite imagery (e.g., Sentinel-2, Resourcesat) to assess crop health, stress, and yield potential
- Integration of soil-test data, weather records, and historical yield information
- Detection of nutrient deficiencies, pest attacks, and disease symptoms using spectral signatures
- Generation of field-level or block-level advisories on fertilizer, irrigation, and pest management

Environmental Benefits

- Enables precision application of fertilizers and pesticides, reducing chemical runoff and soil degradation.
- Supports early detection of crop stress, allowing timely interventions.
- Contributes to better resource-use efficiency and reduced environmental footprint of agriculture.

Resource Requirements

- Access to satellite data, computing infrastructure, and software tools
- Electricity for data processing, storage, and dissemination
- Ground-truthing through field surveys and soil-testing laboratories
- Training for agricultural officers and farmers on interpreting AI-based advisories

Ethical and Sustainability Concerns

- Benefits may be concentrated among large farmers with better access to technology and information.
- Data on crop patterns and yields may have implications for pricing, insurance, and subsidies; governance must be fair.
- Over-reliance on AI recommendations without local validation may lead to inappropriate practices.
- Hardware used for field surveys and data collection contributes to e-waste.

Lessons for Responsible AI

- AI advisories should complement, not replace, soil testing, field observation, and expert guidance.
- Public institutions should ensure that small farmers also benefit from AI-supported services.
- Data should be used transparently and with clear rules on access and privacy.
- Continuous evaluation of model accuracy and relevance is necessary under changing climate and cropping patterns.

Case Study 5: Village-Level Smart Environmental Monitoring (Nathupur and Seoli, Haryana)

Background

Villages near industrial areas face combined pressures from agricultural activities, industrial emissions, and urban expansion. Localized monitoring of soil, water, and air quality can help identify pollution sources and support community-level action.

AI Methods Used

- Proposed deployment of NPK sensors, pH meters, moisture sensors, and air-quality monitors in village fields and common areas
- IoT-based data transmission to central servers for analysis
- Machine-learning models to detect anomalies, trends, and correlations between soil, water, and air parameters
- Community dashboards to display real-time environmental data

Environmental Benefits

- Early detection of soil contamination, water pollution, and air-quality deterioration
- Supports evidence-based dialogue between villagers, industries, and local authorities
- Enables targeted interventions such as tree planting, waste management, and emission controls

Resource Requirements

- Installation and maintenance of sensors, power supply, and communication networks
- Electricity for data logging, transmission, and processing
- Training for local volunteers and school students on using and interpreting data
- Periodic calibration and replacement of sensors

Ethical and Sustainability Concerns

- Data may reveal sensitive information about local industries, farms, or households; privacy and fairness must be ensured.
- Communities should have control over how data are used and shared.
- Hardware must be managed responsibly to avoid creating new e-waste problems.
- Benefits should reach all residents, not only a few informed individuals.

Lessons for Responsible AI

- Community participation should be central to the design, operation, and use of monitoring systems.
- Data should be presented in simple, visual formats that are easy to understand.
- Local institutions such as schools, panchayats, and NGOs should be empowered to use the data for advocacy and action.
- Hardware should be selected for durability, low power consumption, and ease of repair.

3.4 Synthesis of Case Studies

The case studies reveal several common patterns:

- AI can significantly improve the speed, scale, and accuracy of environmental monitoring in India.
- All AI systems require energy, water, hardware, and human resources; these costs must be accounted for in sustainability assessments.
- Ethical issues such as fairness, transparency, accountability, and community participation are critical for trust and long-term success.
- AI should be treated as a decision-support tool, not a replacement for laboratory analysis, field observation, expert judgment, and democratic decision-making.

These insights form the basis for the GREEN-AI framework proposed in this paper.

3.5 Framework Development:

The proposed framework was prepared by combining the principles of Green AI, ethical AI, environmental life cycle thinking, data governance, and community participation. It is designed to be simple enough for adoption by researchers, colleges, laboratories, environmental agencies, and start-up projects.

4. AI and Environmental Sustainability

AI can support sustainability when it helps reduce pollution, conserve resources, improve environmental prediction, and strengthen evidence-based decision-making. Its main environmental applications include:

- Predicting air-pollution levels and issuing early warnings
- Detecting water contamination and forecasting water quality
- Monitoring soil nutrients, moisture, salinity, and crop health
- Optimizing irrigation and fertilizer use
- Mapping deforestation, land-use change, and biodiversity loss
- Managing waste collection and recycling systems
- Forecasting floods, droughts, heat waves, and other climate risks

AI-supported monitoring systems can combine information from sensors, satellite images, laboratory analysis, weather records, industrial discharge data, and community observations. Such integrated analysis is useful because environmental problems are complex and change over time.

Nevertheless, the environmental benefit of an AI system should be evaluated against its own resource consumption. Large models and cloud-based systems may use significant amounts of electricity and cooling water. Data centres also create a growing e-waste burden because servers, batteries, sensors, cables, and chips have limited service life. India generated approximately 1.75 lakh metric tonnes of e-waste in FY 2023–24, while formal recycling capacity remains inadequate.

Therefore, AI should be evaluated by its **net environmental benefit**:

Net Environmental Benefit

= Environmental Benefit Produced – Environmental Cost of AI System

An AI project is truly sustainable only when its environmental benefits are greater than the energy, water, material, and social costs required to operate it.

5. Indian Case Studies:

5.1 AI in Soil and Agricultural Monitoring

Soil quality is essential for crop productivity, food security, and sustainable agriculture. Soil-testing laboratories commonly measure pH, electrical conductivity, organic carbon,

nitrogen, phosphorus, potassium, micronutrients, and heavy metals. AI can combine these laboratory results with remote-sensing images, weather data, crop history, and IoT sensor measurements to provide localized advice to farmers.

Satellite-based crop monitoring and machine-learning classification have been used to assess crop health, estimate yields, identify stressed areas, and support disease surveillance. Such systems can help reduce unnecessary fertilizer and pesticide use. AI-supported irrigation advisories have also been reported to reduce water consumption by approximately 22–38% in pilot deployments.

A village-level model involving NPK sensors, pH meters, and air-quality sensors has been proposed for Nathupur and Seoli villages in Haryana. The objective is to observe soil quality, industrial emissions, and agricultural conditions in real time.

Benefits

- Timely nutrient and irrigation recommendations
- Reduced use of water, fertilizer, and pesticides
- Improved soil-health monitoring
- Early detection of salinity, nutrient deficiency, and crop stress
- Better support for precision agriculture

Ethical and Sustainability Concerns

- Sensor manufacturing and disposal can add to e-waste.
- Rural farmers may not have equal access to smartphones, internet services, AI tools, or training.
- Incorrect or biased fertilizer recommendations may cause crop loss or soil damage.
- Farmers should understand the basis of recommendations before acting on them.
- Data related to land, crop yield, and farm practices must be protected from misuse.

Thus, AI-based agriculture should support, not replace, soil testing, field observation, local agricultural knowledge, and expert guidance.

5.2 AI in Water-Quality Monitoring

Water pollution is a major concern in India due to untreated sewage, industrial discharge, agricultural runoff, plastic waste, and groundwater contamination. Water-quality monitoring commonly involves chemical parameters such as pH, turbidity, dissolved oxygen, biochemical oxygen demand (BOD), chemical oxygen demand (COD), total dissolved solids, nitrate, phosphate, fluoride, heavy metals, and microbial indicators.

AI can analyze historical and real-time data from sensors, laboratories, weather stations, and industries to predict water quality. In river systems such as the Yamuna and Godavari, AI models can help estimate pollution trends and predict key variables such as dissolved oxygen, BOD, and coliform contamination.

IoT sensors and machine-learning models can also support groundwater management by monitoring water-table levels and predicting aquifer behavior under different extraction conditions. Such information can help communities and authorities plan water use more effectively.

Benefits

- Early warning of pollution events
- Improved planning for river-cleaning programs
- Faster identification of contaminated areas
- Better irrigation scheduling and groundwater management
- Efficient allocation of laboratory-testing resources

Ethical and Sustainability Concerns

- Water monitoring systems require electricity, sensors, communication networks, and cloud storage.
- Data centres used for AI processing may consume large amounts of water for cooling.
- Water data may affect farmers, industries, cities, and local communities; therefore, ownership and access rules must be clear.
- Communities affected by pollution should receive understandable information, not only technical reports.

- AI predictions should be verified by chemical laboratory analysis before regulatory action is taken.

AI should be treated as a decision-support tool. Final decisions on water safety and pollution control should involve qualified scientists, pollution-control authorities, and affected communities.

5.3 AI in Air-Quality Monitoring:

Air pollution is a serious public-health and environmental concern in Indian cities. Important pollutants include PM_{2.5}, PM₁₀, sulfur dioxide, nitrogen oxides, carbon monoxide, ozone, volatile organic compounds, and toxic metals. AI can combine air-monitoring data with weather variables, satellite images, traffic information, industrial activity, and seasonal patterns to forecast pollution levels.

Machine-learning-based air-quality forecasting systems have been reported to achieve approximately 84% accuracy in 48-hour PM_{2.5} prediction in pilot studies. Such forecasts can assist in public advisories, school-health measures, traffic management, industrial monitoring, and emergency response planning.

The AIRAWAT Research Foundation at IIT Kanpur and IIT Delhi has also supported AI-based research related to environmental monitoring, including real-time air and bioaerosol assessment.

Benefits

- Early warning of severe pollution episodes
- Better public-health advisories
- Support for traffic and industrial-emission management
- Identification of pollution hotspots
- Improved environmental planning in cities

Ethical and Sustainability Concerns

- Forecasting models may be inaccurate if sensor coverage is poor or data are incomplete.
- Low-income communities may be underrepresented in monitoring networks.
- Pollution data must be made public in simple and accessible language.
- Continuous computing and sensor networks require electricity and replacement hardware.
- Authorities should clearly explain uncertainty in pollution forecasts to avoid panic or misinformation.

AI-based air monitoring should include regular calibration of instruments, comparison with reference laboratory methods, and independent auditing of model performance.

6. Ethical Challenges of AI in Environmental Applications:

6.1 Energy and Carbon Footprint

AI models require electricity during training and use. If this electricity is generated from fossil fuels, AI operations indirectly contribute to carbon emissions. Data centres in India are expected to increase their electricity demand significantly, with projected demand reaching 13.56 GW by 2031–32.

6.2 Water Consumption

Data centres use water directly for cooling and indirectly through electricity generation. In India, data centres used around 150 billion litres of water annually in 2025, and this figure is projected to rise substantially by 2030. This is a serious concern in water-stressed regions.

6.3 E-Waste Generation

AI depends on hardware such as servers, chips, sensors, batteries, routers, smartphones, and storage devices. When these devices become outdated or damaged, they become electronic waste. E-waste can release hazardous substances such as lead, mercury, cadmium, brominated flame retardants, and other toxic materials if not properly managed.

6.4 Bias and Inequality

AI models learn from available data. If data are incomplete, urban-centered, or biased, the resulting predictions may not work equally well for rural areas, tribal communities, small farmers, or economically weaker groups. Environmental AI should not widen the existing digital divide.

6.5 Transparency and Explainability

A “black box” AI system may give a prediction without explaining why it was made. In environmental decision-making, explainability is important because people need to understand the source of a pollution alert, the uncertainty of a model, and the basis of a recommendation.

6.6 Accountability

When an AI system gives an incorrect recommendation, responsibility must be clear. Researchers, software developers, institutions, government agencies, and users should have defined roles. AI should not be used to avoid human responsibility in matters affecting health, livelihoods, and ecosystems.

7. Proposed GREEN-AI Framework

This paper proposes the **GREEN-AI Framework** for ethical AI and responsible computing in environmental sustainability.

Component	Meaning	Practical Action
G – Green by Design	Reduce the environmental footprint of AI systems	Use efficient algorithms, smaller models, renewable energy, edge computing, and low-power sensors
R – Responsible and Accountable	Define human responsibility for AI decisions	Assign clear roles, maintain human oversight, and establish grievance procedures
E – Equitable and Inclusive	Ensure equal access and fair outcomes	Include small farmers, rural users, women, and vulnerable communities in design and testing
E – Explainable and Transparent	Make AI decisions understandable	Share data sources, model limitations, uncertainty levels, and decision logic
N – Nature-Positive and Sustainable	Ensure that AI produces net environmental benefit	Measure energy, carbon, water, e-waste, and real environmental outcomes

The framework is consistent with the growing call for standardized methods to measure AI-related energy use, carbon footprint, and environmental impacts.

7.1 Environmental Performance Indicators:

Every AI-for-environment project should report the following indicators:

- Electricity used for model training and operation, in kWh
- Carbon footprint, expressed as kg CO₂-equivalent
- Water use for cooling and data-centre operations, in litres
- Number and type of hardware devices used
- Expected device life and reparability
- E-waste collection and recycling plan
- Environmental improvement achieved, such as water saved, pollution reduced, or emissions avoided
- Number and category of beneficiaries
- Accuracy, bias, and uncertainty of AI predictions

7.2 Ethical Assessment Questions:

Before an AI project begins, the following questions should be answered:

- What environmental problem is being addressed?
- Is AI necessary, or can a simpler method achieve the same result?
- How much energy, water, and hardware will the system require?
- Who will benefit from the system?
- Could any group be excluded or harmed?
- Are the data accurate, representative, and ethically collected?
- Can users understand the AI recommendation?
- Who is accountable if the system fails?
- How will hardware be repaired, reused, or recycled?
- Does the project create a measurable net environmental benefit?

8. Policy Recommendations

8.1 For Researchers

- Report energy consumption, carbon footprint, and water footprint in AI-based environmental research.
- Use smaller and efficient models where possible instead of unnecessarily large computational systems.
- Compare AI models with conventional statistical and laboratory methods.
- Clearly state limitations, uncertainty, potential bias, and ethical concerns.
- Use chemical analysis and field verification to validate AI predictions in soil, water, and air studies.

8.2 For Colleges and Universities

- Establish an ethics review process for AI-based environmental research.
- Include Green AI, data ethics, life-cycle assessment, and e-waste management in science and technology curricula.
- Promote interdisciplinary projects involving chemistry, environmental science, computer science, agriculture, and social science.
- Install energy-efficient computers and encourage responsible disposal of electronic devices.
- Maintain records of laboratory electronics and ensure authorized e-waste recycling.

8.3 For Industry and Technology Developers

- Design low-power sensors, repairable devices, and energy-efficient software.
- Use renewable electricity where possible for data centres and cloud services.
- Provide transparent documentation of model accuracy, limitations, and resource use.
- Avoid collecting unnecessary personal, agricultural, or location data.
- Develop affordable tools that can be used by small farmers and local environmental agencies.

8.4 For Government and Regulatory Bodies

- Develop national standards for reporting AI energy, carbon, water, and e-waste footprints.
- Require environmental impact assessment for large AI infrastructure and data-centre projects.
- Encourage the use of renewable energy, recycled water, and efficient cooling technologies in data centres.
- Strengthen e-waste collection, repair, reuse, and recycling systems.
- Make public environmental data accessible while protecting sensitive and personal information.
- Support AI tools for pollution monitoring only when they include human oversight, scientific validation, and public accountability.

9. Conclusion:

AI can make environmental monitoring faster, more accurate, and more responsive. In India, AI has useful applications in soil-health assessment, water-quality prediction, irrigation management, and air-pollution forecasting. These applications can support sustainable agriculture, clean-water management, urban environmental planning, and public health.

However, AI systems also consume electricity and water, depend on material-intensive hardware, generate e-waste, and may increase social inequality if access is not fair. Therefore, AI cannot be called sustainable merely because it is used for an environmental purpose. Its complete life-cycle impacts must be assessed.

The proposed GREEN-AI framework provides a practical approach for responsible environmental AI. It emphasizes green design, accountability, inclusion, transparency, and nature-positive outcomes. By applying these principles, researchers and policymakers can ensure that AI contributes to environmental protection without shifting environmental burdens to communities, future generations, or vulnerable ecosystems.

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