

# Chapter 2

# AI for Environmental Sustainability

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## ABSTRACT

*The accelerating pace of global environmental degradation—from climate change to biodiversity loss—demands bold and innovative solutions. This chapter explores how artificial intelligence (AI) is emerging as a transformative force in tackling these challenges. By harnessing technologies such as machine learning, computer vision, and natural language processing, AI offers unprecedented capabilities for monitoring ecosystems, forecasting climate impacts, managing resources efficiently, and guiding sustainable development. AI with complementary technologies like IoT, GIS, and cloud computing enhances data-driven decision-making across agriculture, urban planning, energy, water, and biodiversity conservation. However, the application of AI also raises ethical, social, and environmental concerns that must be addressed to ensure responsible and inclusive deployment. Through a multidisciplinary lens, this chapter examines AI's potential, limitations, and implications in advancing environmental sustainability, aiming to inform policy and practice for a resilient and equitable future.*

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## **1. INTRODUCTION**

Humanity is pivotal in its relationship with the planet, facing urgent environmental crises such as climate change, deforestation, biodiversity loss, pollution, and unsustainable consumption (Shivanna, 2022). While policy reforms, international agreements, and grassroots efforts remain essential, AI offers a transformative tool for environmental sustainability (van Wynsberghe, 2021).

AI enables machines to mimic human intelligence, which is increasingly integral to advancing sustainability goals (Collins et al., 2021). It enhances real-time data analysis, improves climate and disaster prediction, and empowers decision-makers with efficient, scalable solutions. The synergy of AI with technologies such as the Internet of Things (IoT), cloud computing, and geospatial systems opens up new avenues for optimizing resources, automating sustainable practices, and enhancing ecological resilience (Miller et al., 2025).

This chapter examines the diverse contributions of AI to environmental sustainability, focusing on its applications, limitations, and impacts across agriculture, energy, water management, urban planning, and biodiversity conservation. It highlights how AI can align with ecological values and sustainability objectives through technical insights, case studies, and ethical considerations.

The discussion begins by outlining key environmental challenges and the need for integrated solutions. It then explores the emergence of AI in sustainability, detailing innovations in monitoring, resource use, smart cities, and climate action. Ultimately, it provides ethical perspectives and policy recommendations for the responsible integration of AI into environmental governance.

## **2. OVERVIEW OF ENVIRONMENTAL CHALLENGES**

The 21st century faces interconnected environmental crises exacerbated by industrialization, population growth, and unsustainable consumption. Despite global efforts, climate change, deforestation, biodiversity loss, and

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