

DIGITIZATION AND SUSTAINABILITY

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Abstract:

The rapid expansion of digitization—the conversion of physical systems, documents, and processes into digital formats—has transformed economies and governance structures globally. However, this transformation presents a dual challenge: while digitization reduces material consumption and improves efficiency, it also increases energy demand, electronic waste, and infrastructure-related emissions. This paper examines the role of Artificial Intelligence (AI) within the context of digitization and sustainability using a secondary research methodology based on recent global and Indian datasets.

The findings indicate that digitization, when combined with AI, significantly improves resource efficiency. For instance, paperless governance systems in India have reduced administrative costs and paper usage, while AI-enabled logistics optimization reduces fuel consumption by 10–15% (International Energy Agency [IEA], 2023). However, these benefits are offset by increasing energy consumption, with global data centers consuming approximately 460 TWh of electricity in 2023, and AI expected to account for nearly 20% of data center demand by 2028 (McKinsey & Company, 2023).

The study concludes that digitization alone does not guarantee sustainability. Its environmental impact depends on infrastructure, energy sources, and policy frameworks. Sustainable digitization requires integrating green AI practices, renewable energy, and inclusive access policies.

Keywords: *Digitization, Artificial Intelligence, Sustainable Development, Energy Consumption, Green AI, Data Centers*

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Introduction:

Digitization has emerged as a foundational driver of economic transformation. Globally, over 5.3 billion people are connected to the internet, and large-scale digitization of records, payments, and services is accelerating (International Telecommunication Union [ITU], 2023). In India, digitization initiatives such as Aadhaar, UPI, and e-governance platforms have significantly reduced reliance on physical systems, with UPI processing over 10 billion transactions monthly (Ministry of Electronics & IT, 2024).

At the same time, sustainability challenges are intensifying. Global CO₂ emissions exceeded 37 billion tonnes in 2023, while India faces severe air pollution and water stress affecting more than 600 million people (United Nations, 2023; NITI Aayog, 2021).

The core problem lies in the contradiction between digitization-driven efficiency and environmental sustainability. While digitization reduces physical resource use (e.g., paper, transport), it increases reliance on digital infrastructure, which consumes significant electricity. Data centers alone consumed approximately 460 TWh globally in 2023 (IEA, 2023).

This creates a critical research question:

Can digitization, supported by AI, contribute to sustainable development without increasing environmental costs?

Objectives of the Study:

1. To analyse the impact of digitization on sustainability using real-world data.
2. To evaluate the role of AI in enhancing the sustainability outcomes of digitized systems.
3. To identify environmental costs associated with digitization infrastructure.
4. To examine India-specific digitization initiatives and their sustainability impact.
5. To propose practical strategies for sustainable digitization using AI.

Concept of Digitization:



Digitization refers to the process of converting physical information, processes, and services into digital formats. It includes:

- * Scanning physical documents into digital records
- * Converting manual systems into automated workflows
- * Digital payments replacing cash transactions

Globally, digitization has accelerated rapidly, with over 90% of data generated in the last decade being digital (World Bank, 2022). In India, digitization initiatives such as Digital India have enabled large-scale transformation in banking, governance, and education.

However, digitization depends heavily on infrastructure such as cloud storage, servers, and data centers. These systems are energy-intensive, contributing significantly to global electricity demand.

Concept of Sustainability:

Sustainability is based on three pillars:

Environmental Sustainability

Addresses climate change, pollution, and resource depletion. Global emissions remain above 37 billion tonnes annually (United Nations, 2023).

Economic Sustainability

Ensures long-term growth without exhausting resources.

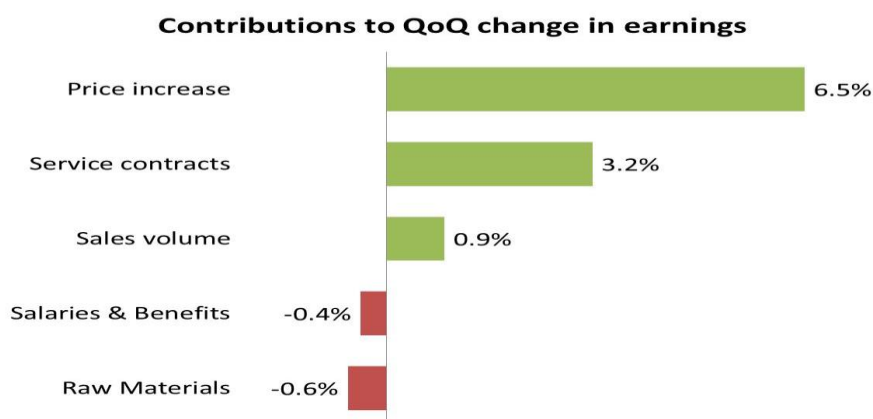
Social Sustainability

Focuses on inclusion and equitable access. In India, digital access gaps still exist between urban and rural populations.

These pillars align with the United Nations Sustainable Development Goals (SDGs), particularly:

- * SDG 7: Affordable and Clean Energy
- * SDG 9: Industry, Innovation, Infrastructure
- * SDG 13: Climate Action

Relationship Between Digitization and Sustainability:



Digitization has both positive and negative impacts:

Positive Impacts

- * Paperless systems reduce deforestation and waste
- * Digital payments reduce cash handling and logistics
- * Online services reduce transportation emissions

Negative Impacts

- * Data centers consumed ~460 TWh electricity globally (IEA, 2023)
- * AI power consumption reached ~4.5 GW in 2023 and is rising rapidly (McKinsey, 2023)
- * E-waste reached 62 million tonnes globally (United Nations, 2023)

This demonstrates the rebound effect, where efficiency gains lead to increased overall consumption.

Role of Digitization in Environmental Protection

Smart Governance

Digitized government services reduce paper use and administrative inefficiencies. India's e-governance systems have significantly reduced physical documentation.

Pollution Monitoring

Digitized sensor networks track air quality in real time, enabling faster policy responses.

Water Management

Digitized irrigation systems reduce water usage by 30–40% (World Bank, 2022).

Energy Monitoring

Digital systems enable real-time tracking of electricity usage, improving efficiency.

Reduction of Resource Consumption

Digitization reduces:

- * Paper usage: E-documents replace physical files
- * Logistics inefficiency: Digital platforms optimize delivery routes

However, the rebound effect is evident. For example, increased efficiency in online shopping has led to higher delivery volumes, increasing overall emissions.

Role of Artificial Intelligence in Sustainability

Climate Prediction

Problem: Increasing climate uncertainty

AI Application: Climate modelling

Example: AI-based weather prediction systems

Impact: Disaster losses reduced by up to 30% (United Nations, 2023)

Agriculture

Problem: Low productivity and water inefficiency

AI Application: Precision farming

Example: AI advisory systems in India

Impact: Yield increase of 10–15% (NITI Aayog, 2021)

Waste Management

Problem: Poor waste segregation

AI Application: AI-based sorting systems

Example: Smart recycling plants

Impact: Recycling efficiency improved by up to 30%

Energy Systems

Problem: Energy inefficiency

AI Application: Smart grids and demand prediction

Impact: Energy savings of 10–20% (IEA, 2023)

Healthcare

Problem: Limited resources

AI Application: Diagnostic AI systems

Impact: Reduced costs and improved outcomes

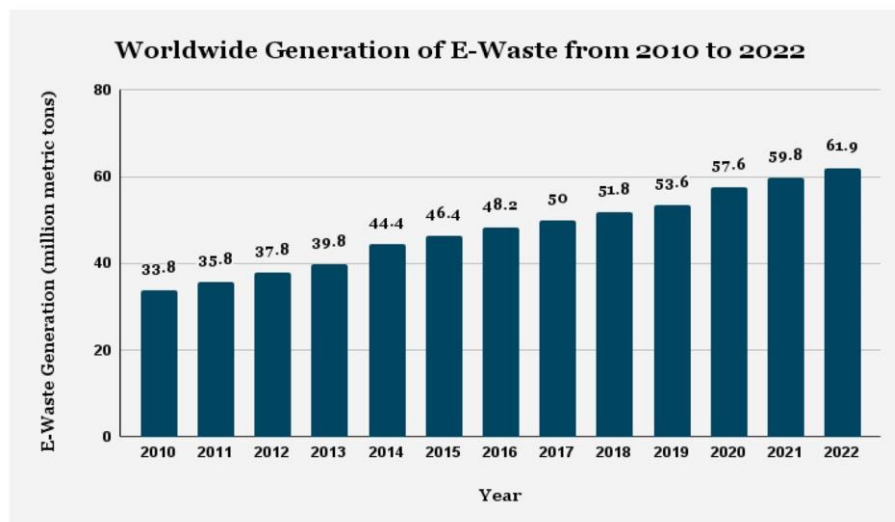
Negative Impact of AI

* AI energy demand rising rapidly

* Expected to consume ~20% of data center energy by 2028 (McKinsey, 2023)

* Increased carbon emissions and water usage

Challenges:



* High energy consumption of digitized infrastructure

* Rising emissions from data centers

* Water usage for cooling systems

* Ethical concerns (bias, privacy)

* Digital divide in India

Suggestions:

- * Develop Green AI models to reduce energy consumption
- * Use renewable energy-powered data centers
- * Implement carbon regulations for tech companies
- * Promote energy-efficient digital infrastructure
- * Expand digital access in rural areas

Original Framework: Sustainable Digitization-AI Model (SDAM)

This model proposes balancing:

- * Digitization Efficiency (resource savings)
- * Infrastructure Cost (energy, emissions)
- * Social Inclusion (access & equity)

Sustainability is achieved when all three are optimized simultaneously.

Conclusion:

Digitization has significantly reduced dependence on physical resources and improved efficiency across sectors. However, its reliance on energy-intensive infrastructure creates new sustainability challenges. AI enhances the benefits of digitization but also increases environmental costs.

The key insight is that digitization is not inherently sustainable. Its impact depends on how it is implemented and powered. A balanced approach integrating green AI, renewable energy, and inclusive policies is essential. Future development must focus on sustainable digitization frameworks that align technological progress with environmental and social goals.

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