



AI-Driven research in India: Potential, risks, and policy framework

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Abstract

Artificial Intelligence (AI) is rapidly reshaping India's research and innovation ecosystem. With expanding digital infrastructure, young workforce, and vast datasets, India is witnessing accelerated AI adoption across healthcare, agriculture, governance, climate studies, finance, and education. Government initiatives such as the National Strategy for Artificial Intelligence, the National AI Portal, the Responsible AI for Youth program, and Digital India have positioned the country as a rising AI hub. However, challenges—including algorithmic bias, inadequate regulation, privacy concerns, infrastructural gaps, and ethical risks—threaten responsible AI development. Using a qualitative exploratory method based on secondary literature, policy documents, and case studies, this paper analyses the potential, risks, and governance gaps of AI-driven research in India. The study finds that while AI offers major socio-economic benefits, unregulated deployment can intensify inequality, weaken data protection, and reduce public trust. The paper concludes with policy recommendations for ethical governance, transparency standards, national legislation, capacity building, and inclusive research ecosystems.

Keywords: Artificial intelligence, India, AI governance, research innovation, data ethics

Introduction

Artificial Intelligence has transitioned from a specialised scientific discipline into a foundational component of research, governance, and industry. For India, AI offers a transformative opportunity to accelerate development across critical sectors. With rising internet penetration, high-volume datasets from platforms such as Aadhaar and UPI, and progress under Digital India, the nation possesses the necessary ingredients to expand AI-driven research at scale (Bhattacharya, 2020) ^[2].

Government-led initiatives have strengthened this trajectory. NITI Aayog's National Strategy for Artificial Intelligence (NSAI) identifies healthcare, agriculture, mobility, education, and retail as high-impact domains (NITI Aayog, 2018) ^[8]. The National AI Portal and Centres of Excellence further support research collaboration and knowledge sharing. However, India continues to face structural and ethical challenges. AI deployment often occurs without dedicated legislation, leading to concerns about data privacy, algorithmic fairness, and accountability (Narayan, 2020) ^[7]. Infrastructure gaps, such as limited access to high-performance computing, also restrict equitable research development (IISc, 2023) ^[4].

The emergence of the Digital Personal Data Protection Act (DPDP) in 2023 marks progress, yet a comprehensive AI regulation framework is still absent. As both private and public institutions expand AI use in sensitive areas—such as welfare delivery, policing, and health diagnostics—the need for ethical governance becomes urgent.

This paper provides a consolidated understanding of India's AI research landscape by examining its transformative potential, risks, and policy needs. It argues that AI development must be guided by transparent, accountable, and rights-based frameworks to ensure inclusive and responsible innovation.

Research Methodology

This study employs a qualitative, exploratory methodology using secondary sources. Materials reviewed include

academic articles, government reports, NITI Aayog publications, industry whitepapers, OECD and UNESCO guidelines, and case studies related to Indian AI applications.

Scope

The study covers AI-driven research in India between 2015 and 2025, focusing on public-sector initiatives, industry innovations, ethical challenges, and governance frameworks.

1. Objectives

- To analyse the current landscape and potential of AI-driven research in India.
- To identify emerging risks and societal implications.
- To evaluate India's evolving policy ecosystem.
- To propose recommendations for responsible AI development.

2. Limitations

- Reliance on secondary data.
- Rapid developments in AI may outpace certain findings.
- Limited transparency in some government AI programs.

Literature Review

Scholars highlight India's demographic strength, digital infrastructure, and large datasets as major drivers of AI potential (Rao & Kulkarni, 2021) ^[9]. These datasets, however, raise critical privacy and ethical concerns, particularly in light of the Supreme Court's recognition of privacy as a fundamental right in *Puttaswamy v. Union of India* (2017).

AI's sectoral applications are well-documented. Research indicates that AI-based tools can enhance diagnostics for tuberculosis, diabetic retinopathy, and cardiovascular diseases (KPMG, 2022) ^[6]. Similarly, AI-enabled precision agriculture improves yield estimation, soil monitoring, and

climate resilience (Singh & Mehra, 2019) ^[11]. Governance applications—such as crime analytics, traffic systems, and disaster management—have expanded significantly (Sharma, 2022) ^[10].

Ethical concerns remain prominent in literature. Algorithmic bias is identified as a major challenge due to socio-economic inequalities embedded in Indian datasets (Srinivasan, 2021) ^[12].

Researchers argue that India lacks cohesive AI regulation, leading to inconsistent technological and ethical standards (Narayan, 2020) ^[7]. Comparative research emphasizes India's need to adopt a hybrid regulatory model that encourages innovation but ensures accountability, similar to the EU AI Act's risk-based approach (Kapoor, 2023) ^[5].

Infrastructure constraints—limited computational resources, uneven funding, and talent shortages—are widely documented (IISc, 2023) ^[4]. Literature suggests urgent investment in public research infrastructure and cross-sector collaboration.

Overall, published studies converge on the need for ethical, transparent, and inclusive AI governance in India.

Potential of Ai-Driven Research in India

1. Healthcare Innovation

AI is transforming healthcare by improving diagnostic accuracy, disease prediction, and telemedicine services. Machine learning models have been used to detect early-stage cancer, tuberculosis, and heart diseases, while AI-based pandemic forecasting proved valuable during COVID-19 (ICMR, 2021) ^[3]. For a country with limited medical personnel, AI offers significant scalability.

2. Agricultural Advancement

With nearly half of India's population dependent on agriculture, AI-driven innovations such as crop monitoring, pest prediction, soil analytics, and satellite-based yield forecasting substantially improve productivity. Startups like CropIn demonstrate how AI can optimize resource use and mitigate climate risks.

3. Governance and Public Administration

AI supports predictive policing, automated service delivery, traffic optimization, and disaster management. AI-assisted early warning systems for floods and cyclones help reduce casualties in vulnerable regions.

4. Industry and Economic Research

Manufacturing, logistics, and finance leverage AI for quality control, predictive maintenance, automation, fraud detection, and risk assessment. Centres of Excellence established by MeitY facilitate industry-academia collaboration to scale innovation.

Risks and Ethical Challenges

1. Algorithmic Bias

AI trained on biased datasets can reinforce discrimination based on caste, gender, socio-economic status, or geography. Biased facial recognition and credit scoring systems illustrate significant risks (Srinivasan, 2021) ^[12].

2. Privacy and Surveillance

Despite the DPDP Act (2023), concerns persist about

consent, data retention, and opaque data-sharing practices. AI-based surveillance tools pose risks of wrongful profiling and violations of individual liberty (Banerjee, 2021) ^[1].

3. Misinformation and Deepfakes

AI-generated deepfakes threaten electoral integrity, social harmony, and national security. Their rapid spread through social media increases societal vulnerability.

Policy and Legal Framework

1. Government Initiatives

National Strategy for AI (NSAI) emphasizes inclusive growth, ethical use, and sectoral development. National AI Portal promotes collaboration, education, and data access. Centres of Excellence support research innovation. Responsible AI for Youth builds early AI literacy.

2. Legislative Gaps

India lacks a dedicated AI regulation law. Existing laws, including the DPDP Act and IT Act, inadequately address algorithmic transparency, accountability, and risk classification. Scholars recommend a risk-based regulatory framework similar to global best practices.

3. Ethical Standards

India must align with OECD and UNESCO AI principles, prioritizing fairness, accountability, transparency, and human rights. Periodic algorithmic audits and explainable AI models are essential.

Barriers to Ai Research Development

1. Infrastructure Limitations

High-performance computing, advanced GPUs, and quality datasets remain scarce outside premier institutions.

2. Human Capital Challenges

Low research funding, limited salaries, and brain drain affect long-term AI capabilities. Skill development programs remain insufficient.

3. Fragmented Research Ecosystem

Lack of integrated networks across academia, industry, government, and civil society leads to duplication and slower innovation.

Recommendations

1. Enact a Comprehensive AI Regulation Law consisting of Risk classification, Transparency mandates, AI certification and audits, and Redressal mechanisms
2. Strengthen Data Governance with Clear consent norms, Data minimization, Cross-border data rules, Mandatory impact assessments
3. Invest in National AI Infrastructure for HPC facilities, open datasets with privacy safeguards, AI labs in state universities
4. Promote Interdisciplinary Research: Integration of ethics, law, policy, and social sciences
5. Build AI Literacy and Workforce Skills by way of Ethics training and Large-scale skill programs
6. Encourage Public-Private Partnerships by way of Co-funded infrastructure and innovation hubs

7. Ensure Transparency in Government AI Use by way of Independent audits, Public reporting, Citizen grievance systems

Conclusion

AI-driven research represents a transformative force in India's socio-economic development. With its strong digital infrastructure and innovative potential, India can emerge as a global leader in ethical AI. However, responsible governance is essential. Without regulatory clarity, infrastructural investment, and ethical safeguards, AI risks amplifying inequality, violating privacy, and undermining public trust. A comprehensive national AI strategy—combining legislation, infrastructure, skill development, and transparency—will be vital to ensuring inclusive and trustworthy AI innovation in India.

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