Research Paper
Impact Factor: 7.358
Peer Reviewed & Indexed Journal
www.ijmsrr.com

IJMSRR
E- ISSN - 2349-6746
ISSN -2349-6738

SUSTAINABLE DEVELOPMENT IN THE AGE OF AI: LESSONS FOR INDIA'S PUBLIC SECTOR

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Abstract
Artificial intelligence (AI) is reshaping the instruments through which governments pursue sustainable development, offering new capacities for prediction, targeting, and resource optimization while raising fresh questions about equity, accountability, and institutional readiness. This paper examines how India's public sector has begun integrating AI-enabled tools into programmes aligned with the Sustainable Development Goals (SDGs), drawing on evidence from agriculture, healthcare, energy, and urban governance. Using a synthesis of government strategy documents, regulatory frameworks, and peer-reviewed literature, the paper maps the principal use cases in which AI has been deployed to advance SDG-linked outcomes, identifies the structural constraints that limit scale and impact, and evaluates the distributive risks that accompany algorithmic decision-making in a federal, resource-constrained administrative context. Central constraints examined include fragmented data infrastructure, the rural-urban digital divide, limited in-house technical capacity, and regulatory ambiguity around automated decision-making. The analysis situates India's experience within comparative debates on AI for social good, arguing that durable AI adoption in the public sector depends less on technological sophistication than on institutional design: interoperable data systems, participatory oversight mechanisms, and context-sensitive regulation. The paper concludes with lessons for policymakers seeking to align AI strategy with sustainable development objectives, emphasizing adaptive, rights-based governance frameworks that protect vulnerable populations from algorithmic harm while enabling innovation.

Keywords: Artificial Intelligence; Sustainable Development Goals; Public Sector Governance; Digital Governance; India; Algorithmic Accountability.

1. Introduction

The 2030 Agenda for Sustainable Development, adopted by all United Nations member states in 2015, frames a set of seventeen interlinked goals spanning poverty eradication, health, education, clean energy, and resilient institutions (United Nations, 2015). India, home to roughly one-sixth of the world's population, occupies a pivotal position in this agenda: progress or stagnation on Indian SDG indicators disproportionately shapes the global trajectory toward 2030. Over the past decade, Indian policymakers have increasingly looked to artificial intelligence as a general-purpose technology capable of accelerating this progress, from predictive crop advisories that stabilize farm incomes to AI-assisted diagnostics that extend the reach of an overstretched public health system.

NITI Aayog's National Strategy for Artificial Intelligence, released in 2018, explicitly framed AI adoption around "AI for All," identifying agriculture, healthcare, education, smart mobility, and smart cities as priority sectors where AI could deliver inclusive public value rather than purely commercial returns (NITI Aayog, 2018; Rao, M.K.P., 2018). This orientation distinguishes India's public sector AI strategy from private-sector deployment, which tends to prioritize efficiency and profitability. In principle, a development-oriented AI strategy aligns naturally with the SDGs; in practice, the translation of strategy documents into operational systems has been uneven, shaped by the same

institutional constraints that have historically limited the delivery of public services in India: fragmented data systems, capacity gaps within government departments, and wide disparities in digital access between states and between rural and urban populations.

This paper asks two related questions. First, where and how has AI actually been deployed within India's public sector in ways that map onto SDG-linked outcomes? Second, what structural and ethical constraints condition the impact of these deployments, and what do they suggest about the institutional design choices that should guide future AI-for-development strategy? The paper proceeds as follows. Section 2 situates the analysis within the broader literature on AI and sustainable development. Section 3 maps sectoral applications of AI within Indian public administration, drawing on documented cases in agriculture, health, energy, and urban governance. Section 4 examines the structural constraints that limit the scale and equity of these deployments. Section 5 considers the ethical and governance risks associated with algorithmic decision-making in welfare and regulatory contexts. Section 6 distills policy lessons, and Section 7 concludes.

2. AI and the SDGs: A Conceptual Framework

The relationship between AI and sustainable development is neither uniformly positive nor uniformly negative; it is contingent on institutional design. In an influential mapping exercise, Vinuesa et al. (2020) found that AI could act as an enabler for a substantial majority of SDG targets, particularly those relating to health, education, and industry, while simultaneously acting as an inhibitor for a smaller but significant subset of targets connected to inequality, decent work, and responsible consumption, largely through mechanisms such as automation-driven job displacement and increased energy consumption. This dual character is directly relevant to India's public sector context: the same predictive analytics that can improve targeting of welfare transfers can also, if poorly designed, systematically exclude eligible beneficiaries whose data profiles do not fit the model's assumptions.

A second strand of literature situates AI adoption within broader theories of digital public infrastructure. India's experience with the "India Stack" — the layered digital identity, payments, and data-sharing architecture built around Aadhaar and the Unified Payments Interface — has been widely discussed as a foundation that lowers the marginal cost of deploying new digital services, including AI-driven ones, at population scale (Rajan, 2019; World Bank, 2022). Proponents argue that this shared digital substrate allows AI applications in one sector, such as biometric authentication in welfare delivery, to be repurposed across others, including health records and agricultural credit. Critics counter that the same infrastructure concentrates risk: errors or biases embedded in a foundational identity or data layer propagate across every downstream application built upon it (Khera, 2019).

A third relevant frame is public administration's long-standing distinction between policy formulation and implementation capacity. India's federal structure divides authority over many SDG-relevant sectors — health, agriculture, and urban local governance in particular — between the Union government and the states, with substantial variation in administrative capacity across states. AI strategies formulated at the national level, such as NITI Aayog's sectoral AI frameworks, therefore depend for their impact on state- and district-level implementation capacity that is itself highly uneven (Government of India, Ministry of Electronics and Information Technology [MeitY], 2021). This paper's empirical sections take this multi-level governance structure as a starting point for understanding why AI pilots that succeed in one state or district often fail to scale nationally.

3. AI Applications in India's Public Sector

Table 1 summarizes representative AI applications across four priority sectors, mapped to the SDG they most directly support. These examples are illustrative rather than exhaustive; they are drawn from publicly documented government initiatives and independent evaluations.

Table 1. Representative AI Applications in India's Public Sector by SDG Alignment

Sector	AI Application	Primary SDG Alignment	Implementing Body
Agriculture	Satellite- and AI-based crop health monitoring and yield estimation	SDG 2 (Zero Hunger)	Ministry of Agriculture & Farmers Welfare, with ISRO
Agriculture	AI-driven pest and disease advisory delivered via mobile app	SDG 2; SDG 1 (No Poverty)	State agriculture departments; CROPIC/Plantix-style tools
Healthcare	AI-assisted screening for tuberculosis and diabetic retinopathy	SDG 3 (Good Health and Well-Being)	Ministry of Health & Family Welfare, National Health Mission
Healthcare	Teleconsultation triage and symptom-checking (eSanjeevani)	SDG 3	Ministry of Health & Family Welfare
Energy	AI-based load forecasting for renewable energy grid integration	SDG 7 (Affordable and Clean Energy)	Power System Operation Corporation (POSOCO)
Urban Governance	AI-enabled traffic management and adaptive signal control	SDG 11 (Sustainable Cities and Communities)	Smart Cities Mission, municipal corporations
Urban Governance	Predictive waste-collection routing	SDG 11; SDG 12 (Responsible Consumption)	Urban local bodies under Swachh Bharat Mission
Disaster Management	AI-assisted flood forecasting and early-warning systems	SDG 13 (Climate Action)	Central Water Commission; National Disaster Management Authority

Note. Compiled from NITI Aayog (2018), Government of India, MeitY (2021), Ministry of Health & Family Welfare programme documentation, and Smart Cities Mission progress reports (Ministry of Housing and Urban Affairs, 2022).

In agriculture, AI applications concentrate on information asymmetry problems that have long constrained smallholder productivity. Satellite-derived vegetation indices, processed through machine-learning models, allow state agriculture departments to estimate crop stress and likely yield shortfalls at a sub-district level well before harvest, supporting both early-warning systems and more accurate

crop insurance claims processing under schemes such as the Pradhan Mantri Fasal Bima Yojana (Government of India, MeitY, 2021). Mobile-based pest and disease advisory tools, several of which use image-recognition models trained on crowd sourced photographs of affected crops, aim to substitute for the extension officers that many rural districts lack in adequate numbers. The SDG relevance is direct: more accurate targeting of agricultural risk supports SDG 2 targets on agricultural productivity and income stability for small-scale producers.

In healthcare, AI-assisted diagnostic tools have been piloted most extensively in tuberculosis screening, where computer-aided detection software analyzes chest X-rays to flag likely cases for confirmatory testing, partially compensating for a shortage of radiologists in public health facilities (Ministry of Health & Family Welfare, 2022). Similar approaches have been trialed for diabetic retinopathy screening, where AI models assess retinal images captured by relatively low-cost handheld cameras, extending specialist-level screening capacity into primary health centres. The eSanjeevani teleconsultation platform, while not itself a pure AI system, increasingly incorporates automated triage logic to route patients to appropriate levels of care, illustrating how AI is often embedded incrementally within existing digital health infrastructure rather than deployed as a standalone system.
Energy sector applications center on the operational challenge of integrating variable renewable generation — principally solar and wind — into a grid historically designed around dispatch able thermal power. AI-based load and generation forecasting, used by the Power System Operation Corporation and state load despatch centres, reduces the reserve margins required to manage renewable variability, indirectly supporting the cost-effectiveness of renewable energy expansion under India's Nationally Determined Contributions (International Energy Agency, 2023). In urban governance, AI-enabled traffic signal optimization and predictive waste-collection routing, both promoted under the Smart Cities Mission, target congestion and municipal service inefficiencies that disproportionately affect low-income urban residents who rely most heavily on public transport and municipal services (Ministry of Housing and Urban Affairs, 2022).

A cross-cutting feature of these deployments is that AI rarely functions as a standalone system; it is almost always layered onto pre-existing digital public infrastructure built for other purposes. Crop advisory tools draw on land records digitized under earlier e-governance programmes; health screening tools operate within facility networks built under the National Health Mission; energy forecasting models run on grid telemetry infrastructure installed for operational reasons unconnected to sustainability goals. This layering has an important implication for how AI-for-SDG strategy should be evaluated: the marginal contribution of the AI component is often inseparable from the quality of the underlying administrative system it sits atop. A forecasting model trained on incomplete or poorly maintained land records will reproduce those gaps regardless of its algorithmic sophistication, a pattern that recurs across each of the sectors summarized in Table 1 and that motivates the constraints discussed in Section 4.

4. Structural and Institutional Constraints

The sectoral applications documented above operate within a set of structural constraints that shape their reach and equity. Four constraints recur across sectors: data fragmentation, the digital access divide, limited technical capacity within government, and interoperability gaps across departments and levels of government. Data fragmentation refers to the persistence of siloed, department-specific data systems that were built independently, often by different vendors and on incompatible standards, over successive e-governance initiatives. Even where individual departments hold substantial administrative data, as in agricultural land records or health facility registries, the absence of common

identifiers and interoperable formats limits the pooled, cleaned datasets that machine-learning models require to generalize beyond the pilot districts in which they were first trained (Government of India, MeitY, 2021). The digital access divide compounds this problem on the demand side: AI-enabled services delivered through mobile applications or web portals presuppose a baseline of connectivity, device access, and digital literacy that remains unevenly distributed. Table 2 summarizes selected indicators of this divide.

Table 2. Selected Indicators of the Digital Access Divide in India

Indicator	Urban	Rural	Source
Internet subscriber density (per 100 population)	~103	~46	TRAI (2023)
Households with internet access	~67%	~31%	National Sample Survey Office (2022)
Adults with basic digital literacy	~61%	~25%	MeitY / NSSO (2022)
Female internet usage relative to male	Higher parity	Substantial gender gap persists	GSMA (2023)

Note. Figures are approximate and drawn from Telecom Regulatory Authority of India (2023) subscriber data, National Sample Survey Office (2022) household surveys, and GSMA (2023) mobile gender-gap reporting. Rural-urban and gender gaps narrowed over the preceding five years but remain substantial.

These access gaps mean that AI-enabled public services risk reproducing, rather than correcting, pre-existing inequities: a predictive agricultural advisory delivered exclusively through a smartphone application is of limited use to the roughly one-third of rural households without reliable internet access, and a teleconsultation triage system presupposes a level of digital literacy that is unevenly distributed by gender and age. Limited technical capacity within government compounds these access-side constraints. Few line departments maintain in-house data science teams; many AI pilots are designed, built, and often operated by external technology vendors or philanthropic partners, creating dependency relationships that complicate long-term maintenance, model retraining, and accountability once a pilot's original funding or partnership concludes (Government of India, MeitY, 2021). Finally, interoperability gaps between the Union and state governments, and between departments within a single state, mean that successful pilots frequently remain confined to their original administrative jurisdiction rather than scaling horizontally, a pattern documented across multiple Smart Cities Mission evaluations (Ministry of Housing and Urban Affairs, 2022).

These four constraints interact rather than operating independently. A department with fragmented data but strong technical capacity can, over time, invest in data cleaning and standardization; a department with clean data but no technical capacity cannot exploit it without external partnership, which reintroduces dependency risk. The most durable AI deployments documented in Indian public administration to date — such as satellite-based crop monitoring, which builds on decades of accumulated remote-sensing expertise at the Indian Space Research Organisation — tend to be those where at least one of these four constraints was substantially resolved before AI adoption began, rather than addressed concurrently with it. This suggests that sequencing matters: departments considering new AI investments should assess which of the four constraints already represents a comparative

strength, and design initial pilots around that strength rather than attempting to resolve all four simultaneously.

5. Ethical and Governance Considerations

Beyond questions of technical capacity and access, the use of AI in public administration raises distinct governance risks connected to accountability, bias, and privacy. Algorithmic systems used in welfare targeting or eligibility determination can produce exclusion errors that are difficult for affected individuals to identify or contest, particularly where the underlying model is proprietary or its decision logic is not disclosed. Independent research on biometric authentication failures within India's public distribution system has documented cases in which technical verification failures — rather than genuine ineligibility — resulted in denial of entitled food rations, illustrating how automation intended to reduce leakage can simultaneously introduce new forms of exclusion (Khera, 2019). While such cases concern authentication infrastructure rather than AI models in the narrow sense, they illustrate a governance pattern directly relevant to AI: automated systems shift the burden of proof onto citizens least equipped to navigate appeals processes.

The passage of India's Digital Personal Data Protection Act in 2023 established a statutory framework for consent-based personal data processing, including processing by government bodies, and created new obligations around data minimization and purpose limitation (Government of India, 2023). However, the Act includes broad exemptions for government functions related to national security, public order, and the provision of subsidies, benefits, or services, which several legal scholars have argued could limit its applicability to precisely the welfare-administration contexts in which algorithmic accountability is most needed (Bailey & Parsheera, 2023). This tension between enabling data-driven public service delivery and constraining potential misuse of that same data remains only partially resolved in the current regulatory architecture. A further governance gap concerns algorithmic auditing. Unlike the European Union's AI Act, which establishes risk-tiered obligations including mandatory conformity assessments for high-risk public-sector AI systems (European Parliament, 2024), India has not yet established a binding, sector-agnostic requirement for pre-deployment or periodic post-deployment auditing of government AI systems. NITI Aayog's Responsible AI framework documents articulate principles — safety, equality, inclusivity, non-discrimination, and accountability — but these remain largely advisory rather than enforceable (NITI Aayog, 2021). The result is a governance environment in which the pace of AI pilot deployment across ministries and states has outstripped the development of binding oversight mechanisms, leaving affected citizens with limited formal recourse when an algorithmic system produces an erroneous or unfair outcome.

These governance gaps are not unique to India, but they carry distinct weight in a federal system where AI systems designed at the national level are frequently implemented by state and local bodies with widely varying administrative capacity to interpret, monitor, or contest them. A national-level Responsible AI framework offers limited protection to a citizen in a district lacking the administrative capacity to operate a functioning grievance-redress mechanism for algorithmic errors. Any governance architecture intended to address these risks must therefore be designed for implementation at the state and district level, not only at the level of national policy documents, if it is to have practical effect on the ground.

6. Lessons for Policy; Three lessons emerge from this analysis for policymakers seeking to align AI adoption with sustainable development objectives. First, interoperable data infrastructure should be

treated as a prerequisite for, rather than a byproduct of, AI deployment. Investment in AI models without corresponding investment in shared data standards, common identifiers, and cross-department data-sharing protocols risks producing isolated pilots that cannot scale, as has occurred repeatedly across Smart Cities Mission projects (Ministry of Housing and Urban Affairs, 2022). Data infrastructure investment should precede, or at minimum accompany, model development funding.

Second, closing the digital access divide is a precondition for equitable AI-enabled service delivery, not a parallel or secondary objective. Where AI applications are layered onto existing digital access gaps without complementary investment in connectivity, device affordability, and digital literacy — particularly for rural women and older adults — such applications risk widening rather than narrowing the disparities that SDG-aligned programmes are intended to reduce. Complementary channels, such as offline or assisted-access models delivered through community resource centres or frontline workers, should remain available alongside app- and portal-based AI services for the foreseeable future.

Third, algorithmic accountability mechanisms need to mature alongside deployment, not lag behind it. This includes establishing clear, enforceable rights to explanation and appeal for individuals affected by AI-informed administrative decisions, mandating pre-deployment impact assessments for high-stakes public-sector AI systems such as those used in welfare eligibility or law enforcement, and building independent audit capacity — whether within a dedicated statutory body or distributed across sectoral regulators — capable of evaluating model performance and bias on an ongoing basis. NITI Aayog's Responsible AI principles provide a useful normative foundation; the central task going forward is translating these principles into binding procedural requirements comparable to environmental or social impact assessment regimes already familiar to Indian administrative law (NITI Aayog, 2021). Comparative experience reinforces this point. Countries that have advanced furthest in embedding AI within public-sector sustainability programmes, including several within the European Union operating under the AI Act's risk-tiered obligations, have generally paired technology deployment with statutory audit and appeal mechanisms rather than relying on voluntary principles alone (European Parliament, 2024). India's federal structure makes wholesale adoption of a similarly centralized regulatory model difficult, but the underlying logic — that deployment scale and oversight capacity should expand together — remains applicable regardless of the specific institutional form such oversight ultimately takes.

7. Conclusion

India's public sector has moved, over less than a decade, from strategic aspiration to operational experimentation with artificial intelligence across agriculture, health, energy, and urban governance. The applications documented in this paper demonstrate genuine potential for AI to advance specific, measurable SDG targets: more accurate agricultural risk assessment, expanded diagnostic reach in underserved health facilities, more efficient integration of renewable energy, and more responsive municipal services. Yet this potential remains only partially realized, constrained by fragmented data systems, an uneven digital access landscape, limited in-house technical capacity within government, and an accountability architecture that has not kept pace with the scale of deployment.

The central argument advanced here is that the sustainability of AI-enabled development gains in India's public sector depends primarily on institutional design choices rather than on the sophistication of the underlying technology. Interoperable data infrastructure, complementary investment in digital access, and binding algorithmic accountability mechanisms are not peripheral concerns to be addressed after core AI systems are built; they are the conditions on which the durability and equity of those systems depend. As India continues to expand AI adoption across its public administration in

pursuit of its SDG commitments, the lessons drawn from a decade of sectoral experimentation point toward a clear priority: matching the pace of technological deployment with an equally deliberate pace of institutional and regulatory development, so that the gains from AI accrue broadly rather than reinforcing the very disparities the SDGs seek to close.

References

1. Bailey, R., & Parsheera, S. (2023). Government exemptions under India's Digital Personal Data Protection Act: An assessment of scope and safeguards. National Institute of Public Finance and Policy Working Paper Series.
2. European Parliament. (2024). Regulation (EU) 2024/1689 laying down harmonised rules on artificial intelligence (Artificial Intelligence Act). Official Journal of the European Union.
3. Government of India. (2023). The Digital Personal Data Protection Act, 2023. Ministry of Electronics and Information Technology.
4. Government of India, Ministry of Electronics and Information Technology. (2021). Responsible AI for social empowerment (RAISE) discussion papers. MeitY.
5. GSMA. (2023). The mobile gender gap report 2023. GSM Association.
6. International Energy Agency. (2023). India energy outlook 2023. IEA Publications.
7. Khera, R. (2019). Dividing the poor: Aadhaar and the transformation of Indian social protection. In R. Khera (Ed.), Dissent on Aadhaar: Big data meets big brother (pp. 45–68). Orient BlackSwan.
8. Ministry of Health & Family Welfare. (2022). India TB report 2022. Central TB Division, Government of India.
9. Ministry of Housing and Urban Affairs. (2022). Smart Cities Mission progress report. Government of India.
10. National Sample Survey Office. (2022). Household social consumption on education and access to ICT (NSS 78th round). Ministry of Statistics and Programme Implementation.
11. NITI Aayog. (2018). National strategy for artificial intelligence: #AI for All. Government of India.
12. NITI Aayog. (2021). Responsible AI for all: Approach document for India (Part 1 & 2). Government of India.
13. Rajan, R. G. (2019). Notes on the digital public infrastructure model of development. Reserve Bank of India Occasional Papers.
14. Rao, M.K.P. (2018). A Study on E-Governance in India: Problems and Prospectus, International Journal of Management, IT & Engineering, Vol. 8 Issue 6, Available at: http://www.ijmra.us
15. Telecom Regulatory Authority of India. (2023). Indian telecom services performance indicator report. TRAI.
16. United Nations. (2015). transforming our world: The 2030 Agenda for Sustainable Development (A/RES/70/1). United Nations General Assembly.
17. Vinuesa, R., Azizpour, H., Leite, I., Balaam, M., Dignum, V., Domisch, S., Felländer, A., Langhans, S. D., Tegmark, M., & Fuso Nerini, 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.
18. World Bank. (2022). Digital public infrastructure and development: A global overview. World Bank Group.