

Received: 14.08.2025Accepted: 16.09.2025Published: 25.09.2025Page No: 88 – 92DOI: [10.5281/zenodo.18975082](https://doi.org/10.5281/zenodo.18975082)✉: [gkujournal@gku.ac.in](mailto:gkujournal@gku.ac.in)

# Application of Machine Learning in Citizen-Centric Services: National Strategy and the Punjab Paradigm

Mr. Manpreet Singh Gill

Assistant Professor, Department of Computer Science, Akal Degree College, Mastuana Sahib, Sangrur, Punjab, India

Email: [gillkotra@gmail.com](mailto:gillkotra@gmail.com)

*Abstract – Machine learning (ML) is revolutionizing citizen-centric service delivery across India, fundamentally enhancing the efficiency, transparency, and reach of public administration. This high-level paper discusses the strategic deployment of ML at a nation-level basis—within policy frameworks such as Digital India and National e-Governance Plan (NeGP)—and provides an in-depth case study of Punjab. Together, these perspectives provide actionable insights for the future of citizen services, suggest challenges, sectoral impacts and recommendations for best practice.*

*Keywords: Machine Learning, Artificial Intelligence, Digital India, Natural Learning Process, Sewa Kendras, Public Grievance Redressal System*

## 1. INTRODUCTION

Projects such as Digital India, NeGP and National Program on Artificial Intelligence indicate India's aspiration to be a front-runner in the digital government worldwide. ML is the core technology driving these efforts, enabling the government automate service delivery, predict citizen wants and needs, attack social challenges. Punjab as a leader of state-level reforms, showing that targeted use of ML can benefit everything from health and agriculture to grievance redressal and law enforcement.

## 2. MACHINE LEARNING IN CITIZEN-CENTRIC SERVICES: INDIAN NATIONAL FRAMEWORK

### 2.1 National Strategy and Programs

NeGP and Digital India mission require all government services to be digitized, intelligent automation and ML-powered for predictive analytics, fraud detection, virtual assistants at the front-end, automated document verification. "NITI Aayog's National Strategy for Artificial Intelligence (#AIFORALL) and MeitY's National Program on AI also institutionalize various aspects of ethics, inclusion and impact assessment.

### 2.2 Major Applications of Machine Learning in Governance

**Predictive Service Targeting:** ML algorithms can identify welfare recipients pro-actively rather than waiting for them to apply, which will reduce exclusion errors and the burden of data acquisition.

- **Fraud Detection in Welfare and Tax:** ML identifies suspicious patterns, curtails misuse, and enhances fiscal accountability. These technologies allow for the analysis of massive datasets, revealing complex, non-linear relationships and spotting patterns suggestive of fraudulent conduct.

- **AI Chatbots and NLP:** Virtual assistants automate query response, application tracking, and service information provision in online citizen centric services.
- **Resource Management:** ML forecasts demand in health, transport, utilities, thereby supporting effective resource allocation and strategic planning which in turn save lot of money and is helpful in tag proactive decisions across various domains.
- **Digital Certification and Document Verification:** E-Governance platforms use ML for automated cross-checking and digital approvals, drastically cutting physical visits and paperwork which in turn a remedy to cut Red Tapism in the system.
- **E-District Platforms:** The E-District Platforms: Internet-based platform makes provision for automatic generation of necessary certificates with NLP integration for local languages.

**3. STATE LEVEL INNOVATION: HOW PUNJAB IS LEADING A DIGITAL REVOLUTION WITH MACHINE LEARNING**

Punjab has led the gold standard in citizen centricity by way of applying ML with sectoral best practices and innovations recognized at national level.

**3.1 Strategic Initiatives and Platforms**

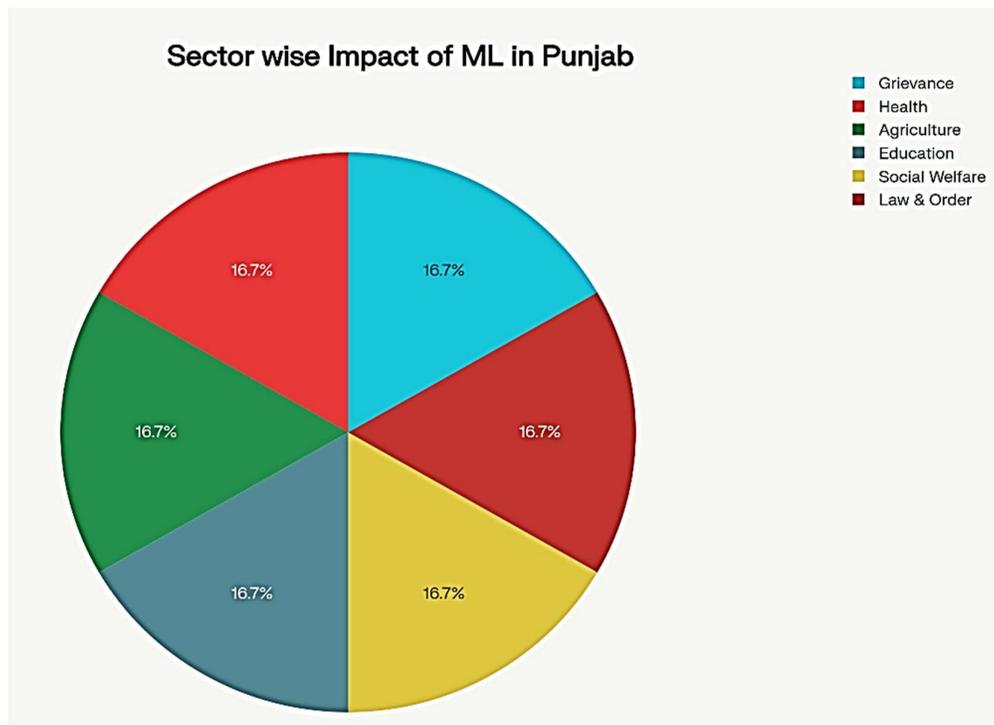
- **Connect Punjab Portal & Sewa Kendras:** ML automates document verification, application processes, and issues digitally signed certificates through SMS/WhatsApp by curtailing waiting time and corruption.
- **Public Grievance Redressal System (PGRS 2.0):** NLP and speech recognition enables the citizens to register a complaint in Punjabi, Hindi as well as English while ML is used for routing, prioritizing and tracking issues for quick redressal.
- **AI in Healthcare:** Examples range from “Cough Against TB,” which utilizes ML for analyzing cough sounds to screen for TB, to risk models that encouraged patient adherence and resource allocation.
- **Agriculture:** AI models forecast pest outbreaks (CottonAce system), optimize pesticide use, and trace seed quality, resulting in higher yields and reduced costs.
- **Education:** ML quantifies ORF, forecasts learning holes and simplifies online admittance process reducing expenses and deriving in more transparent information.
- **Law Enforcement and Safety:** ML-fueled facial recognition and video analytics encourage policing; The introduction of technology is accompanied by community digital literacy in building trust and capacity.

**3.2 Impact Metrics and Outcomes**

Punjab’s digital governance projects achieved:

Sector	ML Impact	Measured Outcomes
Grievance	ML-NLP complaint triage	Time to first Response, satisfaction good

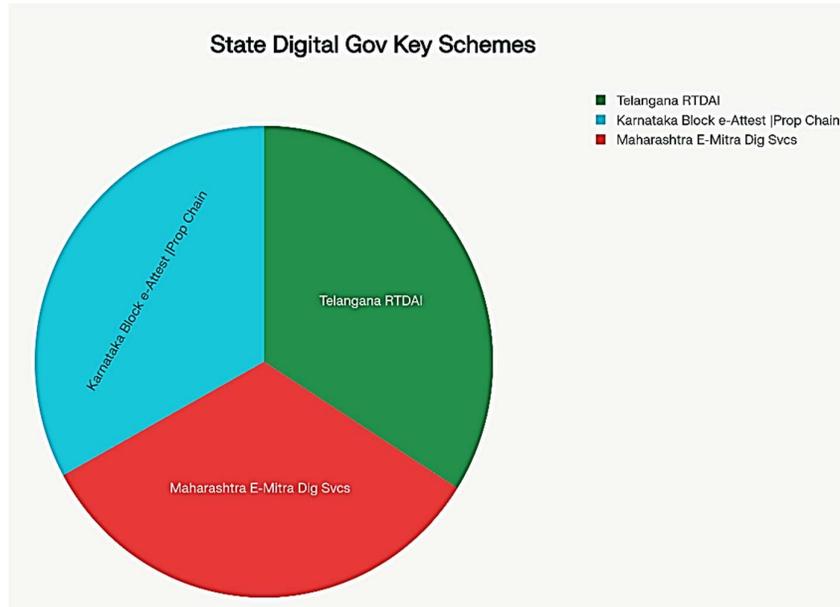
Sector	ML Impact	Measured Outcomes
Health	TB detection, neonatal warning	Improved screening rates, lower dropouts
Agriculture	Pest prediction, seed tracing	Increased Yield, less pesticide costs
Education	Reading assessment, admissions	Greater Disclosure and Learning effects
Social Welfare	Targeted subsidy disbursement	Lower tax fraud and more efficient targeting
Law & Order	Facial recognition, AI chatbots	When assigned to a mobile device, emergence of new threats



Digitising it resulted in pending citizen service rates in Punjab falling from 5 to percent to 4.5 percent, more than 95% of service appointments being completed on-time, and millions of certificates/direct benefits supplied via digital channels.

#### 4. COMPARATIVE REVIEW OF BEST CITIZEN CENTRIC PRACTICES IN INDIAN STATES

States Karnataka, Maharashtra, Telangana, Tamil Nadu and Kerala have started piloting ML and blockchain in citizen delivery of services by using it to provide the targeted rate at which a service needs to be delivered. Real-Time Digital Authentication of Telangana, Karnataka’s Blockchain e-Attestation and Maharashtra’s E-Mitra are other potential successful candidates. Insights from Punjab demonstrate the necessity of implementing cross-sector pilots, engaging communities and co-designing.



## 5. CHALLENGES ENCOUNTERED:

### 5.1 National Level

- **Digital Literacy:** An immense part of the population is not digitally literate, especially in rural areas, among older people and marginalized communities; digital divides persist despite long-embarked mobile penetration.
- **Infrastructure Gaps:** There are barriers for rural areas in connecting to the internet and obtaining devices.
- **Data Privacy and Security:** Strong frameworks are vital to protect private data and guarantee fairness and transparency in the ML systems.
- **Change Management:** in order to keep skills and develop them, coach/mentor/teach/share knowledge and win public confidence in the system through ongoing investment.

### 5.2 Punjab-Specific

- Ongoing demand for digital literacy services delivered locally and hybrid modes of service delivery, as well as enhanced network and software reliability.
- Low citizen trust leading to underutilization and lack of awareness, especially in rural Punjab.

## 6. RECOMMENDATIONS

- **Promote Digital Literacy:** Launch community based and women centric literacy programs in the local languages.
- **Upgrade Rural Infrastructure:** Investment in mobile/BharatNet broadband, user interface – friendly portal design etc and support for hybrid model.
- **Better data governance:** Be compliant with national standards (Digital Personal Data Protection Act) and incorporate strict ML/AI bias validations.

- **Pilot/SACALE OF INNOVATION:** Scale and TVs pilots across the state (CottonAce, PGRS 2.0, AI health screening).
- **Voice of the Citizen:** Provide for continuous improvement based on accessible feedback loops and analytics.

## 7. CONCLUSION

The successful fusion of national e-governance strategy proposed in India with the pioneering effort made by the state of Punjab shows a history turning role played by machine learning technology for service delivery to our globally connected public citizens. ML has helped to provide timely, transparent and personalised access to services, mitigate fraud, and promote inclusive engagement (in economic, health, agriculture and law enforcement). Replicating these successes in other states will need to invest in digital literacy, ethical frameworks and adaptive citizen-centric approaches.

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