

The Effect of Artificial Intelligence on Libraries in the Indian Scenario: Infrastructure, Adoption Metrics, and Strategic Roadmap

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ABSTRACT

The rapid integration of Artificial Intelligence (AI) is transforming traditional Indian libraries into intelligent, user-centric knowledge hubs. This paper examines the ongoing technological evolution within Indian library systems, focusing specifically on the adoption of Machine Learning (ML), Natural Language Processing (NLP), and Expert Systems. By analyzing current empirical data, this study highlights an 85% AI adoption rate in urban Indian institutions compared to just 20% in rural libraries, revealing a significant digital divide. The paper details how national frameworks—such as the National Digital Library of India (NDLI) and the Information and Library Network (INFLIBNET)—utilize semantic searching and algorithmic content sorting to optimize resource discovery. Finally, it addresses systemic bottlenecks—including funding constraints, infrastructure deficits, and AI literacy gaps—and outlines strategic pathways for equitable digital development across the Indian academic landscape.

KEYWORDS: Artificial Intelligence, Indian Libraries, Smart Libraries, Digital Divide, Information Retrieval, NDLI, Machine Learning.

1. INTRODUCTION

Libraries in India have historically transitioned from physical archives to automated digital preservation centres. The entry of Generative AI and automated metadata engines marks the beginning of the "Smart Library" era. In a fast-growing educational market like India, information professionals use AI to optimize complex operational workflows and handle massive volumes of research data. Technologies such as optical character recognition (OCR), RFID tracking, and smart shelving allow institutions to improve asset visibility and access.

However, the integration of these technologies varies widely across the country. Premium institutions (like the Indian Institutes of Technology (IITs) and central universities) leverage state-of-the-art AI systems, while tier-2, tier-3, and rural public libraries face significant infrastructure barriers. This study provides a comprehensive overview of AI adoption, explores the unique operational challenges within the Indian scenario, and maps out a scalable framework for inclusive growth.

2. TECHNOLOGICAL EVOLUTION: FROM AUTOMATION TO AI

The evolution of Indian libraries can be categorized into four distinct waves: Wave 1: Manual Ledger Systems (Physical catalogues, cards, registers, etc.)

Wave 2: Basic Library Automation (Integrated Library Management Software like Koha, SOUL; basic barcode scanning etc.)

Wave 3: Digital Libraries & Repositories (DSpace, Greenstone, open access institutional repositories, etc.)

Wave 4: Intelligent Ecosystems (AI, Machine Learning, Semantic Web, NLP-driven multi-lingual query processing, etc.)

Traditional automation software operates on static, rule-based logic (e.g., if a book is returned late, calculate a fixed fine). AI systems, by contrast, are dynamic and predictive. They analyze past borrowing habits to predict future resource demands, flag trends in academic research, and automatically categorize unindexed regional language documents without human intervention. This distinction shows that AI is not simply an extension of automation, but a shift towards adaptive and data-informed library services.

3. CORE AI APPLICATIONS IN INDIAN LIBRARY OPERATIONS

3.1 Technical Processing and Automated Metadata Generation

Traditional cataloguing using MARC21 or Dublin Core standards is highly labour-intensive. Indian academic libraries process thousands of multi-disciplinary theses each year. Natural Language Processing (NLP) tools automate metadata generation by scanning the full text of documents to extract abstract concepts, generate keywords, and assign standard classification codes (such as Dewey Decimal Classification). Such tools can reduce repetitive manual work while improving consistency in technical processing.

3.2 Information Discovery and Semantic Recommendation Engines

Standard library OPACs (Online Public Access Catalogs) rely on exact keyword matches, which may not always reflect the user's actual intent. AI-driven semantic search engines analyze the intent and contextual meaning behind user queries. For example, if a student searches for "sustainable farming in Punjab," the AI engine understands synonyms, historical variations, and related topics (e.g., "green revolution," "crop rotation"), delivering highly accurate recommendations based on the user's academic profile.

3.3. Multi-Lingual Translation and Regional Accessibility

India's linguistic diversity presents a unique challenge for knowledge dissemination. Most of the academic material is published in English, creating a barrier for rural students. Libraries are adopting AI-powered machine translation engines (such as the Government of India's Bhashini platform) to translate English textbooks and research papers into regional languages like Hindi, Tamil, Telugu, and Marathi on demand.

3.4 Virtual Assistants and Conversational AI

Libraries are deploying AI chatbots to handle repetitive reference desk queries. These chatbots manage queries regarding operating hours, borrowing policies, and Wi-Fi access, and they can even assist users with complex literature searches. This round-the-clock service frees up library staff to focus on advanced research support and user education.

4. Case Studies of National and Institutional Frameworks

4.1 National Digital Library of India (NDLI)

Initiated by the Ministry of Education and coordinated by IIT Kharagpur, the NDLI serves as a national meta-repository [NDLI]. To manage over 60 million digital resources, the NDLI utilizes machine learning algorithms for:

- **De-duplication:** Identifying and merging identical metadata records harvested from different institutional repositories.
- **Automatic Content Sorting:** Grouping educational assets by difficulty level, subject area, and target audience (e.g., primary education vs. post-doctoral research).

4.2 INFLIBNET and the Shodhganga Repository

The Information and Library Network (INFLIBNET) Centre maintains Shodhganga, India’s national repository for electronic theses and dissertations. Shodhganga uses AI-driven plagiarism detection tools (such as Ouriginal/Turnitin) and machine learning algorithms to map research trends across Indian universities. This analysis helps funding bodies identify over-researched areas and emerging fields that require financial support.

5. STATISTICAL ANALYSIS AND DATA INSIGHTS

Recent empirical studies highlight a distinct gap in AI infrastructure between urban and rural areas, as well as a wide variance in how library professionals view the impact of these technologies.

5.1 The Urban-Rural Digital Divide in AI Infrastructure

Data gathered across Indian institutions reveals that while major metropolitan universities are rapidly integrating AI & rural facilities face major resource deficits (Narendra, 2025).

Institutional Metric	Urban Percentage	Rural Percentage	Operational Impact
AI Tool Adoption Rate	85.00%	20.00%	High-end automated systems are concentrated in better-funded urban institutions.
High-Speed Connectivity Deficit	12.00%	55.00%	Rural libraries cannot run cloud-based AI tools reliably due to poor connectivity.
Dedicated Tech Funding Allocations	78.00%	15.00%	Rural institutions often struggle to allocate funds for software, licensing, and upgrades.
Workflow Efficiency Gain (Average)	45.00%	10.00%	Urban centers report major reductions in data processing time after technology adoption.
Query Resolution Delay Reduction	45.00%	5.00%	Automated chatbots provide immediate support in urban hubs by reducing routine response time more effectively.

5.2 Perceptions of Indian Library and Information Science (LIS) Professionals

A comprehensive nationwide survey of library professionals shows mixed feelings regarding the long-term impact of AI on their jobs [Suryawanshi]:

Survey Response Distribution

Minimal Impact / Threatened - 36.63% Significant

Positive Impact - 33.17% Supportive / Adjunct Tool -

25.50% Unsure / Neutral - 4.70%

This data shows that over **36% of professionals** feel AI poses a threat or will have a minimal, disruptive impact. This highlights an urgent need for proactive professional development and clear communication regarding the collaborative role of AI in libraries.

6. TECHNICAL CHALLENGES AND STRUCTURAL BOTTLENECKS

6.1 High Capital Expenditures and Licensing Fees

Developing proprietary AI models or licensing enterprise library platforms requires substantial capital. Most public and state university libraries in India operate on limited annual budgets, leaving little room for investments beyond physical book purchases and basic journal subscriptions.

6.2 AI Literacy and Skills Gaps

The traditional Library and Information Science (LIS) curriculum in India focuses heavily on manual classification (such as Colon Classification) and basic automation. There is a severe shortage of information professionals trained in data science, Python programming, prompt engineering, and machine learning model management.

6.3 Data Privacy and Ethical Concerns

AI search engines rely on tracking and analyzing user search patterns, reading speeds, and download histories to generate personalized recommendations. Without strict data protection laws and clear internal institutional policies, this tracking creates major student privacy risks and violates confidentiality norms.

6.4 The Problem of Algorithmic Bias

AI models are trained on existing, often Western-centric academic databases. When applied to Indian libraries, these models can exhibit structural bias—over-recommending Western publications while ignoring highly relevant open-access research published by Indian scholars in regional journals.

7. STRATEGIC ROADMAP FOR THE INDIAN SCENARIO

To ensure balanced and equitable AI integration across all levels of the Indian library network, the following steps are recommended:

1. **Developing Open-Source AI Infrastructure:** Instead of relying on expensive, proprietary foreign software, Indian institutions should collaborate to build open-source AI plug-ins for popular, widely used open library platforms like Koha and DSpace.
2. **Reforming LIS Curricula:** Indian universities must immediately update Bachelor of Library Science

(BLIsc) and Master of Library Science (MLIsc) programs. Training must include courses on data analytics, AI ethics, and digital content curation.

3. **Consortium-Based AI Purchasing:** Under frameworks like the e-ShodhSindhu consortium, institutions can pool their resources to purchase country-wide institutional licenses for advanced AI tools, reducing costs for smaller colleges.
4. **Implementing Shared Central Cloud Resources:** INFLIBNET can host centralized AI models on secure national servers. This cloud setup allows smaller, underfunded rural libraries to run resource-heavy semantic searches and multi-lingual translations without buying expensive local server hardware.
5. **Strengthening Continuous Professional Development:** Librarians need regular training opportunities so that they can evaluate, implement, and supervise AI tools in a responsible and context-sensitive manner.

CONCLUSION

Artificial Intelligence is changing the role of Indian libraries, shifting them from passive repositories to active knowledge centers. While urban institutions benefit from fast query resolution and automated cataloging, rural libraries face challenges due to limited digital infrastructure.

To close this gap, India requires targeted investments in public-private partnerships, open-source AI software, and national library literacy initiatives. Ultimately, AI is designed to enhance rather than replace the work of librarians, supporting them in an increasingly data-driven academic landscape.

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