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Original Article

Digital Libraries and Archives as Knowledge Management Systems for Born-Digital and Transformed-Digital Literature in India: A Historical Analysis of Preservation Practices

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Abstract

The development of digital libraries and archives in India represents a significant transformation in the management, preservation, organization, and circulation of knowledge. Beginning with large-scale digitization initiatives at the turn of the twenty-first century, Indian digital-library infrastructure has gradually expanded from the conversion of printed books and manuscripts into digital formats to institutional repositories, federated discovery systems, multimedia archives, community archives, and infrastructures capable of preserving born-digital records. This article historically examines major initiatives including the Digital Library of India (DLI), Traditional Knowledge Digital Library (TKDL), Shodhganga, National Digital Library of India (NDLI), Abhilekh Patal, Prime Ministers Museum and Library (PMML) Archives, National Mission for Manuscripts and its successor Gyan Bharatam Mission, IGNCA/Kalanidhi, Panjab Digital Library, Granthappura, Roja Muthiah Research Library, People's Archive of Rural India, Indian Memory Project, Archive of Indian Music, and the AYUSH Manuscripts Advanced Repository. It treats digital libraries as knowledge management systems that capture, classify, preserve, retrieve, contextualize, and disseminate knowledge rather than merely as collections of scanned objects. The analysis demonstrates that India's digital-library history has been considerably more successful in preserving transformed-digital, or digitized, heritage than in systematically collecting and preserving born-digital literary culture. It further identifies continuing inequalities in linguistic, regional, community, and cross-cultural representation. The article argues for an interoperable national preservation framework combining large national infrastructures with regional and community-led repositories and extending archival mandates to born-digital literature, web publications, electronic books, digital periodicals, multimedia narratives, and other forms of contemporary digital cultural production.

Keywords: *digital libraries; digital archives; knowledge management systems; born-digital literature; digitization; digital preservation; Indian languages; cultural heritage; multilingual archives; India*

Introduction

Digital libraries are no longer adequately understood as electronic substitutes for physical libraries. From the perspective of knowledge management, their significance lies in their ability to facilitate the acquisition, organization, storage, retrieval, transfer, and application of knowledge. Alavi and Leidner (2001) conceptualize knowledge management systems as information systems designed to support processes through which knowledge is created, stored, transferred, and applied. Digital libraries and archives perform comparable functions when they transform heterogeneous cultural objects into structured, searchable, contextualized, and reusable knowledge resources. (DOI) This article applies that perspective to India's digital-library and archival history. It distinguishes between two categories. Born-digital literature refers to materials created originally in digital form, including electronic theses, e-books, digital journals, websites, online literary magazines, blogs, digital narratives, databases, and multimedia publications. Transformed-digital literature refers here to analogue material subsequently converted into digital form through scanning, photography, audio conversion, or related processes. The latter is more commonly called *digitized* or *made-digital* material in digital-preservation practice. India's own C-DAC preservation infrastructure explicitly distinguishes born-digital from made-digital records. (CDAC) India presents a particularly important case because its documentary culture is distributed across numerous languages, scripts, religious traditions, regions, knowledge systems, institutions, and oral cultures. Consequently, the history of Indian digital libraries is simultaneously a history of technological modernization and of decisions concerning what kinds of knowledge become digitally visible.

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Research Question

How have digital libraries historically evolved as knowledge management systems to preserve, organize, retrieve, and provide access to both born-digital and transformed-digital literature and related cultural records in India, and what representational gaps persist within these infrastructures?

Objectives

1. To trace the institutional and technological history of significant digital-library and digital-archive initiatives in India.
2. To examine how these initiatives function as knowledge management systems through digitization, metadata creation, classification, preservation, retrieval, contextualization, and access.
3. To distinguish institutional practices directed toward transformed-digital material from those dealing with born-digital records.
4. To examine the contribution of national, academic, regional, community, and specialized repositories to India's digital knowledge infrastructure.
5. To identify linguistic, regional, cultural, and community-based gaps in contemporary digital-library and archival representation.
6. To assess the need for an integrated preservation framework for India's emerging born-digital literary heritage.

Methodology

The study adopts a qualitative historical-comparative document-analysis method. It examines institutional histories, official project descriptions, repository documentation, preservation policies, government reports, current repository statistics, and relevant scholarly studies. The principal cases were selected because they represent different institutional models: national aggregators, academic repositories, government archives, manuscript repositories, regional heritage initiatives, community archives, multimedia archives, and specialized knowledge databases. The analysis is organized around six knowledge-management functions: knowledge acquisition, digitization or ingest, metadata and classification, preservation, retrieval/discovery, and dissemination/access. Particular attention is paid to whether repositories preserve underlying digital objects themselves or primarily aggregate metadata and provide discovery services. Statistics are included only where identifiable institutional or government sources provide verifiable figures; because digital repositories grow continuously, such figures are treated as date-specific rather than permanent totals.

The study is not an audit of every Indian digital repository. Rather, the selected projects are used to reconstruct major historical tendencies and identify structural differences between transformed-digital preservation and born-digital preservation.

Review of Literature

Early scholarship on Indian digital libraries concentrated largely on digitization, collection-building, and information retrieval. Das, Dutta, and Sen (2007), examining indigenous Indian digital libraries, emphasized multilingual and multimedia retrieval and observed the increasing availability of culturally important South Asian collections. Tripathi and Tripathi (2007) focused specifically on problems encountered in representing and retrieving Indian-language materials, demonstrating that script encoding and multilingual information retrieval were fundamental structural issues rather than peripheral technical problems. Mahesh and Mittal's (2008) review of 63 studies of Indian digital-library development found that the literature overwhelmingly emphasized creating digital collections, while comparatively little attention had been given to digital rights management, security, and comprehensive digital-library policies. This indicates that India's first major phase was predominantly **collection-centred**. (Digital Libraries in India: A Review) More recent assessments demonstrate that digitization alone has not resolved questions of metadata, interoperability, access, and representation. Mukherjee and Patra's (2023) survey of approximately fifty Indian digital-library initiatives found uneven search facilities, metadata practices, remote access, and standards adoption. Wadhwa (2024) shifts the debate from technological availability to linguistic inclusion, arguing that minor Indian languages remain inadequately represented within large digital infrastructures. Her analysis of an NDLI snapshot illustrates the scale of this imbalance: of more than 97 million textual resources represented at the time, more than 86 million were identified as English-language resources, while some minor languages had extremely small holdings. (arXiv) Wadhwa and Chowdhary (2024) develop the linguistic argument further through Sindhi libraries, demonstrating that digitization strategies for minor-language literature require script-sensitive OCR, transliteration, text-to-speech technology, metadata development, and community participation. Digital preservation in multilingual India, therefore, cannot be reduced to scanning; it involves the preservation of discoverability and linguistic usability. (De Gruyter Brill)

Historical Evolution of Digital Libraries and Archives in India

1. The Mass-Digitization and Knowledge-Conversion Phase

One of the formative initiatives was the Digital Library of India (DLI), associated with the international Million Book Project in the early 2000s. The project sought to digitize large quantities of books, particularly public-domain and copyright-free literature, and make them electronically accessible. Its importance lies not merely in volume but in establishing scanning workflows, distributed digitization centres, Indian-language processing, metadata creation, and experiments in OCR and retrieval. DLI thus represents an early transition from preservation through physical custody to preservation through digital representation. The Traditional Knowledge Digital Library (TKDL), established in 2001 through collaboration between CSIR and the Ministry of AYUSH, adopted a different knowledge-management model. Instead of simply reproducing pages, TKDL converts information contained in traditional medical texts into structured, classified, multilingual data that patent examiners can retrieve. CSIR reports that the database now contains information concerning more than five lakh formulations and practices from Ayurveda, Unani, Siddha, Sowa Rigpa, and Yoga, represented in five international languages. Its principal function is defensive protection against erroneous patents rather than unrestricted public access. TKDL is therefore an important example of a digital library as a semantic and classificatory knowledge system, not merely a digitized collection. (CSIR) The National Mission for Manuscripts (NMM), established in 2003, extended large-scale digitization to India's manuscript heritage through documentation, conservation, cataloguing, and digitization. By April 2025, the Ministry of Culture reported 350,000 manuscripts digitized, with 136,490 uploaded and 77,152 publicly accessible. The programme has subsequently been restructured and expanded through the Gyan Bharatam Mission. (Press Information Bureau)

2. Institutional Repositories and Organized Scholarly Knowledge

A second phase emphasized structured repositories rather than scanning alone. **Shodhganga**, maintained by INFLIBNET following the UGC regulatory framework for electronic theses and dissertations, employs DSpace and internationally recognized interoperability protocols. Its significance is particularly important to the present study because electronic theses constitute one of India's largest systematically acquired bodies of contemporary digital scholarly writing. By 2026 the repository contained more than 650,000 full-text theses. Shodhgangotri complements it through research synopses and proposals. (INFLIBNET) Shodhganga demonstrates the movement from retrospective digitization toward **deposit-based digital knowledge management**. Its workflow involves standardized submission, metadata verification, storage, indexing, dissemination, and preservation. Unlike the DLI model, therefore, knowledge enters the repository through a continuing institutional process rather than primarily through retrospective conversion.

3. Aggregation and Federated Discovery: NDLI

The National Digital Library of India (NDLI) represents a further stage in which the central problem becomes not simply creating digital objects but integrating distributed resources. Developed and maintained by IIT Kharagpur under the Ministry of Education's National Mission on Education through ICT, NDLI was nationally launched in 2018 as a single-window discovery platform. At its launch, the government reported approximately 1.9 crore electronic books and documents from around 160 content contributors. (Press Information Bureau) NDLI uses filtered and federated searching and is designed to accommodate different languages, resource types, academic levels, and content providers. Its current services also include a Digital Preservation Centre and institutional digital-repository support. NDLI is consequently best understood as a knowledge aggregation and discovery infrastructure. However, aggregation needs to be distinguished from archival custody: a metadata aggregator does not necessarily preserve every underlying object supplied by external repositories. (National Digital Library of India)

4. From Archival Catalogues to Mass Digital Access

The National Archives of India's digitization history predates its public web portal. An Archival Information Management System programme began in 1998, while Abhilekh Patal was launched in March 2015 to provide internet-based access to archival descriptions and digitized records. Mass digitization accelerated from 2021. The NAI reported that by 27 April 2026 more than 204 million digitized pages had been uploaded to Abhilekh Patal. Its Digitize-on-Demand and Page-on-Demand services further connect physical archival custody with digital access. (National Archives of India) The Prime Ministers Museum and Library (PMML) performs a related role for private papers, institutional records, manuscripts, oral histories, newspapers, and other sources concerning modern India. Its current online catalogue explicitly incorporates a Digital Archive, while recent acquisitions demonstrate that its collections now include digital records as well as conventional files and manuscripts. This is significant because born-digital archival material has begun entering traditional archival institutions alongside transformed-digital collections.

Cultural, Regional and Specialized Digital Archives

India's national systems are complemented by repositories developed around linguistic regions and specialized cultural domains. IGNCA's Kalanidhi and Cultural Archives preserve literary, photographic, audio-visual, ethnographic, musical, and artistic collections. The archive explicitly identifies digitization as part of the management of originals and reproductions, while its collections include literature, music, photography, dance, architecture, and ethnographic documentation. (Ignca) IGNCA's wider preservation infrastructure is especially important because the National Cultural Audiovisual Archives has implemented an OAIS-oriented trusted repository developed with C-DAC. This demonstrates a progression from digitization toward standards-based preservation of complex multimedia objects. (National Cultural Audiovisual Archives) Regional projects reveal how decentralized archives can correct gaps in national collections. The Panjab Digital Library preserves manuscripts, books, periodicals, photographs, files, and other materials connected to Punjab while explicitly stating that relevance, rather than language, determines inclusion. Its catalogue currently represents more than 93,000 books and over 6,000 manuscripts. (Panjab Digital Library)**Granthappura**, developed by the Indic Digital Archive Foundation from digitization work begun in 2009, has expanded into a Kerala-focused archive covering several languages and scripts. Its repository currently reports more than one million digitized pages, over 9,000 items, and materials in 18 languages. (Indic Digital Archive Foundation) The **Roja Muthiah Research Library (RMRL)** supplies another regional model. Established around Tamil documentary culture, it reports approximately 500,000 physical collection items and more than three million digitally preserved page images. Its cataloguing practices employ MARC21, and its records have contributed to union catalogues and WorldCat. Such projects demonstrate that regional digital libraries do not merely supplement national institutions; they frequently possess deeper linguistic and bibliographical expertise for particular cultural traditions.

Participatory and Multimedia Archives

The expansion of India's digital archive has also transformed the identity of the record creator. **People's Archive of Rural India (PARI)**, launched in December 2014, describes itself simultaneously as a living journal and an archive. It creates born-digital journalism, photographs, video, audio, and translations while also preserving reports, documents, and earlier materials. By its tenth anniversary it was publishing daily in 15 languages. PARI therefore represents a hybrid model in which preservation occurs continuously alongside digital cultural production. (Rural India Online) The **Indian Memory Project**, founded in 2010 by Anusha Yadav, constructs historical narratives from privately held photographs and, in some cases, letters. Its archival objects are transformed-digital, but the contextual narratives produced around them are born digital. It therefore illustrates how digital archives create new knowledge rather than merely reproduce old objects. (INDIAN MEMORY PROJECT) Similarly, the **Archive of Indian Music** digitizes fragile gramophone recordings, including classical, folk, theatre, early cinema, speeches, and other recordings dating from the early twentieth century. Its primary contribution lies in transforming obsolete or endangered analogue sound carriers into accessible digital cultural records. (Google Arts & Culture) The **AYUSH Manuscripts Advanced Repository (AMAR)** represents specialized manuscript knowledge management. Managed through the CCRAS-National Institute of Indian Medical Heritage, it records manuscript title, source location, language, script, subject, authorship, accession data, and related descriptive information. CCRAS is continuing collection, digitization, and cataloguing of AYUSH manuscripts and rare books, showing how domain-specific metadata can improve intellectual access to specialized textual traditions. (CCRAS)

The Emergence of Long-Term Digital Preservation

A crucial institutional development occurred when the Government of India's information-technology infrastructure began treating digital preservation as different from digitization. The National Digital Preservation Programme was envisaged by the Department of Electronics and Information Technology from 2007, followed by the C-DAC Centre of Excellence for Digital Preservation in 2011. Its objectives included preservation standards, trustworthy digital repositories, digital-preservation technologies, and professional capacity building. (C-DAC) C-DAC's **DIGITĀLAYA** is explicitly designed to manage both born-digital and made-digital records, including provenance, integrity, access control, migration, archival retention, and technological obsolescence. It conforms to the OAIS reference model and demonstrates that India possesses technical architecture capable of true long-term digital preservation. (C-DAC) Yet this infrastructure has been applied especially to government records and institutional audiovisual heritage. A comparable national collection mandate for **born-digital literary and cultural production** remains difficult to identify. This distinction is central: India possesses increasingly sophisticated mechanisms for preserving electronic records, but this does not automatically ensure preservation of online magazines, digital poetry, independent e-books, literary websites, blogs, social-media-based literary communities, digital storytelling, or web-native vernacular writing.

Gyan Bharatam and the New Platform Phase

The **Gyan Bharatam Mission** marks the latest stage of state-led manuscript digitization. Announced in 2025 and implemented through the Ministry of Culture, it seeks to survey, catalogue, conserve, digitize, and provide access to more than one crore manuscripts through a National Digital Repository. By July 2026, the national survey had reported more than 1.19 crore manuscripts. The programme incorporates OCR, handwritten-text recognition, script recognition, semantic search, machine-assisted translation, and other AI-enabled technologies. (Press Information Bureau) Gyan Bharatam therefore signals a movement from basic digitization to computational knowledge infrastructure, where images, metadata, transcription, translation, semantic retrieval, and provenance are increasingly interconnected. Nevertheless, its primary orientation remains inherited manuscript heritage rather than contemporary born-digital literary production.

Gaps in Cross-Cultural Representation

The historical record reveals an important paradox. India has numerous multilingual projects, yet multilinguality at the system level does not guarantee balanced representation within collections. Wadhwa's (2024) study shows that large national repositories may still disproportionately represent English and major languages, leaving minor and non-territorial languages with limited visibility. Wadhwa and Chowdhary's study of Sindhi further demonstrates that inadequate OCR, script conversion, metadata, and local institutional capacity can make literature digitally invisible even when the physical texts survive. (Digital libraries for minor languages in India: frameworks for addressing absences in policy and governance – Kudos: Growing the influence of research)

Representation is also institutional. National repositories generally privilege materials already held by universities, government departments, large libraries, and recognized heritage institutions. By contrast, PARI, Panjab Digital Library, Granthappura, Indian Memory Project, and similar initiatives demonstrate the value of materials originating in villages, families, community institutions, regional libraries, private collections, and oral traditions. A more representative national digital infrastructure therefore requires interoperability between **large national systems and smaller community-controlled repositories**, rather than centralization alone. Cross-cultural representation must consequently be measured not simply by the number of languages listed in an interface, but by the depth of collections, quality of metadata, discoverability across scripts, community participation, representation of oral and multimedia traditions, and the capacity of minor-language communities to determine how their cultural materials are described and accessed.

Major Findings

First, India's digital-library development has progressed historically from **mass digitization to repositories, aggregation, participatory archives, and preservation infrastructures**. DLI exemplifies large-scale retrospective conversion; Shodhganga represents institutional deposit; NDLI represents federated discovery; and C-DAC's preservation programme introduces trustworthy long-term preservation. Second, **transformed-digital material remains the dominant preservation category**. Manuscripts, books, archival files, newspapers, photographs, gramophone recordings, and other analogue heritage have received extensive attention through NMM/Gyan Bharatam, Abhilekh Patal, RMRL, PDL, Granthappura, AIM, IGNCA, and related institutions. Third, India has developed genuine technological capacity for **born-digital preservation**, particularly through C-DAC and electronic-record systems. Shodhganga and PARI also preserve substantial natively digital knowledge. However, there is no comparably comprehensive national framework specifically collecting born-digital literary culture. Fourth, the most successful Indian systems increasingly operate as **knowledge management systems rather than image repositories**. TKDL's classification, Shodhganga's metadata workflow, NDLI's federated discovery, Abhilekh Patal's archival metadata, and Gyan Bharatam's emerging AI-assisted transcription and semantic access demonstrate this transformation. Fifth, **linguistic and cultural inequality remains structural**. Regional archives have helped address this problem, but national-scale infrastructures need stronger representation of minor languages, non-dominant scripts, oral traditions, Indigenous and community knowledge, personal archives, and digitally produced vernacular literature.

Conclusion

The history of digital libraries and archives in India cannot be described simply as a movement from paper to screens. It is more accurately understood as the gradual construction of a national knowledge-management ecology. Early projects concentrated on rescuing and digitizing physical heritage. Institutional repositories subsequently standardized ingestion and metadata; national aggregators improved discovery; community archives diversified the identity of knowledge creators; and digital-preservation programmes introduced requirements relating to authenticity, provenance, technological migration, and long-term accessibility. India's principal achievement has therefore been the creation of a large and diverse infrastructure for **transformed-digital heritage**. The next preservation challenge is different. Increasing proportions of contemporary literature and cultural expression are now created digitally and may never possess stable physical originals. Unless acquisition policies and preservation workflows begin capturing such material at or near the moment of creation, significant parts of twenty-first-century Indian literary history may disappear despite the enormous success of manuscript and book digitization. A sustainable future model should connect NDLI-scale discovery with preservation repositories conforming to recognized standards, while allowing regional and community archives to retain intellectual and cultural authority over their materials. It should support Unicode and script-sensitive metadata, multilingual OCR and handwritten-text recognition, persistent identifiers, preservation metadata,

format migration, web archiving, rights management, and interoperable APIs. Most importantly, preservation policy should treat linguistic and cultural diversity as an architectural requirement rather than merely an interface feature.

The historical development of India's digital libraries thus reveals both considerable institutional achievement and a significant unfinished task: moving from the digitization of India's documented past toward the systematic preservation of its digitally created present.

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