5 Open Access, Copyright, and Scholarly Communication: Recent Advancements in Management and Academic Library Sciences in India

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Abstract

The evolving landscape of scholarly communication in India reflects a growing commitment to democratizing access to academic knowledge. This chapter critically explores the intersection of open access (OA), copyright, and scholarly communication, with a particular focus on recent developments in management and academic library sciences across India. As digital transformation redefines how knowledge is produced, shared, and preserved, Indian academic institutions are actively reconfiguring traditional publishing paradigms through institutional repositories, OA mandates, and government-led initiatives. The chapter begins by tracing the evolution of scholarly communication in India, highlighting the transition from print-centric models to digital dissemination through platforms like Shodhganga, NDLI, and university repositories. It then examines the role of India's Copyright Act and Creative Commons licensing in facilitating or hindering open access practices. Emphasis is placed on recent advancements such as the proliferation of OA repositories, increasing use of preprints, and national strategies like One Nation One Subscription (ONOS) and One DAE One Subscription (ODOS), which aim to consolidate and broaden access to scholarly content. Academic libraries emerge as key enablers in this transformation—supporting repository development, raising copyright awareness, managing Article Processing Charges (APCs), and engaging with faculty to promote open scholarship. The chapter incorporates case studies from institutions like IISc Bangalore, University of Delhi, and CSIR to illustrate both achievements and persistent challenges, including funding limitations, low OA awareness, and legal ambiguities. By integrating quantitative insights with policy review and best practices, the chapter offers a roadmap for enhancing scholarly communication in India. It concludes by recommending strategic interventions such as national OA mandates, capacity building for librarians, and the integration of AI and

blockchain technologies for copyright and metadata management, all of which are essential for a sustainable, inclusive knowledge ecosystem.

Keywords: *Open Access, Scholarly Communication, Copyright, Institutional Repositories, Academic Libraries, ONOS, ODOS, India, Creative Commons, Library Science*.

Introduction

Digital Transformation in Academia

The rise of digital technologies has significantly altered the academic landscape, transforming how knowledge is produced, curated, accessed, and shared. With the proliferation of the internet, digital repositories, and institutional archives, the barriers to accessing scholarly content have diminished in many parts of the world. However, in countries like India, challenges around affordability, copyright restrictions, and equitable access to information remain pressing.

The demand for scholarly communication systems that are efficient, ethical, and inclusive has led to an increased focus on **Open Access (OA)** models and intellectual property frameworks that support broader knowledge dissemination.

Scholarly Communication in the Indian Context

India is home to a vast academic and research community that produces significant knowledge output annually. According to the SCImago Journal & Country Rank (2023), India ranks third globally in the number of research articles published. Despite this, many researchers and students struggle to access leading international journals due to paywalls and institutional subscription costs.

Table 1: Academic Publishing and Access in India (2023)

Indicator	Value
Total research articles published	195,000+
% available through Open Access	34%
Major OA repositories	Shodhganga, arXiv, DOAJ
Institutions with OA mandates	82
Average institutional subscription budget (annual)	₹15–20 lakh

(Source: INFLIBNET, SCImago, UGC Reports)

These challenges underscore the importance of initiatives like **One Nation One Subscription (ONOS)** and **One DAE One Subscription (ODOS)**, aimed at democratizing access to scholarly literature across Indian institutions.

Emergence of Open Access Paradigms

Open Access refers to unrestricted online access to scholarly research outputs, often facilitated through repositories, OA journals, or preprint platforms. The

Budapest Open Access Initiative (2002) and subsequent global declarations have pushed for free, immediate access to research. In India, UGC's Shodhganga and the National Digital Library of India (NDLI) are pioneering platforms promoting OA principles.

This movement challenges traditional publishing models and encourages **knowledge equity**, where researchers, regardless of institutional affiliation or financial means, can contribute to and benefit from scholarly discourse.

Copyright and Licensing Challenges

While Open Access is a step forward, it raises questions around copyright ownership, licensing, and ethical reuse. Many Indian researchers remain unfamiliar with **Creative Commons (CC)** licenses, which are crucial for OA publishing. There is a pressing need for **capacity building in copyright literacy**, especially among early-career researchers and library professionals.

Academic libraries play a pivotal role in guiding faculty on legal sharing practices, managing institutional repositories, and negotiating subscription licenses that allow some level of OA.

Objectives of the Chapter

This chapter aims to:

- Explore the evolution of open access practices in Indian academia.
- Examine the copyright and licensing frameworks that affect scholarly communication.
- Highlight the role of academic libraries in bridging gaps between policy and practice.
- Discuss emerging initiatives like ONOS and ODOS and their impact on knowledge access.

By analyzing these intersections, this chapter lays the foundation for understanding how open access, copyright law, and scholarly communication are transforming management and academic library sciences in India.

Evolution of Scholarly Communication in India

Scholarly communication refers to the creation, evaluation, dissemination, and preservation of academic knowledge. In India, this practice has evolved significantly—from traditional print-based methods to dynamic, digital, and open-access platforms. The transformation reflects broader global trends influenced by technological innovations, policy reforms, and the demand for wider accessibility and visibility of research.

This chapter traces the evolution of scholarly communication in India, focusing on historical practices, the digital transition, institutional developments, and emerging trends that are shaping the future of academic publishing in the country.

- **Historical Foundations: Print and Subscription Era**

For much of the 20th century, scholarly communication in India was dominated by print media. Peer-reviewed journals were published by academic societies, government-funded research institutions (such as CSIR and ICAR), and university presses. Access to such materials was largely limited to institutional libraries, with expensive subscriptions posing a barrier to many scholars, particularly from underfunded or rural institutions.

Conference proceedings were often printed in limited quantities, and dissertations or theses remained archived within university departments with minimal public visibility.

Table 2: Traditional vs. Emerging Forms of Scholarly Communication in India

Aspect	Traditional Model (Pre-2000)	Emerging Model (Post-2000)
Format	Print journals	Electronic journals, digital archives
Access	Subscription-based	Open Access, OA mandates
Distribution	Physical libraries, postal delivery	Online platforms, repositories
Review Process	Slow, print-based peer review	Rapid, often digital, peer or open review
Visibility	Limited (national/local)	Global reach via digital databases

- **The Digital Turn: Emergence of Online Platforms**

The late 1990s and early 2000s marked a turning point in India's scholarly communication landscape with the introduction of digital tools and platforms. Key developments included:

  - **Electronic Journals**: Indian publishers like Medknow and Indian Academy of Sciences began hosting online journals. These offered quicker publication timelines and broader dissemination.
  - **Institutional Repositories**: Institutions such as the Indian Institute of Science (IISc) and IITs launched digital repositories, providing access to faculty publications, theses, and technical reports.
  - **Digital Libraries**: The Information and Library Network (INFLIBNET) launched the **Shodhganga** project, enabling open access to Indian doctoral theses.
  - **Preprint Culture**: Indian scholars started using platforms like **arXiv**, **bioRxiv**, and **IndiaRxiv**, promoting early dissemination of research outputs.

These transformations were further supported by government initiatives like the **National Knowledge Network (NKN)**, which aimed to interconnect universities and research institutions with high-speed bandwidth for research sharing and collaboration.

- **Policy Interventions and Open Access Movement**

India's adoption of open access (OA) principles has played a key role in transforming scholarly communication. The **Department of Science and Technology (DST)** and **Department of Biotechnology (DBT)** mandated open access to publicly funded research outputs in 2014, encouraging institutions to develop repositories and support OA publishing.

Key milestones:

- **Open Access India Movement (2011–present)**: A community-led initiative advocating for equitable access to scholarly information.
- **UGC CARE List**: To improve the quality of scholarly publishing, the University Grants Commission introduced the **Consortium for Academic and Research Ethics (CARE)** to identify reputable journals.
- **One Nation, One Subscription (ONOS)**: Proposed as a national-level initiative to negotiate journal subscriptions collectively, aiming to democratize access to high-quality international research publications.

- **Challenges in Scholarly Communication**

Despite these advancements, India's academic communication ecosystem faces several persistent challenges:

- **Predatory Publishing**: The proliferation of substandard and pay-to-publish journals undermines research quality and global credibility (Shen & Björk, 2015).
- **Language Barriers**: The dominance of English-language publishing marginalizes regional language research.
- **Digital Divide**: Rural and underfunded institutions struggle with limited infrastructure and access to online resources.
- **Lack of Awareness**: Many early-career researchers lack training in responsible publishing practices and copyright management.

- **Rise of Collaborative and Data-Driven Scholarship**

Another shift in Indian scholarly communication is the increasing focus on interdisciplinary, collaborative, and data-driven research. Platforms such as **ResearchGate**, **Academia.edu**, and **ORCID** are widely adopted by Indian scholars for sharing work and building professional networks. Additionally, collaborative tools

and cloud-based reference managers (like Zotero, Mendeley, and EndNote) have facilitated joint research efforts across institutions and borders.

The emergence of **research data repositories** like the **Indian Data Portal** and **ICSSR Data Service** supports data-driven research and promotes reproducibility—core elements of open science.

- **Future Directions: Toward Inclusive and Sustainable Communication**

Looking ahead, India's scholarly communication system is expected to further align with global open science practices, incorporating artificial intelligence tools, blockchain-based verification, and multilingual publishing models. Some promising directions include:

  - **Promotion of Indigenous Knowledge Systems (IKS)** through digitized archives.
  - **Multilingual research communication** platforms for regional inclusivity.
  - **Open peer review** mechanisms to enhance transparency and credibility.
  - **Incentivization of preprint sharing** and open data citation.

To achieve this, collaboration among academia, government, publishers, and technology providers is essential. Policies must ensure equity, quality assurance, and ethical standards while embracing innovation.

Understanding Open Access (OA) in the Indian Context

- **Introduction to Open Access**

Open Access (OA) is a publishing model that allows scholarly research outputs to be made freely available to the public via the internet. This model ensures that users can read, download, distribute, and utilize research without facing subscription barriers or legal restrictions, as long as the original authors are properly credited. OA has emerged as a significant force in global scholarly communication, promoting transparency, equity, and access to knowledge across borders.

- **OA Models: Gold and Green**

Two principal models of Open Access dominate scholarly publishing:

  - **Gold Open Access**: Involves publishing in journals that make content freely available online immediately upon publication. These journals may charge an Article Processing Charge (APC) to authors or their institutions.
  - **Green Open Access**: Refers to self-archiving where authors deposit a version of their manuscript (pre-print or post-print) in an institutional or subject-based repository.

India has seen adoption of both models, though Green OA is more prevalent due to its cost-effectiveness and institutional support (Suber, 2012).

- **Growth of Open Access in India**

The OA movement in India has been significantly influenced by government initiatives, institutional repositories, and digital infrastructure development. Key milestones include:

- **Shodhganga**: A digital repository of theses and dissertations submitted to Indian universities, maintained by INFLIBNET Centre.
- **Shodhgangotri**: A repository for synopses and research proposals of doctoral candidates.
- **National Digital Library of India (NDLI)**: Aggregates metadata from different repositories and provides a unified interface to access millions of scholarly resources.
- **Directory of Open Access Journals (DOAJ)**: India is among the top contributing countries in DOAJ-listed journals.

These initiatives aim to bridge the gap between academia and the public, especially for under-resourced institutions and rural communities.

Table 3: Major OA Initiatives in India

Initiative	Description	Managing Body
Shodhganga	Digital repository of theses and dissertations	INFLIBNET (UGC)
Shodhgangotri	Repository of research synopses and proposals	INFLIBNET (UGC)
NDLI	Federated digital library for all learners	IIT Kharagpur (MHRD)
eGyankosh	OA platform for distance education resources	IGNOU
Indian Academy of Sciences Journals	Gold OA journals across multiple disciplines	Indian Academy of Sciences

- **OA Adoption in Indian Academia**

The growth of OA in India has been uneven. Premier research institutions like the Indian Institutes of Technology (IITs), Indian Institutes of Science Education and Research (IISERs), and central universities have adopted OA practices actively. Many of these institutions maintain institutional repositories (IRs) where faculty and students upload preprints, theses, and grey literature.

However, the situation is less encouraging in state universities and affiliated colleges, where awareness about OA publishing and repositories remains limited. Factors include lack of funding, poor digital literacy, and absence of institutional mandates.

- **Benefits of OA for Indian Researchers**

Open Access provides numerous benefits for Indian researchers and institutions:

  - **Increased Visibility and Impact**: OA articles are more frequently downloaded and cited than paywalled ones (Piwowar et al., 2018).
  - **Global Collaboration**: Easier access to research findings fosters cross-border academic collaboration.
  - **Cost Efficiency**: Reduces dependency on expensive journal subscriptions.
  - **Democratization of Knowledge**: Ensures that students and scholars in rural or underfunded institutions have equal access to research outputs.

- **Challenges in OA Implementation**

Despite its promise, several challenges hinder the wider adoption of OA in India:

  - **Low Awareness**: Many faculty members, especially in state and private colleges, are unfamiliar with OA concepts and repositories.
  - **Predatory Publishing**: The rise of dubious OA journals exploiting APCs has raised concerns about quality and credibility.
  - **Lack of Institutional Mandates**: Few Indian institutions have policies requiring faculty to deposit their work in OA repositories.
  - **Technical Infrastructure**: Smaller institutions often lack the digital infrastructure to host repositories or track OA compliance.

- **Government Policy and Future Directions**

The Indian government has taken steps to promote OA, including the UGC's mandate for mandatory submission of theses to Shodhganga and the creation of NDLI. However, a unified national OA policy—similar to Europe's Plan S—is still lacking.

The **One Nation One Subscription (ONOS)** model proposed by the Ministry of Education aims to provide centralized subscription access to major academic journals and databases, which may reduce OA momentum unless accompanied by support for publishing in OA venues.

Going forward, a dual approach is needed: encourage Gold OA through national publishing funds and enhance Green OA by strengthening institutional repositories and mandates.

- **Recommendations**

To strengthen the OA movement in India, the following strategies are recommended:

- **Mandatory OA Policies**: Institutions should adopt mandates for self-archiving and OA publishing.
- **Capacity Building**: Conduct workshops and training programs on OA awareness and repository management.
- **Funding for APCs**: Provide grants or waivers for APCs to support publishing in reputable Gold OA journals.
- **Collaboration**: Establish national consortia for OA publishing and repository management.
- **Monitoring Tools**: Develop dashboards to track OA compliance and usage metrics across institutions.

Copyright Law and Intellectual Property in Academia

Copyright and intellectual property (IP) laws form the backbone of knowledge dissemination and innovation in academia. In India, the **Copyright Act of 1957**, supplemented by several amendments (notably in 1994, 2012, and 2021), governs the legal rights associated with literary, artistic, and scholarly works. For educators, researchers, students, and institutions, understanding how copyright impacts teaching, publishing, and the digital circulation of knowledge is essential for ensuring compliance and maximizing academic reach.

- **Overview of India's Copyright Framework in Academia**

The **Copyright Act, 1957** protects original works, including books, articles, theses, lectures, and digital materials. Academic institutions fall under this umbrella for works created within their domain. The Act specifies **economic rights** (e.g., reproduction, distribution, and communication to the public) and **moral rights** (such as authorship and integrity of the work).

Key Features of the Indian Copyright Act (1957)

Provision	Description
Section 13	Protects original literary, dramatic, musical, and artistic works
Section 52	Lists acts that do not constitute infringement (e.g., fair dealing for private or educational use)
Section 2(o)	Defines literary work to include computer programs and online content
2012 Amendment	Introduced compulsory licensing, digital rights, and fair use exceptions for education

The **2012 Amendment** was significant in enabling educational institutions to digitize materials for classroom use, distance education, and online libraries.

- **Fair Use and Educational Exceptions**

Section 52 of the Act includes **"fair dealing"** provisions which allow reproduction for research, teaching, and criticism without prior permission. However, these exceptions are not always clearly defined, leading to **legal ambiguity** and cautious institutional practices.

Educational Use under Section 52(1)(i):

- Reproduction by a teacher for instructional purposes
- Reproduction of works for examinations
- Use of short excerpts in research or academic papers

Despite these provisions, **uncertainty remains** regarding the volume, type, and context of permitted use—especially in digital environments like Learning Management Systems (LMS), MOOCs, or open courseware.

- **Open Licensing and Creative Commons in Indian Academia**

To overcome limitations in traditional copyright, many Indian academics and institutions are adopting **Creative Commons (CC)** licenses. These licenses allow authors to retain ownership while permitting varying levels of reuse by others.

Common Types of CC Licenses Used in Academia

License Type	Permission Granted
CC BY	Reuse with attribution
CC BY-SA	ShareAlike reuse with attribution
CC BY-NC	Non-commercial reuse with attribution
CC0	No rights reserved; public domain dedication

Platforms like **Shodhganga**, **e-PG Pathshala**, and **NPTEL** often feature open-licensed content to promote educational equity and knowledge sharing.

Example: The University Grants Commission (UGC) mandates open access deposit of Ph.D. theses in Shodhganga, encouraging authors to assign Creative Commons licenses for greater visibility and reuse.

- **Intellectual Property in Academic Institutions**

IP in academia includes not only copyright but also patents, trademarks, and geographical indications. Increasingly, **research outputs, courseware, software, and digital content** are considered institutional assets. Many Indian universities now have dedicated **IPR Cells** or **Technology Transfer Offices (TTOs)** under schemes like the **National Intellectual Property Rights Policy (2016)** and **Institutional Innovation Councils (IICs)**.

Common Academic IP Assets:

- Lecture notes and digital courses
- Research papers and e-books
- Databases and software

- Innovative teaching tools
- Patented research products

The ownership of such assets can vary—sometimes retained by the individual creator, sometimes claimed by the institution, especially if created under funded projects or employment terms.

- **Challenges and Ethical Considerations**

Despite growing awareness, several challenges persist in the academic use of copyrighted and open materials:

- **Low Awareness:** Many faculty and researchers remain unaware of their rights or licensing options (Saxena & Kapoor, 2021).
- **Plagiarism & Misuse:** Reuse without attribution is common, affecting academic integrity.
- **Protection of Indigenous Knowledge:** Traditional knowledge, folklore, and tribal art are often appropriated without community consent or benefit sharing.
- **Digital Piracy:** Unlicensed sharing of academic books and journals is widespread, especially in student communities with limited access.

- **Case Study: IIT Bombay and Open Licensing**

IIT Bombay's **FOSSEE Project** (Free/Libre and Open Source Software for Education) releases all content under **CC BY-SA** licenses. This model promotes national capacity building in science and engineering education, while respecting authorship and encouraging collaborative reuse.

The institution also encourages faculty to retain author rights when publishing with commercial publishers and to negotiate for open access terms—an emerging best practice in academic publishing.

- **Recommendations for Policy and Practice**

To enhance compliance, openness, and integrity, the following strategies are recommended:

- **Copyright Literacy Programs**: Regular workshops and online modules for students and faculty.
- **Institutional IP Policies**: Clear guidelines on ownership, licensing, and use of educational content.
- **Promotion of Open Access**: Institutional repositories and open publication mandates.
- **Legal Support Mechanisms**: IPR cells with legal advisors for copyright queries.
- **Protection of Traditional Knowledge**: Inclusion of community consent protocols and benefit-sharing mechanisms.

Recent Advancements in Open Access and Institutional Repositories

In the age of digital scholarship, Open Access (OA) has emerged as a transformative movement enabling free and unrestricted access to academic research. Institutional repositories (IRs) are a cornerstone of the OA infrastructure, serving as digital archives for preserving and disseminating scholarly outputs. In India, the past decade has witnessed significant growth in the establishment and development of institutional repositories, supported by technological advancements and favorable policy mandates from governmental and funding bodies.

- **Evolution of Open Access in India**

India was relatively late to adopt the Open Access model compared to Western countries; however, recent years have seen substantial progress. Government initiatives such as the UGC (University Grants Commission) notification mandating the deposit of doctoral theses into repositories like **Shodhganga**, and the DST and DBT policy guidelines on open access for publicly funded research have set the stage for nationwide OA implementation.

The increased awareness about the benefits of OA—visibility, citation impact, and knowledge equity—has encouraged researchers and institutions to contribute to IRs actively. National and institutional mandates have further strengthened the OA ecosystem in India.

- **Technological Advancements in Repository Platforms**

The growth of institutional repositories has been facilitated by open-source software solutions that allow institutions to manage their digital collections efficiently. Among the most commonly used platforms in India are:

  - **DSpace**: Adopted by numerous Indian institutions, DSpace offers robust metadata support, interoperability via OAI-PMH, and customizable workflows.
  - **EPrints**: Favored for its user-friendly interface and modular architecture.
  - **Invenio**: Used by select research institutions for its scalability and support for diverse document types.

Table 4: Popular Repository Platforms in Indian Institutions

Repository Platform	Key Features	Examples of Usage in India
DSpace	Metadata standards, community structure	IITs, IISc, Shodhganga
EPrints	Customizable workflow, plugin support	Anna University, Indian Statistical Institute
Invenio	Large-scale data handling, multilingual	NISCAIR, CSIR Labs

Source: Compiled from institutional websites and INFLIBNET (2024)

- **Notable Institutional Repositories in India**

India boasts several prominent institutional and thematic repositories contributing significantly to the OA movement:

- **Indian Academy of Sciences Repository**: Hosts publications from leading Indian journals, offering full-text access.
- **CSIR-URDIP Repository**: Specializes in intellectual property and patent information related to scientific research.
- **Shodhganga**: Managed by INFLIBNET, it serves as a national repository for Ph.D. theses submitted to Indian universities.
- **NIAS Repository**: Curated by the National Institute of Advanced Studies, focused on interdisciplinary research.

These repositories not only increase the visibility of Indian research but also foster collaboration by allowing global researchers to access regional studies.

- **Policy Support and Funding Agency Mandates**

Recognizing the value of OA, Indian funding agencies have introduced policy guidelines that mandate open dissemination of publicly funded research:

- **DST and DBT Open Access Policies** (2014): Require grantees to deposit the final accepted versions of manuscripts in institutional or subject repositories.
- **UGC Guidelines (2016)**: Promote OA through Shodhganga and emphasize publication ethics.
- **ICMR Open Access Policy (2020)**: Encourages biomedical researchers to share findings freely and promptly.

These policies align with international frameworks like **Plan S**, and several elite Indian institutions—such as IISc Bangalore, IIT Madras, and Jawaharlal Nehru University—are already adapting their workflows to support such mandates.

- **Impact of Open Access on Research Dissemination**

The growth of OA has yielded measurable impacts on scholarly communication in India:

- **Increased Citations**: Studies suggest that OA articles receive 30–50% more citations than paywalled ones (Suber, 2012).
- **Global Visibility**: Institutional repositories have improved the global discoverability of Indian research, particularly in areas like climate studies, agriculture, and public health.
- **Collaboration and Reuse**: OA supports cross-disciplinary collaboration and enables data reuse, fostering a culture of transparency and innovation.

However, the success of OA depends not only on technological infrastructure but also on faculty awareness, training, and academic incentives for repository deposits.

- **Challenges and Future Directions**

  Despite these advancements, several challenges remain:

  - **Low Awareness**: Many faculty members are still unaware of OA benefits or confuse it with predatory publishing.
  - **Technical and Financial Barriers**: Smaller institutions often lack technical expertise or funding to establish robust IRs.
  - **Policy Enforcement**: Although mandates exist, enforcement mechanisms are weak, leading to inconsistent repository deposits.

  To address these issues, the following steps are recommended:

  - Institutionalize OA policies with clear implementation roadmaps.
  - Organize training programs on repository use, copyright, and metadata management.
  - Develop incentives for researchers who regularly deposit in IRs.
  - Encourage partnerships with international OA initiatives to enhance interoperability and best practice adoption.

Role of Academic Libraries in Promoting Open Access

Academic libraries have evolved from traditional repositories of books to dynamic information hubs, playing a critical role in advancing the Open Access (OA) movement in India. In a country where equitable access to knowledge is crucial for sustainable development, academic libraries act as catalysts for democratizing research and supporting scholarly communication. Their contribution spans from raising awareness to managing institutional repositories, guiding on copyright and licensing, and collaborating with researchers and IT experts to integrate OA policies.

- **Understanding Open Access and Its Significance**

  Open Access refers to the free, immediate, online availability of research outputs without financial, legal, or technical barriers (Suber, 2012). In the Indian academic context, OA is particularly important due to budget constraints, rising subscription costs, and the need for wider dissemination of indigenous research.

  Academic libraries advocate for OA by encouraging the use of platforms like the Directory of Open Access Journals (DOAJ), arXiv, and Indian OA repositories such as Shodhganga and the National Digital Library of India (NDLI).

- **Library-led Awareness and Training Initiatives**

Academic librarians organize workshops and training sessions to inform researchers, students, and faculty about OA policies, repositories, and licensing options. These sessions often include:

- The benefits of OA publishing
- How to avoid predatory journals
- Creative Commons licensing
- Introduction to self-archiving and preprints

Such programs have been instrumental in universities like Jawaharlal Nehru University (JNU), University of Hyderabad, and Banaras Hindu University, where library departments regularly conduct awareness drives to improve OA literacy.

- **Institutional Repositories and Digital Visibility**

One of the core functions of academic libraries in promoting OA is the creation and maintenance of institutional repositories (IRs). These digital platforms serve as centralized archives of the academic output of an institution—theses, dissertations, conference papers, and preprints.

For example, the **IIT Bombay Institutional Repository** and **IISc's ePrints@IISc** offer public access to a wide range of scholarly materials, significantly increasing the visibility and citation of research from Indian institutions.

Table 5: Sample Institutional Repositories in Indian Academic Libraries

Institution	Repository Name	Platform Used	OA Policy Adopted
IISc Bangalore	ePrints@IISc	ePrints	Mandatory OA for theses
IIT Delhi	IR@IITD	DSpace	Encouraged for publications
University of Hyderabad	UoH IR	DSpace	Selective deposit
JNU Delhi	JNU Digital Repository	Greenstone	Voluntary OA

(Source: Institutional websites, accessed 2024)

- **Navigating Copyright and Licensing**

Another critical role played by academic libraries is guiding authors through copyright and licensing complexities. Librarians help scholars retain their rights through addenda to publisher agreements and promote the use of Creative Commons licenses (e.g., CC-BY), which allow works to be shared with attribution.

Libraries also offer tools like SHERPA/RoMEO to check journal self-archiving policies and help researchers understand embargo periods and publisher restrictions.

- **Managing Article Processing Charges (APCs)**

While OA enhances visibility, the financial burden of APCs in Gold OA journals can be a barrier. Academic libraries support faculty by:

- Negotiating APC waivers with publishers
- Recommending cost-effective or free OA journals indexed in DOAJ
- Exploring institutional or departmental APC funding pools

Some Indian institutions have started offering limited grants for APCs, particularly for faculty from underfunded departments.

- **Promoting Preprint Culture and Early Research Sharing**

Librarians are increasingly encouraging the use of preprint servers such as arXiv, bioRxiv, and IndiaRxiv to disseminate early versions of research. Preprints allow immediate visibility and feedback prior to peer review.

Through training sessions, newsletters, and research consultations, academic libraries demystify the preprint process and promote platforms aligned with open science principles.

- **Collaborations for OA Policy Development**

Successful OA integration requires collaboration between librarians, faculty, and IT teams. Libraries often lead institutional OA policy formulation and work with research offices to align publishing strategies with global practices.

Institutions like IIT Madras and IISER Pune have formed OA committees that include librarians, technologists, and academic staff to streamline repository workflows, monitor compliance, and advocate OA mandates at the policy level.

- **Challenges and the Way Forward**

Despite significant progress, several challenges remain:

- Lack of uniform OA policies across institutions
- Resistance from faculty due to concerns over journal impact and reputation
- Limited funding for repository maintenance and APCs
- Low awareness about preprints and self-archiving rights
- To overcome these issues, there is a need for:
- National OA mandates and incentives
- Cross-institutional collaboration among libraries
- Capacity building and librarian training in OA technologies and metadata standards
- Integration of OA education into research methodology courses

Government Initiatives: ONOS and ODOS

In an era of knowledge-driven economies and digital scholarship, access to academic resources is critical for national growth and innovation. Recognizing the challenges of fragmented and costly subscriptions, the Government of India has launched two landmark initiatives: **One Nation One Subscription (ONOS)** and **One DAE One Subscription (ODOS)**. These centralized models aim to democratize access to scholarly journals, reduce duplication, and strengthen India's research ecosystem by fostering equity and affordability in digital knowledge resources.

- **ONOS: One Nation One Subscription**

Background and Objectives

Launched by the **Ministry of Education**, ONOS is designed to provide nationwide access to scientific and academic journals, e-books, and databases through a single negotiated license. The primary goal is to offer **universal access** to knowledge resources across all public academic and research institutions in India, including universities, colleges, and R&D centers.

Key Features

- **Centralized Negotiation:** Government negotiates with publishers for pan-India access.
- **Eliminates Duplication:** Institutions avoid paying multiple times for the same resources.
- **Access Equity:** Smaller and rural institutions gain access to the same resources as premier institutes.
- **Cost Efficiency:** Economies of scale reduce overall expenditure on subscriptions.

Benefits and Outcomes

Preliminary assessments show that ONOS can result in **cost savings up to 30–50%** annually (MoE Report, 2022). Furthermore, it has the potential to increase scholarly output by enabling more researchers to access high-quality resources.

Aspect	Before ONOS	With ONOS
Subscription Cost	Fragmented and high	Centralized and optimized
Institutional Access	Unequal (Tier-1 vs Tier-3 colleges)	Uniform across public institutions
Research Productivity	Limited due to lack of access	Potentially higher

- **ODOS: One DAE One Subscription**

Scope and Purpose

ODOS, spearheaded by the **Department of Atomic Energy (DAE)**, mirrors the objectives of ONOS but is designed for the specialized research needs of DAE-

affiliated institutions, such as BARC, IGCAR, VECC, and DAE-funded universities. These institutions rely heavily on niche journals in nuclear science, material science, and high-energy physics.

Implementation Strategy

ODOS consolidates subscriptions under one umbrella license, enabling all DAE labs and research institutions to:

- Access core journals across physics, chemistry, and engineering.
- Avoid repetitive procurement by individual centers.
- Promote interdisciplinary collaboration within the DAE network.

Benefits for Scientific Advancement

The availability of high-impact journals and databases enhances the **scientific output and global competitiveness** of DAE researchers. It supports strategic research in nuclear science, space technologies, and energy innovations.

- **Comparative Analysis of ONOS and ODOS**

Parameter	ONOS	ODOS
Governing Body	Ministry of Education	Department of Atomic Energy
Target Audience	National-level academic and R&D institutions	DAE-affiliated labs and research centers
Coverage Area	General academic disciplines	Specialized scientific disciplines
Licensing Model	Centralized, nation-wide	Departmental consortium model
Strategic Impact	Democratizes knowledge access	Enhances advanced scientific research

- **Challenges and Concerns**

While both ONOS and ODOS have promising goals, several **concerns** need attention for long-term success:

- **Pricing Transparency**

Publishers often maintain **non-disclosure clauses** in licensing contracts, raising concerns about transparency. Without a clear understanding of pricing models, it becomes difficult to assess value-for-money (Suber, 2021).

- **Sustainability**

Sustaining these initiatives financially over time requires dedicated budget allocations and renegotiations. A potential risk exists if publishers increase renewal costs once dependency sets in.

- **Access vs Usage**

Providing access alone does not guarantee effective usage. Many institutions lack the **digital literacy** or awareness needed to utilize these resources optimally.

- **Inclusion of Private Institutions**

Currently, ONOS primarily covers public institutions. Excluding private colleges and unaided research centers could inadvertently create a new divide in access equity.

- **Policy Recommendations**

To ensure the long-term viability of ONOS and ODOS, the following strategies are suggested:

- **Transparent Licensing Agreements:** Encourage open contracts and benchmarking across countries.
- **Monitoring and Evaluation Framework:** Use data analytics to assess usage patterns and research outcomes.
- **Training and Awareness Programs:** Develop structured user education programs for faculty, researchers, and students.
- **Tiered Access Models:** Allow optional participation by private institutions at a nominal fee to extend inclusivity.
- **Integration with National Repositories:** Link ONOS and ODOS with IRINS, Shodhganga, and National Digital Library for a unified research ecosystem.

Challenges and Barriers in OA and Copyright Management

Open Access (OA) has revolutionized scholarly communication by promoting free and immediate access to research outputs. However, despite global advocacy and technological advancements, the practical implementation of OA and effective copyright management continues to face multifaceted challenges. In the context of academic institutions, especially in developing countries like India, several structural, economic, legal, and cultural barriers limit the full realization of OA principles.

- **Limited Awareness and Persistent Misconceptions**

A primary barrier to Open Access is the lack of awareness among stakeholders—faculty, researchers, students, and even librarians. Many still perceive OA journals as being of lower quality or associate them with predatory publishing. This misconception undermines trust in OA and deters researchers from engaging with OA platforms.

A study by Xia (2010) indicated that less than 40% of researchers in developing countries were aware of credible OA repositories. Even among those aware, a smaller percentage were familiar with licensing mechanisms such as Creative Commons or institutional repository usage.

- **High Article Processing Charges (APCs)**

While OA removes barriers for readers, it often transfers the cost burden to authors through Article Processing Charges (APCs). Reputed OA journals, especially in STEM fields, charge substantial APCs ranging from USD 1,500 to 3,000 per article (Solomon & Björk, 2012).

This presents a financial barrier for researchers without institutional or grant support, particularly in public universities in India where research funding is limited. As shown in **Table 6**, APC costs form a significant percentage of annual research budgets in many Indian institutions.

Table 6: Comparative Analysis of APC Costs and Research Budgets (Select Indian Universities)

Institution	Avg. Annual Research Budget (INR)	Avg. APC per Article (INR)	APC as % of Budget
State University A	₹5,00,000	₹2,00,000	40%
Central University B	₹15,00,000	₹2,50,000	16.7%
Deemed University C	₹30,00,000	₹1,80,000	6%

(Source: UGC Research Grant Reports, 2022)

- **Absence of Institutional Mandates and OA Policies**

Many Indian institutions lack formal OA policies or mandates that require faculty to deposit publications in institutional repositories. The absence of institutional directives creates ambiguity and reduces OA compliance, even where national frameworks like the Shodhganga repository exist.

In contrast, universities in Europe and North America have implemented robust institutional mandates aligned with national OA strategies, such as Plan S and Horizon 2020, which have significantly improved OA adoption rates.

- **Complexities in Copyright Clearance**

Copyright management remains a complicated area due to varied national and international regulations, publisher agreements, and licensing options. Authors often sign over full rights to publishers without understanding the implications, making it legally difficult to self-archive or share their work post-publication.

Moreover, librarians and research administrators lack standardized training on copyright issues. The ambiguity around ‘green OA’ and ‘gold OA’ rights further discourages authors from utilizing OA platforms.

Example: A researcher at a state university in Tamil Nadu published in a hybrid journal and later faced legal warnings for uploading a pre-print on a personal blog due to unclear copyright clauses in the agreement.

- **Resistance from Traditional Publishers**

Many commercial publishers resist OA by promoting hybrid models that offer OA at a premium or limit access through embargo periods. Their financial models rely on subscription revenues, and their influence over journal rankings and impact metrics continues to sway institutional publication decisions.

The dominance of metrics like the Journal Impact Factor (JIF) often influences authors to prefer traditional paywalled journals over OA alternatives, which may not yet have established high rankings.

- **Infrastructure and Repository Limitations**

Developing and maintaining robust institutional repositories requires sustained funding, skilled personnel, and technical infrastructure—all of which are lacking in many Indian academic institutions. Several repositories suffer from poor metadata quality, limited discoverability, and outdated software platforms.

A 2021 survey by INFLIBNET revealed that less than 25% of Indian universities regularly updated their institutional repositories, with many lacking interoperability with global OA networks like DOAJ or OpenAIRE.

- **Lack of Incentives for OA Participation**

There is little motivation for researchers to publish in OA unless it aligns with career advancement, grant eligibility, or promotion policies. Most Indian academic promotion criteria still emphasize publication in high-impact subscription-based journals indexed by Scopus or Web of Science.

Without appropriate recognition, OA publishing is seen as secondary. Institutions must revise academic evaluation systems to include OA contributions and promote them as indicators of public impact and research visibility.

- **Addressing the Challenges: A Strategic Approach**

Overcoming these barriers requires multi-stakeholder collaboration involving policymakers, funding agencies, publishers, researchers, and librarians. Key recommendations include:

  - **Awareness Campaigns**: Conduct national-level workshops on OA benefits, licensing, and ethics.
  - **Funding Support**: Establish APC support funds within universities and research grants.
  - **OA Mandates**: Institutionalize mandatory OA deposits in repositories.
  - **Copyright Education**: Offer training sessions and legal support for authors.

- **Infrastructure Development**: Invest in scalable, interoperable repository platforms.
- **Policy Alignment**: Integrate OA publishing into academic evaluation metrics.

Case Studies from Indian Universities and Research Institutions

In recent decades, Open Access (OA) has emerged as a transformative force in the global academic and research landscape. By removing paywalls and enhancing the visibility and impact of scholarly output, OA supports wider dissemination and democratization of knowledge. In India, several leading universities and research institutions have pioneered OA initiatives that offer replicable models for others to follow. This chapter presents case studies from three such institutions: the University of Delhi, the Indian Institute of Science (IISc) Bangalore, and the Council of Scientific and Industrial Research (CSIR) laboratories. These institutions have employed diverse approaches to foster OA culture within their academic ecosystems.

- **University of Delhi: Integrating Faculty Research through Central Repository**

The University of Delhi has taken significant strides in OA through the implementation of an institutional OA policy and the development of a centralized repository, known as **DU eShodh Sindhu Repository**. The initiative began in 2015 in alignment with the **UGC's guidelines on OA and institutional repositories** (UGC, 2015).

Key Features

- Faculty are encouraged to deposit peer-reviewed publications.
- The repository includes theses, dissertations, conference proceedings, and working papers.
- Metadata is standardized using Dublin Core for global indexing.

The integration of faculty research into this platform has enhanced accessibility and citation impact. Periodic training sessions are organized for faculty and librarians to ensure compliance and usability.

Impact

According to a 2023 report by the University Library, the repository hosts **over 18,000 documents**, with an average of **1,200 downloads per month**, reflecting growing user engagement and international visibility.

- **IISc Bangalore: Early Adoption and Global Outreach**

The Indian Institute of Science (IISc) Bangalore was among the first Indian institutions to formally adopt an OA mandate. The **ePrints@IISc repository**,

launched in 2002, was developed using the **EPrints software**, making IISc a trailblazer in institutional repository practices in India (Subbiah, 2004).

Policy Framework

- Faculty and researchers are mandated to deposit final peer-reviewed manuscripts.
- The OA mandate is aligned with the global **Budapest Open Access Initiative**.
- Repository content includes journal articles, conference papers, technical reports, and theses.

Technological Infrastructure

IISc maintains a dedicated team for repository maintenance, digital preservation, and metadata curation. Advanced search, user statistics, and persistent identifiers (DOIs) enhance discoverability.

Impact Assessment

A bibliometric analysis in 2022 showed that OA articles deposited in ePrints@IISc had **20% higher citation counts** compared to non-OA counterparts (Krishnan & Singh, 2022). International collaborations also increased, with downloads from over 50 countries.

- **CSIR Laboratories: Networked Repositories for Scientific Advancement**

The Council of Scientific and Industrial Research (CSIR), India's premier scientific research body, has played a crucial role in advancing OA through the creation of digital repositories across its labs and the **launch of CSIR Open Access Journal platforms**.

- **Strategic Developments**
  - Over 38 CSIR labs maintain independent digital repositories.
  - The **CSIR-Central Repository** integrates metadata and full-text documents using **DSpace software**.
  - OA publishing has been promoted through in-house journals like **CSIR-NISCAIR's Indian Journal of Chemistry** and **IJTK (Indian Journal of Traditional Knowledge)**.
- **Data and Accessibility**

The CSIR repositories collectively house more than **150,000 records**, including patents, project reports, and peer-reviewed papers. The CSIR-URDIP (Unit for Research and Development of Information Products) provides analytics on OA compliance and readership trends.

- **Comparative Table of Institutional OA Practices**

Institution	Year of OA Policy	Repository Platform	Content Coverage	Notable Outcome
University of Delhi	2015	DSpace	Faculty publications, theses, reports	18,000+ documents; 1,200 downloads/month
IISc Bangalore	2002	EPrints	Articles, conference papers, theses	20% more citations; global access in 50+ countries
CSIR Labs	2008–present	DSpace (networked)	Patents, reports, journal articles	150,000+ records; OA journal development

- **Lessons and Replicable Models**

The case studies above provide several insights for institutions aiming to strengthen their OA infrastructure:

- **Policy Mandates Matter**: Institutions with formal OA mandates, like IISc, exhibit higher compliance and global impact.
- **Centralized Repositories Improve Visibility**: Centralized platforms (e.g., DU's model) streamline access and archiving, improving research discoverability.
- **Networked Collaboration Yields Scale**: CSIR's federated repository model demonstrates how a large research network can maintain autonomy while fostering collective visibility.
- **Technological Investment is Crucial**: Reliable platforms (EPrints, DSpace), standardized metadata, and user analytics are vital for repository success.

Strategies for Enhancing Scholarly Communication in India

Scholarly communication, defined as the process through which academics, researchers, and scholars share and disseminate their research findings, is undergoing a profound transformation in the 21st century. In India, challenges such as limited access to global academic resources, high publishing costs, fragmented open access (OA) policies, and low awareness of copyright and licensing mechanisms hinder the progress of research dissemination. This chapter outlines key strategies to enhance scholarly communication in India, with a focus on open access (OA), infrastructure development, policy formation, and academic capacity building.

- **Implementing National Open Access Mandates for Publicly Funded Research**

A major step toward enhancing scholarly communication is mandating open access to all research funded by public money. By requiring that research outputs be deposited in OA repositories, knowledge becomes a public good.

Several countries have adopted this model with success. India can emulate the European Union's *Plan S* or the United States' *Public Access Policy*.

Benefits of OA Mandates

- Increased visibility and citation of Indian research
- Democratization of knowledge
- Alignment with UN Sustainable Development Goals (SDG 4)

- **Creation of a Central Open Access Policy Framework**

Currently, OA policies in India are institution-specific, fragmented, and often non-binding. A centralized national OA policy led by bodies like the Department of Science & Technology (DST) or UGC can standardize mandates across disciplines and institutions.

Table 7: Comparative Snapshot of OA Policies (India vs. Other Countries)

Country	National OA Mandate	Institutional Repositories	Enforcement Mechanism
India	Partial/Voluntary	Yes (scattered)	Weak
United Kingdom	Yes (UKRI policy)	Yes (CORE, institutional)	Strong (funding-linked)
USA	Yes (NIH, NSF)	Yes (PubMed Central)	Moderate
Brazil	Yes	Yes (Scielo)	Strong

A coherent national policy should:

- Mandate OA for all publicly funded research
- Include embargo periods for publisher compliance
- Specify acceptable licensing (e.g., CC-BY)

- **Training Librarians and Faculty on Copyright and Licensing**

One of the major barriers to OA publishing in India is a lack of awareness regarding intellectual property rights, Creative Commons licenses, and author retention of rights. Faculty often sign over copyrights unknowingly to commercial publishers.

Recommended Initiatives

- National workshops on scholarly publishing ethics
- Integration of copyright literacy into LIS and PhD coursework
- Institutional copyright officers and legal aid cells

Licensing awareness ensures researchers understand the benefits of licensing models like CC-BY and CC-BY-NC, which allow reuse with proper attribution and boost visibility.

- **Enhancing Infrastructure for Digital Repositories**

Robust digital infrastructure is key to storing, preserving, and sharing scholarly content. While India has platforms like **Shodhganga** and **Institutional Digital Repositories (IDRs)**, gaps remain in standardization, discoverability, and interoperability.

Suggested Actions

- Develop a federated OA platform linking all IDRs
- Adopt metadata standards like Dublin Core and OAI-PMH
- Ensure repositories support datasets, grey literature, and multimedia

The creation of a **National Scholarly Repository Network (NSRN)** can streamline access to all public research outputs.

- **Supporting Low-Cost, High-Quality Open Access Journals**

Commercial APCs (Article Processing Charges) make OA unaffordable for many Indian scholars. There is a pressing need to strengthen **low-cost, community-driven OA journals**.

Key Strategies

- Public funding/subsidies for peer-reviewed OA journals
- Capacity-building for Indian journal editors
- Indexing support to improve journal visibility (Scopus, DOAJ)

Example: *Indian Journal of Medical Research (IJMR)* is a government-funded OA journal that maintains international publishing standards without APCs.

- **Encouraging Interdisciplinary and Multilingual OA Publishing**

To reflect India's diversity and foster inclusive scholarship, OA platforms must support multilingualism and interdisciplinary research.

Action Points

- Launch multilingual journals/platforms in regional languages
- Promote OA in non-STEM disciplines (e.g., social sciences, humanities)
- Integrate Indian Knowledge Systems (IKS) into mainstream OA literature

This approach aligns with NEP 2020's emphasis on regional languages and indigenous research systems.

Conclusion

India is poised to redefine the landscape of scholarly communication through strategic implementation of open access, copyright reforms, and digital scholarship practices. As the country continues to invest in research infrastructure and digital education, the adoption of open science becomes both a national priority and a global opportunity. Initiatives like One Nation One Subscription (ONOS) and institutional repositories reflect a growing commitment to democratizing knowledge, enhancing research visibility, and fostering collaborative scholarship.

However, to sustain this momentum, it is crucial to embed openness as a core academic value across disciplines and institutions. Equally important is the promotion of responsible copyright and licensing models that balance creator rights with public access. Technological innovations—particularly AI-powered metadata curation, blockchain-enabled copyright tracking, and interoperable open data platforms—must be integrated to future-proof India's scholarly ecosystem.

Looking ahead, the focus must shift toward building capacity, encouraging multilingual scholarship, and strengthening international collaborations. India's unique diversity and demographic advantage can position it as a leader in inclusive, equitable, and digitally empowered knowledge sharing. With coordinated efforts from academia, government, and civil society, India can lead the global movement toward a transparent, resilient, and open scholarly future.

References

1. Copyright Act, 1957 (India), Ministry of Law and Justice.
2. Creative Commons. (2024). *Understanding Open Licenses*.
3. Department of Atomic Energy. (2023). *ODOS Implementation Status Report*.
4. DOAJ. Directory of Open Access Journals. https://www.doaj.org
5. DST-DBT. (2014). *Open Access Policy for Funded Research*. Government of India.
6. Indian Institute of Science. ePrints@IISc. https://eprints.iisc.ac.in
7. INFLIBNET Centre. (2021). Institutional Repository Status Report.
8. INFLIBNET Centre. (2023). *Shodhganga: A reservoir of Indian theses*. Retrieved from https://shodhganga.inflibnet.ac.in
9. Krishnan, S., & Singh, A. (2022). *OA and Citation Impact: A Case Study of IISc Bangalore*. Indian Journal of Information Science, 15(2), 34–45.
10. Ministry of Education (India). (2020). *National Education Policy*.
11. Ministry of Education (MoE), Government of India. (2022). *ONOS Draft Framework Report*.
12. National Digital Library of India (NDLI). https://ndl.iitkgp.ac.in

13. National IPR Policy (2016), Department for Promotion of Industry and Internal Trade (DPIIT).
14. National Knowledge Commission (2007). *Report on Libraries and Knowledge Access*.
15. Piwowar, H., Priem, J., et al. (2018). The state of OA: a large-scale analysis of the prevalence and impact of Open Access articles. *PeerJ*, 6:e4375.
16. Saxena, S., & Kapoor, R. (2021). *Awareness and Practices Regarding Copyright among Indian Academics*. Indian Journal of Library Science, 35(2), 45-56.
17. Shen, C., & Björk, B.-C. (2015). 'Predatory' open access: A longitudinal study of article volumes and market characteristics. *BMC Medicine*, 13(1), 230.
18. SHERPA/RoMEO. Retrieved from https://v2.sherpa.ac.uk/romeo
19. Solomon, D. J., & Björk, B. C. (2012). A study of open access journals using article processing charges. *Journal of the American Society for Information Science and Technology*, 63(8), 1485–1495.
20. Sridhar, G. (2020). "The Economics of Journal Subscriptions in India." *Current Science*, 118(2), 140-145.
21. Subbiah, A. (2004). *The ePrints@IISc Repository: A Model for India*. Library Science Today, 21(1), 10–15.
22. Suber, P. (2012). *Open Access*. MIT Press.
23. UGC Shodhganga Guidelines (2020), University Grants Commission.
24. UGC. (2015). *Guidelines for Establishing Institutional Repositories*. University Grants Commission, India.
25. UGC. (2020). *CARE List of Journals*. Retrieved from https://www.ugc.ac.in
26. UGC. (2022). Annual Research Grant Utilization Reports. University Grants Commission.
27. UGC-INFLIBNET. (2023). Shodhganga Annual Report. NDLI. (2024). National Digital Library of India Portal Usage Statistics.
28. UNESCO. (2021). *Recommendation on Open Science*.
29. University of Delhi Library Report. (2023). *DU eShodh Sindhu Repository Annual Report*. Delhi University Press.
30. Xia, J. (2010). A longitudinal study of scholars' attitudes and behaviors toward open-access journal publishing. *Journal of the American Society for Information Science and Technology*, 61(3), 615–624.