

# Open Science: Global Position and Share of India

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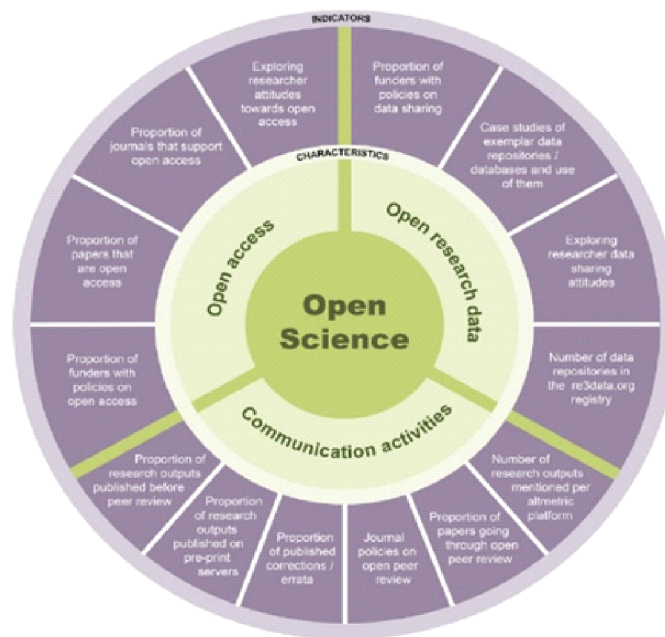
*Various movements, such as open access, open data, and open-source software have sought to address different facets of the crisis in science. While the open science movement has been gaining momentum in different parts of the world, the movement hasn't gained due momentum in India. Like most other parts of the globe, science in India is also facing a severe crisis in various aspects. Unfortunately, appropriate action has not been taken to address the problem in science in India in a holistic manner. With the Open Science movement accelerating globally, it is vital to understand India's position in formulating and implementing OS initiatives and policies. This article attempts to map the global position of India in advocating, adopting, and supporting Open Science and to figure out India's share in the global Open Science movement.*

## Open Science

Most issues concerning scientific publication are primarily concerned with the phase of science usage. As both phases are interrelated, enhanced and more equitable utilization of scientific knowledge will undoubtedly result in a temporary fix to the concerns in the production process. We need remedies that can tackle problems at both scientific stages. The concept of open science has been thought of as a tool to an end. Open Science incorporates all other open movements. Different from other open movements that concentrate on the research end of the value chain, open science focuses on all segments of science. Open science policies and approaches can aid in the advancement of higher-quality science, co-creation, and interactions between research and society, all of which can result in greater social and economic influences from research. According to Irina Bokova, Director-General of UNESCO: "To overcome the knowledge divides, we need more cooperation across disciplines and across borders to help governments develop more effective and inclusive policies, North and South. International networks, open data sources, co-creation of knowledge, open access to publishing and software – these are all vital to achieving this" (Das & Dutta, 2020). In the context of Horizon 2020 projects, the EU has defined open science as "The way research is carried out, disseminated, deployed, and transformed by digital tools, networks, and media. It relies on the combined effects of technological development and cultural change toward collaboration and openness in research. Open science makes scientific processes more efficient, transparent, and effective by offering new tools for scientific collaboration, experiments, and analysis and by making scientific knowledge more easily accessible". The open science movement is making inroads currently. Large numbers of open-access journals and repositories emerge. Apart from the prevalently subscribed indexing databases such as Scopus and Web of Science, open-access databases such as PubMed are also available. The reality is that there are various components to open science publication and dissemination.

## 2. Open Science Monitoring Indicators

The Open Science Monitor was created by the European Commission to gain quantitative and qualitative insights into evolving open science practices. The policy's goal is to promote open science. The Open Science Monitor is not a tool for evaluation. The Commission intends to make inferences from monitoring and evaluation of open science dynamics, as well as their drivers, in order to propose new policies to promote open science. Open science is a multifaceted phenomenon that is rapidly evolving. According to the OECD (2015), "open science encompasses unhindered access to scientific articles, access to data from public research, and collaborative research enabled by ICT tools and incentives". The Open Science Monitor seeks to collect the most recent and relevant indicators of open science advancements in Europe and other worldwide allied nations in order to obtain data and perspective on the headway of open science in Europe. The monitor scales the openness with the Open Science characteristics as a base. Open Access is the most prominent characteristic of Open Science (Smith et al., 2016). The monitor includes indicators for each characteristic that adheres to a set of core principles as shown in Figure 1 below. To begin with, indicators must be standardized in order to be compared and have meaning. In this paper, we try to monitor the status and progress of Open Science in India by putting the OECD monitor into an Indian context. As India is still in the growing phase of openness, it is not possible to check all indicators mentioned in the monitor.



Source: RAND Europe (2016)

Figure 1: the OECD Open Science Monitor

### **3. Open Science in India**

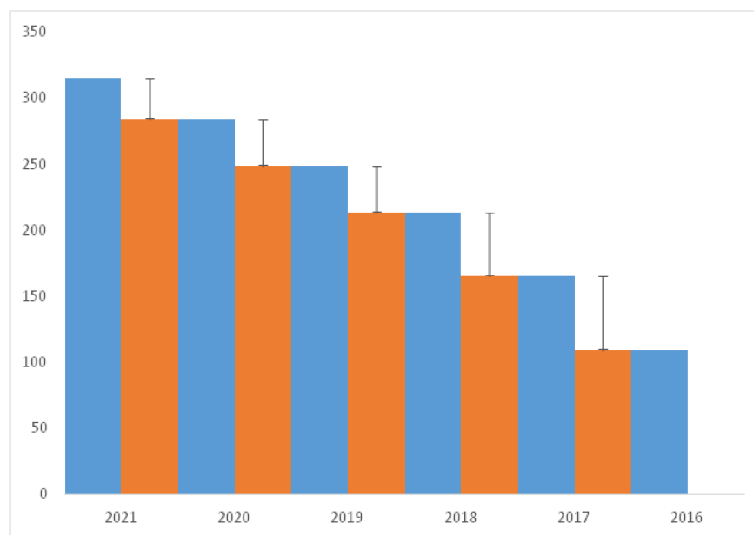
The global rise of different open movements has had an influence on India. The majority of these approaches are focused on scientific knowledge consumption and may not manage all features of open science. The vast bulk of them is covered by open movements like open access and open data. In this perspective, it is interesting to note that, because of the many interpretations of the term “open science”, even the few Indian actions that kept referring to it as “open science initiatives” may not be characterizing the term as comprehensively as it should. Examining the measures put in place within diverse platforms of the various open movements could be one strategy for gaining a global scope of open initiatives in India. While it may be unrealistic to provide an exhaustive account of all open activities implemented in India in this space, attempting to address a few prominent measures and evaluating the content and implementation of current policies and mandates may aid in understanding the nature of the larger context in which open movements operate, as well as the diverse challenges they face. Because it includes all other open movements, it would also help provide adequate legal and policy guidelines for a bigger, more powerful, and more viable open science movement in India.

### **4. State of the Art of Open Science initiatives in India with regard to the Open Science monitor.**

As India is not up to par with the developed nations all around the globe, it is only possible to assess certain indicators in the Open Science Monitor to assess India’s growth as an Open Science advocating and practicing country.

#### **4.1 Open Access**

- ❖ Although it is nearly hard to ascertain the onset of the open access movement in India, some early indications of openness in published papers can be traced back to 2001, when Dr. T B Rajasekhar of the National Centre for Science Information, IISc, initiated the founding of India’s first repository, EPrints@IISc. Indian researchers had a hard time getting access to international journals and as a result, there was a lack of visibility for research papers. OA is seen as an answer to this issue. According to Rajasekar (2003), India’s concern is to respond positively to information exchange and better access, thereby increasing the impact of Indian research. To meet this challenge and build a national R&D resource base, an open-access strategy based on the Budapest Open Access Initiative was promoted.
- ❖ When analyzing the journals with an Indian publisher indexed in the Directory of Open Access Journals (DOAJ) peripherally, it can be seen that there is an exponential growth in the number of Indian OA journals in DOAJ.

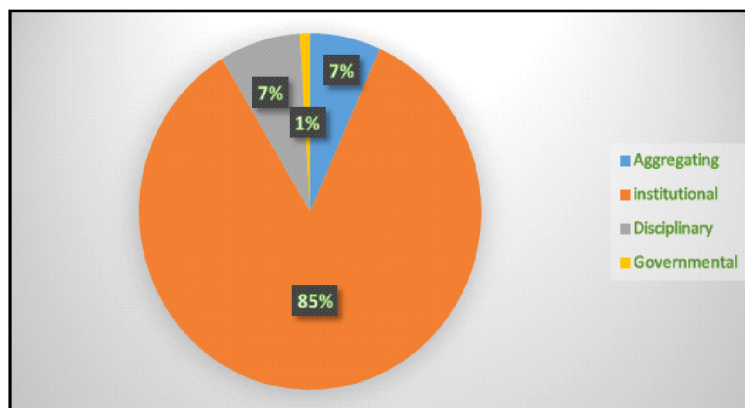


**Figure 2: Growth of journals with an Indian publisher indexed in the Directory of Open Access Journals (DOAJ)**

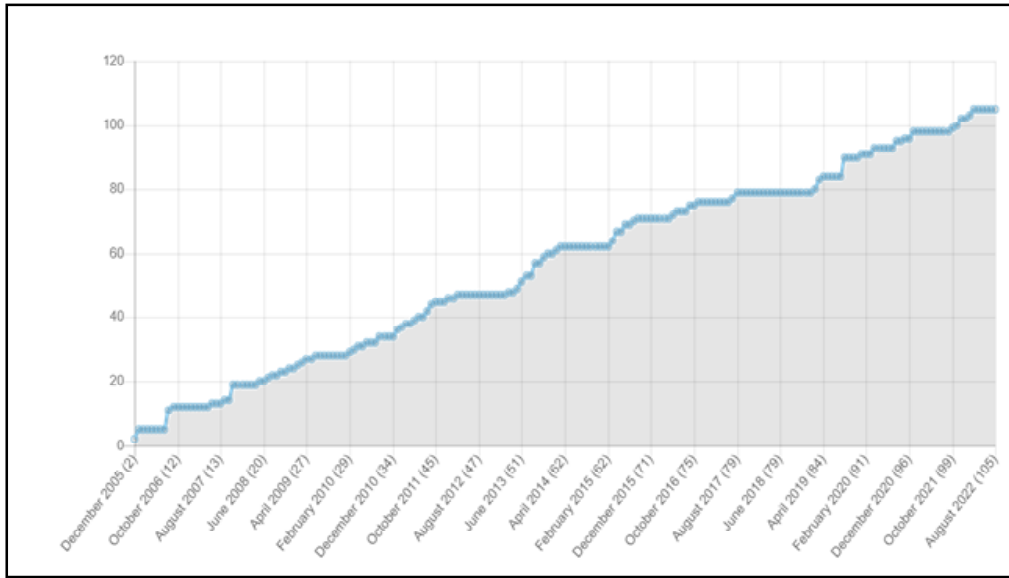
We can see from Figure 2 that there is a 188.99% increase in the number of journals with Indian publishers.

- ❖ The first main OA mandate from the central government emerged in 2014 when the Departments of Science and Technology (DST) and Biotechnology (DBT) implemented an open access policy. The DBT-DST regulation relates to the full transcript of accepted manuscripts associated with DBT/DST-funded projects. This involves activities within its scope that use the required infrastructure with DBT/DST support. This mandate institutions accepting ‘core funding’ from DBT/DST to set up and run institutional repositories for uploading and making available the previously mentioned content, and it motivates other organizations to do the same. In the absence of an institutional repository, the policy envisions material being shared on DBT/DST-created central repositories. Recent studies show that the OA mandate did not thrive as expected by 2022 due to a lack of proper facilities and understanding. Most journals in the STEM fields have a 12-month embargo on self-archiving of the post-print, which counters the DST-DBT OA mandate. (Koley & Lala, 2022).
- ❖ The CSIR (Council of Scientific and Industrial Research) Open Access mandate and the ICAR (Indian Council of Agricultural Research) Open Access Policy are two other notable pivotal initiatives. They are substantial in part because they are government entities that receive massive public funding for research and have a major role in scholarly research in India. The CSIR policy applies to all CSIR journals, published research information, the full text of papers submitted by CSIR labs and supported by CSIR funding, as well as contextual information. It requires every CSIR lab to establish institutional repositories and encourages labs to gradually make all of their publications open access.

- ❖ The Indian Medlars Centre is a collaboration between the ICMR and the National Informatics Centre (NIC) that began hosting open-access editions of many Indian medical journals in 2003. This was done to complement an existing bibliographical database of Indian biomedical research with full-text articles. Professional societies publish the majority of them.
- ❖ IndiaRxiv is an Indian preprint server. IndiaRxiv was re-launched on 24 February 2022 after a temporary run two years ago. The Centre for Open Science (COS), a non-profit based in the United States, provided the initial funding for communities to release co-branded preprint servers. agriRxiv was started as a preprint server in a subject area by Open Access India. IndiaRxiv was also established and launched at the time (in 2019), but due to a lack of funds a year later to host the servers, it stopped taking manuscripts. During its brief existence, the IndiaRxiv server received 140 paper uploads between 2019 and 2020. When the Public Knowledge Project (PKP), a strategy to advance open-source software for research, released its Open Preprint Systems in 2021, the unfunded initiative was able to find new hosting.
- ❖ National Digital Library of India was developed by IIT Kharagpur, and launched by the Ministry of Human Resource Development (MHRD) under its National Mission on Education through Information and Communication Technology. The idea is to provide a single-window search feature that serves as a one-stop shop for all digital content. Information can be customized based on educational status, language preference, level of difficulty, content medium, author, source, and so on. All users have free access to the NDL system for general browsing (Arul George Scaria et al., 2018). To access some confidential documents, however, one must first register and create a user id and password. Furthermore, the ease of access to materials that may reside on the servers of other institutions is decided by those institutions' policies and access rules.
- ❖ India has a total of 105 open repositories indexed in Open DOAR, out of which 85% are institutional repositories as depicted in Figure 3. As figure 4 shows there has been considerable growth in Indian repositories getting indexed in Open DOAR.

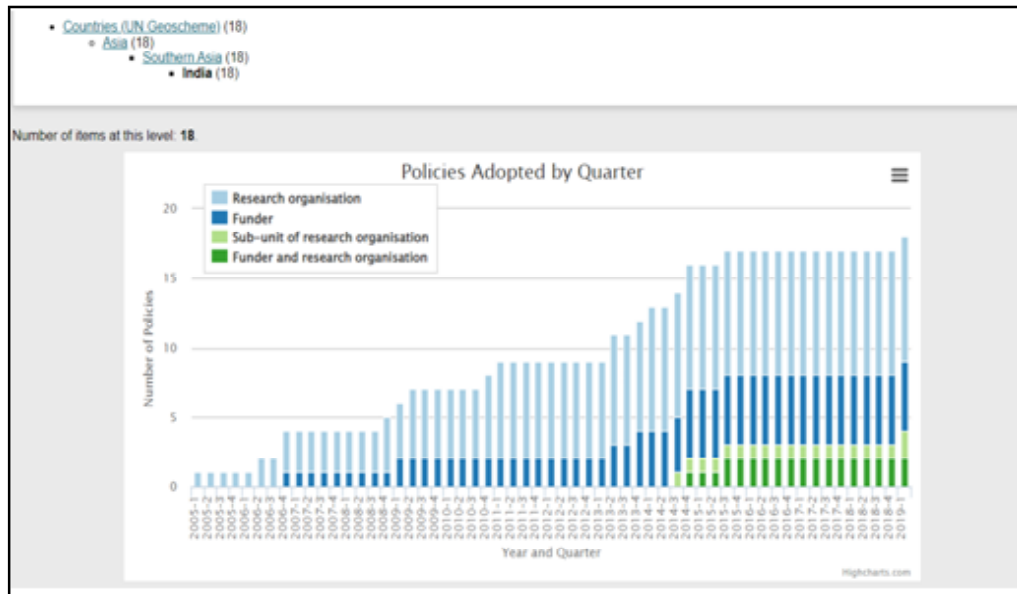


**Figure 3: Distribution of types of Indian Open Access Repositories on Open DOAR**



**Figure 4: Growth of Indian repositories in Open DOAR**

- ❖ According to The Registry of Open Access Repositories Mandatory Archiving Policies (ROARMAP), a total of 18 Indian institutions have adopted an OA policy as shown in Figure 5. Out of these 18, only three have defined an embargo period (Nazim et al., 2022).

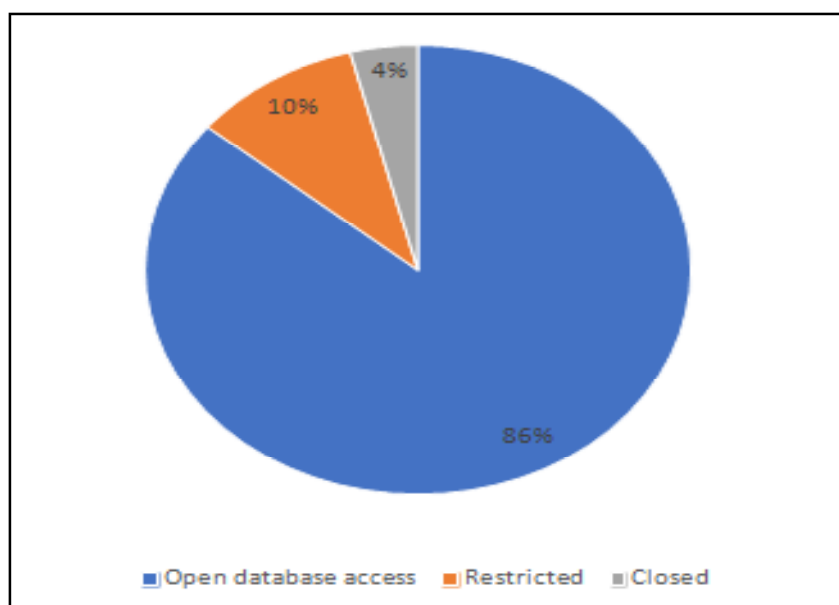


**Figure 5: Policies adopted by India by a quarter in ROARMAP**

- ❖ EPrints@IISc, India's first repository, was established at a time when there were few repositories in the world. Despite the fact that only authorized members could obtain the information on this repository, this effort was notable as it was one of the first across the country to implement an institutional repository. The repository currently houses over 7000 of the institute's research publications. The SHERPA/RoMEO project website (<http://www.sherpa.ac.uk/romeo.php>) contains the guidelines of many academic journal publishers regarding the self-archiving of scientific publications in an institutional repository. According to the site, more than 92 percent of publishers permit some method of self-archiving or another. Some publishing companies only accept preprints, while others accept both preprints and post-prints. Some publishers even permit or require that their PDF versions be placed in institutional repositories (Jayakanth et al., 2008).
- ❖ Institutions like the National Institute of Technology (NIT) Rourkela, the International Crops Research Institute for the Semi-Arid Tropics, the Indian Academy of Sciences, and the Indian National Science Academy have their own open access policies for the institutional research output. The EThesis@NIT Rourkela runs with 7410 theses to date.
- ❖ A notable Open repository for the ETD initiative is 'Shodhganga', a repository of Indian Electronic Theses and Dissertations. The Information and Library Network (INFLIBNET) Centre is in charge of creating, hosting, and retaining a virtual repository of Indian electronic theses and dissertations that is available to all institutions and universities. Shodhganga has been supplying access to documents from various disciplines and constantly updating the repository. It currently holds 375492 theses, 8861 synopses, and 52 fellowship reports. In addition, the Centre is working on a semantic web-based interface to facilitate subject-based browsing, navigation, lookup, and extraction of content from the repository.
- ❖ Open Educational Resources: according to UNESCO, "Open Educational Resources (OER) are learning, teaching and research materials in any format and medium that reside in the public domain or are under the copyright that have been released under an open license, that permits no-cost access, re-use, re-purpose, adaptation and redistribution by others". Some of the major OER initiatives by India are e-PG Pathshala; an initiative of the MHRD under its National Mission on Education through ICT (NME-ICT), NPTEL (National Programme on Technology Enhanced Learning), a joint venture of the IITs and IISc, funded by the Ministry of Education (MoE) Government of India which now offers close to 600+ courses for certification every semester in about 22 disciplines, Vidya-mitra; an online learning portal for all the e-content projects developed under the NME-ICT (National Mission on Education through Information and Communication Technology), MHRD which provides facility to search and browse all hosted content wherein a learner can easily access the desired material including audio/video learning material, textual material, multimedia-enriched materials, etc. through a single interface.

## 4.2 Open Research Data

- ❖ **re3data.org** indexes a total of 50 Indian data repositories out of which 43, i.e., 86% are open. India is in 13th place in number with USA and Germany leading with only 4% closed.



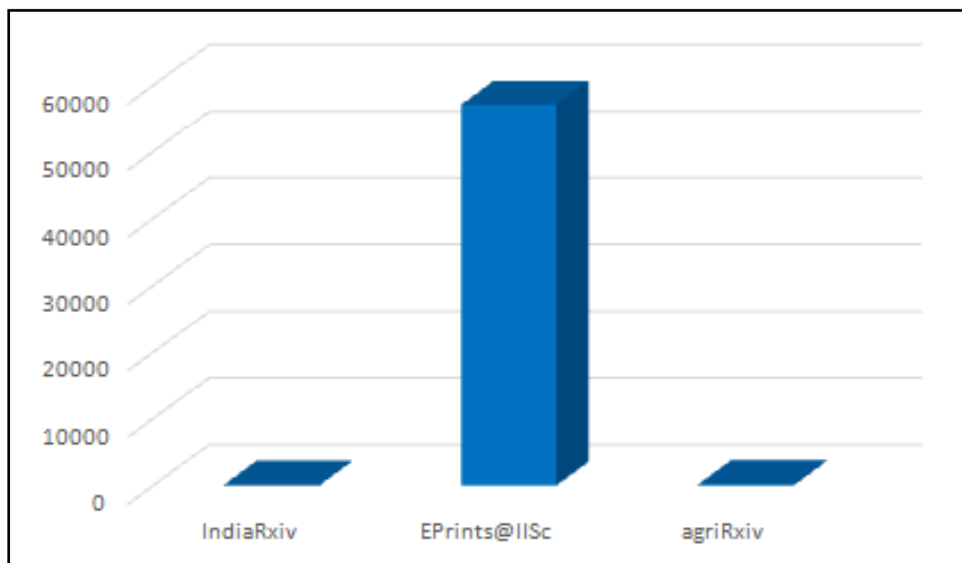
**Figure 6: Indian data repositories indexed in re3data.org**

- ❖ **ICSSR Data Service** is a Memorandum of Understanding (MoU) between the Indian Council of Social Science Research (ICSSR) and the Ministry of Statistics and Programme Implementation (MoSPI). The MoU calls for the establishment of an “ICSSR Data Service: Social Science Data Repository” to house NSS and ASI datasets obtained by MoSPI. Under the action plan, social science research institutes, NGOs, individuals and others related to social science research are also being contacted to deposit/provide their research datasets for hosting in the repository of ICSSR Data Service. The INFLIBNET Centre is carrying out the project to establish the ICSSR Data Service with ICSSR funding.

## 4.3 Communication Activities

Though picking up at a slower pace than the developed countries, India also is moving towards openness and its novel initiatives. Preprints are said to be the present and future of scholarly communication. A clear onset of preprint servers both at the national and institutional level can be seen in the Indian publishing environment like IndiaRxiv, EPrints@IISc, and, agriRxiv. IndiaRxiv currently hosts a total of 148 preprints with its start in 2019. The preprints related to agriculture and allied sciences are now shifting to **agriRxiv** from AgriXiv which currently holds 427 preprints. agriRxiv has now a collection of 229 preprints in agriculture and related subjects. ePrints@IISc to date adopts 57178 preprints which are accessible to registered users.





**Figure 7: Volume of major Indian preprint servers**

## 5. Conclusion

Though India has come a long way with its policies and adoption of Open Science, characteristics used by policymakers, institutions, and funding agencies to evaluate the performance of researchers must be updated to include sharing practices, the social relevance of research, and adherence to transparency policies. The priority of academic institutions has become the number of publications to state the hard truth. Aside from changing assessment criteria, commercial publishers' power to impose fees on authors and users of research without providing a corresponding value addition should be addressed by rethinking publication models. In this regard, we believe that professional societies and institutions can function independently as publishers, as well as administrative and other transactional entities. Although the market is expanding rapidly and there is a high output of high-quality science articles, the proportion of articles published in so-called "predatory" journals is also high. India has a substantial national scientific foundation, but even with its volume, articles published on a global scale would receive more recognition and citation than domestic publications. Despite being in the top tier in terms of the number of articles produced by researchers associated with national institutions in 2019, India has the lowest percentage of researchers per million inhabitants, which, despite its large population, indicates great potential. In terms of article production, India's growth is comparable to that of the United Kingdom (STM, 2021) and also, despite India's 23% share of OA publications (7% less than the global average of 30%), the yearly rate of growth of OA publications is around 18% (Nazim et al., 2022). Although regulatory agencies and organizations have made a concerted effort to require researchers to use open-access publishing and self-archiving, execution is quite low among

Indian researchers. India does not have a national open access policy but intends to introduce a “one nation, one subscription” model to provide open access to scientific publications to all of its citizens.

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**Keywords:** Open Science; Open Access; OS Monitoring Indicators

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